Boosting Efficiency

Delivering affordability, security and jobs in Latin America

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Abstract

Countries around the world are facing an energy security and affordability crisis affecting households, businesses and public budgets. In Latin America, household expenditure on energy services is second only to food. On average, the share of household budget for energy ranges between 7% and 9% of income – and up to more than 24% for the poorest households. As governments urgently implement measures to protect citizens and secure their economies, it is important to consider short- and long- term solutions to ease existing pain and reduce risks over time. While much attention focuses on securing energy supplies, it is equally important to take a hard look at the role of more efficient and flexible demand in securing affordable, reliable energy.

There are several reasons for this. First, one of the fastest and cheapest options for short-term emergency situations is to reduce demand. Second, investments in more efficient technologies and practices can reduce risk over time while improving access to energy services, saving money and supporting efficient, less costly energy systems. Third, managing demand by improving efficiency and making loads more flexible is key to cost-effectively meeting decarbonisation goals.

Decades of policies and programmes have delivered energy savings around the world. As a result, energy systems are more resilient, bills are lower, and public budgets feel less pressure than they would have without these efforts. This report looks at energy efficiency and demand management policies and programmes across Latin America. It presents evidence of the results of these efforts on improving living standards, public budgets, energy security and employment, and provides a view on the opportunities to expand these benefits and support just energy transitions.

Acknowledgements, contributors and credits

This report was prepared by the Energy Efficiency Division (EEFD) of the Directorate of Energy Markets and Security (EMS) of the International Energy Agency (IEA).

This publication was produced with the support of the Danish Ministry of Energy and IEA Clean Energy Transitions Programme. Edith Bayer led the analysis and production of the report with strategic guidance from Melanie Slade, Senior Manager of the Energy Efficiency in Emerging Economies Programme and Brian Motherway, Head of the IEA EEFD.

Important inputs, comments and feedback were provided by the following IEA and Energy Efficiency Hub collagues: Alejandra Bernal, Olivia Chen, Joerg Husar, Kristina Klimovich, Vida Rozite and Daniel Wetzel. Ana Lepure and Luiz Gustavo de Oliveira provided invaluable research and input.

The IEA would like to thank the following experts who provided essential inputs, review and encouragement:

Júlia Alvez and colleagues from Mitsidi Projetos; Carlos Eduardo Barreira Firmeza de Brito and Carmen Silvia Sanches from the Brazilian National Electricity Agency (ANEEL); Luisa Fernanda Manrique and colleagues from the Colombian Fund for Non-Conventional Energy Efficiency (FENOGE); Estefania Neiva de Mello from Eletrobras; Flávio Raposo de Almeida and colleagues from the Brazilian Energy Research Office (EPE); Anabella Ruiz from the Argentinean Ministry of Economy; the Mexican Secretary of Energy (SENER), Electricity Energy Saving Trust Fund (FIDE), and Commission for the Efficient Use of Energy (CONUEE); George Soares and Alexandre de Sousa Rodrigues dos Reis from ENBPar; Samira Sousa and Alexandra Albuquerque Maciel from the Brazilian Ministry of Mines and Energy (MME); José Antonio Urteaga from the Inter-American Development Bank (IDB); Sebastián Wainberg and colleagues at the Ministry of Industry, Energy and Mining of Uruguay.

Thanks also to the IEA Communications and Digital Office (CDO) for their help in producing the publication, especially to Astrid Dumond and Clara Vallois.

Energy security and affordability

The first fuel

Energy efficiency improvements have delivered big savings – and provide big opportunities

Today the world is facing an energy crisis within a broader climate emergency. The crisis comes on the heels of the Covid-19 pandemic, already volatile energy prices and weather-related challenges in many countries. Much of the focus lies on how to secure supply, with policymakers focussed on how to "keep the lights on." Yet if we stick to lighting for a moment, it is equally relevant to consider whether we might meet the same goal by installing more efficient light bulbs. The same balancing act occurs throughout the energy system, across buildings, transport, and industry. In each sector the demand side determines how much energy is needed, and equally, can be managed to be more efficient and flexible.

Decades of experience show that energy efficiency and other demand management measures such as load shifting and conservation can deliver both short- and long- term benefits to the energy system and to consumers. These measures slim down demand, lower costs, cut emissions, avoid more expensive supply side investments and can be shaped to complement variable renewable generation. They save households, businesses and governments money and improve competitiveness. And they improve access to energy services and generate jobs – many of them local. This is true of emergency measures as well as of sustained improvements over time.

Consider what a decade of energy efficiency improvements has delivered in the region's largest economies. In Brazil, by 2019 ten years of energy efficiency improvements had prevented 14% higher energy use in freight transport and almost 6% higher energy use in households. In Mexico, by 2015 ten years of energy efficiency improvements had avoided almost 8% higher energy use. In the residential sector, energy efficiency is estimated to have avoided 33% higher energy use. And this is just a slice of the energy savings achieved in both countries over nearly 30 years, thanks to which they require less effort to procure energy – at home or abroad – to satisfy demand.

In Chile, the national plan for energy efficiency, published in 2013, delivered the equivalent of 9% of projected energy demand in 2019. This represented a

savings of 8.7 million tonnes of CO_2 equivalent, the same as the annual emissions of five million cars, delivering energy security while advancing climate goals.

The examples highlighted in this report reflect the results of key policies and programmes in Latin America, demonstrating the value of energy efficiency and demand management in advancing policy priorities including energy security, affordability, access to energy services, and jobs and skills creation. The conclusions are powerful. Energy efficiency delivers and has tremendous potential to grow and to help deliver affordable, reliable access to energy services now and into the future.

Affordability and security for households

In Latin America, household expenditure on energy services is second only to food. On average, the share of household budget for energy ranges between 7% and 9% of income. The poorest households (the bottom income quintile, representing one one ten households) pay more than 24% of their income on energy, often concentrated on electricity and gas.

The current energy crisis is hitting households hard, raising the costs of fuel and food, and combining with inflation to drive a dire cost-of-living crisis. This comes on the back of the Covid-19 pandemic, which already disrupted livelihoods for many people. In 2019-2021, the number of people living below the poverty line in Latin America and the Caribbean increased from 28% to 30% – this means 14 million people fell into poverty. This figure would have been much higher if not for important social support programmes implemented across the region.

Affordable energy is essential to ensure access to basic energy services, including lighting, clean cooking, space cooling, heating and transport. Providing relief on energy bills is important to maintain access to these services – a need that increases when energy prices rise. Yet old and inefficient appliances often lock in high bills, requiring high levels of support to help meet basic needs. Energy efficiency can help more permanently lower bills and government expenditures. Policies and programmes, such as those that improve the minimum efficiency of appliances and equipment available in the market, can help households purchase efficient appliances, or implement other measures such as shading to increase passive cooling.

Take the example of Mexico. Over 30 years, the Mexican minimum energy performance standards (Normas Mexicanas or NOMs) have driven the worst-performing appliances out of the market, improving the efficiency of available models. This has delivered cumulative savings of 7% of annual electricity consumption. Over this period, there has been a powerful correlation between

improvements in efficiency, increased ownership of basic appliances, and a *decrease* in final energy consumption.

This correlation has been tracked closely for two key appliances: refrigerators and washing machines. Over the 30 years that the Mexican standards have been in place, the number of households with refrigerators has grown by 19% and with washing machines by 20%, yet total average household electricity consumption has dropped by 17%. While there are some differences between areas with high first-time appliance ownership and those replacing old appliances with more efficient models, across the country households at all income levels have reduced the portion of income spent on energy bills. The poorest households saw the biggest savings: in 1994 they spent 9% of their bills on energy, dropping by nearly half by 2016.

