United Nations ESCAP/APEF/2018/2

Economic and Social Council

Distr.: General
26 January 2018

Original: English

Economic and Social Commission for Asia and the Pacific
Second Asian and Pacific Energy Forum

Bangkok, 3–5 April 2018
Items 2 and 5 of the provisional agenda*

Review of the draft ministerial declaration on regional cooperation for energy transition towards sustainable and resilient societies in Asia and the Pacific

Policy perspectives on the role of regional cooperation for energy transition towards sustainable and resilient societies in Asia and the Pacific

Energy transition in Asia and the Pacific: pathways to ensure access to affordable, reliable, sustainable and modern energy for all

Note by the secretariat**

Summary

The present document contains information and analysis with a view to identifying energy transition pathways for the Asia-Pacific region through the implementation of Sustainable Development Goal 7 (Ensure access to affordable, reliable, sustainable and modern energy for all).

In the analysis, gaps are identified between the current status and the outlook and pathways to achieving the targets. Based on the gap analysis, member States may wish to explore a range of options for furthering their efforts to accelerate implementation of the Goal.

The document contains an analysis of the role of connectivity as an accelerator of the Goal by describing its benefits in terms of access to energy, energy efficiency and renewable energy. Common challenges with respect to connectivity are identified, and it is suggested that a regional road map should be developed to identify pathways to address these challenges. Lastly, the means of implementation for energy transition, with a focus on finance and cooperation, are analysed by reviewing the official development assistance and fossil fuel subsidies.

The representatives of member States may wish to deliberate on the prospects outlined in the present document, along with the draft ministerial declaration, and provide the secretariat with suggestions on how to transform these opportunities into a common regional response and initiatives aimed at promoting energy transition for the Asia-Pacific region.

* ESCAP/APEF/2018/L.1.

** The present document was submitted late owing to the need to incorporate additional inputs.

I. Introduction

1. The Asia-Pacific region's development has, in the past, been coupled with increasing energy consumption. However, this development model has led to environmental pollution, resource scarcity and climate change. The adoption of the 2030 Agenda for Sustainable Development and the Paris Agreement signals an acknowledgement by countries in Asia and the Pacific of the need to move beyond business as usual and to search for a new energy paradigm while maintaining energy security and stable energy markets. This will require a far-reaching energy transition.

2. The uneven distribution of resources in the Asia-Pacific region and the uncertainties of global energy markets add to this imperative. This is reflected in the report of the Committee on Energy on its first session (E/ESCAP/73/30), in which reference is also made to challenges including growing energy demand, reliance on fossil fuels, low energy efficiency, limited use of renewable energy, lack of access to affordable and clean energy, and the need to shift to low-carbon development and an environmentally friendly energy future.

3. The energy transition will be a long-term effort with Sustainable Development Goal 7 as a guiding force. This report contains an overview of the status of the Goal, the outlook for its achievement and policy recommendations to fill current gaps. These recommendations reflect pathways to attaining affordable, reliable, sustainable and modern energy for all.

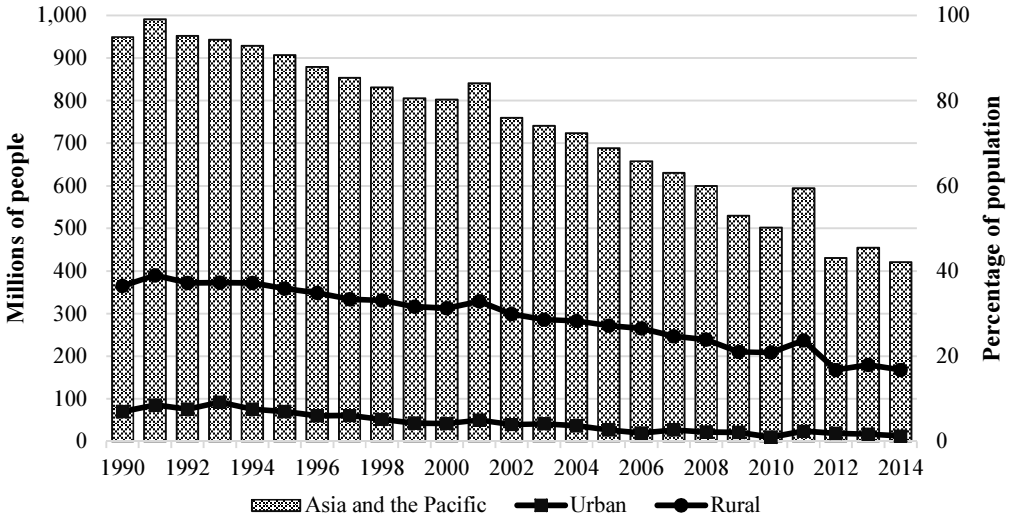
II. The point of departure of the energy transition in Asia and the Pacific

A. Energy access: ensuring participation in the energy transition

4. The Asia-Pacific region has made great progress in providing access to modern energy services and now provides electricity access to more than 90 per cent of its population. However, 421 million people (9.7 per cent) remain without electricity (figure I). Between 2012 and 2014, 93.1 million people in the region gained access to electricity while the population grew by 83.8 million. With access rates outpacing population growth, the achievement of universal access is within reach. However, progress has slowed down from 2.2 per cent annual growth rate during the period 2010–2012 to 0.5 per cent during the period 2012–2014.[1] The divide between urban and rural populations is significant and the electrification gap remains considerable, with the rural electrification rate reaching just 83.8 per cent. Closing the gap requires locally adapted solutions.

[1] Several countries showed progress; in particular, China, India and Pakistan each added between 13 and 16 million people to the total populations with access to electricity.

Figure I
Population of Asia and the Pacific without access to electricity, 1990–2014



Source: Economic and Social Commission for Asia and the Pacific (ESCAP), Asia Pacific Energy Portal. Available from http://asiapacificenergy.org/#en (accessed 15 January 2018).

5. Achieving universal access to clean cooking is an even larger challenge. In 2014, the regional rate of primary use of clean cooking fuels and technology was just 51.2 per cent, up from 39.8 per cent in 2000. This means that nearly 2.1 billion people, half the population, remains without access. Only 12 Asia-Pacific economies had rates of at least 99 per cent in 2014. India and China make up approximately two thirds of the deficit, and Afghanistan, Bangladesh, the Cook Islands, Kiribati, Sri Lanka and Timor-Leste have experienced declining access rates. In 2014, the lowest absolute levels were found among the least developed countries, such as Kiribati, the Lao People's Democratic Republic and Timor-Leste, where access was less than 5 per cent.

6. Finding good, reliable data to measure progress remains a challenge. Even statistics from international organizations on electricity access sometimes differ by as much as 200 million people.[2] In some countries, villages may be reported as electrified once basic infrastructure is provided to only 10 per cent of the total number of households.[3]

7. Furthermore, statistics do not currently capture the quality of access, which has a tremendous impact on social well-being. The International Energy Agency defines the minimum services that should be accessible (the ability to power several light bulbs, phone charging, radio and others for a certain number of hours).[4] This equates to an annual electricity consumption of

[2] A comparison can be found in International Energy Agency and World Bank, *Sustainable Energy for All: Progress toward Sustainable Energy 2015 — Global Tracking Framework Report* (Washington, D.C., 2015); available from http://seforall.org/sites/default/files/GTF-2105-Full-Report.pdf. These differences are due to different data sources and modelled input.

[3] See https://garv.gov.in/faq (India).

[4] International Energy Agency, *Energy Access Outlook 2017: From Poverty to Prosperity — World Energy Outlook Special Report* (Paris, 2017). Available from www.iea.org/access2017/.

1,250 kilowatt-hours per household with standard appliances, or 420 kilowatt-hours with efficient appliances (stressing the value of energy efficiency). For this reason, the debate has to shift to the quality of access based on a unified measure. The multi-tier framework proposed by the World Bank provides this basis and includes an outline of some related challenges for consideration. For instance, it is critical to consider the number of hours that electricity is available as well as how affordable it is, as these are two indicators of access quality.[5] Capturing the quality of service will be crucial to reaping the benefits from electricity for its productive use and social benefits. Employing this kind of unified measurement framework will better inform response strategies at the national level.[6]

8. Defining access to clean cooking proves even more challenging, because countries define the term differently and, accordingly, promote different fuels and technologies through policies and programmes. The National Action Plan for Haritha Lanka Programme in Sri Lanka promotes the use of efficient cooking stoves, preferably using biogas. This is also included in the updated National Energy Road Map (2016–2030) in Vanuatu, adding liquefied petroleum gas as a desired fuel source. In the nationally determined contribution of Nepal, efficient cooking stoves are also recommended but biogas is recommended as another possible technology. The aim of the Pradhan Mantri Ujjwala Yojana programme in India is to expand connections to liquefied petroleum gas in order to provide access to clean cooking, while in the National Energy Policy (2016–2020) of Papua New Guinea, cleaner charcoal and wood-burning stoves are advocated. Evidently, the view on what constitutes a clean cooking solution differs for each country.

