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Economic Cooperation

Advancing Free Trade
for Asia-Pacific Prosperity

Follow-Up Peer Review on Energy Efficiency in Peru

APEC Energy Working Group

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ABBREVIATIONS AND TERMS

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
DSM	Demand Side Management
EEV	Energy Efficient Vehicle
ESCO	Energy Service Company
FiT	Feed-in Tariff
GHG	Greenhouse Gasses
IEA	International Energy Agency
ISO	International Organization for Standardization
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MEM	Ministry of Energy and Mines
MEPS	Minimum Energy Performance Standards
PREE	Peer Review on Energy Efficiency
UNFCCC	United Nations Framework Convention on Climate Change

PREFACE

According to the guidelines for the APEC Peer Review on Energy Efficiency (PREE), the objectives of PREE as endorsed by APEC Leaders at their 2007 meeting are to:

- Share information on energy efficiency performance as well as on policies and measures for improving energy efficiency.
- Provide opportunities for learning from the experiences of other economies and for broadening the network among energy efficiency policy experts.
- Explore how energy efficiency goals on an overall and/or sectoral basis and action plans could be effectively formulated in each economy under review, taking into account the range of possible strategies that could be used, according to the circumstance of each economy.
- Monitor progress on energy efficiency goals on an overall and/or sectoral basis and progress on action plans, if such goals and plans have been already formulated at the time of the review.
- Provide recommendations for voluntary implementation on how the action plans could be improved to achieve energy efficiency goals.

Two activities are undertaken as part of PREE:

- Peer Review of volunteer member economies.
- The Energy Efficiency Policy Workshop for capacity building of member economies.

A first Peer Review on Energy Efficiency (PREE) in Peru was conducted by a team of eight experts from 8 to 12 November, 2010 and a report was published in May 2011. Almost eight years later, this Follow-up PREE in Peru took place from 18 to 22 March 2019. Given the time that had elapsed, this follow-up again took a broad scope, focusing on the following six key areas: overarching issues, data, industry, transport, buildings and appliances, and electricity and supply sectors. The Review Team that visited Lima consisted of six experts and four APERC staff and made 47 recommendations. During the visit, the Review Team held comprehensive discussions on energy efficiency with representatives and experts from government ministries and agencies, industrial associations, academia and non-governmental organisations.

The Review Team wishes to thank all the presenters and key stakeholder who participated in the discussions (Annex B). The Expert Team would like to especially thank to the officials from the Ministry of Energy and Mines and organising staff, in particular to Claudia Espinoza, Rommel Castro, Cristina Condezzo, Rosendo Ramirez and Vice-Minister Patricia Elliot Blas, without whom this event and report would not have been possible.

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EXECUTIVE SUMMARY

Efficiency is an essential component of modern energy policy and an indispensable tool for low carbon energy transitions. Energy efficiency is one of the key topics of the APEC Energy Working Group (EWG), and The Peer Review on Energy Efficiency has been a core part of the EWGs work to reduce APEC energy intensity the since its inception in 2007. The Follow-up Peer Review on Energy Efficiency (PREE) phase 9 represents the joint work and engagement between APEC and the Ministry of Energy and Mines, on behalf of the Peruvian Government.

Peru has made significant efforts in developing energy efficiency for the past 20 years, being one of the pioneers in the Latin-American region. However, several challenges remain in each of the primary energy consuming sectors analysed in this report. This PREE follows up on the peer review conducted in 2011. As a result of this first peer review, feasibility studies were commissioned and there was progress on the implementation of some recommendations including audits in buildings, construction codes and partnerships with the industrial sector. Nevertheless, institutional and economic changes made a follow-up PREE a value next step in peruse energy efficiency policy development.

Energy demand in Peru has been growing steadily in recent years Peru's final energy demand (FED) grew 73% in 2000-16, owing to steady economic (5.2% CAGR)[1] and population (1.3% CAGR) growth over that time period. Transport energy demand is the largest end-use sector, followed by industry and the by the buildings sector. In terms of fuels, oil-based products remain with the largest share of final energy demand, followed with an increasing trend by electricity and natural gas.

This report contains two parts. The first present's background information on Peru's energy sector and the second part analyses Peru's energy efficiency policies in six critical areas:

- Institutional framework and policy
- Goals, targets and data
- Industry sector
- Transport sector
- Buildings sector and appliances
- Electricity sector

The PREE Expert Team sincerely hopes that each of the recommendations contributes to enhancing energy efficiency in Peru. A short summary of each section of this report is provided in the remainder of Executive Summary, along with the 47 expert recommendations.

INSTITUTIONAL FRAMEWORK AND POLICY

A strong and reliable institutional framework within the energy efficiency field requires the engagement of different levels of government as well as the private, academic and non-governmental sectors. Although Peru has made significant efforts in developing its energy efficiency institutional framework for the past 20 years, as was acknowledged in the previous PREE in 2011, global and domestic trends in this field demand an acute and strategic modernisation. The MEM's long-term strategy is included in Peru's Energy Policy 2010-40. Current and future trends in the energy sector require a revision of this document within the energy efficiency scope adapting

[1] Compound annual growth rate.

it to Peru's current needs. It is important that this document clearly establishes priorities and goals with indicators and monitoring procedures. Additionally, the Referential Energy Efficiency Plan, published in 2009, as well as other energy efficiency planning documents should be reviewed, updated and aligned with a cross-sectoral vision.

Recommendation 1

The MEM should work with relevant stakeholders on drafting an updated, inclusive and aligned energy transition legislation that, when released, replaces the existing Efficient Use of Energy Promotion Law.

Recommendation 2

The MEM should work on revising its long-term planning documents, establishing priorities, measurable goals and indicators for energy efficiency.

Recommendation 3

The MEM should revise the DGEE's institutional framework to give the DGEE a clearer authority on energy efficiency matters beyond the use of electricity, especially in the transport sector.

Recommendation 4

As recommended in the 2011 PREE report, the Government of Peru should establish a dedicated energy efficiency agency to coordinate related analysis and policy implementation.

Recommendation 5

The MEM should revise Peru's energy efficiency operational frameworks and create a project implementation unit.

Recommendation 6

The MEM needs to ensure that sufficient funding is provided to energy efficiency programs such as auditing and accreditation efforts.

Recommendation 7

The DGEE should explore energy efficiency finance mechanisms domestically and internationally via development banks, financing units, or international multilateral organisations.

Recommendation 8

The DGEE should explore the possibility of designing and developing a research, development and innovation plan for energy efficiency.

Recommendation 9

The DGEE should explore new technical assistance, cooperation and financing sources both domestically and internationally.

GOALS, TARGETS AND DATA

While energy efficiency policy requires the involvement of multiple agencies, the coordination of governmental efforts must be led by a single body. In the case of Peru, the DGEE seems to be the best fit to play this role. This is particularly relevant with sectors such as the industrial one, which seems to be willing to further participate in energy efficiency programs, but communication within this sector seems to have challenges. Proactive government guidance in this regard has proven to be a successful approach in the international experience. Similarly, there is a lack of leadership around energy related data collection with different agencies over different time periods in Peru, making trends for energy use harder to examine. A single entity must have the responsibility for gathering information and disseminating the data to the various agencies that need data for specific activities.

Recommendation 10

The DGEE should have a strong leadership role, particularly while coordinating with other organisations, and communicating with energy consumers.

Recommendation 11

The DGEE should improve its labelling to clearly communicate to consumers the energy and financial savings that can be expected from more energy efficient appliances.

Recommendation 12

The DGEE should set up a program similar to Industries of the Future, implemented in the US, to coordinate Research, Design, Development and Demonstration (RDD&D) with the industrial sector.

Recommendation 13

The Peruvian Government should establish a data collection and statistics office to collect, analyse and publish energy data.

Recommendation 14

The MEM should work towards more frequent updates of national energy statistics (annually, for example).

Recommendation 15

The MEM should develop energy efficiency indicators for each sector considering technical and economic energy savings potential and related carbon reductions. Based on this, create energy and carbon reduction targets for key sectors.

Recommendation 16

The MEM should accelerate development and implementation of an energy efficiency roadmap.

Recommendation 17

The MEM should work together with academia and local consulting firms to develop baselines and models that can effectively evaluate energy demand, energy efficiency measures and technological advances in a variety of scenarios.

Recommendation 18

The MEM should have work to house all audit and accreditation efforts in one decision-making agency, ideally in the energy efficiency agency proposed in recommendation 4.

Recommendation 19

The MEM should aim to simplifying the label approval process and introduce mandatory labelling as a way to provide automatic data collection (including baseline and average values).

TRANSPORT SECTOR

While there have been significant improvements to Peru's transport system since the previous PREE, the efficiency of the vehicle fleet is lagging, congestion remains a serious problem with concomitant air pollution – some of the worst in the world – and integration of urban and land use planning not in place to reap transport system efficiencies. A labelling system which contains a mandatory and relative value would be an excellent first step towards improving vehicle efficiency. This represents a form of minimum energy performance standards (MEPS) for vehicles, also known as a fuel economy standard, which can be a MEPS by vehicle class or across a manufacturer fleet as done in the US with the so-called CAFE standards. Interest in electromobility is also surging in Peru, as it is elsewhere, and many important discussions are being had regarding energy and fuel supplies. However, picking a single fuel to utilise across all sectors is the wrong policy, rather, an energy efficiency outcome should be sought, with efficiency used as "the first fuel" of Peru.

Recommendation 20

The Government should introduce a label for vehicles, which needs to include the following measures to ensure effectiveness:

- *Make it mandatory for all new cars, and consider it as well for second-hand cars (as New Zealand has done) due to the large share of second-hand imports.*
- *Include a relative value and cost saving figure compared to the average efficiency for a vehicle of the same class so that consumers can make informed decisions.*
- *Link to a short-to-medium-term introduction of MEPS / a fuel economy standard / a ¨feebate¨ scheme.*
- *Link to the introduction of European emission standard Euro VI for diesel and gasoline to tackle not only efficiency, but also deteriorating air quality, especially from diesel vehicles.*

Recommendation 21

The Government should Integrate and centralise informal transport into the formal sector so as to improve route planning and quality, the number of buses going to underserved areas, and ameliorate traffic congestion.

Recommendation 22

In the long-term, set quality standards for concessions (licensed routes), including energy efficiency, and harmonise vehicle purchasing to lower overall operation and maintenance costs.

Recommendation 23

The Government should further integrate land use and transport planning to incentivise dense buildings next to public transport stops, including appropriate parking regulations, as well as encouraging non-motorized transport (NMT)

Recommendation 24

An outcome-based (efficiency in this case) transport technology policy should be strived for, rather than selecting and promoting hybrids or natural gas cars, per se.

Recommendation 25

The government should tap into existing knowledge on electric mobility, both those going through first steps, and those farther along by coordinating with other centres in the region and world (such as Centro Mario Molina in Chile) and the IEA's Implementing Agreement on Hybrid and Electric Vehicles (IA-HEV). This can save a lot of time and money on determining the best path forward.

Recommendation 26

Establish an inter-governmental working group to coordinate transport policy, including urban planning.

Recommendation 27

On fuels, the MEM should:

- *Study the costs and benefits of LPG use in the transport sector.*
- *Make a roadmap for electrification and suitability for all vehicle modes e.g. including electric two-wheelers (very high energy efficiency benefit), and the potential of electric trucks with catenaries (overhead lines) for repetitive paths in mines and ports.*
- *Study the cost of stranded assets of investing in infrastructure for natural gas as a fuel for transport (pipelines, vehicles, and other infrastructure) to avoid wasting funds.*

Recommendation 28

Scrapping incentives is a welcome step, but more rigorous inspection and maintenance can also do the job and save a lot of energy and money and avoid deleterious air quality given that a few vehicles emit a disproportionate amount of pollutants.

INDUSTRY SECTOR

The industrial sector is the second largest user of energy behind the transport sector (45%), consuming 27% of the total energy demand in Peru, and should be a priority area for Peru's energy transition to a less carbon intensive energy system. A good starting point would be for the government to clarify the value proposition for

companies of achieving ISO certification. For example, it is worth considering tax advantages for companies with ISO certification in Peru, as is the case in Germany and the United Kingdom. MEM should consider energy audits (compulsory or voluntary), as they provide a detailed energy balance, which looks into how much overall energy is supplied to the site, where it is used and what wastage can be reduced. For small and medium enterprises, offering an online self-assessment tool could help to reduce their energy efficiency program costs. For larger energy users, if the partnership model is not taken up by industry, the Government should consider implementing a compulsory energy efficiency opportunities programme.

Recommendation 29

The MEM and the designated data collection unit should engage in partnership agreements with key industry associations (such as the Sociedad Nacional de Industrias: SNI) to work alongside its members to implement Peru's energy efficiency and carbon reduction goals. This could not only increase cooperation with large energy users but also improve energy data collection.

Recommendation 30

The MEM should build stronger links with industry and sub-sectors by helping them with sectorial benchmarking tools, and promoting energy management awards and recognition for exemplary companies as well as program delivery partners.

Recommendation 31

The MEM may consider introducing voluntary agreements and standards for energy management systems, such as ISO 50001, as well as building domestic capacity and capability to deliver these systems.

Recommendation 32

The MEM should consider multiyear (three or more years) voluntary agreements with large energy users to help reduce energy use and emissions.

BUILDINGS SECTOR AND APPLIANCES

While there are some technical codes and advice available, Peru does not yet have a mandatory buildings energy code (BEC). The BEC lays out a set of rules that specify a minimum level of energy consumption and therefore it is the fundamental tool for enhancing energy efficiency in the buildings energy sector. After having a BEC, an energy audit code (EAC) should be developed. An EAC can help to provide the actual energy consumption from the building's own energy system (to see how it compares to the code). Implementing these codes can begin with public buildings before being implemented in the private sector. There should also be increased deployment and enforcement of minimum energy performance standards (MEPS) and mandatory energy labelling for appliances. Regarding conformity assessment, focus should be placed on achieving outcomes (improving energy efficiency), rather than processes (in this case, doing all accreditation and testing domestically).

Recommendation 33

The MEM should improve public building energy performance by implementing mandatory BECs with different climate zones, a starting point could be adapting some established in neighbouring economies.

Recommendation 34

The MEM could improve the energy performance of buildings components and systems by implementing minimum energy performance standards (MEPS) and supply chain improvements.

Recommendation 35

The MEM should increase disclosure of energy consumption for whole buildings (and building components and systems) by implementing mandatory energy labels and certificates, and developing mechanisms for performance-based contracting to ensure that buildings will achieve energy efficiency targets.

Recommendation 36

The MEM should benchmark and disclose the energy efficiency of building managers and tenants by implementing mandatory Energy Audit Code (EAC) for building management and benchmarking systems for tenants.

Recommendation 37

The MEM should adopt the performance certification standards similar to programs implemented in the APEC region, including Energy Labelling Scheme (Singapore), Mandatory Energy Efficiency Labelling Scheme (Hong Kong, China), the ENERGY STAR (US), or Sello FIDE (Mexico) programs.

Recommendation 38

The MEM should implement mandatory MEPS and energy labels for appliances by including energy performance criteria in public procurement, and regularly updating and improving standards and label categories.

Recommendation 39

The MEM should promote the phase-out the least efficient products through:

- *Combining MEPS, market transformation and other phase-out policies*
- *Taxation, subsidies and regulations for the private sector*

Recommendation 40

The MEM should engage in regional collaboration and harmonisation of standards and testing procedures to reduce compliance and testing costs, and increase demand for energy efficient products.