The Brazilian Programme for Energy Efficiency (PEE) is another example of how low-income households can benefit from long-term energy efficiency programmes. Under the PEE, utilities must dedicate a portion of revenues to improve end-use energy efficiency. Historically, about half of the investments in energy efficiency have been made in low-income households. Estimates show these projects have saved around 30 kWh per household per month, or about 15% of average monthly electricity consumption for a low-income household. Some projects have been implemented using innovative approaches, such as partnering with NGOs and local residents in low-income communities to enable access to homes to put in place energy efficiency measures, demonstrating the value of partnerships to deliver results.

These programmes play an important role in advancing equitable distribution of the benefits of national policies. For example in the case of appliances, they ensure that low-income households benefit from the continuous improvements in the efficiency of new appliances in the market that are driven by minimum energy performance standards and labelling programmes.

While few countries in the region have tracked the link between policies and their impacts on low-income households at national level, a number of targeted programmes demonstrate the value of focussed efforts to improve access to efficient technologies and practices:

- In Chile, the Ministry of Housing and Urbanism implemented a subsidy programme for insulation of low-income housing. From 2009-12, nearly 33 000 families benefitted from the programme.
- The Housing Improvement Programme (Programa de Mejoramiento de Vivienda) delivered weatherisation improvements in socio-economically vulnerable communities in Uruguay. The pilot programme delivered improvements that reduced heating demand (mostly met with gas heaters) by 21% in summer and

24% in winter. Projects further improved both the health and comfort of households by reducing temperature fluctuations and excess humidity.

- In Colombia, the Fund for Non-Conventional Energy and Energy Efficiency, FENOGE, plays an important role in supporting energy efficiency and clean energy policy objectives through project financing and investment. From 2020 to 2022, FENOGE replaced more than 218 000 light bulbs and 10 150 refrigerators and air conditioners with high-efficiency models in low-income households.
- In Uruguay, the programme Canasta de Servicios (Basket of Services) combines social support with energy efficiency to improve access to energy services while optimising use of public support systems.
- In Mexico, the Sustainable Light and Save Yourself a Light programmes together replaced 86 million incandescent bulbs with CFLs. The Save Yourself a Light programme, which replaced 40 million bulbs, is estimated to have helped 7.9 million Mexican families to save USD 160.9 million in energy expenditures a year, avoiding government payments of USD 470.3 million in annual subsidy payments.

Energy savings translate into budget savings

Energy efficiency is an important source of savings for public budgets. Most countries in Latin America subsidise energy prices. Subsidies for electricity alone, primarily geared towards households, account for about 1% of GDP on average. Measures to reduce the costs of diesel and gasoline have grown across the region. In Mexico, recent fuel subsidies account for about 1% of GDP, and across the region subsidies and other fiscal support mechanisms have been in place to offset the imipact of increasing fuel prices.

Programmes delivering energy savings, such as appliance replacement schemes, can be an important part of a package of public support that focuses on lifting families out of energy poverty, while generating public budget savings.

In Mexico, a dedicated programme replaced 1.9 million refrigerators and air conditioners – all over 9 years old – among low-income families from 2009 to 2012. The programme led to estimated savings of 6 770 GWh, equivalent to 8% of annual residential electricity consumption in Mexico. The government recovered its costs in about four years, saving the equivalent of USD 83.2 million in annual subsidies through avoided energy consumption. The public utility company benefitted from demand savings of 210 MW, equivalent to an investment of USD 147 million in power generation infrastructure. The programme eliminated 147 tons of refrigerant gases and reduced another 3.4 million tons of CO_2 emissions.

Similar programmes have been rolled out in other countries in the region, including Brazil, Colombia, Cuba, and Ecuador. The Inter-American Development Bank estimates that there is the potential to replace at least 20

million inefficient refrigerators through loans paid back on energy bills throughout the region.[1]

The Brazilian PEE, mentioned earlier, has not only saved low-income households money; it has led to government budget savings through lower overall subsidy payments due to reduced energy use. Over the past five years, projects saved the equivalent of between 1% and 1.3% of energy consumption across all low-income households. This is the equivalent of between BRL 165 million and BRL 220 million (approximately USD 31 million and USD 38 million)[2] in subsidy savings – or 41% to 55% of the resources allocated for Procel's programmes in 2022 and 2023.[3]

Brazil's leading energy efficiency programmes

Brazil has two leading national energy efficiency programmes: The Programme for Energy Conservation (Procel) and the Programme for Energy Efficiency (PEE). Together, these programmes deliver energy savings across all sectors, often with a strong focus on low-income households and the public sector.

Procel was established in 1985 and housed within a subsidiary of Eletrobras, the state-owned electricity company. The programme has the objective of promoting energy conservation within the electricity sector. The governance structure of the programme has evolved over time in response to political and institutional changes. In its early years, Procel was funded from two primary sources: sectoral funds established to support development and innovation in the electricity sector, and directly from the budget of Eletrobras. In 2016, utility contributions began to fund the programme. In 2023, with the privatisation of Eletrobras, Procel is moving to the new state-run energy company, ENBpar.

The Programme for Energy Efficiency (PEE) is the other major driver of programmatic energy efficiency in Brazil. It was established following the passage of Law 9.991/2000, which mandated electricity distribution companies to invest a portion of their revenues in research, development and energy efficiency initiatives. It is one of two utility-funded energy efficiency programmes in Latin America, with the other based in Uruguay.

[1] Inter-American Development Bank, analysis based on own data, 2023.
[2] Exchange rate: 1 Real Brasileño (BRL) = EUR 0.18 = USD 0.19 (as of 28 Feb 2023).
[3] The published Par Procel plan for 2022 to 2023 contains several projects totalling BRL 225 million. However, the total budget collected from the utilities (0.1% of their revenue) was higher, totalling BRL 402 million. The calculation here is based on this higher figure.

Energy efficiency can deliver significant savings to municipal budgets. In cities, public energy expenditures cover things like street lighting, sanitation, and public transport. Street lighting can constitute up to 65% of municipal electricity budgets, while drinking water and wastewater plants can often account for 30% to 40% of total municipal energy consumption. In all of these areas, programmes to improve energy efficiency are an important part of budget balancing strategies.

In Mexico, a series of programmes has driven energy savings in the public sector.

- Buildings and transport. In 2021, the Federal Public Administration project in Mexico saved 16.7 GWh of electricity in public buildings, 5.3 million litres of diesel and 1.3 million litres of gasoline in public vehicle fleets. This programme has been in place since 1993. Over the past decade, the programme has saved more than MXN 180 million (USD 9.81 million)[4] in federal public expenditures.
- Street lighting. Mexico has transformed street lighting, replacing less efficient lights with LEDs. In 2012, LEDs accounted for just 3% of street lighting in the country; in 2021 the share reached 62%. A combination of minimum energy performance standards, the National Project for Energy Efficiency in Public Municipal Lighting, and city leadership drove this transition. The 61 cities (with a combined population of 12 million people) who participated in the project saw their electricity bills shrink by 40%, and, in some cases, savings reached as high as 75%. By 2019, a similar project in Uruguay had replaced 42% of all public lighting in the country with efficient bulbs, up from zero in 2013.

Packages of energy savings projects can generate even deeper benefits. The city of Guarulhos, Brazil, has implemented seven actions to save energy, including replacing street and hospital lighting, replacing electric showers with solar water heaters in public social housing projects, and improving the efficiency of the municipal water supply system. These measures reduced electricity consumption by 26 351 MWh per year, saving the city BRL 5.25 million (USD 1 million)[5] annually with measures paying for themselves in around five years. Families participating in the solar water heater programme saved an estimated 40% on their monthly electricity bills. The projects drew support from several programmes, including EDP São Paolo (the regional electricity distribution company) and the Technological Research Institute (IPT), as well as Procel Municipal Energy and Procel Reluz.

