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Review of issues pertinent to the subsidiary structure of the Commission, including the work of the regional institutions: energy

Report on energy transition in Asia and the Pacific: pathways for ensuring access to affordable, reliable, sustainable and modern energy for all

Note by the secretariat

Summary

The aim of the present report is to assess current and projected progress towards achieving Sustainable Development Goal 7 in the Asia-Pacific region. Potential gaps in the road to achieving Goal 7 are identified and policy options to close these gaps are provided. In line with the theme topic of the seventy-fourth session of the Economic and Social Commission for Asia and the Pacific, inequality issues pertaining to energy are also examined. Member States may wish to use the report as a basis to reflect on key policies and initiatives for ensuring access to affordable, reliable, sustainable and modern energy for all, as well as on how best to address the issues and challenges of inequality in the implementation of Goal 7.

The Commission may wish to review the report and provide guidance for the future work of the secretariat.

I. Introduction

1. The Asia-Pacific region produces approximately one third of the world's gross domestic product (GDP) and consumes more than half of the global energy supply. With both population and standards of living rising, the region is facing the highest increase in energy demand in the world.

2. The Asia-Pacific region's development has, in the past, been coupled with and driven by increasing energy consumption. This development model has led to environmental pollution and resource scarcity.[1] Furthermore, the region's growth has not addressed deep-seated regional inequalities. In some

* ESCAP/74 /L.1/Rev.1.

1 Economic and Social Commission for Asia and the Pacific (ESCAP), "Towards a resource-efficient and pollution-free Asia-Pacific", 5 September 2017. Available from www.unescap.org/op-ed/towards-resource-efficient-and-pollution-free-asia-pacific.

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respects, disparities may have risen owing to uneven energy access.[2] The adoption of the 2030 Agenda for Sustainable Development and the Paris Agreement signals a need to move beyond business as usual and to implement a new energy paradigm at the national and regional levels. This will require a far-reaching energy transition that enables economic development while lowering the negative impact of energy consumption and increasing efficiencies.

3. In spite of the region's fast-growing energy industry, many of its countries have large deficits in energy access. Some countries struggle with an uneven distribution of resources, with drastically lower energy access rates in rural compared with urban areas. Jointly addressing access issues in the face of growing demands while lowering reliance on fossil fuels presents a challenge. With Sustainable Development Goal 7 as a guiding force, the energy transition will be a long-term effort to increase the efficiency and utilization of renewables in order to meet rising demand and achieve universal access.[3]

4. Issues of inequality related to energy are also examined in the present report. On the basis of a recent study undertaken by the secretariat,[2] some of the demographic characteristics associated with lower access are outlined, including locality, poverty and gender.[4]

5. Opportunities for the energy transition are also presented, including the rectification of inequality and the alleviation of poverty through universal energy access and the direct and indirect benefits of the transition.