Recommendation 41

The MEM should enhance energy labels through the use of smart meters and QR codes.

ELECTRICITY SECTOR

The current approach to "efficiency" for the electricity sector in Peru seems to be more about thermal efficiency and transmission efficiency than about end-use efficiency. Development of an energy efficient roadmap or portfolio standard should be a priority. In the generation sector, vertical integration leads to problems with

generators bidding in at zero resource costs to inhibit competition. Existing laws for Return on Investment (ROI) seem to allow for higher profits than would normally be allowed for a monopoly. Current ROI rules were established to encourage development, but should be reviewed as they are inhibiting efficiency incentives. In the transmission and distribution sector, return on investment/equity for these companies should not depend on just delivering units of electricity, such that revenue streams are decoupled from electricity demand. Regulations should allow electric utilities to have a fair profit while providing services other than electricity to end use consumers (for example, providing funding for installation of new energy efficient appliances to low income families).

Recommendation 42

The government of Peru should consider using rebate mechanisms (for example, tax deductions) and incentives for the private sector to participate in energy efficiency campaigns.

Recommendation 43

The MEM should continue efforts to increase the robustness of the transmission and distribution networks and reduce technical transmission losses. If developing new thermal capacity, prioritise high efficiency combined cycle turbines or cogeneration (CHP, combined heat and power) plants.

Recommendation 44

The Government should develop new regulations with lower return of investment (ROI), and an increased focus on energy efficiency.

Recommendation 45

The Government should develop laws and regulations to prevent "gaming" of the system.

Recommendation 46

The government should develop regulations to proactively work with distributors to incentivise energy efficiency within their network.

Recommendation 47

The government should develop publicly funded projects that can reduce overall electricity demand such as improved street lighting, and improved space conditioning in schools.

PART 1: BACKGROUND INFORMATION

Consisting of energy statistics and institutional and political context, with information provided by Peru's Ministry of Energy and Mines.

ECONOMIC AND POLITICAL CONTEXT OF PERU

Peru is a constitutional republic on the central west coast of South America, bordered by the Pacific Ocean to the west, Chile to the south, Ecuador and Colombia to the north and Brazil and Bolivia to the east. Its land area of 1.3 million square kilometres (km^2) comprises three main geographical regions: the western coastal region, the mountainous central highland region (Andes Mountains) and the jungle region of the Amazon Basin in the east. These regions are divided into 25 political/administrative regions.

In 2016, Peru had a total population of 32 million, an increase of 1.3% from the previous year. Income inequality remains a challenge, as Peru had a Gini coefficient of 44[2] in 2016 (World Bank, 2018). In 2015, approximately 20% of the population was considered poor and 3.8% extremely poor (INEI, 2017). Lima, the capital and main population centre, has about nine million people, or nearly one-third of the total population (INEI, 2015). The urbanisation rate was 78% in 2017 (INEI, 2018).

Between 2000 and 2016, the economy expanded rapidly at a compound annual growth rate (CAGR) of 5.2%. This rate dropped to 4.6% from 2010 to 2016 due to decelerating demand growth in other emerging economies (such as China) and global uncertainty. This resulted in negative growth of investments, both private (-5.7%) and public (-6.2%) in 2016 (BCRP, 2017). In 2016, Peru's gross domestic product (GDP) was USD 410 billion and GDP per capita was USD 12 891.

Structural reforms began in 1990 and led to the establishment of a market-oriented economy. In 2016, key sectoral contributors to GDP were services (49%), mining and energy (14%), manufacturing (13%) and trade (11%) (BCRP, 2019). Mining is especially important because the economy is a major global producer of several metallic and non-metallic minerals, ranking third in silver, zinc, copper and tin; fourth in lead; and sixth in gold production (USGS, 2018). Consequently, minerals have consistently accounted for a significant share of export revenues, contributing 59% in 2016 (BCRP, 2019). During 2016, around 22% of Peru's USD 25 billion of foreign direct investment was dedicated to the mining sector and about 13% to the energy sector (Proinversion, 2016).

Peru has considerable natural gas reserves: 0.44 trillion cubic metres in 2016, the ninth-largest in the Asia-Pacific Economic Cooperation (APEC) region. In 2004, the development of the Camisea gas field and associated 730 km pipeline to Lima drastically changed the Peruvian energy sector. This has allowed Peru to meet growing domestic demand and become a net natural gas exporter. All natural gas exports are sent as liquefied natural gas (LNG) through the Peru LNG Melchorita export terminal (4.4 million tonnes per annum), one of only two LNG export terminals on the Pacific coastline of the Americas (the other is Alaska's Kenai LNG terminal). In 2016, 41% of total natural gas production was exported via LNG.

Peru has limited proved oil—1.2 billion barrels—and negligible coal reserves. There is no nuclear power generation in Peru or any concrete nuclear development plans, despite reserves of 14 000 tonnes of uranium. Renewable resources are abundant at 110 gigawatts (GW) of potential generation capacity, mostly for hydro

[2] The Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution; 0 represents perfect equality while 100 implies perfect inequality. Peru's Gini index is similar to that of Chile, Mexico, Turkey and Zimbabwe.

power (70 GW) (Osinergmin, 2017a). There is also 22 GW of wind power potential, mostly in the coastal region, and another 10 GW of solar, 7 GW of biomass and 3 GW of geothermal. Despite this potential, the actual installed capacity of all non-hydro technologies combined was only 0.77 GW in 2016.

ENERGY POLICY CONTEXT AND RECENT DEVELOPMENTS

As Peru's energy demand continues to increase with economic and demographic growth, the government faces the challenge of building sufficient infrastructure to provide secure and affordable energy access to all consumers. The Ministry of Energy and Mines (MEM) published its National Energy Plan 2014-2025 as the guiding policy document for the energy sector. However, as of 2019, it has not been updated or reissued since 2014, highlighting the lack of a long-term and specific energy plan. Some of the Energy Plan's goals are to increase the share of natural gas to 35% of total primary energy supply (TPES) by 2025, expand access to natural gas networks, and raise the electrification rate to 99% by the same year (MEM, 2014).

The Energy Plan establishes that renewable resources (excluding large hydro power) should be used for at least 5% of total power generation; once this is achieved, the renewable generation goal should be revised every two years. The Energy Plan has no specific goals or timeline for energy efficiency, but it estimates energy demand reductions of 10% to 15% by 2025 as a result of energy efficiency measures compared to business-as-usual scenario (MEM, 2014). Similarly, the Energy Plan does not quantify any fossil fuel subsidy phasing-out goals but states that energy prices should 'reflect real costs' (MEM, 2014). It does not mention nuclear energy.

One of the Energy Plan's key aims is to promote investments to expand infrastructure for oil and natural gas exploration and production, electricity and natural gas transmission, and refining capacity. While there has been some progress with the Talara refinery being overhauled to process heavy oil and increase capacity by 2022, the same cannot be said for the expansion of Peru's natural gas pipeline network.

In 2015, the MEM awarded a construction contract for the 1 000 km, 32-inch Peruvian Southern Gas Pipeline (Gasoducto Sur Peruano), one of the largest infrastructure projects in the economy's history (El Peruano, 2014). Construction started in 2016, but in January 2017, with 40% of construction complete, the government terminated the contract after the consortium failed to meet its financial deadline (El Peruano, 2017). This occurred amid a corruption scandal with the main contractor, Brazilian company Odebrecht, which is currently involved in similar accusation across Latin America (El Peruano, 2017; El País, 2017). As of July 2019, construction has not resumed, leaving this key energy sector project in limbo.

ENERGY USE IN PERU

Peru's final energy demand (FED) grew 73% in 2000-16, owing to steady economic (5.2% CAGR) and population (1.3% CAGR) growth over that time period. Energy consumption has been characterized by the predominance of liquid hydrocarbon fuels, as shown in Figure 1-1. However, in recent years, these have been partially replaced by natural gas.[3]

Another major trend since 1990 is the increase in electricity consumption. It should be noted that the methodology for calculating electricity consumption for each economic sector has changed. Whereas previous statistics were an estimation using socio-economic models, based on data from the 1998 National Useful Energy

[3] Liquid hydrocarbons refers to refined oil products, mostly diesel, gasoline and liquefied-petroleum gas (LPG).

Balance surveys, the present data is based on reports that the electric companies and self-producing companies send to the Directorate-General for Electricity.

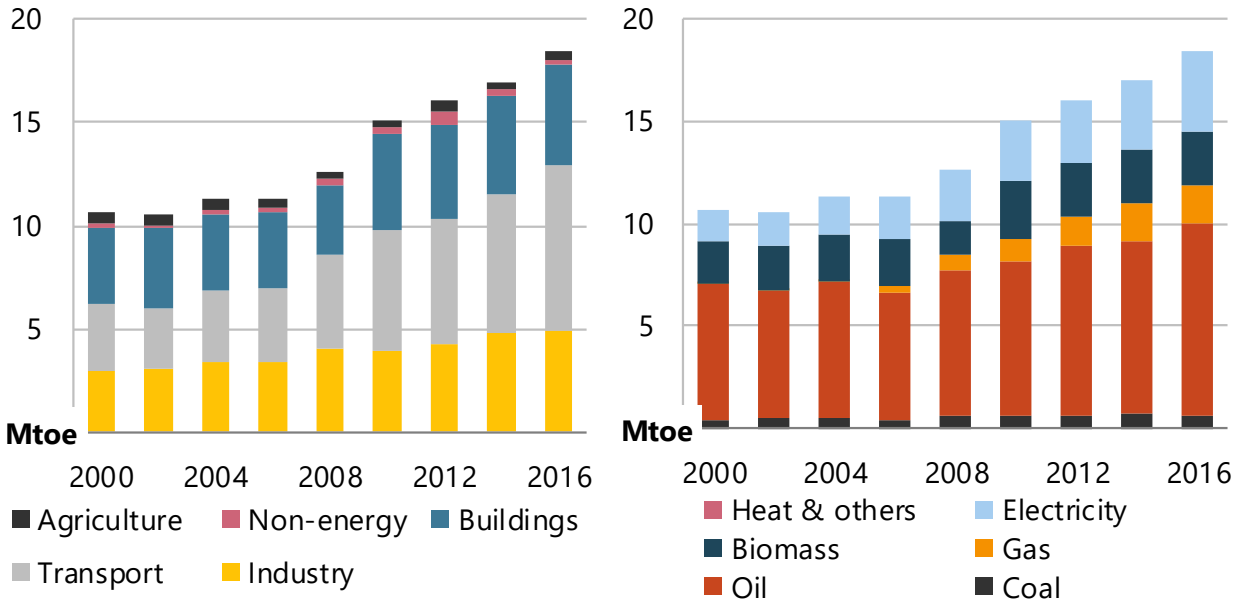
In the case of firewood, which is consumed in large quantities especially in rural areas, consumption shows a decreasing trend. This is due to the migration of rural population to urban areas and the replacement of traditional biomass with LPG in the residential sector.

FINAL ENERGY CONSUMPTION

Official statistics in Peru divide energy consumption into five sectors: residential, commercial and public (hereafter called "buildings"); transportation; farming, agro-industry and fishing (hereafter called "agriculture"); industry and mining; and non-energy use. The transportation sector was the highest energy consumer (360 777 terajoules [TJ]; equivalent to 8.6 million tonnes of oil equivalent [Mtoe]) and increased by 2.7% from 2016 to 2017. Industry and mining, the second largest energy consumption sector, grew more moderately (1.0%), to 231 202 TJ (5.5 Mtoe) in 2017. On the other hand, the buildings sector decreased by 2.9%, possibly due to lower firewood and charcoal consumption. Also, there was a 9.9% increase of natural gas consumption due to progressive use in residential and transportations sectors.

Figure 1-1 shows final energy demand by sector. Transport accounts for 45% of energy consumption; partly because of low growth in industry, the second largest sector. In 2017, industry and mining together had a share of 27%. The third largest sector was the buildings sector with a 25% share.

Figure 1-1• Final energy consumption by sector and fuel , 1990-2017



Source: IEA, 2018

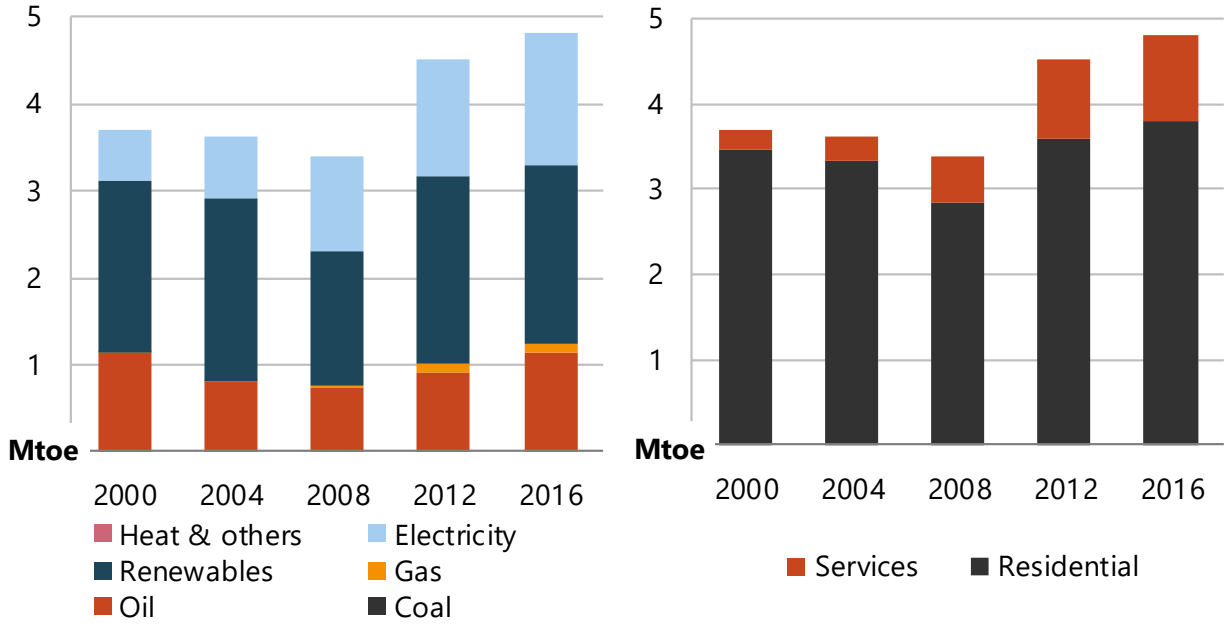
Energy demand in Peru's buildings sector has grown 31% since 2000, mainly driven by a wider segment of the population having access to better living conditions. This is most evident in increased electricity demand, which has more than doubled since 2000. The residential subsector accounted for 79% of energy demand in 2016; the services and public subsectors consumed the remainder.

TRENDS OF THE RESIDENTIAL SUBSECTOR IN THE BUILDINGS SECTOR

Although Peru has significant natural gas reserves and a variety of renewable resources, the residential buildings energy fuel mix was still dominated by traditional biomass in 2017 (47%). Non-commercialised fuelwood is the predominant source of traditional biomass, but charcoal and dung are also used. Traditional biomass is mostly used for cooking but also for water and space heating. While traditional biomass consumption has decreased 21% from 2010 to 2017, it remains the main source of energy for about 20% of households in Peru (Osinergmin, 2017b).

On the other hand, there is growth in the consumption of LPG, natural gas and electricity. Electricity and LPG demand have a share in this sector of 22% and 24%, respectively. Kerosene sales were prohibited by the Peruvian Government in 2010, resulting mostly in an increase on consumption of LPG but also of traditional biomass. Finally, despite the increase in natural gas consumption in this sector, its participation in the sector is still incipient in the residential sector, as seen in Figure 1-2.