City carbon emission reduction goals can be an important driver of energy efficiency programmes. Medellin, Colombia aims to reduce emissions from municipal buildings by 60%, and new municipal buildings must meet 100%

[4] Exchange rate: 1 MXN = EUR 0.051 = USD 0.054 (as of 28 Feb 2023).
[5] Exchange rate: 1 BRL = EUR 0.18 = USD 0.19 (as of 28 Feb 2023).

sustainability and carbon neutral criteria by 2030. So far, a number of municipal buildings have been retrofitted, saving an average of 22% on bills. Measures undertaken include energy audits, envelope upgrades, system replacements and green building certifications.

Similarly, Mexico city estimates that it can reduce GHG emissions by 20.5% through replacement of high energy consuming household appliances, and 37% through energy efficiency measures in buildings, businesses, services and industry.

In several countries, there has been a push to increase the efficiency of public transport fleets to both increase efficiency and reduce emissions. Both Santiago, Chile and Medellin, Colombia, have seen significant cost savings with electric public buses. In Santiago, electric buses have 75% cheaper energy costs than diesel, and 37% lower maintenance costs. In Medellin, fuel costs have been 55% lower, and operating and maintenance costs have been 25% lower than for buses fuelled by compressed natural gas (CNG). Both countries are transforming public transport fleets as part of broader transport policies driving towards lower emissions and higher efficiency. A city initiative in São Paulo is requiring all new buses to be electric from October 2022, with 2 600 out of 14 000 buses expected to be electric by the end of 2024.

Chile recently announced one of the most ambitious vehicle electrification policies in the world that sets zero-emission sales targets for 100% of light- and medium- duty vehicles and city buses by 2035.

In Uruguay, a programme to purchase public electric buses has replaced 4% of the national diesel bus fleet. A subsidy has brought the purchase price of an electric bus down to that of a bus of equivalent dimensions. The subsidy for electric buses is the same as that paid to support the cost of diesel fuel for the lifetime of a diesel-powered bus, making this a case of shifting public spending to low-carbon alternatives. The programme has also required buses to modernise, including by having a low floor, air conditioning, travel information and security cameras. Similar programmes exist in other countries in the region.

A low-cost resource to address the risks of today and tomorrow

There is a story of a fox[6] that comes across a boar sharpening its tusks. Seeing no hunters or other dangers nearby, the fox asks why the boar is bothering with this. The boar responds that when it is being hunted, it will have no time to sharpen its tusks; it must be ready. Similarly, it is important to sharpen energy

[6] *Aesop's Fables*, Avenel Books.

efficiency and demand management programmes to be ready to respond to near-term crises and to strengthen long-term energy security.

Energy efficiency strengthens energy security in several ways. It reduces reliance on energy imports and can create space to increase exports. It brings down the amount of energy needed to deliver energy services, lowering bills under normal circumstances, and buffering the cost impact of running an appliance or driving a vehicle during price spikes. Adding strategies to shift energy consumption through automation, price signals, or other methods further mitigates the impact of high prices by shifting demand away from high-priced periods and increasing consumption when prices are low.

Short-term emergency measures

Brazil is one of the countries with longest experience with emergency demand management measures in the region due to the effect of record-breaking droughts on its hydro-dominated power system. From June to December 2001, a drought led regions to impose conservation mandates, reducing demand by between 18 to 21% compared with the previous year. The main driver was a series of incentives and penalties linked to quotas, followed by savings from programmes distributing CFLs and an increase in the purchase of energy efficient appliances. Some of the energy savings persisted: in 2003 electricity consumption was still 7% below 2000 levels, despite 4% annual GDP growth in both intervening years.

In 2021, Brazil faced its second worst hydrological crisis in history due to drought. The government rapidly mobilised emergency measures across the energy system. Pricing incentives and information campaigns stimulated electricity customers to reduce their consumption by 5.6 TWh, lowering bills by 4.5%. Federal buildings, which were mandated to reduce consumption, cut their demand by an average of 21% from September 2021 to April 2022. The Voluntary Electricity Demand Reduction programme (RVD) delivered a further 28.8 GWh of electricity savings from small and medium consumers from September – December 2021. This is equivalent to the annual electricity consumption of the state of Paraiba and enough to supply 32.8 million families for one month. Successful demand response among large consumers helped to support the conversion of Brazil's pilot demand response programme to a structural programme in the electricity sector in 2022.

Countries across the region face the challenge of adapting to hydropower disruptions driven by climate change. Hydropower is the main source of electricity generation in most countries, accounting for 45% of electricity supply across the region. Analysis of the impacts of climate change on hydro systems in the region finds that Mexico, Argentina, Chile and several Central American

countries in particular are likely to see a consistent decrease in mean hydropower capacity factors due to changing rain patterns.

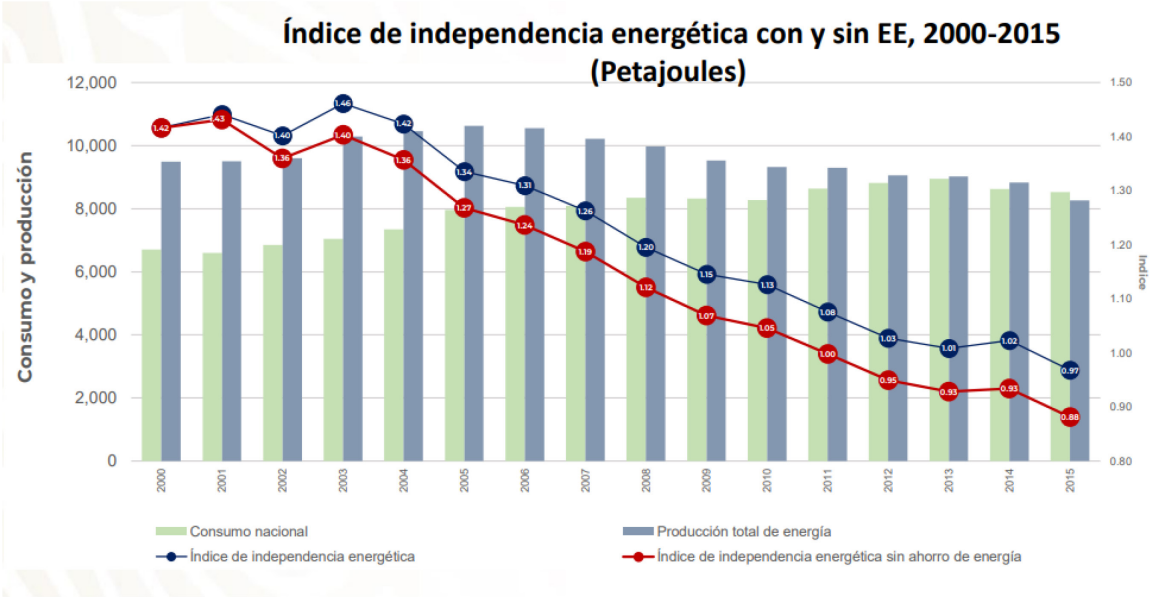
Continuous improvements in energy efficiency and demand management are essential to strengthen energy systems against future crises and, increasingly, to help manage growing stress on energy systems.

Longer-term energy security

Energy security can be defined in different ways, including by import/export balances, diversity of energy sources, resilience of energy systems to disruption, and reduction of exposure to risks – such as price volatility on global markets. Energy efficiency can contribute to each of these dimensions.

Mexico, for example, has calculated the contribution of energy efficiency programmes to energy independence, defined as the level of consumption to production in-country. While energy independence has decreased over time, energy efficiency has tempred this trend. From 2000-2015, energy efficiency improved the level of energy independence by 9% relative to a scenario without energy savings.

Index of energy independence with and without energy efficiency (in petajoules) in Mexico, 2000-2015



Source: National Commission for the Efficeint use of Energy (CONUEE) (2020), Indicadores de Eficiencia Energética en México.