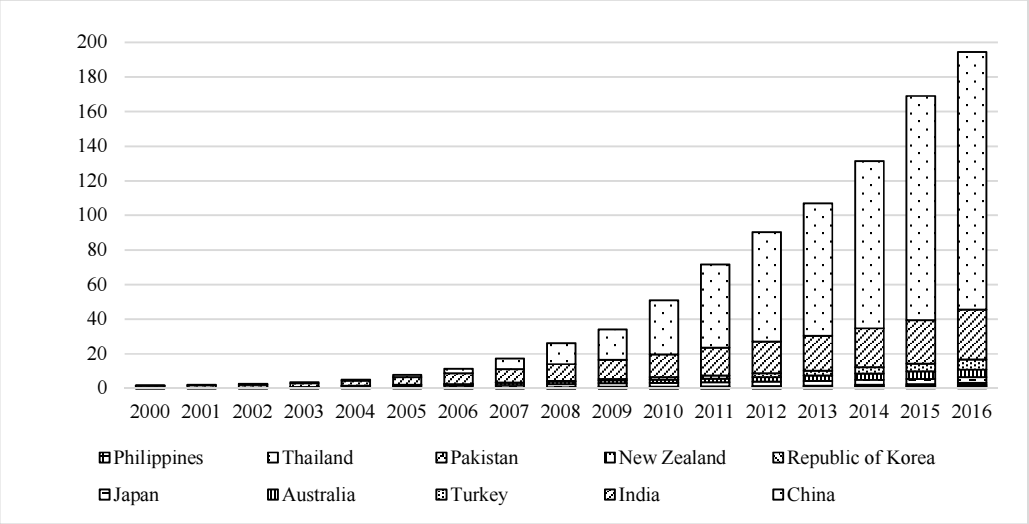
B. Renewable energy: the fuel of the energy transition in Asia and the Pacific

9. Asia and the Pacific faces significant challenges in increasing the share of modern renewable energy in its energy mix. Fossil fuel consumption has risen dramatically, leaving the overall share of modern renewables relatively low, at around 6 per cent, with important country differences. Recent years have demonstrated an accelerating upward trend, particularly within the power sector, where renewables accounted for 18.8 per cent of the regional electricity mix in 2014. Once dominated entirely by hydropower, renewables are experiencing growth accompanied by increased diversification as wind (figure II), solar, biomass and, to a lesser extent, geothermal power gain shares. Furthermore, the region shows greater levels of renewable energy investment, installed capacity and consumption than any other region in absolute terms.

[5] All the dimensions captured by the framework are described in World Bank, *Beyond Connections: Energy Access Redefined — Conceptualization Report* (Washington, D.C., 2015); available from www.worldbank.org/content/dam/Worldbank/Topics/Energy%20and%20Extract/Beyond_Connections_Energy_Access_Redefined_Exec_ESMAP_2015.pdf.

[6] Differences can be enormous, as studies show. See, for example, International Energy Agency and World Bank, *Sustainable Energy for All: Progress toward Sustainable Energy 2015*.

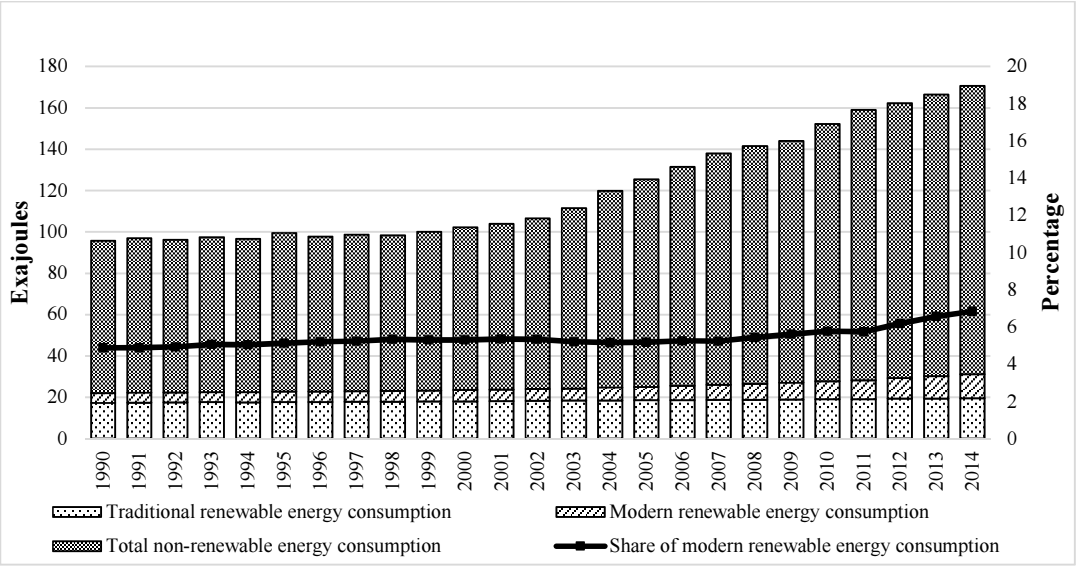
Figure II
Installed wind capacity, top ten Asia-Pacific countries, 2000–2016
(Thousands of megawatts)



Source: ESCAP, Asia Pacific Energy Portal.

10. It should be noted that modern renewable energy is distinct from renewable energy production as a whole. Modern energy production as a whole includes solid biofuels (such as wood and charcoal), consumption of which continues to rise: in 2014, consumption of solid biofuels was 31.1 exajoules, up from 22.0 exajoules in 1990 and 29.3 exajoules in 2012. Solid biofuels represent 72.6 per cent of the renewable energy consumption and 13.5 per cent of total final consumption (figure III). Most likely, the majority of consumption of solid biofuels occurs in the residential sector. Notably in South Asia, South-West Asia and South-East Asia, the use of traditional biomass is increasing owing to the increase in the rural population in some countries.

Figure III
Energy consumption in Asia and the Pacific, 1990–2014



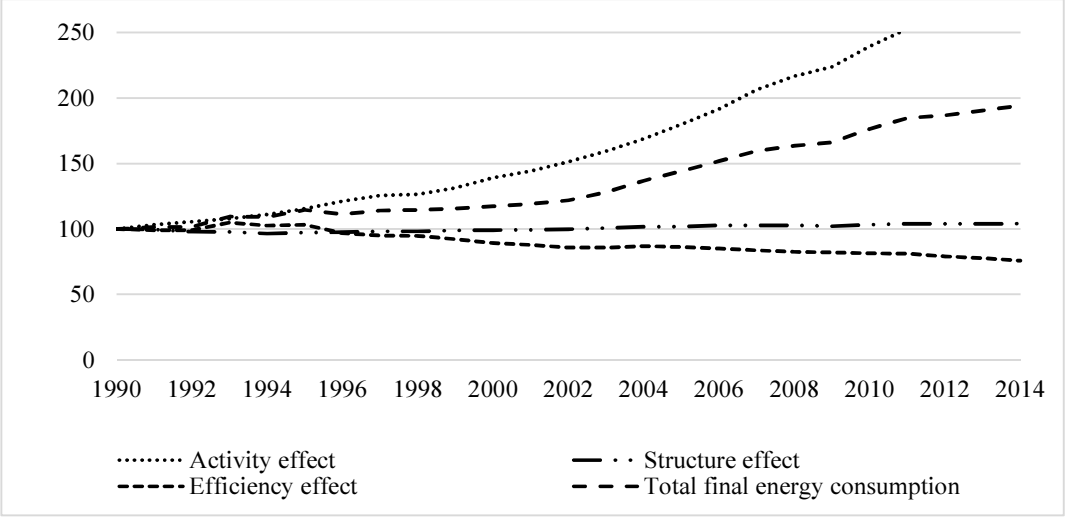
Source: ESCAP, Asia Pacific Energy Portal.

11. Globally, on- and off-grid renewable energy markets are expanding, and investment in terms of dollars and capacity surpasses that for conventional energy, even without large hydropower.[7] This suggests a strong business case for renewable energy, which creates jobs in the manufacturing, distribution, installation, operation and service sectors. While renewable energy uptake may mean divestment from other sectors, the overall impact will most likely be positive as the renewable energy sector is rather labour-intensive. In 2015, for example, an estimated 4.5 million renewable energy jobs were created in Bangladesh, China, India and Japan.[8] Furthermore, renewable energy drives not only economic development, but also social benefits, such as health improvements for women and children owing to reduced air pollution.

C. Energy efficiency: insufficient use of the catalyst of the energy transition

12. The Asia-Pacific region has demonstrated a long-term, steady decline in energy intensity, resulting in a decoupling of energy use from gross domestic product (GDP). Meeting Sustainable Development Goal 7, however, will require scaled-up action. Between 1990 and 2014, energy intensity fell from 9.1 to 6.0 megajoules (MJ) per United States dollar. This trend was particularly strong in the period 2012–2014, showing a short-term reduction in annual average energy intensity of 3.0 per cent, outpacing other regions. GDP has tripled since 1990 while energy consumption has doubled (figure IV), resulting in energy savings equivalent to the 2014 consumption of the Republic of Korea and Thailand combined. Yet despite a trend towards the global average energy intensity of 5.4 MJ per United States dollar, the region continues to rank the highest among global regions in terms of energy intensity.

Figure IV
Growth in total final energy consumption, 1990–2014
(index; base year 1990 = 100)



Source: ESCAP, Asia Pacific Energy Portal.

[7] Frankfurt School of Finance and Management-United Nations Environment Programme Collaborating Centre for Climate and Sustainable Energy Finance, *Global Trends in Renewable Energy Investment 2017* (Frankfurt, 2017). Available from http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2017.

[8] International Renewable Energy Agency, *Renewable Energy and Jobs: Annual Review 2016* (Abu Dhabi, 2016). Available from www.se4all.org/sites/default/files/IRENA_RE_Jobs_Annual_Review_2016.pdf.