Figure 1-2 • Buildings energy consumption by fuel and subsector, 1990-2017



Source: IEA, 2018

TRENDS OF THE SERVICES SUBSECTOR IN THE BUILDINGS SECTOR

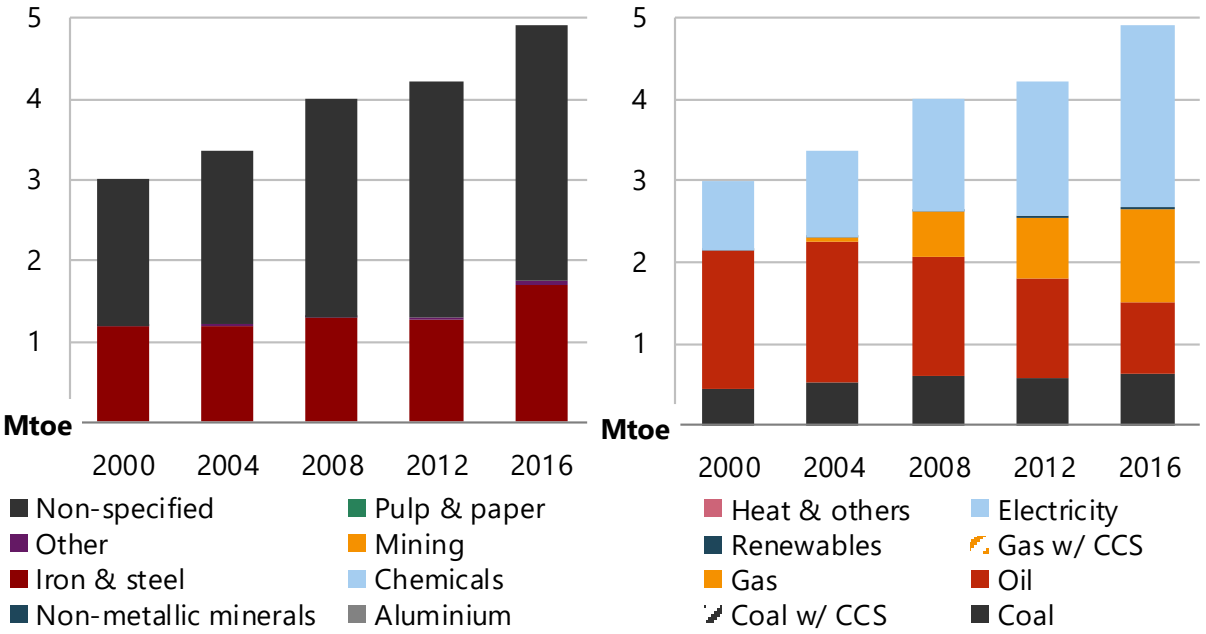
In 2017, energy consumption in the services sector increased by 2.1% compared to 2016, due to a higher consumption of electricity and LPG, which represent 65% and 10% of the total in this sector, respectively. This sector includes both the commercial and public sector, as per official Peruvian energy statistics. Likewise, the consumption of fuelwood shows a slight increase driven by increasing activities in hospitality and restaurants. Finally, the consumption of natural gas in this sector reaches a share of 3% (Figure 1-3).

In 2017, consumption of energy in the public sector was reduced by 15% with respect to 2016. This reduction was mainly due to a lower demand for fuels from the armed and police forces, most of this reduction was from oil products, particularly jet fuel. This is barely visible in Figure 1-2 however, as it is lumped together with commercial consumption in the 'services' subsector.

TRENDS OF THE INDUSTRIAL SECTOR

Energy demand in Peru's industry sector grew steadily in 2000-16 (64%). Industry energy demand is mainly driven by the manufacturing, iron and steel, and mining subsectors. In 2017, energy consumption in this sector increased by 3% on a year to year basis.

Figure 1-3 • Industry energy consumption by fuel, 1990-2017



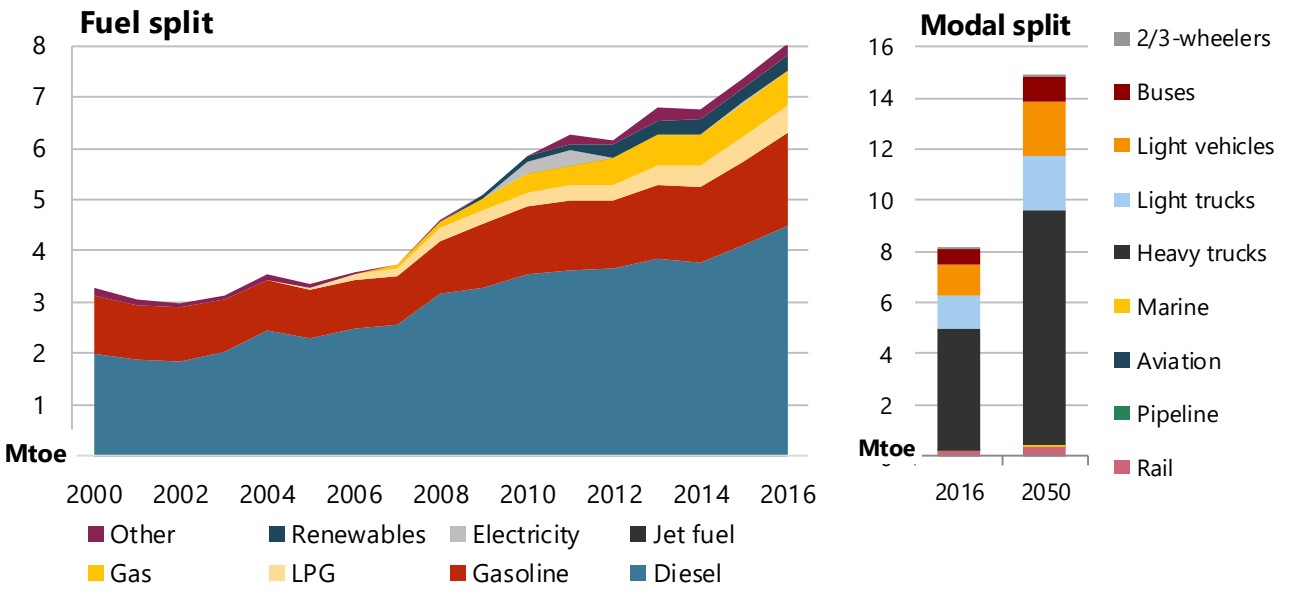
Source: IEA, 2018

TRENDS OF THE TRANSPORT SECTOR

Peru's domestic transport sector has had the highest and fastest-growing energy demand of all sectors since 2008, more than doubling between 2005 and 2016. Road transport dominates demand with more than 95% of the sector's energy consumption and about 30% of FED since at least 2000. Most of the growth in transport energy demand between 2005 and 2016 resulted from a considerable surge in road transport stock: a 119% increase in the light-duty vehicle fleet, 164% increase in light-duty trucks, three times the number of heavy-duty trucks and double the buses.

This is an indicator of both Peru's rapid economic growth in the past decade and the rise in average income that has allowed a larger share of the population to own private vehicles. Moreover, the lack of an extensive, safe and efficient public transport network in most cities incentivises consumers to acquire private vehicles. In 2017, energy consumption in the transport sector grew at an annual rate of 2.7% compared to 2016. The fuel with the greatest share is diesel with 53%; followed by gasoline and jet fuel, with 18% and 11%, respectively (Figure 1-4).

Figure 1-4 • Transport energy consumption by fuel, 1990-2017

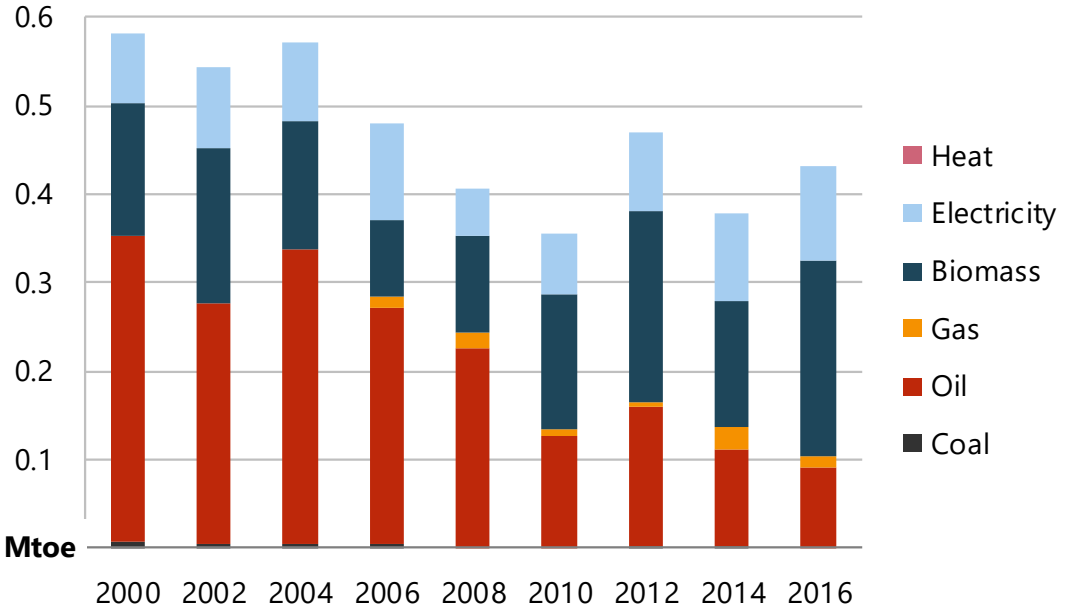


Source: IEA, 2018

TRENDS OF THE AGRICULTURE SECTOR

In 2017, energy consumption in this sector increased by 1.2% compared to 2016, however agriculture only accounted for 2.3% of final energy demand in Peru. This includes mostly fuel consumed in machinery and motors such as tractors and fishing vessels, as well as water pumping for irrigation.

Figure 1-5 • Agricultural energy consumption by fuel, 1990-2017



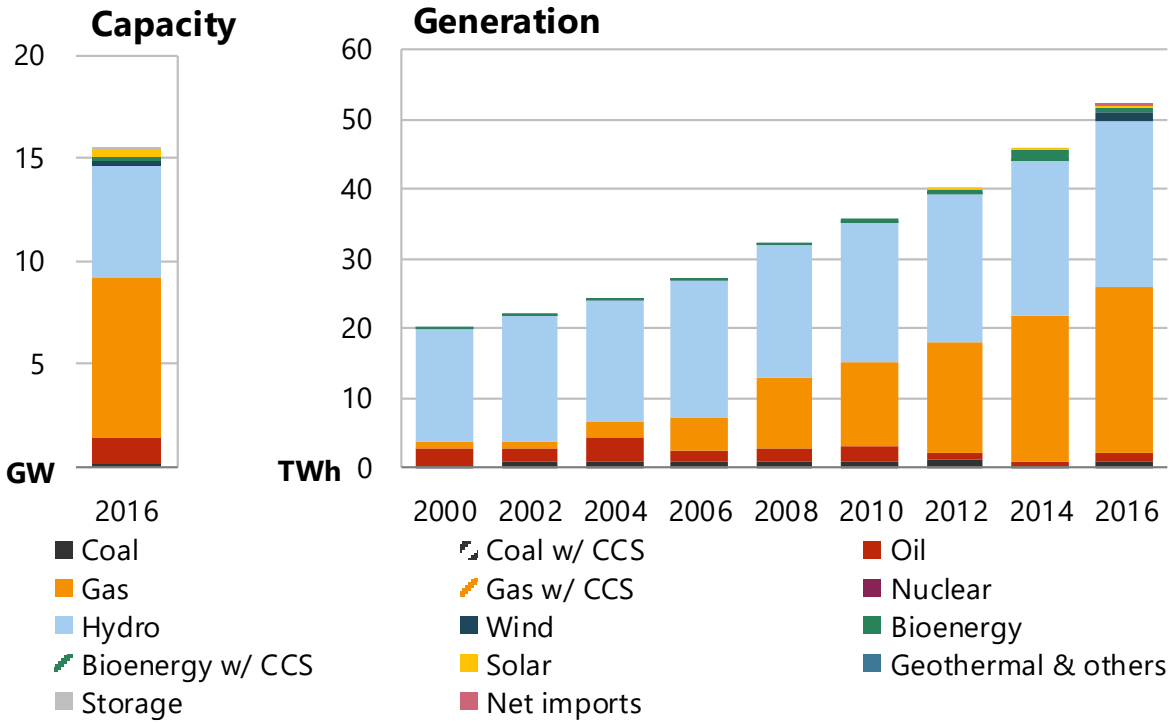
Source: IEA, 2018

ELECTRICITY

In Peru's National Integrated Electrical System (SEIN), which consists of more than 40 competing power generation companies, electricity rates are mostly based on marginal costs and free-market forces. The SEIN accounts for 96% of electricity generation in Peru, the remainder coming from isolated systems and own-energy consumption (MEM, 2016). Total power generation capacity was 15 GW in 2016, mainly gas-fired (51%) owing to the development of the Camisea gas field in 2004, but hydro power-based capacity also accounts for a large portion (35%). Peru's power generation fuel mix is therefore not diverse, as it relies mainly on these two sources and relatively small amounts of oil, coal and non-hydro renewables. In 2016, hydro resources accounted for 47% of power generation and natural gas for 46%. The rest was divided almost evenly among oil, wind, coal, and biomass and solar.

Figure 1-6 shows the installed capacity and the electricity generation trends in Peru. It is particular evident the uptake of gas-fired generation after 2004, following the Camisea field development.

Figure 1-6 • Power capacity and electricity generation, by fuel, 2016-50



Source: IEA, 2018

REFINING TRENDS

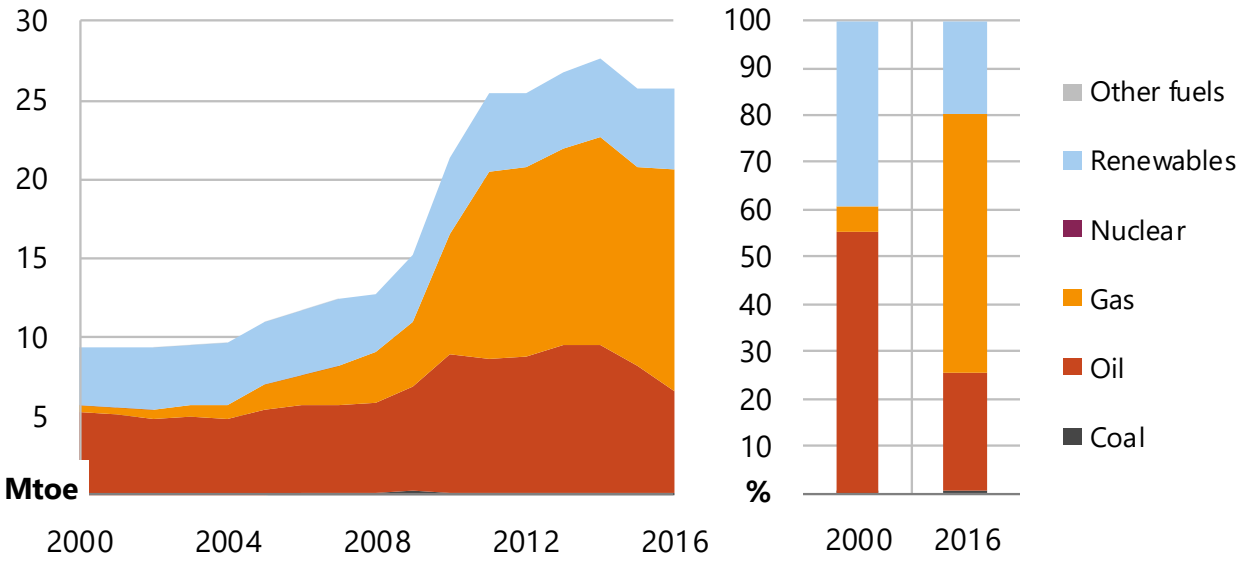
As domestic crude oil production is unable to keep up with demand, around 70% of refinery intake in Peru is imported (MEM, 2016). Additionally, the total capacity of Peru's seven refineries (200 000 barrels per day) is not enough to meet demand, resulting in net imports of some oil products as well. Diesel is the most demanded liquid fuel, with net imports growing more than five-fold from 2005 to 2016, driven predominately by rapid transport growth. Conversely, gasoline, jet fuel and fuel oil production exceed domestic demand, resulting in Peru being historically a net exporter of these oil products.