Transport is another important strategic sector across Latin America, with road transport playing an important role. Trucks are particularly important because of

the long distances often travelled to transport goods. Take the case of Brazil. Over the past 20 years, Brazil has become one of the world's leading agricultural exporters. This has increased freight demand and, correspondingly, fuel demand. Increasing diesel demand and imports have led the country to implement several initiatives and programmes in order to reduce the country´s energy dependence. A few highlights are the auto labelling, Inovar Auto, Rota 2030, Proconve, RenovaBio, PNPB, Pro Trilhos and BR do Mar programmes. Along with new investments in railways and an increase in the size of trucks, this suite of policies has led to a 38% reduction in the energy intensity of the freight sector from 2000 to 2022.

Institutional frameworks for energy efficiency

Targeted policies, programmes and institutional frameworks play a central role in delivering energy savings, helping to overcome barriers to energy efficiency and driving the market for energy efficient products and services.

Countries with the strongest advancements in energy efficiency have developed institutional frameworks to develop, track and improve energy efficiency policies and programmes. In Mexico, for example, the Secretary of Energy (SENER) is the central authority overseeing the planning, coordination, and definition of energy efficiency policies. In addition, the National Commission for the Efficient use of Energy (CONUEE) plays a central role as the expert body on energy efficiency, including by promoting energy efficiency, capacity building, analysing progress and informing policy.

Some other countries in Latin America have divided these responsibilities among several agencies, such as in Brazil with the Ministry of Mines and Energy (MME), National Energy Conservation Programme (Procel), Energy Research Office (EPE), and National Electricity Regulatory Agency (ANEEL) all having important roles. Other countries have dedicated agencies or entites leveraging public-private cooperation such as in Chile, where the Sustainable Energy Agency focusses on implementing projects and developing the market for efficiency services.

Securing a least-cost, reliable power sector

Energy efficiency has a strong track record of reducing electricity consumption, including peak demand. This is important, as the value of energy savings and demand-side management will only grow with the continued expansion of electricity demand and intermittent renewable generation.

Several countries' programmes have delivered significant electricity system benefits over time:

- In Uruguay, a national lighting programme rolled out in two phases from 2008 to 2009 and 2011 to 2012, replaced incandescent bulbs with CFLs in households across the country. Each time, households benefitted from receiving two CFL bulbs. The first phase of the programme generated peak savings of up 100 MW, with another 82 MW shaved off peak in the second phase. The second phase saved 2.4% of total residential, and 1% of total electricity consumption in the country. It reached 72% of homes, benefitting the vast majority of the population through lower bills, and all users on the system through avoided electricity generation costs.
- In Brazil, Procel and the Programme for Energy Efficiency (PEE) have together saved an average of more than 13 000 GWh of electricity a year over the most recent decade of their operation, equivalent to 82% of all of the consumption of solar PV on the Brazilian system in 2021 (16 752 GWh). They have reduced peak demand by about 4.6% of Brazil's historic peak, demonstrating the value of peak-coincident energy savings to benefit power systems in addition to customer bills.

Appliance standards and labelling programmes have further delivered important savings, as illustrated by air conditioning and electric motors. Many countries in the region have introduced standards and labelling frameworks for appliances and electric motors, including Uruguay, Chile, Argentina, Colombia, Panama, Mexico and countries in the Central American Integration System (SICA) region.

Air conditioning (AC) is an important area of focus, given the growth in air conditioner ownership in the region. In the IEA's Future of Cooling report, improving the energy efficiency of ACs could reduce the contribution of ACs to peak demand from 24% to 15% in Mexico and from 31% to 20% in Brazil. The Brazilian Energy Research Office has estimated that demand for electricity due to the use of air conditioners in the residential sector could grow by 5.4% per year from 2017 to 2035 and reach 48 TWh.

In 2022, Brazil updated its minimum energy performance standards for air conditioners, which are expected to deliver 67 TWh of electricity savings by 2040. Combined with passive cooling measures, energy efficiency and demand management for ACs can support affordable access to cooling while limiting the stress of peak loads on power systems.

Electric motors are another priority sector. Electric motors are nearly ubiquitous, and power everything from large industrial processes to household fans. In Latin America, they account for 644 TWh of consumption, more than the annual electricity consumption of Brazil. Few countries in the region have adopted the premium IE3 international efficiency standard for motors. In 2017, Brazil approved the adoption of a minimum performance standard at the level of IE3 for motors up to 500 horsepower. These new indices are expected to generate an accumulated saving of 11.2 TWh between 2019 and 2030, with annual

savings equivalent to the annual consumption of more than half a million households.

Across the region, even in countries with high standards, there is the challenge of very old motors with low efficiencies (IE1 level or below) that continue to operate. By one estimate, replacing old motors with IE3 standard-level motors, the minimum required in Brazil and Mexico, would lead to 8% energy savings. Going one level higher to IE4 would lead to 10% energy savings. The payback on motor replacement, through lower energy bills, can be less than a year. This can make a tremendous impact on electricity systems while cutting costs, but requires policy action to accelerate.

The potential for energy savings is much greater

These numbers are significant. And yet, consider the remaining potential. In Mexico, the Commission for the Efficient Use of Energy (CONUEE) has calculated that a new refrigerator can consume up to 65% less energy than one that is more than 10 years old. In Colombia, inefficiencies in energy consumption across the economy are estimated at 67%. Applying best available technologies can reduce these inefficiencies by between 38% and 62%. If we move beyond technologies to system strategies, such as combining buildings materials and passive technologies with efficient end uses, the savings can reach much higher, putting critical visions for decarbonisation – such as net zero buildings – within grasp.

The IEA's Net Zero Scenario estimates that investments in energy efficiency and demand-side measures (such as behaviour, fuel switching, and demand response) must quadruple by 2030. Achieving this will require countries to build on existing policy frameworks and experience, including with financing energy efficiency projects, to overcome barriers to energy efficiency and accelerate energy savings.

It is important to learn from experiences both inside and outside of the region to identify strategies to scale energy efficiency. These might include bulk procurement, which has had success in driving down costs of efficient lighting in Mexico and lighting, air conditioning and other equipment and appliances in India. Appliance replacement programmes have helped many households, particularly low-income ones, to gain access to newer, more efficient appliances. Working with banks to ensure the supply of affordable loans and supporting private sector investments to complement government spending is key. Innovative business models are under development across the region, such as cooling as a service, and combining energy efficiency with solar PV for low-income households in Brazil.

Jobs of the present, careers of the future

A jobs engine

Energy efficiency is an important source of local jobs, with rapid near-term growth potential

Around the world, energy efficiency is an important source of jobs. According to the IEA's World Energy Employment report, energy efficiency accounted for 10.9 million full-time-equivalent (FTE) jobs in 2019. In Latin America, direct energy efficiency jobs accounted for about 8% of energy sector jobs. In Central and South America, 33% of energy efficiency jobs are in the construction sector, and around 25% in manufacturing.

Estimates of employment impacts tend to be measured in terms of full-time equivalence (FTE). This is helpful in generating absolute estimates; however, looking only at FTE as an indicator masks the importance of energy efficient technologies and practices among many more workers and professions, because part-time employment is prevalent in the delivery of energy efficiency projects. For example, a bottom-up survey of Brazilian stakeholders found that while energy efficiency consultants spend 100% of their professional time working on energy efficiency, construction workers dedicate only about 9% of their working hours to energy efficiency activities. As this example illustrates, in addition to net job creation, it is important to look at the role of energy efficiency in the broader structure of key sectors.

Statistical information on job creation in energy efficiency is scarce. Most countries do not collect economy-wide data on the subject. Rather, national statistical agencies tend to collect data on key sectors such as manufacturing and construction which are delineated clearly by economic sector classification systems, and where energy efficiency jobs are not broken out.

Still, there is evidence of the employment benefits of energy efficiency from some specific programmes. For example, a recent survey conducted by the Inter-American Development Bank looked at job creation in emerging sectors such as electric mobility, digitalisation, hydrogen, storage, energy efficiency, and batteries. The survey covered three countries: Bolivia, Chile and Uruguay, and found that investing 1 million USD in these sectors can create up to 49 new jobs depending on the country – more than the number of jobs created by traditional energy sector

investment. Job creation differed significantly between countries, depending on national circumstances. Of the emerging sector firms surveyed, energy efficiency accounted for 27% of activity in Chile, 13% in Bolivia and 35% in Uruguay. While this is just a sample, it provides some insight into the role of energy efficiency in employment creation alongside other key emerging sectors in the energy transition.