13. It is important to note that energy intensity improvements in the Asia-Pacific region were driven by energy efficiency measures and not structural changes. Increased economic output and population growth or the activity effect, pushed up the region's overall energy consumption, or total final consumption. Changes in the economic structure of the region – such as a shift away from heavy industry – did not influence energy intensity. This is contrary to beliefs that Asia and the Pacific made energy intensity gains only by shifting from industry to service economies; real energy efficiency gains were made. North and Central Asia is the only subregion where this shift has happened, constituting a reason for this subregion to focus more on energy efficiency standards.

14. Current progress in efficiency improvements is unevenly distributed among countries and sectors. While two-digit improvements are exceptional, improvements of 4 to 6 per cent are remarkable, and far better than the worsening levels of energy intensity that some countries display. Notably, progress in China – the region's largest economy, accounting for 55 per cent of industrial energy consumption in the region in 2014 – helped drive improvements as it continued to adopt aggressive measures in the industrial sector. This included eliminating outdated technologies and establishing standards, which resulted in a reduction of 4.5 per cent in industrial energy intensity.

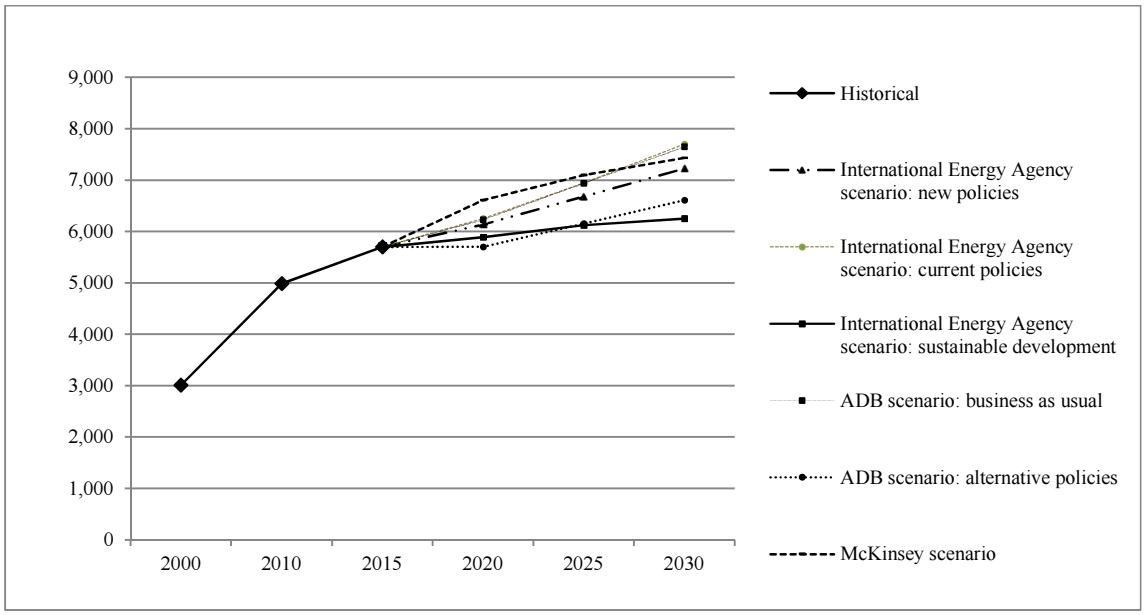
III. Outlook and pathways for the energy transition in Asia and the Pacific

15. Forecasting energy trends for Asia and the Pacific is challenging as global models do not provide access to underlying data. Hence, no tailored models for the whole energy system are available, leaving decision makers with a critical information gap that it is crucial to address. Existing global models include only some countries of the region and extracting data is difficult. Furthermore, international targets may not be linked to the modelled outcome and may not have clear end points themselves. Even Sustainable Development Goal 7 provides clear-cut measures for the achievement of access only, and assumptions have to be made to judge the achievement of renewable and efficiency targets. The modelled variable is usually energy demand growth – total primary energy supply – which is matched by different sources of energy supply to keep the market in balance. Different scenarios then show the impact of higher and lower demand and more or less clean supply. Few outlooks attempt long-term forecasts. In the present document, 2030 is used as a reference point and assumptions are made on the basis of existing scenarios with respect to the achievement of Goal 7.

16. The energy transition to achieve the Goal requires significant progress on energy efficiency through enhanced demand-side management combined with an increased supply of cleaner energy sources. A comparison of different outlooks for Asia and the Pacific shows that aggressive measures are to be taken to keep the forecasted total primary energy supply in 2030 within sustainable limits. The measures associated with a low-carbon future can be deduced by comparing different scenarios (figure V).[9]

[9] The following is based on insights from: International Energy Agency, *World Energy Outlook 2017* (Paris, 2017); and Asian Development Bank (ADB), *Energy Outlook for Asia and the Pacific: October 2014* (Manila, 2015).

Figure V
Comparison of different outlooks for Asia and the Pacific: total primary energy supply, 2000–2030
(Million tons of oil equivalent)



Source: ESCAP compilation.

17. Following current business as usual (as in the "business as usual and "current policies" scenarios in figure V), energy demand may grow by more than 2,000 million tons of oil equivalent by 2030. This means that if no action is taken, energy efficiency will not improve, and energy demand will continue to rise, making it difficult to raise the share of modern renewables in the mix. Consequently, under the business-as-usual case, no energy transition will take place.

18. New policies announced to date, such as the nationally determined contributions, will result in only a slight demand reduction (as in the "new policies" scenario). However, reports show that the nationally determined contributions are insufficient to reach the goals of the Paris Agreement.[10] This gap will be further illustrated in the following sections. More progressive policies and technologies can decrease energy demand even further (the "alternative policies" scenario).

19. The achievement of Sustainable Development Goal 7 and more ambitious targets beyond 2030 will require a demand reduction of 25 per cent compared to the business-as-usual case (the "sustainable development" scenario). As shown in the analysis, the business-as-usual case and measures already promised in new policies are insufficient to achieve that reduction. As a consequence, adopting even more progressive measures is required to reach the targets of the Goal and set the region on a sustainable energy transition.

[10] PricewaterhouseCoopers, "The Low Carbon Economy Index 2017: Is Paris possible?", available from www.pwc.co.uk/services/sustainability-climate-change/insights/low-carbon-economy-index.html (accessed 7 December 2017); and Janet Arlene Amponin and James Warren Evans, "Assessing the intended nationally determined contributions of ADB developing members", ADB Sustainable Development Working Paper Series, No. 44 (Manila, 2016), available from www.adb.org/sites/default/files/publication/189882/sdwp-044.pdf.

20. Given their long asset lifespan and the levels of sunk investment, fossil fuels cannot be eradicated overnight and are part of all forecasts. In the business-as-usual scenario, the share of fossil fuels remains between 70 and 80 per cent. To be on track for sustainable development, this share will have to drop to less than 70 per cent. In the business-as-usual predictions, coal retains a share of 40 to 50 per cent depending on the scenario's assumptions, oil's share remains at 25 per cent and gas sees a slight increase from 10 per cent to 15 per cent. This leaves the share of renewable energy (including bioenergy, hydro and other renewables) at around 15 per cent. To achieve sustainable development, the share of renewables will have to increase to more than 20 per cent of the total primary energy supply.

21. Energy efficiency is vital to curbing energy demand. It contributes largely to the potential for reductions in carbon dioxide emissions (more than 40 per cent in some scenarios). Renewable energy has the second highest potential for reductions in carbon dioxide emission globally, at approximately 35 per cent. Fuel switching, nuclear and cleaner use of fossil fuels (such as carbon capture and storage) contribute far less in future scenarios.[11] This suggests that policy frameworks benefit from strengthening energy efficiency and encouraging the uptake of renewable energy. Under such policy frameworks, fossil fuels remain part of the energy mix, with gas as the most important fuel, but energy efficiency and wind (onshore and offshore) and solar energy (photovoltaic and concentrated) play a greater role in the future. There is an important role for natural gas in replacing coal for power generation and, owing to its flexible generation characteristics, complementing the use of greater shares of renewables.

22. Ensuring that the energy transition leaves no one behind by providing universal access will not impede progress toward achieving targets relating to demand and emission reduction; in fact, universal access is not contradictory, but complementary to goals on renewable energy and energy efficiency. It is estimated that universal access will increase global energy demand by only 0.23 per cent.[12] Renewable energy and energy efficiency will provide the most effective and efficient solutions to achieve universal access while meeting the targets, as detailed below.