ENERGY PRODUCTION

Peru's energy production was relatively stable during the 1990s and early 2000s, with some crude oil and limited natural gas production. The Development of the Camisea natural gas field in 2004 revolutionised Peru's energy market, however, providing more than 98% of the economy's natural gas production and 60% of the natural gas liquids used for LPG production (Osinergmin, 2014). Primary energy production more than doubled from 2005 to 2016 owing to the development of the Camisea field. Natural gas dominated energy production (55%) in 2016. Peru has been a net natural gas exporter (all of it via LNG) since 2010, with 41% of natural gas production designated for LNG exports in 2016 (mainly to Mexico and Spain) (MEM, 2016). Natural gas production grew dramatically in 2005-16 (more than eight-fold).

Although crude oil production has been declining since the late 1990s, a greater output of natural gas liquids from the Camisea field has boosted overall oil production by 36% since 2004. Consequently, oil production has followed a similar trend to natural gas production. In contrast with fossil fuels, overall renewable energy production grows 23% by 2050 as production from all renewable energy sources (except bioenergy) increases.

Figure 1-7 • Total primary energy production, 2000-2050



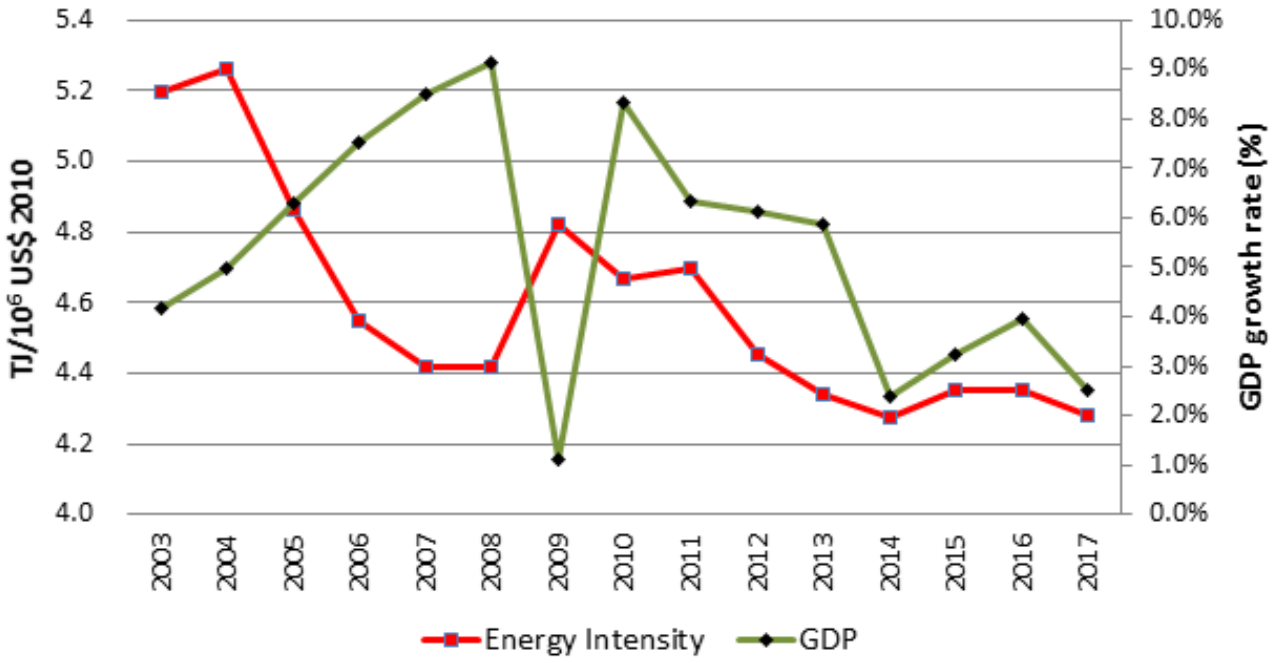
Source: IEA, 2018

OTHER INDICATORS

Energy intensity (EI) is an indicator that measures the productivity of energy within an economic process. It can also be defined as the amount of energy needed to produce a monetary unit. From 2000 to 2017, this indicator has registered a significant reduction from 5.9 to 4.3 TJ (or 141 to 103 tonnes of oil equivalent [toe]) per billion 2010 US dollars (annualized variation of -1.9%) as a consequence of more efficient use of the energy, greater participation from commercial sources and productivity improvements.

Energy consumption per capita has shown an increasing trend during the analysis period, going from 19.5 GJ (0.47 toe) in the year 2000 to 26.7 GJ (0.64 toe) in 2017, with an annualized percentage variation of 1.9%.

Figure 1-8 • Energy intensity in Peru, 2003-17



Source: MEM, 2019.

ENERGY EFFICIENCY INSTITUTIONS, POLICIES AND MAJOR PROGRAMS

ENERGY POLICY

The government published the National Energy Plan 2014–25 (MEM, 2014) detailing the policies and objectives to guide the energy policy of Peru. According to the plan, Peru's overarching goal is to have a reliable, continuous and sufficient energy system that can support sustainable development partly by promoting investments in infrastructure (e.g. transport, refinery and production) and exploration. The National Energy Plan's main goals are to provide energy security and universal access to energy supply and develop energy resources under a social and environmental perspective (MEM, 2014). Under the same plan, the government also set energy efficiency goals, focusing on the following:

- Establishing new labelling rules for electrical appliances, water heaters, lighting, engines and boilers;
- Promoting an energy efficiency culture;
- Strengthening and making more energy efficient the public transportation system;
- Maximising the use of natural gas in power generation;
- Promoting the substitution of LPG and diesel to natural gas; and
- Striving to maintain energy prices in real terms, avoiding price distortions.

However, this plan has not been updated or reissued since 2014. Peru's overarching energy policies and goals have not changed significantly since the last edition of this Overview, highlighting the lack of a long-term and specific energy plan. Some of the Energy Plan's goals are to increase the share of natural gas to 35% of total

primary energy supply (TPES) by 2025 and expand access to natural gas networks along the coastal region (MINEM, 2014).

ENERGY EFFICIENCY POLICY

In 2000, the government passed the Law for the Promotion of the Efficient Use of Energy (Law 27345). Consistent with this legislation, the Peruvian Government promoted energy-saving measures in the public sector, such as by replacing less-efficient incandescent lamps with compact fluorescent lamps and acquiring equipment with energy efficiency labels.

In September 2009, the MEM published the Referential Plan for the Efficient Use of Energy 2009–2018. This is the main instrument to achieve the economy's energy efficiency goals, with action plans proposed for each sector. The plan includes an analysis of energy efficiency in Peru, identifying sector programs that could be implemented to achieve the proposed targets. Some of the most relevant points include:

a) The Referential Plan considers 4 sectors: residential, productive and services, public and transport. The improvements of efficiency have been calculated from the demand point of view.

b) The Plan established a 15% energy savings goal for the 2009-2018 baseline forecast. Cumulated energy savings is projected at 373 PJ (8.9 Mtoe) during the forecast period. This would be accomplished with all activities that are proposed in the present Referential Plan.

c) The Referential Plan stated that it "shall be updated when more recent data becomes available", however no update has been made by 2019.

d) The Energy Efficiency Referential Plan was elaborated mainly with data from the 2007 Energy Balance, the yearbooks of the Directorate General for Electricity and the Directorate General for Hydrocarbons and the regulator (OSINERGMIN).

f) The reduction of CO_2 emissions as a result of energy efficiency projects was quantified, in order to evaluate the effectiveness of carbon certificates.

RESIDENTIAL SECTOR

A series of objectives and actions have been proposed in order to form an efficient use of energy culture within the population as well as the coming generations, so that they become responsible users. This is aimed through the improvement of consumption habits and the selection of adequate electrical equipment and appliances, as well as the intense use of efficient architecture, in accordance with the climatic conditions of each region.

Four important projects to be implemented were included in the plan: the substitution of 1 million traditional kitchen stoves for improved and more efficient units, the modernization of all the residential sector lighting (mainly, the substitution of all incandescent lamps for energy saving lamps), the improvement of consumption habits of the population, and the substitution of 100 000 electric water heaters for solar ones.

Table 1- 1 • Energy demand reductions with energy efficiency programs

SECTORS	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL
1. Reductions with energy efficiency programs (TJ x 1000)											
Residential Sector	2.76	4.84	8.57	13.96	18.92	18.92	18.92	18.92	18.92	18.92	143.65
Productive and Services Sector	3.77	7.67	11.56	16.46	17.95	17.95	17.95	17.95	17.95	17.95	147.16
Public Sector	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.95
Transport Sector	1.15	2.39	3.76	5.23	6.80	8.48	10.24	12.20	14.27	16.43	80.95
TOTAL	**7.73**	**15.00**	**23.99**	**35.75**	**43.77**	**45.45**	**47.21**	**49.17**	**51.24**	**53.40**	**372.71**
2. Emissions reductions (x 1000 tCO_2/year)	779	1499	2362	3468	4262	4381	4506	4645	4791	4945	35638
3. Annual economic savings ($x10^6$ US$)	121	231	347	490	571	612	655	703	754	807	5291
4. Incomes through carbon certificates ($x10^6$ US$)	8	14	20	27	30	30	30	30	30	30	249
5. Required investments ($x10^6$ US$)	97	100	124	185	98	14	14	14	14	14	674

Source: MEM, 2009.

PRODUCTIVE AND SERVICE SECTOR

In this sector, the government of Peru will promote the optimization of energy consumption with the objective of improving competitiveness within the productive and service sectors. A series of actions were analysed in this sector, including: the substitution of 30 000 electric motors, the improvement of 60% of the economy's boilers, the promotion of cogeneration, and the use of efficient. The plan stated that specific financial mechanisms would be required to develop these projects in the medium and long-term.

PUBLIC SECTOR

The plan identified all governmental buildings but also state-owned facilities like schools, hospitals and public spaces as one sector. The stated aim was to achieve the modernization of energy in public infrastructure by decreasing energy consumption, taking into account that such infrastructure is similar for climates, and carry out the necessary actions for its maintenance. The most relevant area in this sector was the modernization of lighting. Although projected savings are modest in comparison to those of other sectors, the goal was to show that the public sector (specifically the Peruvian State) can be seen as an example model and to be a guideline with a multiplier effect to other energy sectors.

TRANSPORT SECTOR

The plan identified increasing efficiency in transport through information campaigns and other regulatory measures in order to achieve an efficient conduction and management of the vehicular traffic, which in other economies have originated savings of approximately 10%. However, the plan did not include specific measures apart from an educational campaign for energy efficient driving.

Table 1- 2. Annual energy savings by sources in 2018 (1000 TJ)

Sector	Residential				Productive & Services				Public	Transport		
Program	Cooker	Lighting	Water heaters	Consumption habits	Engines	Boilers	Lighting	Cogeneration	Lighting	Efficient driving	Total	%
Biomass savings	16.53										16.53	30.97
Fuel savings						8.75		5.95		16.43	31.13	58.31
Electricity savings		0.8	1.16	0.41	1.4		1.84		0.1		5.71	10.73

Source: MEM, 2009.

Table 1- 3. Electricity demand reductions by sectors (MW)

SECTORS	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. RESIDENTIAL										
Efficient lighting	109	113	116	121	121	121	121	121	121	121
Electrical water heaters	0	0	0	0	0	0	0	0	0	0
Consumption habits improvement	20	40	60	80	80	80	80	80	80	80
2. PRODUCTIVE & SERVICES										
Engine substitution	20	40	60	80	103	103	103	103	103	103
Cogeneration	20	40	80	160	196	196	196	196	196	196
Efficient lighting	27	70	95	95	95	95	95	95	95	95
2. PUBLIC										
Efficient lighting	3	6	6	6	6	6	6	6	6	6
TOTAL	**199**	**309**	**417**	**542**	**601**	**601**	**601**	**601**	**601**	**601**

Source: MEM, 2009.

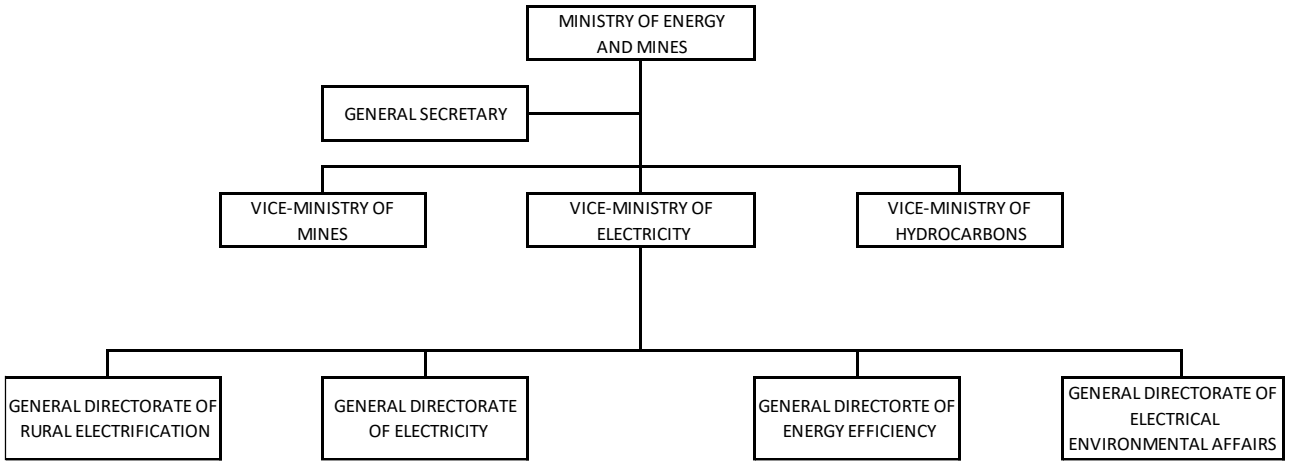
INSTITUTIONAL FRAMEWORK

Peru's Ministry of Energy and Mines is responsible for the formulation and evaluation of energy and mining policy and strategies as well as for environmental issues in these activities. The MEM was reorganised in 2018, dividing the former Vice Ministry of Energy in two new Vice Ministries, leaving the current structure with three Vice Ministries: The Vice Ministry of Hydrocarbons, the Vice-Ministry of Electricity and the Vice-Ministry of Mines. The Vice-Ministry of Hydrocarbons covers essentially all the value chain and activities related to the oil and gas industry. On the other hand, the Vice-Ministry of Electricity, despite its name, oversees several areas other than the electricity sector, such as energy efficiency, planning, rural electrification, environmental affairs, among others.