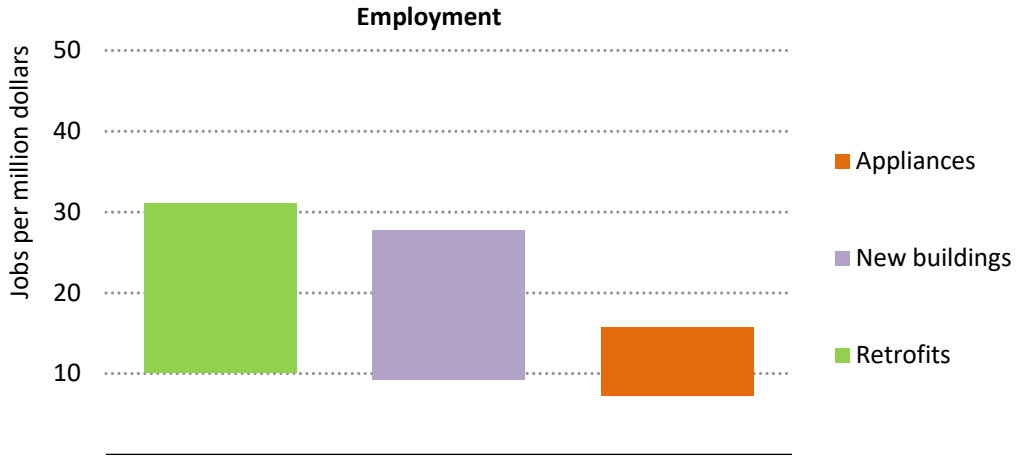
Another recent survey of green building practices in Colombia found that most companies surveyed generated new jobs when incorporating sustainable practices, with the highest job creation in the manufacturing and supply of efficient materials and in financing.

In Mexico, the household refrigerator replacement programme mentioned earlier is estimated to have created around 9 000 direct and 3 000 indirect jobs.

Organisations including the IEA and International Labour Organization (ILO), academic researchers, and initiatives at national level such as in Brazil, have developed jobs multipliers based on available evidence to help determine the jobs creation potential of investment in energy efficiency. In its 2020 Sustainable Recovery report, the IEA estimated that globally, every million USD invested in energy efficiency generates significant jobs in key sectors including building construction, renovation, appliances and transportation.

In the buildings sector, every million dollars invested in energy efficiency generates an estimated 10 to 31 jobs in manufacturing and construction for retrofitting existing buildings and implementing energy efficiency measures in new construction. Most construction jobs are local. Manufacturing focuses on key materials, such as insulation, window glazing and heat pumps. For appliances, every million dollars invested would generate an estimated 7 to 16 jobs, mainly in supply chains and sales.

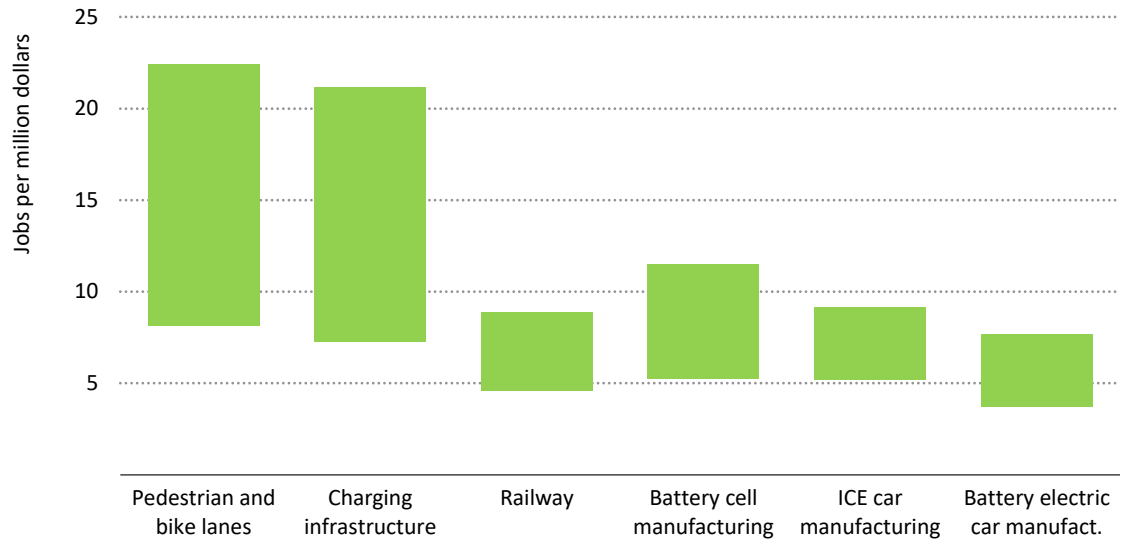
Average jobs created globally per million dollars invested, buildings and appliances



Source: IEA (2020), Sustainable Recovery (World Energy Outlook Special Report).

In the transport sector, many of the energy efficiency jobs are in the manufacture of electric vehicles, batteries and charging infrastructure. Expanding rail travel can create additional jobs and provides significant efficiency improvements compared to other modes of transport. Investments in urban infrastructure to shift to walking and cycling are estimated to create between eight and 22 jobs per million dollars invested, making them a jobs engine in city centres.

Average jobs created globally per million dollars invested, transport infrastructure



Source: IEA (2020), Sustainable Recovery (World Energy Outlook Special Report).

Understanding the key sectors where energy efficiency is driving employment can help target policies, programmes and training initiatives to strengthen capacity and deliver energy efficient solutions.

Construction is a particularly important sector, both as the largest sector in which energy efficiency jobs are created and as a strategic source of local employment across Latin America. The sector accounts for about 7.4% of total employment across Latin America and the Caribbean. In some countries, this share is higher. In Mexico, for example, construction is the fourth biggest economic sector, accounting for 8.0% of GDP, and generating 13.9% of jobs in the country, behind only agriculture and commerce.

Informal employment, which refers to forms of employment where there is no clear employer-employee relationship, is high in the construction sector. Around 60% of construction workers in Latin America are informal, with the number ranging from 36% in Chile to 72% in Argentina. In Mexico, the percentage of informal workers in the construction sector was 94.3% in 2022 – well above the average 39% of informality in the broader labour market. This dynamic means

that addressing energy efficiency – and related jobs – is important across both formal and informal construction in the region.

A recent innovative project in Mexico demonstrates one way to address energy efficiency in both the formal and informal construction sectors through financing, training and empowering low-income households to attain home ownership. The project was implemented by the Institute of the National Housing Fund for Workers (INFONAVIT) and the National Housing Commission (CONAVI), together with the World Bank. It provided support in two areas: purchase and efficiency improvements of homes constructed formally, and training and financing to help people build their own homes. Overall, the programme supported 28 864 households in purchasing or building their first home. The programme was part of a broader Covid-19 strategy to increase economic activity in key economic sectors such as construction and real estate.

International green building practices and third-party labels and certifications are growing across the region, including LEED, EDGE, BREAM and VERDE. To add to these, some countries have established their own certifications. Chile has introduced the CES Seal, and Brazil the PBE Edifica Seal. As these certifications grow in popularity, the number of specialised workers is increasing. Training is happening on many levels, including professional accreditation in internationally-recognised green building standards, national and regional programmes aimed at training builders and installers, and initiatives to develop policy roadmaps to drive sustainable construction and renovation across the region.