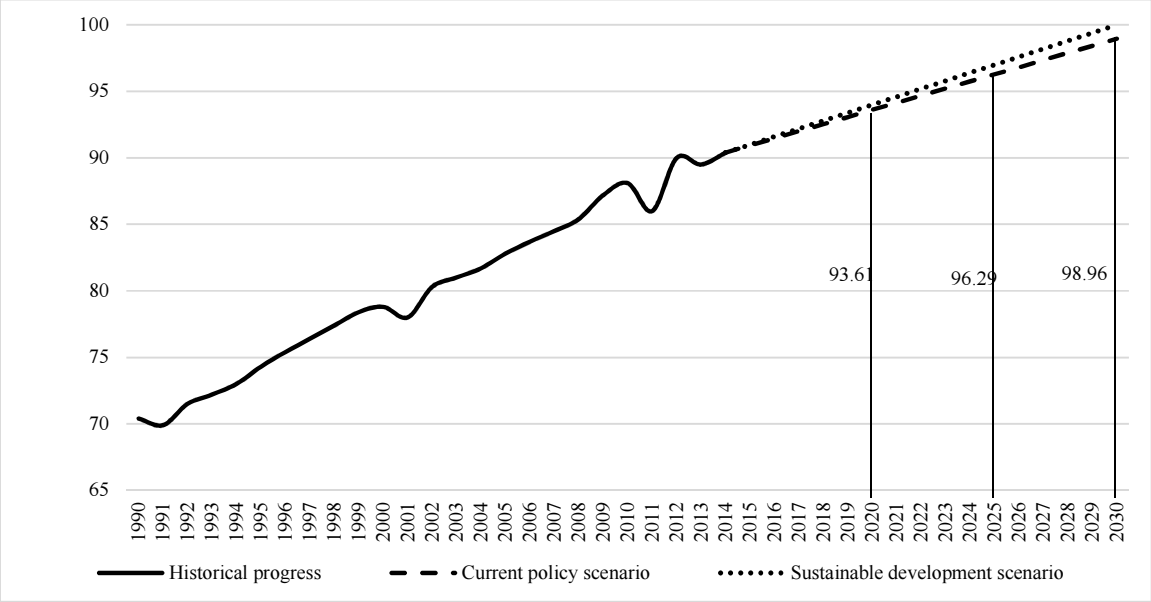
A. Energy access requires energy transition with a pro-poor focus

23. With existing and planned policies, the Asia-Pacific region is set to achieve the most basic level of energy access, with 99 per cent electricity access by 2030. The relative gap is small, yet results in an important number of people without electricity short of the target. Figure VI shows that constant progress is needed to achieve the 2025 milestone. Its success will mainly depend on progress in those countries that currently lag behind.

[11] International Energy Agency, *World Energy Outlook 2017*.

[12] International Energy Agency, *Energy Access Outlook 2017*.

Figure VI
Outlook for electricity access in Asia and the Pacific: proportion of the population with access to electricity
(Percentage)



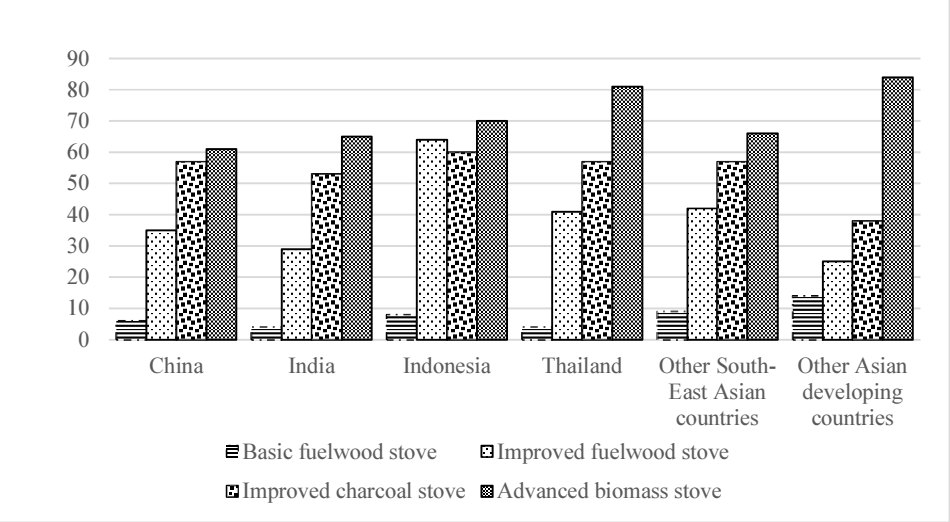
Source: ESCAP analysis.

24. Experience has shown that reaching the last 10–15 per cent is both expensive and time-consuming. China and Thailand have shown that increasing electrification, from 30–40 per cent to 85–90 per cent, took the same amount of time as the remaining 10–15 per cent.[12] Pathways for the energy transition would therefore benefit from prioritizing traditional grid connection projects immediately. As global data shows, half the progress will come from traditional grid connection, the processes for which are well known.[12] Consequently, focusing on these projects now will facilitate achievement of the 2025 milestone. To continue on the trajectory for the 2030 target, new strategies need to be developed between now and 2025 to significantly speed up the decentralized, off-grid systems for rural areas. This is much less understood and less prevalent. Small, local village grids may be considered where cost-effective.

25. Providing access to clean cooking systems is even more challenging. Given the low current rates, the outlook for the future is not bright. A clear gap can be noted between the current levels of clean cooking systems and the universal target. Consequently, assigning a higher priority to clean cooking solutions is crucial. This is important to make the energy transition happen and to harvest the socioenvironmental benefits associated with cleaner cooking. However, there are no one-size-fits-all strategies, as the cooking system choice is particularly dependent on the local context. Based on experience, pathways for urban areas should include the provision of liquefied petroleum gas and electricity. Indonesia stands out as the world leader, with a growth rate of 4.3 per cent per year in access to clean cooking solutions. Through a combination of building strong networks for the distribution of liquefied petroleum gas and providing subsidies, the country dramatically increased its rate of clean cooking fuel access from 2.4 per cent in 2000 to 56.6 per cent in 2014. For rural areas, the pathway will be more complex and require a diversified combination of technologies.[12]

26. The choice of technology is determined by a range of local factors, including stove cost, fuel cost, reliability, health impact, gender implications, environmental implications and fuel availability. The solution ideally aims for the optimum among these factors in a given context. Traditional and improved biomass, coal, kerosene, liquefied petroleum gas, electricity, biogas and solar cookers each have advantages and disadvantages, and the optimal solution depends on local context factors. For this reason, the process of directing pathways towards achieving the target is context sensitive (figure VII).

Figure VII
Comparison of stove costs in Asia and the Pacific, 2016
(United States dollars)



Source: International Energy Agency, *Energy Access Outlook 2017*.

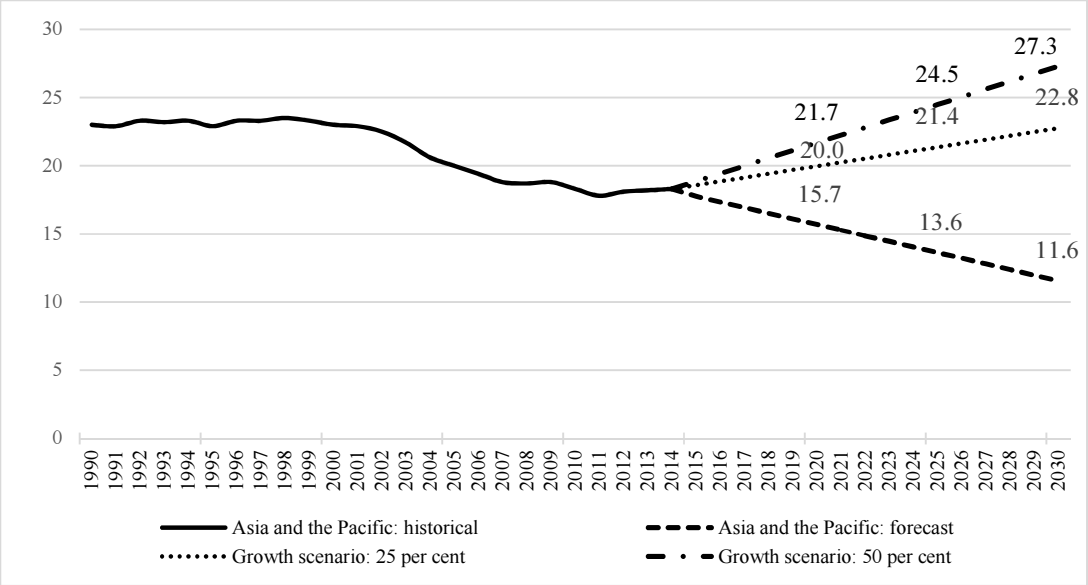
27. Governments benefit from paying particular attention to developing cost-effective energy solutions. If a solution is too costly, it will not be affordable in terms of access. Although government support can be considered, and may be necessary to providing access in the first place, Governments need to be mindful about the financial sustainability of the programmes. Data indicates that cleaner cooking technology requires a significantly higher upfront investment than its dirtier alternatives. In assessing life-cycle costs, fuel costs, fuel availability, durability and maintenance are relevant considerations. The challenges related to clean cooking systems are related not so much to a lack of knowledge of which technologies are available, but to a lack of understanding of which approaches work in which context. The logistical challenge of reaching every household with the solution is far bigger than the technological challenges. The pathways towards achieving Sustainable Development Goal 7 should prioritize delivering clean cooking solutions to those people for whom logistical matters have been resolved, in order to set the region on track towards the 2025 milestone. During this time, research could identify the strategies for reaching those where logistics are more challenging in order to reach the target by 2030.

B. Uptake of renewable energy needs to be increased significantly

28. An examination of national energy plans and strategies reveals that with currently existing policies, renewable energy in total final energy consumption is set to decline, not to significantly increase (figure VIII). This mismatch means achieving a significant increase will require important efforts. By the

2025 milestone, half the achievements towards the target must be already locked in.

Figure VIII
Share of modern renewable energy in total final energy consumption in Asia and the Pacific
(Percentage)



Source: ESCAP analysis.