Within the then Vice-Ministry of Energy, Executive Decree Nº 026-2010-EM created the Directorate-General of Energy Efficiency (DGEE) in 2010. Currently, the DGEE depends from the Vice-Ministry of Electricity as shown in Figure 1-9.

DGEE is the technical regulatory body in charge of proposal and assessment of energy efficiency and non-conventional renewable energy policies, the promotion of an efficient use of energy formation, as well as the lead of energy planning.

Figure 1-9 • Organization of the Ministry of Energy and Mines, Peru



Source: MEM, 2019.

The DGEE has defined five pillars for energy efficiency, explained as follows:

Education:

- To develop an energy efficiency culture (at all education levels)
- Local experience regarding energy saving programs in the MEM
- Agreements with the Ministry of Education.

Renewable energy:

- Potential of renewable energy at national level
- Local use of renewable energy such as biomass (bio digesters), solar (heaters), rural electrification with hybrid technology, etc.

Regulations:

- Developing energy efficiency labelling regulations for engines, eco-efficient buildings, appliances, etc. (Such as the National Institute for Quality [INACAL].)

Technology:

- Efficient lighting (use of LED technology)
- Fuel switching in transport sector
- Intelligent traffic lights
- Smart grid

Market:

- Good environment for business
- Private investments
- Establishment of Energy Service Companies (ESCOs)

- Participation of financing institutions such as COFIDE (Peru's development bank), Inter-Development Bank, etc.
- International cooperation
- Other economic incentives

INSTITUTIONS AND ORGANISATIONS

In addition to the MEM, the Supervisory Agency for Investments in Energy and Mining (OSINERGMIN) is Peru's autonomous regulatory agency, created in 1996. OSINERGMIN is responsible for setting electricity tariffs and gas transportation rates. Its goal is to promote efficiency in the power and gas sectors at the lowest possible cost for the customer by designing and implementing effective regulations.

While the DGEE is strictly speaking the only institution responsible of energy efficiency policies, other institutions and organizations that carry out activities related to energy efficiency:

- Public and private universities: Research and development. Examples of such institutions include the Universidad de Ingeniería, Pontificia Universidad Católica del Perú, Universidad Nacional Agraria La Molina, Universidad del Santa, and the Universidad San Agustín de Arequipa, among others.
- National Institute for Quality (INACAL): Promoting the accreditation of product certification bodies for energy efficiency labelling.

GOVERNMENT LAWS, DECREES AND ACTS

The legal and regulatory framework regarding energy efficiency is as follows:

- Law Nº 27345 – Efficient Use of Energy Promotion Law of 8 September 2000
    - Efficient use of energy is declared of national interest in order to assure energy supply, protect consumers, promote national economy competitiveness, and reduce negative environmental impacts.
    - MEM is the authority responsible for the promotion of efficient use of energy: It promotes the creation of a culture towards energy efficiency; market transparency regarding efficient processes, technologies and services; international cooperation projects for the development of efficient use of energy; elaborates and executes referential energy efficiency programs; promotes the establishment of ESCOs; coordinates the development of energy efficiency policies with other public and private sectors; and promotes the efficient consumption of energy carriers in isolated and remote areas.
- Law Nº 27345 – Executive Decree Nº 053-2007-EM of 23 October 2007
- Executive Decree Nº 034-2008-EM of 19 June 2008
    - Energy saving measures for the public sector.
- Ministerial Resolution Nº 038-2009-MEM/DM of 20 January 2009
    - Approved energy consumption indicators and monitoring methodology.

PART 2: REVIEW TEAM REPORT

The Follow-up PREE in Peru is divided into six categories:

- Institutional framework and policy
- Goals, targets and data
- Industry sector
- Transport sector
- Buildings sector and appliances
- Electricity sector

INSTITUTIONAL FRAMEWORK AND POLICY

A strong and reliable institutional framework within the energy efficiency field requires the engagement of different levels of government as well as the private, academic and non-governmental sectors. In Peru, energy efficiency's progress has its main pillars in legislation, a long-term strategy, a review of the authorities and operational frameworks; adequate financial resources; research, development and innovation; and, national and international cooperation.

Although Peru has made significant efforts in developing its energy efficiency institutional framework for the past 20 years, as was acknowledged in the previous PREE in 2011, global and domestic trends in this field demand an acute and strategic modernisation.

ENERGY EFFICIENCY LEGISLATION

Peru's Efficient Use of Energy Promotion Law was published in 2000. However, both globally and domestically the energy sector and its priorities have changed significantly over the past 20 years. Major reports on energy use and climate change (including those released by the United Nations Intergovernmental Panel on Climate Change [IPCC], the IEA and APEC-EWG), coincide that energy efficiency is vital for reaching a peak on global emissions and the Paris Agreement pledges (APEC-EWG, 2019) (IPCC, 2019). Hence, there is an urgent need to enhance and reinvigorate energy efficiency improvements, amid a global faltering momentum of these policies (IEA, 2019).

Therefore, the Ministry of Energy and Mines (MEM) requires a modern mandate that can become the new pillar for the sector´s transformation. This mandate should support an energy transition policy to a low-carbon energy system. Considering energy efficiency as the 'first fuel' (i.e. as a cheaper source of energy in itself) as well as clearly describing the differences and regulations between energy efficiency and renewable energy generation is also essential in this new legislation.

Other APEC economies have drafted or updated their energy efficiency legislation in recent years. In 2012, for instance, Mexico embarked on a deep energy reform that included energy efficiency and required amendment of their constitution and several other laws. In particular, the previous laws were derogated, and a new energy transition law was enacted. Mexico's energy transition law provided a sound legal framework that clearly delimits responsibilities among the key institutional actors on energy efficiency policy. Peru's new legal framework may also demand and encourage the participation of other Ministries and Agencies, regional and local governments, as well as the private sector to reach the economy's energy efficiency goals and targets.

Recommendation 48

The MEM should work with relevant stakeholders on drafting an updated, inclusive and aligned energy transition legislation that, when released, replaces the existing Efficient Use of Energy Promotion Law.

LONG-TERM ENERGY EFFICIENCY STRATEGY

The MEM's long-term strategy is included in Peru's Energy Policy 2010-40. Current and future trends in the energy sector require a revision of this document within the energy efficiency scope adapting it to Peru's current needs.

It is important that this document clearly establishes priorities and goals with indicators and monitoring procedures. Additionally, the Referential Energy Efficiency Plan as well as other energy efficiency planning documents should be reviewed, updated and aligned with a cross-sectoral vision.

Energy efficiency is an increasingly relevant issue in Peru's energy sector, but the circumstances that surround it are rapidly changing, requiring a constant update of the targets, programs and goals for both the short and long-term.

Energy efficiency and conservation are some of the most important elements in energy planning worldwide. Despite past efforts and some achievements, the potential for energy efficiency in Peru remains largely untapped and previous plans and strategies may need an update. International organisations such as the International Energy Agency (IEA), the International Partnership for Energy Efficiency Cooperation (IPEEC), the World Bank, the Inter-American Development Bank (IADB), the G-20 and the Asia-Pacific Economic Cooperation (APEC), among others; encourage a long-term strategy that is monitorable, measurable and adaptable when necessary.

Recommendation 2

The MEM should work on revising its long-term planning documents, establishing priorities, measurable goals and indicators for energy efficiency.

ENERGY EFFICIENCY AUTHORITY FRAMEWORK

Within the Ministry of Energy and Mines, the Directorate-General for Energy Efficiency (DGEE) is the body in charge of energy efficiency policies for both hydrocarbons and electricity. However, the DGEE falls under the auspices of the Vice Ministry of Electricity (within the MEM) and oversees the promotion of renewable electricity generation at the same time.

A redefinition in terms of authority is necessary for the DGEE to establish priorities as well as to create new operational units (such as a regulation and technical unit as well as a project design and operations unit). The DGEE should have a clearer mandate beyond the electricity sector, as there is great potential for efficiency in sectors like transport, industry and buildings and fuels like gasoline, diesel, natural gas and fuelwood. This is particularly relevant in the case of Peru where, in contrast to other APEC economies, the transportation sector has the largest share of final energy demand; leaving substantial room for increasing efficiency.

Recommendation 3

The MEM should revise the DGEE's institutional framework to give the DGEE a clearer authority on energy efficiency matters beyond the use of electricity, especially in the transport sector.

In the previous Peer Review on Energy Efficiency for Peru in 2011 it was recommended that an autonomous energy efficiency agency or centre be established. Unfortunately, that goal has not been reached yet. However, other APEC economies have established a dedicated energy efficiency policy authority either within the Ministry of Energy or as independent bodies reporting to the Ministry. New Zealand's Energy Efficiency and Conservation Authority (EECA) and Mexico's National Commission for Efficient Energy Use (CONUEE) are examples of energy efficiency dedicated agencies that have carried out successful programs, projects and publications. Whichever model fits best to Peru's needs, it is important that lines of authority are well designed, defined and clear to all the stakeholders in the energy efficiency arena.

Recommendation 4

As recommended in the 2011 PREE report, the Government of Peru should establish a dedicated energy efficiency agency to coordinate related analysis and policy implementation.

ENERGY EFFICIENCY OPERATIONAL FRAMEWORKS

In order for project implementation to be successful, the Ministry should evaluate the creation of a national energy efficiency project implementation unit. Internal and external communication will be essential to the success of this unit. The Directorate-General for Energy Efficiency needs to expand its capacity in order to design, develop and implement projects or create a dependent structure that could possibly honour that role.

Governments around the world such as Mexico and the United Kingdom have relied on independent trusts like the *Fideicomiso para el Ahorro de Energía Eléctrica* (FIDE) and "The Carbon Trust", respectively, as operational bodies that support the design and implementation of energy efficiency projects.

Recommendation 5

The MEM should revise Peru's energy efficiency operational frameworks and create a project implementation unit.

ENERGY EFFICIENCY FINANCE AND FINANCING

The financial resources of the DGEE are limited. The MEM needs to ensure that sufficient funding is provided to continue auditing and accreditation efforts. The MEM and DGEE must address the pressing need to mobilise and increase investments into energy efficiency projects and programs, which has been a common challenge in the APEC region. National budget authorities such as the Ministry of Economics and Finance and Congress should be aware of the importance of energy efficiency and its multiple benefits. The MEM is encouraged to work together with relevant budgetary institutions to highlight the relevance of energy efficiency, its environmental benefits and the related financial savings.

Recommendation 6

The MEM needs to ensure that sufficient funding is provided to energy efficiency programs such as auditing and accreditation efforts.

Additionally, the DGEE should explore the possibility of establishing compulsory standards and supervision for developing financial resources. Moreover, development and commercial banks, international organisations and green funds have been reliable partners for the implementation of energy efficiency projects in other APEC

member economies The DGEE currently has little experience implementing energy efficiency finance projects with support from development banks, financing units, or international multilateral organisations.

Alternatively, international experience shows that enforcement of energy efficiency standards can also be a financial resource, through the collection of penalty fees. An area of opportunity is the creation of a fund dedicated specifically to energy transition and sustainable use of energy, similar to the Climate Change Fund, created by the Ministry of the Environment. This fund could serve as the recipient of international fund with a strict criterion for project selection and very robust monitoring and evaluation tools. Mexico created three of these type of funds in 2008, which have been use since for developing and financing diverse energy efficiency projects.

Recommendation 7

The DGEE should explore energy efficiency finance mechanisms domestically and internationally via development banks, financing units, or international multilateral organisations.

RESEARCH, DEVELOPMENT AND INNOVATION

The DGEE lacks a research, development and innovation platform. Universities and research centres do not currently participate in the value creation chain. It is necessary to identify which stakeholders should be considered and which shared milestones could be achieved. Additionally, human capacity building for the sector should be encouraged and incentivised. Finally, innovation schemes need to be designed and implemented.

Energy efficiency is linked to technology, and technology depends on research, development and innovation. A strategic and clear path should support Peru's progress on energy efficiency. APEC economies like the US, Japan and Mexico have designed and developed strategic plans allocating funding for human capital development at all levels, and for establishing strong bridges of cooperation between public and academic sectors, both domestically and internationally. Besides developing and adapting new technologies, research and innovations can contribute to reducing the cost of existing energy-efficient technologies.

Recommendation 8

The DGEE should explore the possibility of designing and developing a research, development and innovation plan for energy efficiency.

NATIONAL AND INTERNATIONAL COOPERATION

The technical platform of the DGEE is limited. Domestic and international non-governmental organisations have developed strong and reliable capacity that could be leveraged to strengthen the DGEE. Hence, the DGEE should explore new sources of technical assistance, cooperation and financing with regional business and sectoral organisations, chambers of commerce, etc. as well as with other international organisations or agencies such as the United Nations, IEA/OECD, APEC, IPEEC, the World Bank, the IADB, the Development Bank of Latin America (CAF), Sustainable Energy for All (SEforALL) and the Global Environment Facility (GEF), among others. Moreover, some of these institutions and particularly the IEA and APEC organise regular workshops, trainings and webinars (IEA, 2019b).

Additionally, some governments have been very active on cooperation projects via their international development agencies such as Germany, Denmark, Sweden, France and the United Kingdom, among others.

International cooperation has resulted in the successful completion of energy efficiency projects in several APEC economies like Chile, Mexico and Thailand.

While currently domestic and international cooperation on energy efficiency has already achieved some progress in Peru, there is room for further improvement. Additionally, the long-term strategy should explore new areas of cooperation enhancing both domestic and international cooperation considering the participation of other stakeholders in the energy efficiency sector. Cooperation allows for the exchange of good practices of energy efficiency policy design and implementation.

Recommendation 9

The DGEE should explore new technical assistance, cooperation and financing sources both domestically and internationally.

GOALS, TARGETS, STRATEGIES AND DATA

This section covers several cross-cutting issues with the discussion and recommendations divided into the following areas: communication and coordination; outreach; data management; planning; and certifications and audits.

COMMUNICATION AND COORDINATION

Peru's goal for energy efficiency are commendable, but the means to achieve these goals tend to lack focus. The goals must be translated into an implementation plan, coupled with effective communication.

While energy efficiency policy requires the involvement of multiple agencies, the coordination of governmental efforts must be led by a single body. In the case of Peru, the DGEE seems to be the best fit to play this role. This will allow for consistent messaging that will be critical for working between agencies and with the public sector. Coordination is essential. The lead agency must be effective in coordination, while also allowing the other agencies the freedom to do their respective jobs. This issue is particularly evident in the energy efficiency labelling process, where there has been an obvious lack of coordination between the main stakeholders.

Recommendation 10

The DGEE should have a strong leadership role, particularly while coordinating with other organisations, and communicating with energy consumers.

OUTREACH

In general, labelling activities are effective on enhancing energy efficiency, but key information, such as the financial benefits associated with energy savings, are not sufficiently communicated to consumers or to industry. It is critical that government labelling is transparent to the energy user. In the case of the US program Energy Star, all appliances (washers, driers, refrigerators, etc.) have projected energy savings on their labels. These labels include the dollar amount that can be expected to be saved based on the energy savings.

Recommendation 11

The DGEE should improve its labelling to clearly communicate to consumers the energy and financial savings that can be expected from more energy efficient appliances.