Career pathways

It's not just today's jobs that matter. Countries around the region are setting national decarbonisation pathways and targets, often with strong emphasis on energy efficiency. This will create new demand for workers and call for new skillsets. According to the ILO, a decarbonisation scenario, which includes a strong energy efficiency component, has the potential to create 15 million new net jobs in Latin America and the Caribbean by 2030. This would include creation of 58% more jobs in construction and 50% more in manufacturing by 2030 than in 2014 – both sectors key to delivering energy savings.

Investing in energy efficiency means investing in youth employment. Global youth employment declined by 34 million between 2019 and 2020, largely due to the Covid-19 crisis. In 2022, it was still expected to remain one percentage point below 2019 levels. Overall, Latin America and the Caribbean saw a drop in working hours equivalent to 36 million full-time jobs due to the Covid-19 pandemic.

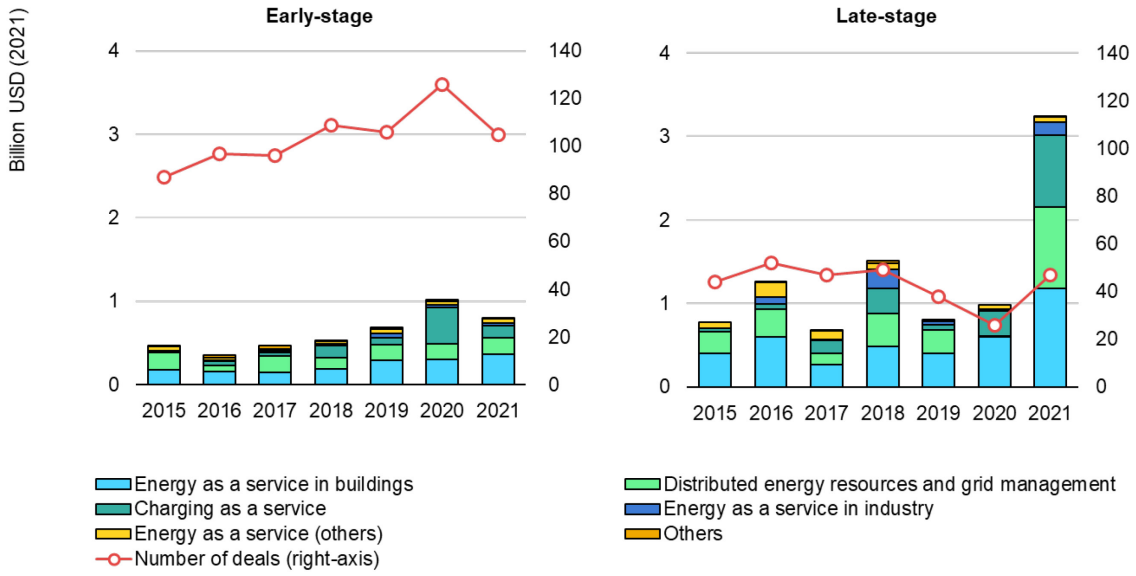
The increase in demand for workers will not just be to multiply existing jobs; it will be for new skills across career pathways and for greater inclusion of historically underrepresented groups in the energy sector. For example, digital

technologies can amplify savings potentials in buildings, but require skills such as modelling to optimise building design, operating building management systems, smart lighting, and many other digitally-enabled demand-management solutions. The Inter-American Development Bank's survey mentioned earlier has found a higher participation of women in emerging sectors, including energy efficiency, compared to traditional energy sector jobs. In addition to skills and inclusion, it is important for countries in the region, and globally, to focus on good-quality jobs.

While the technologies and techniques exist today to expand energy efficiency across buildings, industry and transport, innovation will be needed in policies, programmes, business models and finance to broaden their application. This is particularly true at the intersection of energy efficiency and demand-side flexibility. For example, electric vehicles, air conditioners and electric heat pumps all present opportunities to improve energy efficiency, at the same time that they can add significant demand to the electricity system. This presents a challenge – but also an opportunity to adjust consumption patterns both to reduce strain on the grid and to help integrate greater shares of variable renewable resources.

Digital technologies provide a key opportunity in this area. One measure of progress – and of job creation – is the rate of venture capital investment in areas relating to digital innovation and efficiency. In 2021, venture capital investments more than tripled year-on-year to USD 3 billion. This increase was led by distributed energy resources (which include demand-side management) and grid management, demonstrating the interest of the finance community in these areas. With electricity demand climbing and variable renewable resources expanding, opportunities will continue to grow.

Global venture capital investments in clean energy start-ups in the fields of efficiency and electrification, by technology, 2015 – H1 2022



Source: IEA (2022), Energy Efficiency 2022.

There are many examples of training initiatives across the region to meet the growing demand for energy efficiency services.

In Colombia the number of professionals accredited in a green building standard has increased significantly over the past few years, with EDGE, LEAD and CASA certifications leading the pack. The government and Colombian Chamber of Construction (CAMACOL) have worked together to strengthen university curricula to train students in sustainable building practices.

The Energy Efficiency in the Colombian Industry project (Proyecto de Eficiencia Energética Industrial en Colombia), implemented from 2016 to 2019, aimed to boost the market for energy efficiency services and products. This project monitored 180 industries and trained more than 100 industry technicians, including 22 women, in seven regions of the country, bringing social and employment benefits to communities.

Chile launched a capacity building programme to train energy managers and to support the implementation of energy efficiency measures in industrial sectors. From 2019 to 2021, the programme trained 476 energy managers and 390 registered energy consultants. Over the three years, 138 participating companies adopted an energy management system and another 637 undertook energy efficiency improvements. These efforts were a response to the finding that lack of trained personnel and insufficient knowledge to implement energy efficiency were key barriers to energy efficiency in industry.

In 2021, the National Electricity Conservation Programme, Procel, promoted training courses for public officials from municipal, state and federal level in Brazil to disseminate knowledge about energy management, operational energy performance of public buildings, efficient technologies for public lighting and opportunities for energy efficiency in public sanitation. Five training courses were carried out with participation from nearly all Brazilian states. These are in addition to other courses carried out in 2021 and 2022. The PotencializEE programme further provides training and certification to deliver energy efficiency in industrial facilities in Brazil.

Energy efficinency offers a significant opportunity to grow jobs and careers. New skills will be needed to harness the full potential of digital technologies, data other innovations. As policymakers advance energy efficiency and demand management policies and programmes, it will be important to continue to build on existing programmes to ensure that the workforce is ready to deliver greater savings, taking advantage of new and evolving opportunities.

Conclusions and recommendations

Capturing the value

A proven track record of delivering value to people, governments and energy systems

Energy efficiency and demand flexibility can play a key role in improving affordability and access to energy services, managing public budgets, strengthening energy security and generating jobs today and into the future. Evidence from well-structured policies and programmes across Latin American demonstrate the kinds of benefits that can be achieved with thoughtful design and targeted objectives.

- Policies and programmes to save and manage energy consumption have a demonstrated track record of expanding affordable access to energy services and lowering bills for households and businesses across Latin America.
- Investment in energy efficiency in public infrastructure and cities can deliver improved services and financial savings across sectors, including in buildings, transport, street lighting and water treatment.
- In crisis situations, targeted programmes and measures can reduce demand quickly and inexpensively relative to the cost of supply. Over the longer term, energy efficiency and demand-side flexibility are essential levers to incorporate and manage new loads such as air conditioning, electric vehicles and heat pumps, and to integrate variable renewable resources.
- Energy efficiency is an important source of employment. Career opportunities will continue to grow as countries work to meet their climate, economic and social objectives. Digital technologies provide new opportunities to understand energy consumption patterns and to deliver and measure energy savings and flexibility. New skills are being developed, but further skills building is needed to keep up with innovative opportunities.

While there are many examples of successful delivery of these, and many other, benefits of energy efficiency and demand management, significant potential remains. Many efficiency policies and programmes could be improved to more equitably benefit all people. Similarly, many areas traditionally focussed on energy sector regulation and markets could be improved to capture the benefits that efficiency and demand management can deliver.