29. The power sector is the most promising for initiating the energy transition and a priority sector for pathways towards the 2025 milestone. It is the sector where quick, large-scale deployment of renewable energy is possible and policy options are available. Reducing fossil-fuel-based power generation and increasing the deployment of modern renewable energy facilitates a rising share of renewable energy in power generation and overall total final energy consumption, especially in the absence of large-scale carbon capture and sequestration. The historical average growth rate of modern renewables in power generation in Asia and the Pacific is not nearly enough to achieve the targets.

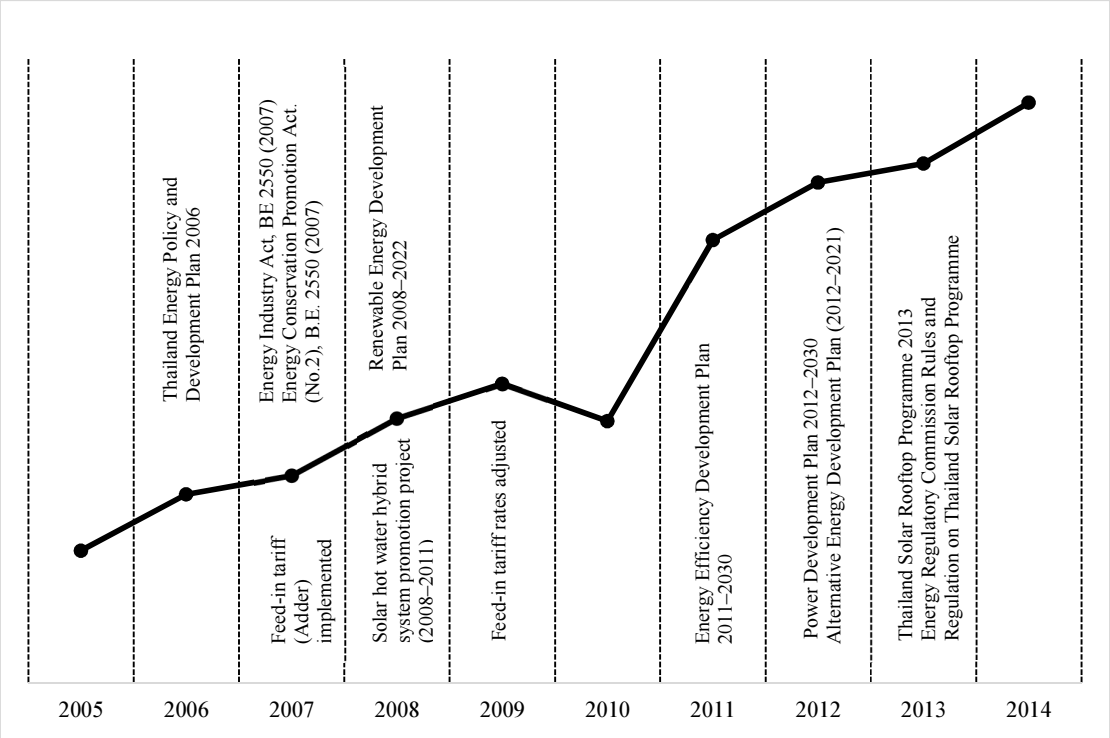
30. Setting renewable energy targets is the first step in developing a pathway to achieving a significant uptake, as it demonstrates the Government's commitment and has a signal effect for markets. As of 2016, 48 of the 58 Asia-Pacific economies had identified economy-wide and/or sector-specific renewable energy targets, up from only one in 2000.[13] Increasing renewables and reducing the import bill for fuel would also help to increase energy security, especially for some Pacific islands with ambitious targets of 100 per cent renewable energy. While price is probably driving the speed and quantity at

[13] 2000: Malaysia. 2016: Afghanistan; American Samoa; Armenia; Australia; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Fiji; Guam; Hong Kong, China; India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Lao People's Democratic Republic; Macao, China; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Zealand; Niue; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Thailand; Timor-Leste; Tonga; Turkey; Tuvalu; Vanuatu; and Viet Nam.

which renewable energy is deployed, the policy framework can facilitate or hamper the uptake.

31. The range of instruments and options introduced in the power sector is broadening. While measuring the impact of policy on the uptake of renewables with statistical robustness is complex, looking into lessons learned from other countries is easy and a good option. The importance of declining prices cannot be forgotten as it makes solar and wind energy in some countries highly competitive. Solar module prices declined by 80 per cent globally between 2010 and 2016, and 26 per cent in the past year alone.[14] Similarly, average wind turbine prices declined 38 per cent between 2009 and 2016.[15] There are lessons to be learned in the region. Thailand, for instance, is one of the subregional leaders in renewable energy in South-East Asia, and there are indications that this was facilitated by policy. Since the launch of the Energy Policy and Development Plan in 2006, the share of modern renewable energy in total final consumption has increased steadily and has nearly tripled since the adjustment to feed-in tariffs in 2009 (figure IX).

Figure IX
Share of modern renewables in total final energy consumption in Thailand, 2002–2014: trend line



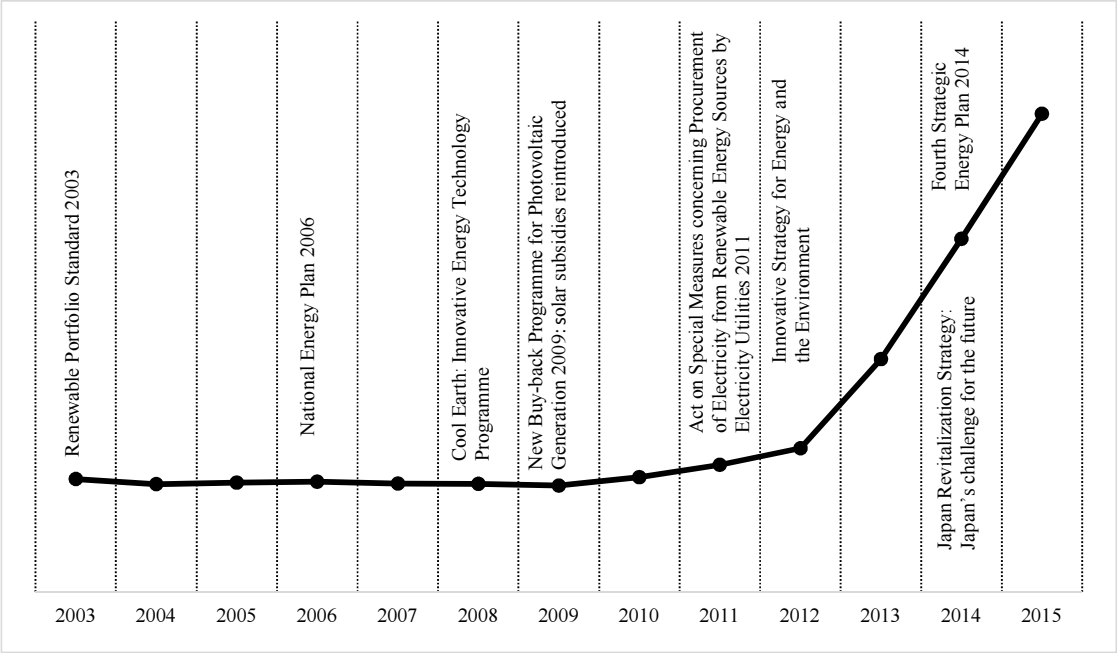
Source: ESCAP analysis.

[14] Chandra Bhushan, "Massive energy transition", 31 October 2017, available from www.downtoearth.org.in/coverage/the-end-of-coal-58909; and Joe Romm. "Solar panel prices plunge by a shocking 26 percent in one year", 28 November 2017, available from https://thinkprogress.org/wind-solar-prices-plunge-6fd34b55cb66/.

[15] International Renewable Energy Agency, "Renewable power: sharply falling generation costs". Available from www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/IRENA_Sharply_falling_costs_2017.pdf?la=en&hash=124D0C6FF4AE247D8CFB4FF7F064F5F25432AC5B%20 (accessed 16 January 2018).

32. Renewable energy portfolio standards are another policy option. Japan introduced these standards (2003–2011), and they represented a policy shift towards market-driven mechanisms which covered solar, wind, biomass, small-scale hydropower and geothermal energy (figure X). The standards required electric power retailers to have a fixed quota of renewable energy in power sold, and led to a dramatic improvement in wind energy production from 2000 onwards. Between 2002 and 2011, there was near linear growth at an annual average rate of 33 per cent. However, in order to increase the uptake of solar power, Japan had to revise its policy again. Following the reintroduction of solar subsidies, in the period 2009–2011, production grew modestly at an annual average growth rate of 8.55 per cent. The real uptake came with the end of the renewable energy portfolio standards and a shift towards feed-in tariffs. This change came into effect in 2012 and solar production increased more than three times over between then and 2015.

Figure X
Solar photovoltaic and thermal energy production in Japan: trend line



Source: ESCAP analysis.

33. These two examples also illustrate the importance of finding the right policy framework for a specific target in a given context. Policy requires a holistic approach. Public policies need to be refocused to curb energy consumption, while encouraging cleaner energy consumption. Finding the right policy mix requires studies, evidence and trial and error. Furthermore, the policy environment is important; lengthy environmental assessments for wind installations may, for example, favour solar energy if all other conditions for the two technologies are equal. Because the optimal choices for both, policy and technology, is context-dependent, it is impossible to provide a one-size-fits-all approach. Policymakers may consider focusing only on setting a regulatory framework, leaving the technology selection to the market. Some technologies are already cost-efficient, but the most progressive sustainability scenarios may still require support from Governments, such as to conduct pilot testing to generate data to demonstrate to the private sector the technologies' viability and investment potential.