It appears that the industrial sector wants to be involved with energy efficiency programs, but communication within this sector seems to have challenges, particularly in agreeing joint programs with the DGEE. Government leadership in this regard has proven to be a successful approach in the international experience. For instance, in the US, the Department of Energy led for many years a program called "Industries of the Future", the focus was on growth industries for the economy. While the federal government provided substantial funding, the various industries, either through associations or as individual companies, generally matched the funding. This could be a model for Peru where companies that are important to the economy work with the government to become more energy efficient.

Recommendation 12

The DGEE should set up a program similar to Industries of the Future, implemented in the US, to coordinate Research, Design, Development and Demonstration (RDD&D) with the industrial sector.

DATA MANAGEMENT

Currently, different agencies collect data over different time periods in Peru, making trends for energy generation, transmission, distribution, and end use harder to examine. A single entity must have the responsibility for gathering information and disseminating the data to the various agencies that need data for specific activities.

This can be a dedicated agency such as the Energy Information Administration in the US or, alternatively, a group within an existing agency as is the cases of Australia (Australian Energy Statistics Office) or Chile (Comisión Nacional de Energía [CNE]). This entity would be made responsible for the collection, analysis and publishing of data for different sectors, fuels and periods with a high level of disaggregation and detail. For instance, such entities publish monthly figures by source including fuel production, exports, imports, refining output, electricity generation, energy intensity, etc. (CNE, 2019), (DEE, 2019).

In any case, according to the Peru-specific needs, the agency selected to lead energy data collection will also need to develop programs with other agencies to ensure that data are collected on an annual basis. As a subset to these updates, for any new program develop processes for obtaining data to determine the impact of the program. This accumulation of programmatic data will be important for "lessons learned". Furthermore, some of the data are about methods of conservation. It is important to note that this is a personal decision on electricity use as opposed to installing new energy efficient appliances and technologies.

Recommendation 13

The Peruvian Government should establish a data collection and statistics office to collect, analyse and publish energy data.

Recommendation 14

The MEM should work towards more frequent updates of national energy statistics (annually, for example).

PLANNING

It will also be important for the government to develop programs working with academia and other local experts. This will allow the development of better models for projecting energy demand, program uptake or other

government services. Moreover, in line to some of recommendations of the last PREE, particularly the thirteenth recommendation, this Follow-up PREE reiterates that the MEM should develop a set of energy efficiency indicators that allows them to monitor progress and energy potential savings for each sector.

The IEA published an important report (translated into Spanish) on the development of such indicators by sector (IEA, 2015). Once the indicators are developed, it would be possible to set and calculate specific targets for sectors and subsectors to better understand the opportunities and challenges of energy efficiency in each sector. An interesting example in the APEC region on this matter took place in Mexico, where CONUEE (the energy efficiency agency) worked together with the French Agency for Development (AFD) to develop a database of energy efficiency indicators (CONUEE-Enerdata, 2018). This database includes indicators such as final energy intensity, primary energy intensity, electricity intensity, CO_2 emissions intensity, disaggregated by sector, year and fuel.

Recommendation 15

The MEM should develop energy efficiency indicators for each sector considering technical and economic energy savings potential and related carbon reductions. Based on this, create energy and carbon reduction targets for key sectors.

Additionally, it will be important to nurture the development of domestic intellectual capacities to address energy issues. Only local expertise can address the multi-disciplinary (resource, environmental, societal, cultural) issues that must be resolved for energy development. Development of an energy efficient roadmap or portfolio standard with goals, targets and strategies section and should be pursued.

Recommendation 16

The MEM should accelerate development and implementation of an energy efficiency roadmap.

More attention should also be paid to working with the private sector (to build on the current focus on the public sector). When projecting future energy demand, it appears that the models only extend current historical trends without including any analysis of new technological advances.

Recommendation 17

The MEM should work together with academia and local consulting firms to develop baselines and models that can effectively evaluate energy demand, energy efficiency measures and technological advances in a variety of scenarios.

CERTIFICATIONS AND AUDITS

The MEM has a well-informed perspective on Peru's energy challenges and opportunities and should be commended for its progress and efforts so far, but a lack of overall coordination is evident in some presentations, especially in labelling programs. The government already recognises that it must be working with other multi-national organizations such as UL (a global testing laboratory) for the proper accreditation of testing laboratories and auditing staff and/or organizations.

Recommendation 18

The MEM should have work to house all audit and accreditation efforts in one decision-making agency, ideally in the energy efficiency agency proposed in recommendation 4.

Recommendation 19

The MEM should aim to simplifying the label approval process and introduce mandatory labelling as a way to provide automatic data collection (including baseline and average values).

TRANSPORT SECTOR

Peru's vehicle fleet accounts for the largest source of final energy demand, with over 80 percent of the vehicle stock in Peru originally imported as used vehicles from the United States or Japan (Davis and Kahn, 2011). The government recognises the need for action with eight transport measures in Peru's NDC. Certain progress has been made with the deployment of bus systems ('El Metropolitano', a 33 kilometre system with 38 stations) and rail (a single-line metro system of 35 kilometres and 26 stations) in Lima, as well as the creation of the joint public authority of Lima-Callao. However, the efficiency of the vehicle fleet is lagging far behind, congestion remains a serious problem with concomitant air pollution – some of the worst in the world – and integration of urban and land use planning is not in place to reap transport system efficiencies.

LABELLING

Commendable initial work has been conducted on labels by the government of Peru, giving industry time to prepare as well as evaluating best practices around the world. However, nothing mandatory is yet in place nor foreseen for the transport sector, which would help ensure consumers can make an informed choice based on efficiency.

Recommendation 20

The Government should introduce a label for vehicles, which needs to include the following measures to ensure effectiveness:

- *Make it mandatory for all new cars and consider it as well for second-hand cars (as New Zealand has done) due to the large share of second-hand imports.*
- *Include a relative value and cost saving figure compared to the average efficiency for a vehicle of the same class so that consumers can make informed decisions.*
- *Link to a short-to-medium-term introduction of MEPS / a fuel economy standard / a ¨feebate¨ scheme.*
- *Link to the introduction of European emission standard Euro VI for diesel and gasoline to tackle not only efficiency, but also deteriorating air quality, especially from diesel vehicles.*

The US Environmental Protection Agency is considered a best practice for fuel economy labelling, including a comprehensive website for consumers to be able to learn more, compare vehicle efficiency, and even adjust reference assumptions to make own calculations based on personal driving characteristics (www.fueleconomy.gov). Currently, Peru appears to move towards a voluntary vehicle efficiency label with an absolute value. Firstly, voluntary labels are much less effective and have none-to-negligible effects on national GHG reductions. Furthermore, an absolute value is not very useful and perhaps even misleading if not updated on a regular basis, as an absolute value presumes consumers know both energy metrics (e.g. kWh/km) as well as what a good-versus-bad number should be, both of which are not realistic expectations of consumers.

A mandatory and relative value is therefore strongly recommended in order to have any effect on efficiency. A label in itself is a first step towards some form of minimum energy performance standards (MEPS) for vehicles,

which can either take the place of a MEPS, also known as a fuel economy standard, which can be a MEPS by vehicle class or across a manufacturer fleet as done in the US with the so-called CAFE standards (UCUSA 2019). Alternatively, a so-called "feebate" scheme could also be considered, as applied in Singapore (Transport Policy, 2019) whereby purchasers of inefficient vehicles pay a fee, and those buying efficient vehicles get a corresponding rebate.

PUBLIC AND NON-MOTORISED TRANSPORT

As well as awareness-raising, there is a strong overall focus by the government on public transportation, albeit with bus routes lacking quality standards. The creation of the *Autoridad de Transporte Urbano* (ATU) for Lima and Callao is a very welcome step, and should be taken advantage of for the opportunities that are now presented by combining the planning capacities of a larger metropolitan area to ensure overall system efficiencies.

Recommendation 49

The Government should Integrate and centralise informal transport into the formal sector so as to improve route planning and quality, the number of buses going to underserved areas, and ameliorate traffic congestion.

Recommendation 50

In the long-term, set quality standards for concessions (licensed routes), including energy efficiency, and harmonise vehicle purchasing to lower overall operation and maintenance costs.

Recommendation 23

The Government should further integrate land use and transport planning to incentivise dense buildings next to public transport stops, including appropriate parking regulations, as well as encouraging non-motorized transport (NMT).

The current 'El Metropolitano' bus system as well as the urban rail system in Lima represents welcome progress to increase mobility for citizens of Peru's capital. Yet, the metro system is quite delayed, and the bus rapid transit (BRT) line is quite limited when compared to other economies in the region. For example, Chile, has roughly half the population of Peru, but has more than four times the BRT length (Global BRT Data, 2019). Further, vehicle and overall system efficiencies are being neglected, with too much focus on natural gas, when in fact integrating land use and transport planning could have big impacts by linking together non-motorised transport (NMT) and bus usage with actual land use patterns. Currently, bus routes are allocated in a splintered fashion with little consideration for vehicle quality or overall system efficiency, and instead bus drivers are incentivized to compete for passengers on the same routes, creating a lot of congestion, unsafe driving conditions, vehicle inefficiencies, as well as underserving areas that could otherwise be served.

VEHICLE FUELS

The government has set up a technical committee on adopting international technical standards (CTN UREEE), which is starting activities in early 2019 – certainly a welcome step – as is a first cooperation between DGEE and the Ministry of Transports and Communications (MTC) in 2015, following a recommendation from the original PREE. The government is keen to understand how electricity rate structures should be set up in regard to electric mobility, as well as who manages infrastructure installations, maintenance, and payment systems. The

government is also looking at the best way to use its diversity of fuels in the transport sector, including LPG, natural gas (CNG and LNG), electricity, and how to reduce diesel (53% of usage) and gasoline.

Recommendation 24

An outcome-based (efficiency in this case) transport technology policy should be strived for, rather than selecting and promoting hybrids or natural gas cars, per se.

Recommendation 25

The government should tap into existing knowledge on electric mobility, both those going through first steps, and those farther along by coordinating with other centres in the region and world (such as Centro Mario Molina in Chile) and the IEA's Implementing Agreement on Hybrid and Electric Vehicles (IA-HEV). This can save a lot of time and money on determining the best path forward.

Electrification needs to be prepared across multiple sectors. Establishing a working group to coordinate transport policy including urban planning (also to capture and share best practices from a city level) is one potential approach to be considered by the Government of Peru. Alternatively, Peru could follow the UK example and set up an Office of Low Emission Vehicles (OLEV), which puts staff in separate ministries and integrates industry and research secondees (for example from utilities) to ensure successful integration and deployment. In the UK, OLEV licenses who is allowed to install charging stations, maintain them, and how to pay network fees for charging.

Recommendation 26

Establish an inter-governmental working group to coordinate transport policy, including urban planning.

Interest in electromobility is a surging in Peru, as it is elsewhere, and many important discussions are being had regarding energy and fuel supplies. However, picking a single fuel to utilise across all sectors is the wrong policy, rather, an energy efficiency outcome should be sought, with efficiency used as "the first fuel" of Peru. While liquid petroleum gas (LPG) and natural gas are both currently in use in Peru's transport sector, it is worth studying whether or not the costs of importing LPG do not outweigh the benefits of its usage. Similarly, for natural gas, it is worth studying what the best use of natural gas reserves is for Peru, and the likely answer is industry, power sector, and perhaps long-haul liquid natural gas (LNG) use for trucks, in that order. Peru is at a crossroads in regard to electromobiliy and needs to proceed strategically in order to achieve the best outcomes while avoiding pitfalls and mistakes already experienced by others.

Recommendation 27

On fuels, the MEM should:

- *Study the costs and benefits of LPG use in the transport sector.*
- *Make a roadmap for electrification and suitability for all vehicle modes e.g. including electric two-wheelers (very high energy efficiency benefit), and the potential of electric trucks with catenaries (overhead lines) for repetitive paths in mines and ports.*
- *Study the cost of stranded assets of investing in infrastructure for natural gas as a fuel for transport (pipelines, vehicles, and other infrastructure) to avoid wasting funds.*

Getting rid of the oldest cars on the road is a sound policy given its cost effectiveness. A very few number of vehicles often account for a disproportionate share of local air pollution and vehicle inefficiency. However, this share is nevertheless small, and for a larger overall effect, the government would be wise to consider stronger inspection and maintenance (I&M) regimes, which have an overall positive effect on the whole vehicle fleet, and is more impactful given that it is not a one-off incentive, but an overall standard that applies to all vehicles equally.

Recommendation 28

Scrapping incentives is a welcome step, but more rigorous inspection and maintenance can also do the job and save a lot of energy and money and avoid deleterious air quality given that a few vehicles emit a disproportionate amount of pollutants.

INDUSTRY SECTOR

The industrial sector is the second largest user of energy behind the transport sector (45%), consuming 27% of the total energy demand in Peru, and should be a priority area for Peru's energy transition to a lower carbon intensive energy structure. The industry sector has also increased CO_2 emissions by 276% between 2001 and 2014. However, there is a lack of integration between the Peruvian Climate Change obligations and emission reduction targets and the work undertaken by other key ministries. This cross-government work needs to occur urgently as Paris climate change obligations come into effect from 2021.

The industrial sector is growing rapidly with the government's free market approach to attract foreign investors. The Government seems to be focussed on the energy supply side, utilising recent discoveries of natural gas for electricity generation and promoting investment in natural gas pipelines for manufacturers. On the other hand, improving energy efficiency and reducing carbon emissions on the demand side doesn't appear to be a high priority for the Government.

There has been little evidence of implementing the four recommendations from the 2011 PREE in the industry sector. Some energy efficiency activities are however occurring by some businesses on their own, as seen at the Alicorp site visit. It is difficult, however, to know how widespread similar projects are across Peru (amongst the more than 2 000 manufacturing businesses and about 100 energy intensive businesses).

There does not seem to be any active energy efficiency engagement by the Government with the industrial sector. The Government is focused on the public sector to showcase energy efficiency leadership, which is to be congratulated. Nevertheless, this is of little relevance for the industry sector. For example, the technologies and best practices are vastly different between energy use optimisation in a public building such as a hospital or library, compared to a mining or manufacturing operation.

Additionally, there is no evidence of energy (and related carbon) savings potential studies or baselines for each sector, which are essential to help prioritise areas for maximum impact with MEM's limited funding and staff resources.

INDUSTRIAL SECTOR ENERGY SAVINGS POTENTIALS AND PARTNERSHIPS

In its presentations to the Peer Review Panel, The National Society of Industries (SNI) highlighted 15 areas of work it can deliver alongside the MEM (Appendix C). On one hand, large energy users are usually powerful

corporates and may have an interest in lobbying against government programmes. On the other hand, the government requires energy use data, which can sometimes be difficult to obtain. The Government has powers to demand information, but it is not always practical to take a regulatory path for this. Hence in the international experience, building stronger relationships with large energy users seems to be a better approach.

Recommendation 29

The MEM and the designated data collection unit should engage in partnership agreements with key industry associations (such as the Sociedad Nacional de Industrias: SNI) to work alongside its members to implement Peru's energy efficiency and carbon reduction goals. This could not only increase cooperation with large energy users but also improve energy data collection.

Recommendation 30

The MEM should build stronger links with industry and sub-sectors by helping them with sectorial benchmarking tools and promoting energy management awards and recognition for exemplary companies as well as program delivery partners.

It can be difficult for companies to appreciate the value of ISO 50001 certification on energy management, especially if their products are commodities such as oil, cement, sugar, steel and there is no branding opportunity for them. The government needs to clarify the customer value proposition for ISO certification. For example, it is worth considering tax advantages for companies with ISO certification in Peru, as is the case in Germany and the United Kingdom.