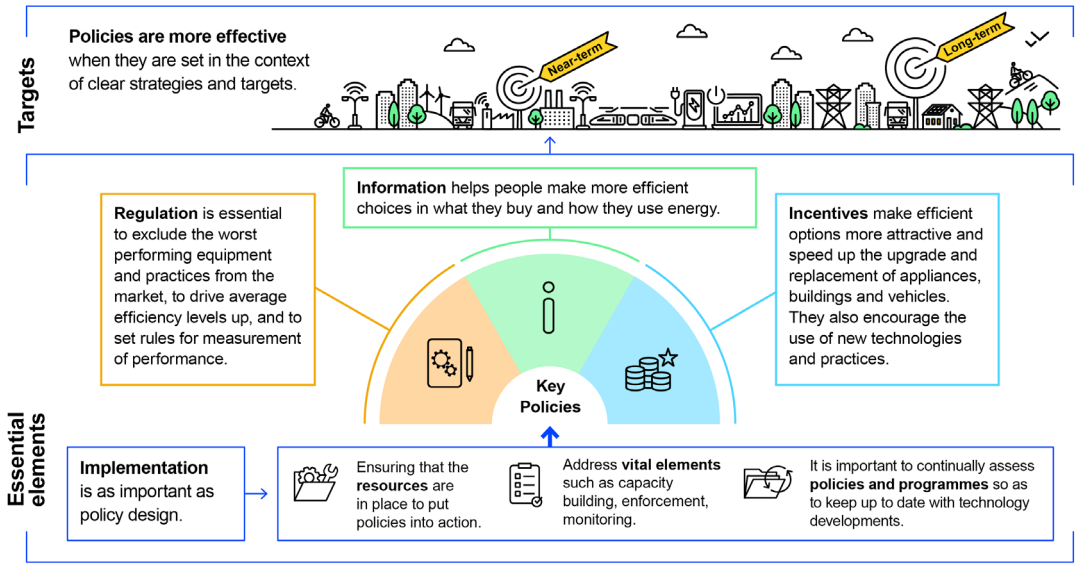
Harnessing this capacity will require decisionmakers to build on existing policies and programmes while identifying additional pathways to expand and deepen the role of energy efficiency and demand-side flexibility in the energy transition. A key dimension of these efforts will be to ensure that historically marginalised and hard-to-reach populations benefit. In some cases, energy efficiency programmes will help enable access to critical energy services such as space cooling, clean cooking and refrigeration, rather than achieving net energy savings. It will be important to clearly define and track policy objectives in order to measure, communicate and improve on efforts over time.

Recommendations to advance key benefits of energy efficiency

1. Reviewing and strengthening policy packages. Evidence from energy efficiency and demand management policies and programmes across Latin America and globally demonstrate the value of policy packages to deliver improvements in energy efficiency and demand management. Leading jurisdictions have in place systems of regulations, information frameworks and incentives that work together and are underpinned by the necessary institutional support to track progress and improve on existing policies and programmes.

It is important to review and build on these policy structures to accelerate and expand savings. It is also essential to consider introduction of new policies – such as those enabling demand response – to advance demand flexibility. Digital technologies provide significant potential in this area, but require adjustments to market and regulatory frameworks to deliver robust demand-side flexibility.

A package of policies and implementation are needed to deliver energy efficiency



Source: IEA (2022), The value of urgent action on energy efficiency (Policy Toolkit).

2. Designing policies to advance innovative solutions. Energy consumption covers every aspect of daily life, from flipping a light switch, to manufacturing and powering electronic devices, and all the way to the heavy industrial processes that support construction of buildings and bridges. Innovation is occurring across these and other areas of energy use. Small innovations can make a big difference. To take one example, the introduction of LED lighting is driving enormous savings across the globe. Minimum energy performance standards and labelling programmes for appliances and equipment are helping to deliver these and other savings. Many other policies are driving innovation across the buildings, transport and industry sectors.

At the same time, there are many innovations whose potential is not yet captured, and where policies can play an important enabling role. Digital technologies and the data and services that they can deliver are one such area. Technologies such as smart sensors and smart meters can help collect data on key end-uses such as air conditioning and electric vehicle charging, providing data on consumption levels and patterns, facilitating development of strategies to save and shift energy use to align with the availability of cheap energy. This is an essential area of development for low-carbon energy systems and can help bolster responses to crisis situations. Capturing the value of these kinds of innovative developments requires a focus on policies that enable new ways of operating energy systems and new business models, as well as building a skilled workforce that can deliver. In return, such policies can help meet energy transition goals more affordably and equitably.

3. Strengthening evaluation of policies and programmes. In the context of this report, the role of information deserves special mention. The evidence presented from various country policies and programmes relies on data collection and programme evaluation to demonstrate the savings generated – including energy, bill, fuel and public budget savings – as well as employment creation. Yet many more programmes and policies exist for which data are not being collected, making it difficult to provide evidence on the benefits they are delivering and to identify opportunities for improvement.

International methodologies exist to collect and organise data, both through top-down analysis (such as through decomposition analysis) as well as bottom-up evaluation of programmes and policies. It is important to consider opportunities and strategies to strengthen the data collection process.

Programmes and policies should have clearly defined objectives and indicators to track progress against goals. These might include energy and as well as non-energy related goals, such as those discussed in this paper. This will help strengthen the understanding of the role energy efficiency in advancing policy priorities and carve a path for structuring policy solutions into the future.

Annex

Policies and programmes mentioned in this report (by country)

The following is a summary of examples referenced throughout the paper. It is not a comprehensive summary of policies or programmes, but rather a tool to navigate the policies, programmes and other sources of information cited in this paper. Sources are listed by country, and then in the order that they appear throughout this report, alongside the lead agency or actor responsible for the material, and key sectors covered. For a more complete overview of the policy framework for energy efficiency in the region, please see the IEA's Policies and Measures Database and publication by OLADE summarising energy efficiency laws in the region.

Country/Reference	Lead agency or actor	Sectors
Argentina		
Weatherizers Without Borders	WWB-Argentina	Buildings
Brazil		
Programme for Energy Efficiency (PEE)	ANEEL	Buildings, Transport, Appliances, Industry
Neoenergia-Programme for Energy Efficiency (PEE)	AVSIBrasil & Neoenergia	Buildings
Guarulhos (SP): 360-degree view on improving municipal energy efficiency	Guarulhos Municipality & EDP São Paulo	Buildings, Appliances, Water systems
Widespread National Power Shortage: Brazil in Demand-Side Management in China's Restructured Power Industry	GCE & ANEEL	Energy security
Use of Air Conditioning in the Brazilian Residential Sector: Perspectives and Contributions to Advances in Energy Efficiency	EPE	Buildings, Appliances
Energy generation and global load	EPE	Buildings, Energy security
Decenial Plan for Energy Expansion 2029	EPE	Buildings, Transport, Appliances, Industry
PROCEL Awards in Electric Power. Efficient City. 7th Edition	Eletrobras	Buildings, Appliances, Water systems
1st solar energy cooperative in Favelas of Brazil	RevoluSolar	Buildings