34. Another policy option is auctioning programmes, which have seen rapid dissemination during the past decade.[16] This is mainly because they achieve significantly lower prices. The decentralized auctioning programme in India has seen the price of solar falling from $250 per MWh in 2010 to $73 per MWh in 2016.[16] Furthermore, auctions are easily adaptable to a country's local context.

35. Renewable energy portfolio standards, feed-in tariffs, and auctioning programmes all are options to increase renewable energy in the power sector. Given the long lead time of power generation projects, immediate policy action is required now to provide incentives to the market. The measures enacted should ideally be structured in such a way as to bring online the renewable energy projects with the shortest lead time early and the ones with the longest lead times later. Only then would sufficient projects be ready by the 2025 milestone and the path set towards the achievement of the 2030 target. Feed-in tariffs seem to have a particular advantage for small-scale projects, and auctions for large-scale projects.[16]

36. The issue of the variability of wind and solar energy can be addressed through effective planning and policy. These are crucial to ensure that power systems with high shares of renewable energy are stable and reliable.[17]

37. Countries would benefit from taking a more integrated view of renewable energy and energy efficiency. Energy efficiency not only offers a significant impact in terms of enhancing the sustainability of energy systems, but also offers a low-cost option that can be rapidly deployed. This helps member States to address rapid growth in demand and reduce investment in the construction of additional power plants.

38. One sector where the link between renewable energy and energy efficiency is particularly evident is the transport sector. While transport is only the third highest energy-consuming sector in Asia and the Pacific, its share in total final consumption has increased from 17.2 per cent in 2000 to 18.6 per cent in 2014. Therefore, action is required. First and foremost, integrated solutions should be searched according to the avoid-shift-improve approach.[18] This involves first searching for solutions to avoid transport in the first place, such as city planning and telework. If this is not possible, shifting to more efficient modes of transport is encouraged, such as public transport instead of private means. For the remaining transport, the most efficient technology is required. A priority action is the adoption of more stringent fuel efficiency standards. However, in the long run, the advantages presented by electric motors may mean that they will ultimately replace the internal combustion engine (in trucks, buses, cars and motorbikes), exemplifying the intersection of renewables and efficiency.

[16] International Renewable Energy Agency, *Renewable Energy Auctions: Analysing 2016* (Abu Dhabi, 2017).

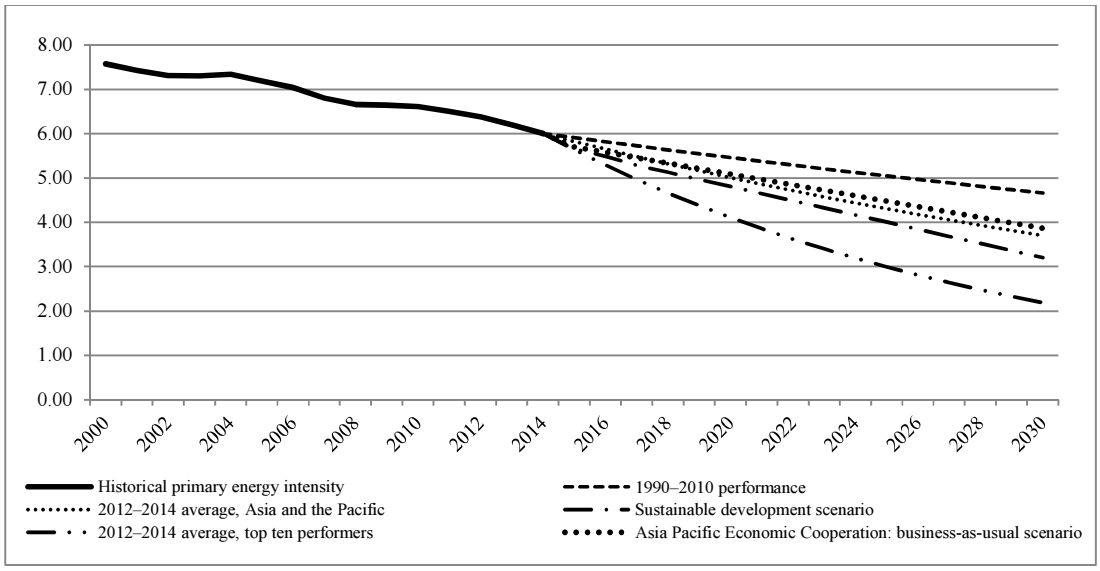
[17] International Energy Agency, *Status of Power System Transformation 2017: System Integration and Local Grids* (Paris, 2017).

[18] "Avoid-shift-improve" is a term commonly used in transport planning to refer to the concepts outlined in the text. See, for instance, German Agency for International Cooperation, "Sustainable urban transport: avoid-shift-improve (A-S-I)"; available from www.sutp.org/files/contents/documents/resources/E_Fact-Sheets-and-Policy-Briefs/SUTP_GIZ_FS_Avoid-Shift-Improve_EN.pdf (accessed 4 December 2017).

C. Energy efficiency needs to accelerate and requires more attention

39. By maintaining its average rate of the last two years, Asia and the Pacific would double its average achievement rate between 1990 and 2010 (one possible reading of the Sustainable Development Goal 7 target) and even go beyond (figure XI). However, historical primary energy intensity and the 1990–2010 average improvement rate indicate that this will be challenging for the region and require a significant effort. Doubling its 1990–2010 performance would mean that the Asia-Pacific region would reach similar energy intensity levels to that of Europe today shortly before 2030, which would allow the region to reap a significant energy productivity bonus (the amount of GDP produced per unit of energy). In Europe, this figure was $260 billion during the past year alone.[19]

Figure XI
Energy intensity in Asia and the Pacific, 2000–2030
(Megajoules per unit of GDP)

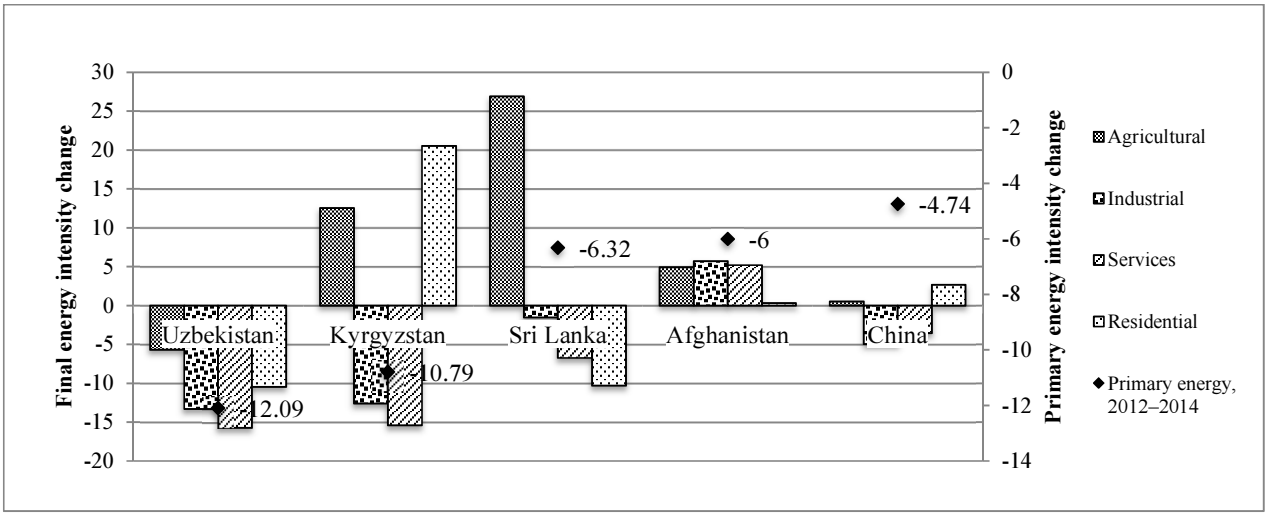


Source: ESCAP analysis.

40. Consequently, Governments in Asia and the Pacific are required to speed up their legislative support if they want to continue on track towards the target. This is reflected already in the outlooks available. Nevertheless, these efforts will still leave a gap with the target in 2030. Indications are that the 2025 milestone will show where the direction is heading and whether or not the region is set to be on track towards the 2030 goal. In figure XII, the changes in energy intensity among the top performers in the region are outlined. If the rest of the region could attain reduction rates of this magnitude, the region would meet the target. This means that the target is within reach if Governments are committed.

[19] International Energy Agency, *Energy Efficiency 2017* (Paris, 2017).

Figure XII
Primary and final energy intensity changes among top performers in Asia and the Pacific
(Percentage)



Source: ESCAP, Asia Pacific Energy Portal.

Note: Turkmenistan is among the top performers (overall primary energy intensity reduction) but is not included in the figure owing to data gaps in sectoral intensity.

41. Identifying the most impactful sectors first is a good strategy to deduce pathways for increasing energy efficiency. The cases of the top performers show that no single sector drives success alone. In all cases, countries acted on considerations of size and impact of the sector in their country context. With regional sectoral fuel consumption in industry at more than 35 per cent, continued efforts to reduce the amount of energy used per unit of output is essential for Asia and the Pacific. Experience from the top performers indicates that this may be an area for quick wins and a priority action towards the 2025 milestone. As the residential sector is the second most consuming sector (slightly less than 25 per cent of total final consumption), energy efficiency regulation for buildings should be another priority. Given the lifespan of buildings, strong building performance standards will lock in performance for decades. Consequently, it would be beneficial to put in place building codes for new buildings now to set the way towards 2025, and building codes for existing buildings to come into force by 2025 at the latest for the 2030 target. Notably, space heating and cooling will be an important challenge across the region. The third priority is the transport sector, owing to its fast growth in the recent past, which will likely only increase with the demands of a growing middle class. As a gear shift in the transport sector is difficult and takes time, it is probable that most progress will be seen between 2025 and 2030.