For example, in Mexico, the industrial sector is adopting best practice energy management based on the ISO 50001 Energy Management Standards, using Learning Networks at the regional level to share information and skills. This program is called PRONASGEn and is being implemented by CONUEE, Mexico's energy efficiency agency (CONUEE, 2019). It has seven networks with 18 companies participating already. The program is developed on the German Learning Energy Efficiency Networks (LEEN) experience and is a good model for large energy users who have the biggest opportunity to save energy through industrial process optimisation of pumps, fans, compressed air, and heating systems (ACEEE, 2015).

LEEN is a concept developed in Switzerland in the 1990s. Since then, the approach has been successfully transferred to Germany, France and Austria. With these networks, 10 to 15 regionally based companies from different sectors share their energy efficiency experiences in moderated meetings. After the companies have formed the network, the process starts with an energy review and the identification of profitable energy efficiency measures in each company. Afterwards, the participants decide upon a joint target, which is allocated to the partners according to their efficiency potential. The subsequent networking process enables a continuous exchange on energy efficient solutions fed by the experiences of the network partners as well as external experts. The performance of each company is continuously monitored and controlled on a yearly basis. The network operating period is typically from three to four years.

There is also a need to clarify the necessary plan for building the capacity (number of experts) and capability (level of training and skills) to support and grow a profitable energy management industry. Without this, energy and carbon savings target for the industrial sector may be difficult to achieve.

Recommendation 31

The MEM may consider introducing voluntary agreements and standards for energy management systems, such as ISO 50001, as well as building domestic capacity and capability to deliver these systems.

Finally, the MEM should consider energy audits (compulsory or voluntary), as they provide a detailed energy balance, which looks into how much overall energy is supplied to the site, where it is used and what wastage can be reduced. There are international standards for energy audits, and they provide a template of want areas of the process need to be reviewed, and to what level of detail. New Zealand provides an interesting example in which energy audits are just one part of the ISO50001 Energy Management System, which put into place a framework to manage the energy use for the organization (EECA, 2019).

Other than audits, a few mechanisms could enhance energy efficiency, including the abovementioned Learning Networks, energy management plans, benchmarks, awards, hosting large energy user conferences and workshops. Once again, New Zealand's EECA provides a good example of implementation of these innovative practices across the industrial sector (EECA, 2019b).

For small and medium enterprises, offering an online self-assessment tool could help to reduce their energy efficiency program costs. The New Zealand Government has recently created a web-based tool called the energy management journey (EECA, 2019c) that allows businesses to self-asses themselves, and offers ways to make improvements.

For larger energy users, if the partnership model is not taken up by industry, the Government should consider implementing a compulsory energy efficiency opportunities programme (EEO) such as that from Australian experience[4] (EEX, 2019), or the UK Energy saving Opportunities Scheme (ESOS) (UK Government, 2019), which requires an energy audit report from all energy intensive business (e.g. businesses that consume over 500 TJ (or 140 Gigawatt-hour [GWh] use per year) every 2 years, reporting to MEM what has been implemented and why projects cannot be implemented.

This will help MEM identify and track energy savings opportunities to the specific business and report to top management. The idea is to highlight energy savings projects that can be implemented to reduce energy costs and carbon emissions. MEM can then decide to review and publish aggregated sector data and trends and recognise best and worst performers. Usually, the energy audits costs pay for themselves within 2 years from the savings.

Recommendation 32

The MEM should consider multiyear (three or more years) voluntary agreements with large energy users to help reduce energy use and emissions.

BUILDINGS SECTOR & APPLIANCES

In 2017, the buildings sector (comprising the residential, commercial and public subsectors) was the third largest end-use demand sector, accounting for 25% of total final energy consumption (213 395 TJ) in Peru. The buildings

[4] Given that Peru has a large mining and energy intensive sector similar to that of Australia, the EEO programme and experience is particularly worth exploring. The program's EEO Five Year Results Report identified opportunities amounting to energy savings of 164.2 PJ, which was equivalent to 2.7% of Australian annual energy use over the period 2006–2011.

sector also consumed around 40% of electricity supplied in 2017, mostly in the residential sector (52%), followed by the commercial (37%), and public (11%) sectors.

Peru's housing deficit was around 1.86 million houses in 2014 (Scotiabank, 2015). On the other hand, the floor area of Peru's building stock (including residential, office & retail, and other commercial) is projected to increase by 9.4%, from approximately 530 million m^2 in 2018 to 580 million m^2 in 2025 (IFC-EDGE, 2017). If building energy efficiency stays constant over that period, then the stock increase will result in a 3.8% rise in electricity consumption from 2018 to 2025.

BUILDINGS SECTOR

Concerning the improvement of building energy efficiency, the Ministry of Housing, Construction and Sanitation (MVCS, *Ministerio de Vivienda, Construcción y Saneamiento*) is the government ministry responsible for regulating and promoting the ordering, improvement, protection and integration of centres, towns, villages, urban and rural areas, as a sustainable system in the national territory. The responsibilities of the MVCS also pertain to housing materials, construction, standards, and procedures of developing sustainable construction, in coordination with the related bodies. Additionally, some sustainable construction technical codes have been developed and some approaches of energy efficiency in the current regulations for buildings have been proposed by providing some information related to comfortable temperature of ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) standards.

However, currently Peru has not enforced any buildings energy codes. Moreover, there is no concrete plans to develop a buildings energy code (BEC), although some recommendations [5] in the previous PREE report (APEC-EWG, 2011) indicated the need and importance of BEC to Peru. Despite this, the MVCS has been developing a certain amount of technical codes of construction material which is the first step of developing the BEC. Hence, Peru needs to take advantage of the existing specialised experts on buildings sector and energy efficiency field, and increase its capacity building for forming more experts on this field.

The BEC requires the development of knowledge regarding construction materials, methods, and energy systems. By running simulations, users can estimate building energy performance under their energy codes, which can be useful baseline energy consumption indicators (e.g. kWh/m^2). The BEC also refers to a set of rules that specify a minimum level of energy consumption and therefore it is a fundamental tool for enhancing energy efficiency in the buildings sector. Once a BEC is developed, an energy audit code (EAC) should be undertaken. An EAC can help to provide the actual energy consumption for the whole building mainly from the building's own energy system. Due to different incentives between tenants and landlords (building management), the government needs to provide different end-use benchmarking systems separately (since they might have different priorities).

On the other hand, when developing a BEC, there are specific challenges in Peru's context, including:

- The wide diversity of climatic zones requiring distinct standards that add to the complexity of developing adequate building energy efficiency codes.

[5] Recommendation 28: It is recommended to conduct detailed studies on energy efficiency status in order to obtain indicators of the efficient use of energy of each economy's sector. Recommendation 30: The Peruvian government should implement monitoring and evaluation of policies in order to establish the steps towards the next stage as well as to provide an indicator of the efficiency benchmarking. Recommendation 32: It is necessary to develop and implement mandatory energy efficiency standards and seek for its international harmonization. Recommendation 34: It is highly recommended to develop minimum energy performance standards as a priority action in the commercial and residential sector.

- The lack of awareness and/or interest among consumers and construction companies of the advantages of energy efficiency.
- The lack of technical capacity and resources to establish and monitor the compliance with building codes.

Based on the understanding of the challenges related to BEC, EAC, benchmarking systems of tenants and building management in Peru, we found that some IEA recommendations can be adopted and modified for Peru's buildings sector (IEA, 2015). A step on the right direction was done by the MEM by initially focusing on implementing energy efficiency programs on the public sector, and later on the private sector. By doing so, possible barriers related to the absence of qualified technicians and high initial investment costs which threaten market-driven energy savings measures can be alleviated. However, the extent of these programs is still limited and there is much room for this expansion and improvement.

The government should adopt mandatory BEC for public buildings and play a leading role, showcasing successful energy efficiency projects and providing guidelines on best practices. Different building energy codes should be considered covering different climate zones.

Recommendation 33

The MEM should improve public building energy performance by implementing mandatory BECs with different climate zones, a starting point could be adapting some established in neighbouring economies.

There are many BECs established overseas, such as Energy Efficiency Requirements of the Building Code of Mexico[6], Australia[7], Hong Kong Building Energy Code[8], and Singapore's Energy efficient features of Code for Environmental Sustainability[9]. More overseas examples of APEC's building (energy) codes can be found in APEC-EWG (2010) and APEC (2013). On the other hand, Building Codes Assistance Project[10] provides development tools for creating national BECs. For BECs with climate zones, see China's BECs[11]

The government should support the development, adoption and enforcement of mandatory BECs which provide a minimum quality level for all public buildings. These policies could be combined with demonstration projects, financial mechanisms, and technical capacity building, which become an asset for enforcing the mandatory BECs to the private sector.

The Peruvian Government should provide a stable regulatory framework and standards to support the market in driving the improvement of energy performance of both new and existing buildings in the public sector. Hence, the government should enable minimum energy performance standards (MEPS) for building components and systems such as windows, insulation, ventilation, hot water, heating and cooling systems. The government should also facilitate improvements in high efficiency building components and systems through the publication of best practice guidelines and enhanced research, development and demonstration programmes. In addition, the government should improve access to high efficiency building components and systems by providing financial incentives throughout the supply chain.

[6] https://onncce.org.mx/es/codigos-y-publicaciones/366-mbeecdc
[7] https://www.abcb.gov.au/Initiatives/All/Energy-Efficiency/NCC-2019-Energy-Efficiency-Project
[8] https://www.emsd.gov.hk/beeo/en/mibec_beeo_codtechguidelines.html
[9] https://www.bca.gov.sg/
[10] http://bcapcodes.org/
[11] https://china.lbl.gov/sites/all/files/building_code_roadmap_english_oct_20_2015_formatted.pdf

Recommendation 34

The MEM could improve the energy performance of buildings components and systems by implementing minimum energy performance standards (MEPS) and supply chain improvements.

The Peruvian government should require public display of information including labels, certificates and public disclosure of energy consumption for selected public buildings. Labelling of buildings (and their components and energy systems) is a useful information tool for owners, buyers and renters, supports informed decision-making and promotes a gradual shift in market demand to more efficient buildings.

Recommendation 35

The MEM should Increase disclosure of energy consumption for whole buildings (and building components and systems) by implementing mandatory energy labels and certificates, and developing mechanisms for performance-based contracting to ensure that buildings will achieve energy efficiency targets.

The MEM should develop mechanisms for performance-based contracting to ensure that buildings will achieve energy efficiency targets. These energy efficiency targets should be aligned with the mandatory BECs for public buildings. For example, builders for new public buildings must show that they have the technical capacity to compile the mandatory BECs.

In order to deal with the barrier that arises from incentives being split between tenants and landlords (since tenants are the ones who save money on energy efficiency improvements that are usually paid for by landlords), the Peruvian government should conduct a benchmarking analysis of energy efficiency for tenants and building managers of public buildings. These benchmarking results should be disclosed in order to provide peer pressure to the private sector. It should be noted that building management's energy efficiency performance refers to the management performance of using energy systems of the buildings by the mandatory EACs while the tenant's energy efficiency performance cannot be controlled by the building management. These two benchmarking results include all the end-users' performance. Once all public sector buildings compile their EACs, Peru's government will have the technical capacity to broaden the program to include the private sector.

Recommendation 36

The MEM should benchmark and disclose the energy efficiency of building managers and tenants by implementing mandatory Energy Audit Code (EAC) for building management and benchmarking systems for tenants.

APPLIANCES

Following recommendations 41-46 of the previous PREE, there is some progress on the implementation of these energy efficiency recommendations. In the framework of the Supreme Decree N° 004-2016-EM, there are 78 *Minimum Efficiency Standard Sheets* (Minimum Energy Performance Standards) approved for lighting products, air conditioners, motors, washing machines, refrigerators, freezers and public lighting bulbs. Technical regulation of energy efficiency labelling has been approved via Supreme Decree N° 009-2017-EM for appliances: general lighting for domestic and similar uses, ballasts for fluorescent lamps for general lighting for domestic and similar uses, refrigerator appliances for domestic use, domestic washing machines, domestic drum dryers, air conditioners, and water heaters for domestic use.

Following the development of the energy labelling scheme, the Regulation for Energy Efficiency was issued by the MEM under Decree No. 009-2017. The new regulation includes appliances such as: air conditioners, fridges, washing machines, and cloth dryers. All manufacturers and/or importers must provide technical reports and energy efficiency labelling to ensure the regulation compliance. On the second year of implementation, a Certificate of Conformity (CoC) issued by a recognised certification body is required. However, due to some delays in the certification process of energy efficiency labelling for appliances, the enforcement of energy efficiency label regulation has been postponed. Additionally, the primary issue with the CoC process was with accreditation laboratories.

On top of the above, there are other challenges faced by the energy efficiency labelling scheme and Minimum Energy Performance Standards (MEPS) in the Peru's context:

- A lack of technical expertise.
- Low energy prices.
- Energy efficiency measures not a priority for companies.
- No mandatory energy labelling scheme.

As mentioned in other reports, implementing mandatory energy labelling schemes and MEPS is highly recommended for enhancing energy efficiency, with several successful cases happening across the APEC region (IEA, 2015).

Recommendation 37

The MEM should adopt the performance certification standards similar to programs implemented in the APEC region, including Energy Labelling Scheme (Singapore), Mandatory Energy Efficiency Labelling Scheme (Hong Kong, China), the ENERGY STAR (US), or Sello FIDE (Mexico) programs.

Having enough internationally recognised and accredited laboratories in Peru to undertake all testing is not feasible in the short or medium term. Instead, the Peruvian government should temporarily adopt performance certification standards, such as Energy Labelling Scheme in Singapore (NEA, 2019) and other similar programs. In general, the Peruvian government could adopt a set of standards for the laboratory tests and a list of internationally accredited laboratories (both in Peru and abroad) and provide them to appliance suppliers (manufacturers or importers). Then, suppliers would need to submit the test reports issued by one of the listed laboratories. Later, the Peruvian government could verify if the tests fulfil the requirements, in which case it will issue the corresponding CoCs. By using this kind of process, the Hong Kong government (EMSD, 2019) can issue a certified energy efficiency label within 17 days (EMSD, 2019), and any person who contravenes the requirements commits an offence under the Ordinance, is liable to a maximum fine of HKD 100,000 (around USD 13,000) upon conviction.

During this temporary period, the Peruvian government could progressively establish its own internationally accredited laboratories recognized without postponing the energy efficiency labelling scheme and Minimum Energy Performance Standards (MEPS).

The MEM should lead energy efficiency efforts by demonstrating best practices and applying MEPS and labels in public procurement processes. Dissemination of the inclusion of energy labels and MEPS criteria in public procurement processes can enhance the recognition of energy labels and MEPS in the private sector. It also helps drive the uptake of energy efficient technologies and services.

The Peruvian government should ensure both energy labels and MEPS are enforced and regularly updated. The standards and labelling should focus on products that will deliver the greatest energy savings as well as provide greatest economic and environmental benefits. Sufficient resources should be allocated to monitoring compliance with the standards and labelling requirements. Other Latin-American economies, with similar challenges to Peru, have successfully implemented MEPS, for instance Argentina, Ecuador and Mexico (SEforALL, 2017).

Recommendation 38

The MEM should implement mandatory MEPS and energy labels for appliances by including energy performance criteria in public procurement, and regularly updating and improving standards and label categories.