Country/Reference	Lead agency or actor	Sectors
Potential jobs generated in the area of Energy Efficiency in Brazil from 2018 to 2030	IEI & Mitsidi	Buildings, Industry
Demand Response Programme	ANEEL	Buildings, Energy security
Atlas of Energy Efficiency Brazil 2021	EPE	Buildings, Transport, Appliances, Industry
Procel Results (2003-2021)	PROCEL	Buildings, Transport, Appliances, Industry
Statistical Yearbook for Electricity	EPE	
Brazilian Labelling Program (PBE) for commercial, service and public buildings and residential buildings (EDIFICA)	Eletrobras-PROCEL	Buildings
Transforming Energy Efficiency Investments Program in Industry (PotencializEE)	PotencializEE-SENAI-SP	Industry
Federal Government Procurement Portal	Federal Government	
Results of the Voluntary Energy Consumption Reduction Program	MME	Buildings
Chile		
Energy Efficiency Action Plan 2020	Ministry of Energy	Buildings, Transport, Appliances, Industry, Mining, Clean cooking
Fuel economy standards and zero-emission vehicle targets in Chile	ICCT	Transport
National Energy Efficiency Plan 2022-2026	Ministry of Energy	Buildings, Transport, Appliances, Industry
Energy Efficiency Plan for the Industry and Mining Sector	Ministry of Energy	Industry, Mining
First National Energy Efficiency Survey for Businesses	Ministry of Energy	Industry
Sustainable Building Certification	Ministry of Public Works	Buildings
Colombia		
Efficient Caribbean Program	FENOGE	Appliances
Indicative Action Plan 2022 – 2030 for the development of the Program for the Rational and Efficient Use of Energy, PROURE	Ministry of Mines and Energy	Buildings, Transport, Appliances, Industry, Mining
Programme for Three-Phase Induction Motors Squirrel Cage Rotor	Ministry of Mines and Energy	Appliances
State of Sustainable Construction in Colombia	CCCS	Buildings

Country/Reference	Lead agency or actor	Sectors
Energy Efficiency in Industry – Presentation of Results	UPME	Industry
Mexico		
Energy Consumption Decomposition Tool	CONUEE	Buildings, Transport, Appliances, Industry
Replacement Programme Home Appliance Equipment (PSEE)	FIDE	Appliances
Federal Public Administration Programme	CONUEE	Buildings, Transport
Energy services, energy poverty and energy efficiency: a perspective from Mexico	CONUEE	Buildings, Appliances
National Project for Energy Efficiency in Public Municipal Lighting	CONUEE	Appliances
National Programme for the Sustainable Use of Energy 2014-2018. Progress and Results 2016	CONUEE	Buildings, Transport, Appliances, Industry
The electricity saving program in buildings of the federal public administration: A recount (1993-2019)	CONUEE	Buildings, Transport
National Report on Monitoring Energy Efficiency in Mexico (2018)	CONUEE	Buildings, Transport, Appliances, Industry, Energy security
Efficient Lighting and Appliances Project	FIDE	Appliances
Current Situation and Construction Industry in Mexico Outlook	CMIC	Buildings
Construction Support Workers	Data Mexico	Buildings
Efficient lighting and appliances project: implementation completion and results report	World Bank Group	Appliances
Local Climate Action Strategy 2021 - 2050 and Climate Action Programme of Mexico City 2021 - 2030	SEDEMA-CDMX	Buildings, Transport, Appliances, Industry
Energy Efficiency in Small and Medium Enterprises	NAMA Facility	Industry
Uruguay		
Basket of Services Programme	Ministry of Industry, Energy and Mining (MIEM)	Buildings, Appliances
National Energy Efficiency Monitoring Report of the Republic of Uruguay	MIEM	Buildings, Transport, Appliances, Industry
First Annual Report on Electric Buses	MIEM	Transport

Country/Reference	Lead agency or actor	Sectors
Regional		
How do households consume energy in Latin America and the Caribbean?	IDB	Buildings
Economic impacts of the war in Ukraine on Latin America and the Caribbean	UNDP	
Poverty in Latin America and the Caribbean: a long and bumpy road ahead	World Bank	
The main challenges in energy efficiency in Latin America and the Caribbean	IDB	Buildings, Appliances
Efficient refrigeration equipment in Latin America and the Caribbean: An opportunity to cool the planet and accelerate the regional economy	UNEP	Appliances
No diesel, no gas: Latin American cities prefer electric buses for big savings	C40	Transport
Climate Impacts on Latin American Hydropower	IEA	Energy Security
Labour Informality in Latin America and the Caribbean: Patterns and Trends from Household Survey Microdata	UNLP	
Jobs in a net-zero emissions future in Latin America and the Caribbean	ILO & IDB	Buildings, Appliances, Industry, Mining
EELA: Energy Efficiency in Brick Kilns in Latin America	BEAM & Swisscontact	Buildings
Energy Efficiency Laws in Latin America and the Caribbean	OLADE	Buildings, Transport, Appliances, Industry, Mining
Implications of the Energy Transition on Employment: Today's Results, Tomorrow's Needs	IDB	
Global		
IEA Energy Efficiency Indicator Highlights	IEA	Buildings, Transport, Appliances, Industry
Empowering Cities for a Net Zero Future	IEA	Buildings, Transport
C40 Net Zero Carbon Buildings Declaration: How cities are delivering low carbon and energy efficient buildings	C40	Buildings
The Future of Cooling	IEA	Buildings, Appliances
World Energy Outlook 2022	IEA	
Super-efficient AC Programme in India	EESL	Appliances
Cooling as a Service (CAAS)	BASE	Appliances
World Energy Employment	IEA	
2020 Sustainable Recovery	IEA	

Country/Reference	Lead agency or actor	Sectors
Greening with jobs – World Employment and Social Outlook 2018	ILO	
World Employment and Social Outlook – Trends 2021	ILO	
Global Employment Trends for Youth 2022	ILO	
Policies and Measures Database	IEA	
Energy Efficiency in Electric Motors	WEG	Appliances
Energy Efficiency Indicators: Essentials for Policy Making	IEA	Buildings, Transport, Appliances, Industry
Demand-side data and energy efficiency indicators	IEA	Buildings, Transport, Appliances, Industry
Skills Development and Inclusivity for Clean Energy Transitions	IEA	Buildings, Transport, Appliances, Industry
The potential of digital business models in the new energy economy	IEA	Buildings, Transport, Appliances, Industry

List of abbreviations

AC	Air Conditioner
ANEEL	National Electricity Regulatory Agency
BREEAM	Building Research Establishment Environmental Assessment Methodology
BRL	Brazilian Real
CAMACOL	Colombian Chamber of Construction
CCCS	Colombian Sustainable Green Building Council
CES	Sustianble Building Certification
CFL	Compact Fluorescent Lamp
CMIC	Mexican Chamber of Construction Industry
CNG	Compressed Natural Gas
CONAVI	National Housing Commission
CONUEE	National Commision for the Efficient Use of Energy
EDGE	Excellence in Design for Greater Efficiencies
EDIFICA	Brazilian Labelling Programme for commercial, service and public buildings and residential buildings
EELA	Energy Efficiency in Brick Kilns in Latin America
EESL	Energy Efficiency Services Limited
EPE	Energy Research Office
FENOGE	Fund for Non-conventional Energy Efficiency
FIDE	Trust Fund of Energy Saving
FTE	Full-time-equivalent
GCE	Electricity Crisis Management Chamber
GDP	Gross Domestic Product
GHG	Greenhouse Gas
ICCT	International Council on Clean Transportation
IDB	Inter-American Development Bank
IDP	Regional Electricity Distribution Company
IEI	International Energy Initiative
ILO	International Labour Organisation
INFONAVIT	Institute of the National Housing Fund for Workers
IPT	Technological Research Institute
LEED	Leadership in Energy and Environmental Design
MIEM	Ministry of Industry, Energy and Mining of Uruguay
MME	Ministry of Mines and Energy of Brazil
MXN	Mexican Peso
NGO	Non-Governmental Organisation
NOM	Mexican Minimum Energy Performance Standard
OLADE	Latin American Energy Organisation
PBE	Brazilian Labelling Programme
PEE	Brazilian Programme for Energy Efficiency
PotencializEE	Transforming Energy Efficiency Investments Programme in Industry
PROCEL	National Energy Conservation Programme
PV	Photovoltaic

RVD	Voluntary Electricty Demand Reduction
SEDEMA	Ministry of Environment of Mexico City
SENER	Ministry of Energy of Mexico
UNAM	National Autonomus University of Mexico
UNEP	United Nations Environmental Programme
UNLP	National University of La Plata
UPME	Mine-Energy Planing Unit of Colombia
WWB	Weatherizers Without Borders

International Energy Agency (IEA).

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Typeset in France by IEA - March 2023
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