42. Tightening energy efficiency regulations regularly is important to provide incentives for continual improvement. Lawmakers would benefit from looking not only at regulatory breadth (covering as many sectors as possible) but also at regulatory depth (strengthening requirements to drive performance further). Therefore, developing regulations across sectors can be seen as a first step on the pathway to 2025, and subsequently tightening regulatory depth would be important. Analysing this requires a common measurement framework, including monitoring and enforcement of existing standards.

43. Energy efficiency, despite its virtue as a low or negative cost measure, does not receive the same attention as large-scale infrastructure projects.

Henceforth, communication from energy efficiency professionals about their achievements will be valuable to get the necessary resources and raise awareness among the public. Between 2006 and 2014, energy efficiency gains in China eliminated the need for over $230 billion of investment in new power generation. This is a convincing argument for energy efficiency.

44. Advocacy of energy efficiency would ideally highlight its multiple benefits. For example, energy efficiency may lead to public health improvements owing to better air quality, or lower energy prices owing to lower energy demand, or it may improve energy security. Research shows that in Japan, 20 per cent of energy imports of gas and oil alike were saved as a result of rigorous energy efficiency policies. The Republic of Korea likewise benefited from increased energy security because of energy efficiency measures, although not to the same magnitude.[19] These measures also generate important savings for public budgets, money that can be invested elsewhere, such as in education or public health. An interesting new feature of the most advanced energy markets in the United States of America (notably California) is that energy efficiency bids are allowed in capacity markets. In this way, energy efficiency is remunerated based on its service to lower demand, and on avoided energy consumption and, consequently, on avoided capacity requirement.

45. Energy efficiency can become a driver for development. Worldwide, around $2.2 trillion in economic value was created by improved energy intensity, and more than half of this by China.[19] This has direct benefits for households: savings on energy expenditure per household amounted to $370 in Japan and $60 in China.[19] In India, State-owned company Energy Efficiency Services Limited is aggressively investing in energy efficiency. In 2014, one front-runner project supplying more efficient lighting to the population drove prices of light-emitting diode light bulbs down to a fifth of what they had been only two years earlier.[20] Moreover, energy efficiency can become an industry in itself. In 2015, 5,426 energy service companies specialized in realizing and financing energy efficiency projects across China, providing employment for 607,000 people (8 per cent more than in the previous year).[20]

IV. Connectivity as an effective and efficient accelerator for Sustainable Development Goal 7

46. Energy connectivity is a critical and viable pathway for member States to achieve the energy transition. Connectivity can help member States enhance energy security, meet projected energy demand, address gaps in energy access and create a decarbonized energy system. While energy connectivity includes the trade and exchange of energy in multiple forms, the power sector presents the greatest opportunities for harnessing the benefits of connectivity. Governments can lead the way in addressing energy challenges through regional cooperation.

47. Cross-border power connectivity offers connection between those countries with surplus power generation and those that face a deficit, providing mutual benefits to all, as outlined in the following paragraphs.

48. **Energy security**. By connecting resources, it is possible to diversify energy sources, leading to enhanced energy security for the entire region. With the establishment of cross-border power markets, risks and vulnerabilities become shared, lessening their potential impacts on any single country.

[20] International Energy Agency, *Energy Efficiency Market Report 2016* (Paris, 2016).

49. **Access to energy**. Cross-border electricity connectivity through comprehensive, integrated planning could increase access to rural communities. Hydropower from Sarawak, Malaysia, has reduced oil dependency for power generation in the Kalimantan region of Indonesia, resulting in the connection of approximately 8,000 households to the grid. The Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000) has provided opportunities to connect 600 communities along the Peshawar-Kabul route. The initiative includes a 1-per-cent transmission charge to support social and environmental costs along the transmission line.

50. **Renewable energy**. Increased geographic coverage in terms of market justifies investment and promotes the use of existing hydropower and variable renewable energy potential. Projections show that renewable energy can reach more than 50 per cent of the generation mix for the proposed power grid of the Association of Southeast Asian Nations (ASEAN).

51. **Economies of scale and optimization of investment**. Major capacity cost savings occur owing to avoided generation capacity through complementary demand profiling across countries, lower reserve margins, the improved load factor of generators, an increase in load mix and the coordination of maintenance schedules. For example, ASEAN estimates that the ASEAN power grid could increase GDP by 1 to 3 per cent. The South Asian Association for Regional Cooperation estimates that its energy ring and market could bring about economic benefits of $4 billion annually. ADB estimates that within the framework of the Central Asia Regional Economic Cooperation Programme, the region could save $37 million of costs by avoiding the construction of a 450-MW thermal power plant.

52. **Learning and knowledge-sharing**. While there is a concern that the region needs to choose to liberalize the electricity market, the Electricity Interconnection System for the Countries of Central America and the Southern African Power Pool initiatives have demonstrated that competitive market and bilateral arrangements can coexist. One major benefit of cross-border electricity is that it drives innovative solutions, promoting sustainable development, regional energy cooperation and integration as well as energy security.

53. Despite potential benefits, efforts to connect the energy sector in the region have not yet been very successful. Some of the major challenges include:

(a) Fragmented political support, geopolitical differences or lack of common vision;

(b) Requirement for significant upfront investment;

(c) Geographically specific infrastructure requirements that result in value creation for one group of people over the rest;

(d) Difficulties associated with investment from the private sector where energy markets are dominated by State ownership, as underlying institutional, regulatory and policy frameworks are not conducive to private investment;

(e) Uncertainty about the overall benefits of cross-border electricity connectivity — for example, quantifying the regional economic benefits of connectivity versus the costs of new transmission lines — contrary to commodity trade, which has been largely initiated by multinationals with well-defined value chains;

(f) Long pay-back period of some cross-border electricity connectivity initiatives;

(g) Different legal and regulatory capabilities among member States and lack of transparent governance to manage and operate cross-border electricity connectivity;

(h) Lack of rules and regulations to deal with externalities and lack of means to measure the impact of externalities;

(i) Absence of a robust institutional mechanism to balance gains with overall costs between different stakeholders;

(j) Lack of consensus in defining a comprehensive model of integration and satisfying the interests of the whole region;

(k) Human resource capacity.

V. Means of implementation of the energy transition: finance and cooperation

54. International cooperation can facilitate the energy transition. Countries need forums in which to share experience, agree to strategies and action plans and exchange best practices. Only through North-South, South-South and triangular cooperation can technologies flow to the countries most in need. In Sustainable Development Goal 7, this is reflected in the means of implementation.

55. Globally, investment in the energy system was estimated at more than $1.8 trillion in 2016. China accounted for more than 20 per cent of the global total, followed by the United States and India.[21] In order to achieve the goals of the Paris Agreement, $120 trillion to $144 trillion in energy investment is needed between 2016 and 2050.[22] This will mainly affect demand-side investment (energy efficiency, electrification and renewables) which has to increase eight times over. Supply-side investment remains more or less at current levels and needs to be shifted from fossil fuels towards renewable energy.[22]

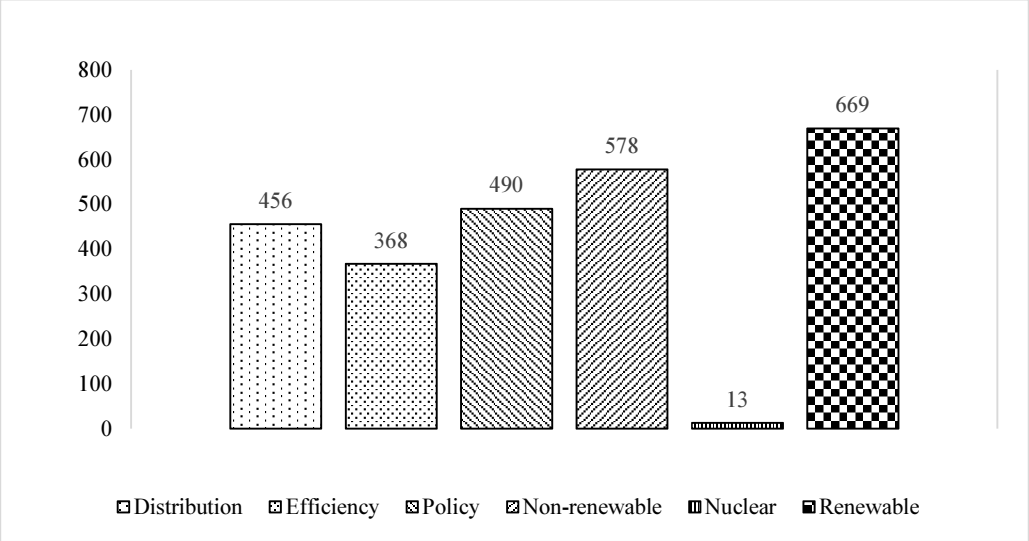
56. While donors advocate strongly for the energy transition, official development assistance (ODA) does not reflect this. In 2015, ODA disbursed amounted to $106 billion, of which 22.1 per cent was targeted at ESCAP member States, of which in turn 11.1 per cent targeted the energy sector.