The MEM should impose mandatory phase-out policies in the public sector to the least efficient appliances. Such phase-out policies can enrich the content of energy labels and MEPS at a fast pace. In the future, these mandatory phase-out policies can cover manufacturing, imports and sales of products that consume more than a specific amount of energy. Phase-out incentives can include taxation of least efficient products and subsidies for replacement with highly efficient products. The subsidies should be supported by the collected tax revenue from least efficient products.

Recommendation 39

The MEM should promote the phase-out the least efficient products through:

- *Combining MEPS, market transformation and other phase-out policies*
- *Taxation, subsidies and regulations for the private sector*

To increase compliance and testing efficiency, regular collaboration on standards and labels, sharing of best practices and lessons learnt, and harmonisation of standards should be promoted within Latin America. Moreover, Peru's standardisation agencies and relevant government stakeholders should engage with neighbours to establish coordinated policies to increase the demand for efficient appliances and equipment. Hence, Peru's government should prepare to have such kind of regular technical collaboration.

Recommendation 40

The MEM should engage in regional collaboration and harmonisation of standards and testing procedures to reduce compliance and testing costs, and increase demand for energy efficient products.

While smart metering is not common in Peru, in some cities and municipalities, smart meters can be used to collect energy end-use data of public and private sectors. At first, energy labels can be improved by adding QR codes (Mddb, 2019 and Pocketwatt, 2019). Customers can scan the QR code to obtain more information, such as how much money they can save, learn about the appliances and upload the location of the appliances to governmental institutions (e.g., the DGEE). Smart meters can also provide electricity consumption data of all the corresponding appliances. With these electricity consumption data, the DGEE could benchmark energy label quality remotely, which can reduce the quality assurance efforts of energy labelling.

Recommendation 41

The MEM should enhance energy labels through the use of smart meters and QR codes.

ELECTRICITY

The electricity sector serves as a driver for economic development in Peru, as it does in most other economies. It is important to have a stable, resilient, and reliable supply of electricity, and laws and regulations that will promote energy efficiency as it relates to electricity usage.

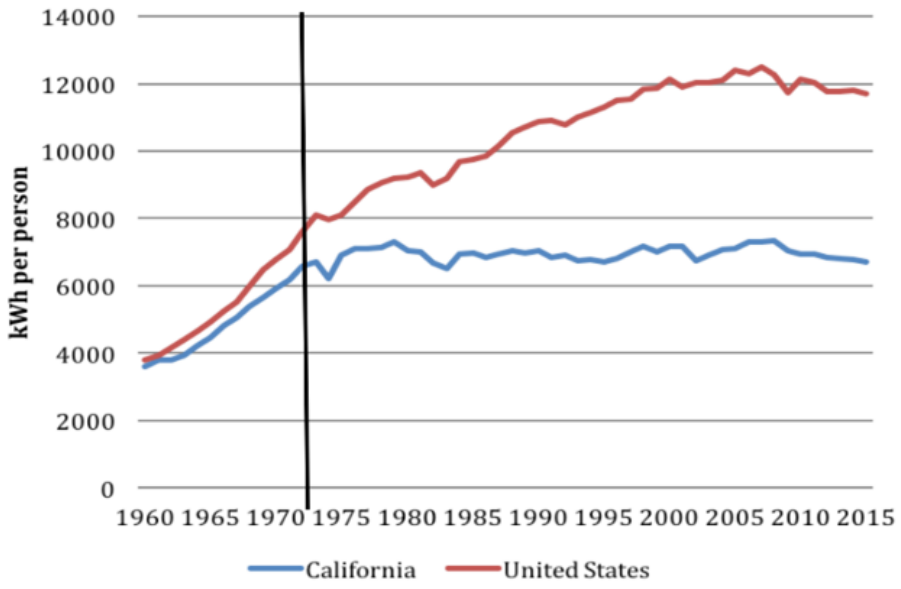
GENERAL RECOMMENDATIONS

The current approach to "efficiency" for the electricity sector in Peru seems to be more about thermal efficiency and transmission efficiency than about end-use efficiency. Increasingly, many governments have shifted to a more comprehensive approach of efficiency with a focus is more on end-use energy efficiency.

The most important aspect of electricity use will be to develop laws and regulations in regard to end-use energy efficiency and its enforcement capabilities. For example, California has set requirements for end use efficiency standards (under Title 24) which are updated every three years. On a federal level, the US Energy Star has efficiency standards for many appliances. Peru could examine these rules and regulations to determine how best to utilise them for economy-specific regulatory development. Note in the graph below how aggressive development of rules and regulations has led to no increase in electricity used on a per capita basis in California since the mid-1970s.

California's success was accelerated by a variety of rebates to commercial and industrial users that encouraged those entities to find mechanisms for reducing energy use. At the federal level, the US Department of Energy developed and implemented an "Industries of the Future" program that worked public-private partnerships with specific industries to become more energy efficient and, in doing so, become more competitive and profitable.

Figure 2-1 • California energy use per capita vs. the rest of the USA 1960-2015



Source: CEC integrated Policy report 2017

Recommendation 42

The government of Peru should consider using rebate mechanisms (for example, tax deductions) and incentives for the private sector to participate in energy efficiency campaigns.

Since many of the presentations focused on thermal efficiency and transmission efficiency, the recommendation for increasing the development of regional and distributed resources is listed here. Any future development of natural gas-fired generation which utilises national resources should do so using natural gas combined cycle gas turbines (CCGT). The efficiency of this technology is about 60% as opposed to less than 40% for single cycle.

Recommendation 43

The MEM should continue efforts to increase the robustness of the transmission and distribution networks and reduce technical transmission losses. If developing new thermal capacity, prioritise high efficiency combined cycle turbines or cogeneration (CHP, combined heat and power) plants.

For reducing transmission line losses, it will be important to continue to the development of new generation in southern Peru. Additionally, new laws and regulations need to be developed and implemented for the electricity distributors to do a better job in installing distributed energy resources, including behind-the-meter generation and energy storage systems.

GENERATORS

A vertically integrated approach leads to problems with generators bidding in at zero resource costs to inhibit competition. Existing laws for Return on Investment (ROI) allow for higher profits than would normally be allowed for a monopoly.

Current ROI rules were established to encourage development. ROI could be as high as 16%. As in the United States, most of the generators are essentially regulated monopolies whose profits are approved by regulatory commissions, such as the California Public Utility Commission. In this mature marketplace, ROI is almost always below 10%. If development goals have been achieved, new regulations with lower ROI, and an increased focus on energy efficiency should be developed.

Recommendation 44

The Government should develop new regulations with lower return of investment (ROI), and an increased focus on energy efficiency.

An additional issue brought to the attention of the Review Team was the fact that generators could bid at zero resource costs as their margins will still allow them to be profitable at that value. A similar problem arose under deregulation in California in 2000. Resource providers discovered that by withholding supplies or in the case of independent power producers shutting generation, electricity prices could be increased dramatically. This "gaming of the system" caused one utility to file for bankruptcy as it could not pass on their costs to end users. Since a similar activity is occurring in Peru, laws and regulations must be developed to avoid this corporate behaviour. Further, by artificially decreasing the price of resources, the additional development of energy efficiency will be inhibited.

Recommendation 45

The Government should develop laws and regulations to prevent "gaming" of the system.

DISTRIBUTION NETWORKS

As in many other economies, distribution entities can be leaders in promoting and implementing energy efficiency and demand response.

Return on investment/equity for these companies should not depend on just delivering units of electricity, such that revenue streams are decoupled from electricity demand. In the international experience, state governments in the US are, increasingly, introducing various approaches to decoupling. That is, regulations that allow electric utilities to have a fair profit while providing services other than electricity to end use consumers. For example, in California, this takes the form of providing funding for installation of new energy efficient appliances to low income families. Some of these programs are managed by distribution companies such as Pacific Gas and Electric Company (PG&E), including rebates, energy savings assistance for common areas in multifamily building and upgrades for low-income households (PG&E, 2019). Additionally, sub-national governments can also contribute to these efforts, for instance, the California State Government has a program for financing energy efficiency projects called Residential Energy Efficiency Loan (REEL) (GoGreenFinancing, 2019). These programs should necessarily include emerging technologies such as two-way smart meters which will encourage behind the meter generation and energy storage and demand response technologies.

Recommendation 46

The government should develop regulations to proactively work with distributors to incentivise energy efficiency within their network.

In addition, rate-payer revenues have been used in a number of states for improving energy efficiency in public places. Since much of the current work in Peru is focused on public building and organisations, efforts should be made to expand these activities. As an example, the Hawaiian government recently used excess ratepayer fees to rehabilitate electricity use in their public schools. Thus, this funding was utilised to upgrade air conditioning units and lightings at public elementary and high schools throughout the state. Hawaii can serve as a useful example of effective use of public funds, having ranked number one in the US for performance contracting – rehabilitating public building to be more energy efficient – over the last few years.

Recommendation 47

The government should develop publicly funded projects that can reduce overall electricity demand such as improved street lighting, and improved space conditioning in schools.

APPENDIX A: REVIEW TEAM MEMBERS

Name	Position	Organisation	Economy	PREE Responsibilities
Dr. Kazutomo Irie	President	APERC	Japan	Team Leader
Mr. Pramesh Maharaj	Programme Manager-Industrial	The Energy Efficiency and Conservation Authority (EECA)	New Zealand	Industry
Mr. Tali Trigg	Consultant	Independent	USA	Transport
Mr. Santiago Creuheras Diaz	Consultant	Former Director General for Energy Efficiency, Ministry of Energy	Mexico	Institutional framework and policy
Dr. William Chung	Associate Professor	City University of Hong Kong	Hong Kong, China	Buildings and appliances
Dr. Terry Surles	Independent contractor / Academic	California Institute for Energy and Environment	USA	Goals, targets and data / Electricity
Dr. Viritphol Vacharapanich	Professional Engineer	Department of Alternative Energy Development and Efficiency, Ministry of Energy	Thailand	Electricity
Mr. Munehisa Yamashiro	Vice President	APERC	Japan	MC
Mr. Diego Rivera Rivota	Researcher	APERC	Mexico	Facilitator
Mr. Thomas Willcock	Researcher	APERC	Australia	Facilitator

APPENDIX B: AGENDA

DAY 1: 18 March 2019 (MONDAY)

Title	Speaker
Welcome remarks and briefing	**Kazutomo Irie,** President (APERC)
Introduction of delegation and participants	**Munehisa Yamashiro**, Vice President (APERC)
1-1 Results and progress of the Peer Review on Energy Efficiency in Peru (2010)	**Rosendo Ramirez Taza,** Director General for Energy Efficiency (MEM)
1-2 Overview of Peru's energy sector	**Rosendo Ramirez Taza,** Director General for Energy Efficiency (MEM)
1-3 Institutional energy efficiency framework in Peru	**Rosendo Ramirez Taza,** Director General for Energy Efficiency (MEM)
1-4 Overview of information, evaluation and statistics on energy efficiency	**Rosendo Ramirez Taza,** Director General for Energy Efficiency (MEM)
1-5 Energy efficiency education and capacity building for households and regional governments	**Cristina Condezo Alarcon,** Directorate General for Energy Efficiency (MEM)
1-6 Standards - Energy efficiency in the buildings sector (commercial and public sub-sectors)	**Guillermo Tardillo Hidalgo**, Directorate General for Energy Efficiency (MEM)
1-7 Standards - Energy efficiency in the transport sector and electro-mobility.	**Félix Bernabel Badillo,** Directorate General for Energy Efficiency (MEM)

DAY 2: 19 March 2019 (TUESDAY)

Title	Speaker
2-1 Energy efficiency in Peru	**Pedro Gamio Aita**, Professor, (Pontificia Universidad Católica del Perú)
2-2 Overview of labelling policy in Peru	**Walter Carrasco Chacón,** Directorate General for Energy Efficiency (MEM)
2-3 The Electricity Sector in Peru.	**David Arias**, Director for Electrical Studies and Promotion (MEM)
2-4 Rural electrification in Peru and its relationship with energy efficiency	**Hugo Sulca,** Director General for Rural Electrification (MEM)
2-5 Energy efficiency in the oil and gas sector	**Francisco Torres Madrid,** Director General for Hydrocarbons (MEM)
2-7 Regulation of the electricity sector and energy efficiency	**Luis Grageda Puelles**, Rates Regulation Manager, (OSINERGMIN)
2-8 Power dispatching and energy efficiency	**César Butrón Fernandez,** President (COES)
2-9 Environmental policy and energy efficiency	**Laura Secada Daly,** Director General for Greenhouse Mitigation, (Ministry of Environment)
2-10 Energy efficiency in the transport sector	**Jose Luis Reynoso Zarate,** General Direction for Land Transportation (Ministry of Transport and Communications)

DAY 3: 20 March 2019 (WEDNESDAY)

Title	Speaker
3-1 Energy efficiency policy in the buildings sector	**Richard Montes Escalante,** Director General for Policy and Regulation of Construction and Sanitation (Ministry of Housing, Construction and Sanitation)

3-2 Accreditation of certifying institutions for products and people.	**Estela Contreras,** Director for Accreditation (INACAL)
3-3 Certification of energy equipment and energy efficiency auditors	**Rosana Bautista Zeremelco**, Unfair Competition Commission – INDECOPI
3-5 Energy Efficiency in the industrial sector	**Marco Mejia,** President of glass and related industries committee, **(**National Industrial Association [SNI])
3-7 International cooperation and National Appropriate Mitigation Actions (NAMA)	**Daniella Rough**, NAMA project coordinator (MEM)
3-8 Energy efficiency incentives and project credit	**Jose Vergara**, (Development Bank of Peru [COFIDE])
3-9 Energy efficiency research and development	**Johnny Nahui**, Professor (National University of Engineering [UNI])
3-10 Energy efficiency and environmental issues	**Julia Justo**, Executive Director (National Environment Fund [FONAM])

DAY 4: 21 March 2019 (THURSDAY)

Site visit to Alicorp food manufacturing facility

DAY 5: 22 March 2019 (FRIDAY)

PREE expert team discussion and finalisation of draft recommendations	**PREE Expert Team**
PREE expert team presentation of the preliminary recommendations to MEM	**PREE Expert Team**
Closing Remarks	**Kazutomo Irie**, President (APERC)

APPENDIX C: RECOMMENDATIONS MADE BY THE SOCIEDAD NACIONAL DE INDUSTRIAS

Capacity Building and Information

1. Build capacities in lead institutions for implementing energy efficiency policies and programs
2. Generate and Disseminate energy efficiency data collection systems & indicators
3. Develop information campaigns & educational / training programmes on energy efficiency and Circular Economy

Promotion and Finance

4. Stimulate Energy Management & energy efficiency / Circular Economy projects: fiscal incentives & less tax burden to grasp positive externalities
5. Promote financial schemes for EE & green investment, especially for SMEs
6. Build market-based instruments to boost EE products and business model innovation, especially for SMEs
7. Facilitate information and access to Energy Audits
8. Reward and Replicate successful experiences in energy efficiency
9. Implement efficiency-based vehicle taxation

Regulation and Investment

10. Improve energy laws to boost competition and efficiency, promoting: i) consumer freedom, ii) renewable energies, and iii) natural gas secondary markets
11. Remove non-efficient energy subsidies
12. Develop certification systems on EE, harmonizing regional standards
13. Implement Energy Performance Standards, phasing-out least efficient products
14. Enhance energy efficiency Labelling w/ best international practices: Technical Regulations (MINEM), Testing & Accreditation (INACAL) & Supervision (INDECOPI), for both intermediate and final key goods (lighting, appliances and equipment, e.g. motors and heat pumps)
15. Implement effective transport planning & smart transit measures

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