57. While disbursements dedicated to renewable energy amount to almost $670 million in Asia and the Pacific, the majority are dedicated to hydropower energy. Non-renewable energy projects rank second, with 22.5 per cent of ODA received for energy. The majority of this was geared towards the construction or expansion of fossil-fuel-powered generation. Projects in energy efficiency amounted to $368 million or 14.3 per cent, including those aimed at enhancing the efficiency of existing fossil fuel power plants (figure XIII).

[21] International Energy Agency, *World Energy Investment 2017* (Paris, 2017).

[22] International Energy Agency and International Renewable Energy Agency, *Perspectives for the Energy Transition: Investment Needs for a Low-carbon Energy System* (Paris and Abu Dhabi, 2017). Available from www.irena.org/DocumentDownloads/Publications/Perspectives_for_the_Energy_Transition_2017.pdf.

Figure XIII
Disbursement of official development assistance in Asia and the Pacific by energy sector, 2015
(Millions of United States dollars)



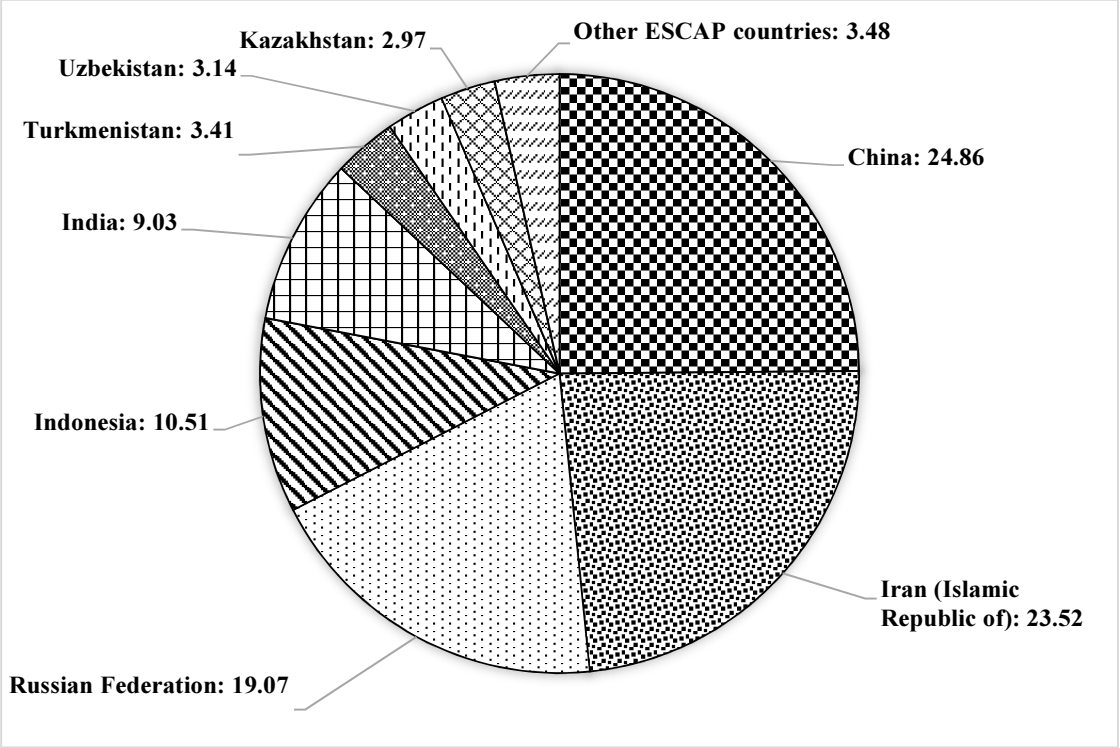
Source: ESCAP analysis.

Note: In the analysis, the focus was first on projects classified as "energy sector" and then on project descriptions. Projects not addressing any specific technology or fuel are included in the "policy" category.

58. Compared to trade, private sector investment or fossil fuel subsidies, ODA is miniscule for the energy sector. Trade of energy products amounts to $446 trillion. Private sector participation in infrastructure projects in Asia and the Pacific amounted to $20.4 billion in 2016. Fossil fuel subsidies may impede a fast uptake of the energy transition if they are not designed in a smart and targeted way. Consumer-targeted fossil fuel subsidies stood at $148 billion in ESCAP member States, representing 56.5 per cent of the global total (figure XIV).[23] If all the negative externalities that subsidies may cause, such as pollution, were considered in the calculation of subsidies — as the International Monetary Fund does — the amount would increase further.

[23] International Energy Agency, *World Energy Outlook 2017*.

Figure XIV
Share of regional fossil fuel subsidies by country, 2016
(Percentage)



Source: International Energy Agency, *World Energy Outlook 2017*.

59. Attracting private investment for energy access may prove challenging as it is less interesting for investors, although social entrepreneurs are active in this field. Bangladesh spends 2 to 3 per cent of GDP on financing electricity access, and more than 40 per cent is domestically sourced. India ($8 billion), Philippines (more than $2 billion) and Bangladesh (just less than $2 billion) are the largest investors in electricity access worldwide.[24]

60. Energy efficiency deserves special attention as it is the most important contributor to the energy transition and has been specifically highlighted as an indicator for the means of implementation. Worldwide, energy efficiency investment stood at $231 billion in 2016, driven by China.[25] China spent 0.66 per cent of its GDP on energy efficiency (more than $62 billion), and India 0.28 per cent ($7 billion). The rest of Asia spends slightly more than $9 billion on energy efficiency.[21]

VI. Conclusions and recommendations

61. Asia and the Pacific can achieve the energy transition if the region rapidly transforms the way that the energy system is designed and used. The energy transition requires holistic energy planning and a coordinated effort across all levels and parts of Governments.

[24] Sustainable Energy for All, *Energizing Finance: Scaling and Refining Finance in Countries with Large Energy Access Gaps* (Washington, D.C., 2017).

[25] International Energy Agency, *Energy Efficiency 2017.*

62. Holistic energy planning would ensure that all the targets of Sustainable Development Goal 7 are addressed in tandem, reducing the potential for contradictory policies. Holistic energy planning would also take into account and be embedded within overall national development plans. Coordination mechanisms within energy ministries and on a cross-ministerial level could ensure that plans are holistic.

63. The energy transition will depend on better understanding of future energy demand and supply. To that end, improved data and more accurate forecasts are essential. The Asia Pacific Energy Portal provided by ESCAP is one potential resource, but agreements are needed on a common measurement framework such as the multi-tier framework.

64. The transition of energy access requires a combination of improved on-grid electricity, off-grid electrification and faster deployment of improved cooking systems. Half the progress will likely come from improvements in traditional grid connection. New strategies will also be needed to significantly speed up the decentralized, off-grid systems for rural areas. Higher priority would need to be accorder to scaling up clean cooking solutions, including the provision of improved cooking stoves, liquefied petroleum gas and electricity. The issue of significantly higher upfront investment that cleaner cooking technology requires has to be addressed. Lessons can be learned from the significant progress in electrification in China and Thailand. The example of the deployment of liquefied petroleum gas for clean cooking in Indonesia is another good practice in the region.

65. The renewable energy transition requires increased ambition in national policy commitments. Setting ambitious renewable energy targets in line with national commitments for Sustainable Development Goal 7 and the Paris Agreement is the first step towards developing a pathway to achieving a significant update. While price is probably driving the speed and extent of renewable energy deployment, a policy framework can facilitate or hamper uptake. Renewable energy portfolio standards, such as those that require electric power retailers to have fixed quotas of renewable energy, feed-in tariffs, targeted subsidies for modern renewables such as solar and wind, and auctioning programmes, are options to increase renewable energy in the power sector and provide incentives to the market. Experiences in Thailand (feed-in tariffs), Japan (renewable energy portfolio standards and targeted subsidy for solar photovoltaic energy) and India (auctioning programme) are sources of regional lessons to be learned.

66. Energy efficiency requires countries to analyse carefully their local demand structure. Regulations for the industry sector are a priority for the region, as the global manufacturing hub. Likewise, building codes for new buildings are urgently required. Furthermore, more complex regulations on energy efficiency for the existing building stock and the transport sector have to be developed. Lessons can be learned by looking at those countries that have shown good progress over the recent past, such as Afghanistan, China, Kyrgyzstan, Sri Lanka and Uzbekistan. The immediate focus would be on strengthening regulatory breadth, then on tightening regulatory depth subsequently to maintain incentives.

67. Energy connectivity requires a regional mechanism to facilitate cross-border electricity connectivity. Broad regional agreement and a strong institutional arrangement are critical to monitoring and ensuring the achievement of benefits, while neutral institutions will be essential to regulating project implementation and benefits. Political support is an important building block towards establishing such a mechanism. To facilitate

this process, a regional road map is proposed to guide the secretariat and international partners towards the development of this regional mechanism, to be considered by the Committee on Energy at its second session.

68. Financing the energy transition requires ODA and domestic public finance, particularly for the last mile. However, increasing private investment is essential. The private and public sectors remain the most important sources for renewable energy and energy efficiency finance. Combining those resources through partnerships can leverage resources, an example of which is the experience of China with respect to new business models, such as energy service companies. More funding is needed for energy demand projects, while for supply existing funding may be reallocated from fossil fuels to cleaner sources. An urgent step is phasing out untargeted, inefficient fossils fuels.