II. Energy access: ensuring inclusive participation to achieve universal access with a pro-poor focus

A. Current status and trends

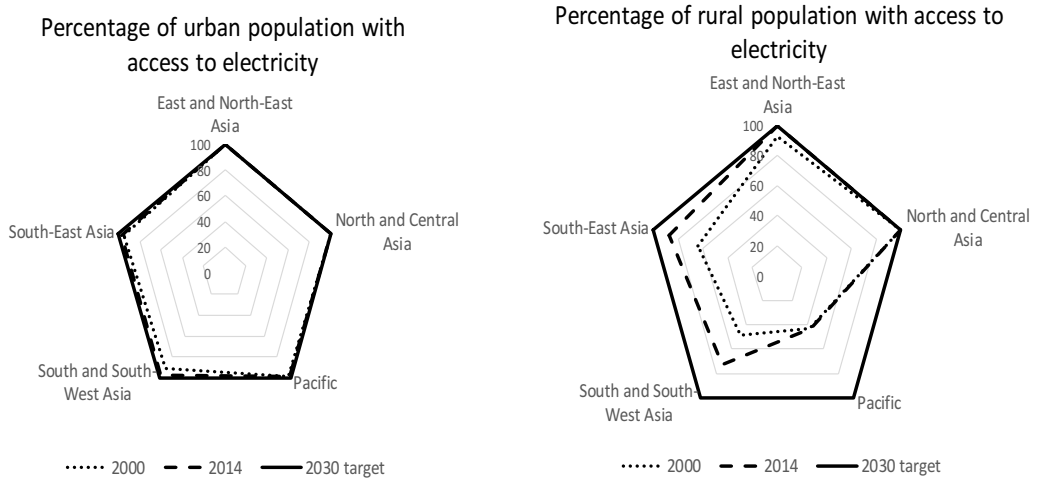
6. The Asia-Pacific region has made great progress in providing access to modern energy services; however, greater action is still needed. The region now provides electricity to more than 90 per cent of its population. However, over 420 million people (9.7 per cent) remain without electricity, of which 389 million are located in rural areas. These are frequently the most impoverished and remote communities. 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, but requires drastic action. 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 (figure I). Closing the gap requires locally adapted solutions.

[2] *Inequality of Opportunity in Asia and the Pacific: Clean Energy* (ST/ESCAP/2818). Available from www.unescap.org/resources/inequality-opportunity-asia-and-pacific-clean-energy.

[3] In providing projections, this report uses 2030 as a reference point and makes assumptions from existing scenarios with respect to the achievement of Goal 7.

[4] While other demographics may also correlate with likelihood of access, for the purposes of the present document, inequality primarily refers to locality, income and gender. However, decision makers may consider investigating energy's relationship other characteristics, as relevant in the context.

Figure I
Access to electricity in rural areas lags behind urban areas

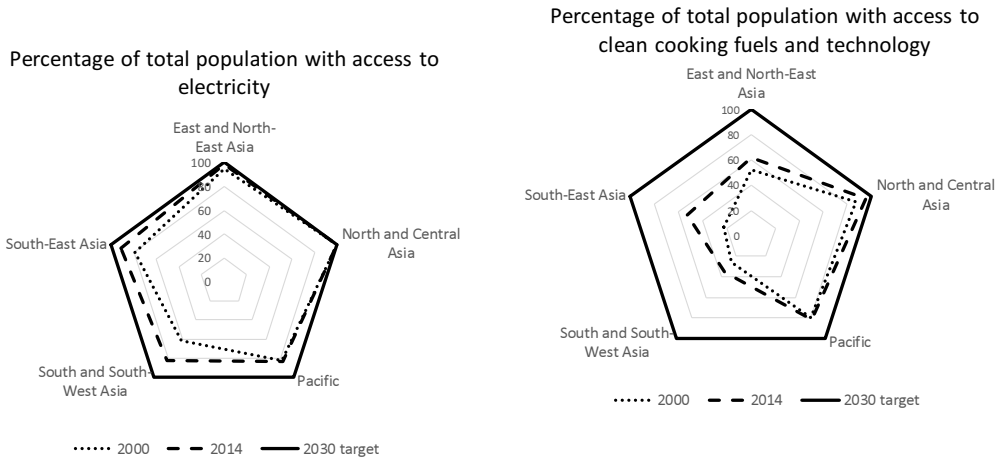


Source: ESCAP calculations based on data from International Bank for Reconstruction and Development/World Bank, *Sustainable Energy for All 2017: Global Tracking Framework – Progress toward Sustainable Energy* (Washington, D.C., 2017). Available from http://gtf.esmap.org/data/files/download-documents/eegp17-01_gtf_full_report_for_web_0516.pdf.

7. Some of the demographic characteristics associated with lower access include locality, poverty and gender. It is most difficult to provide energy to communities in remote areas that lack infrastructure, hence remote villages and island nations are less likely to have energy access. Poverty is associated with lower likelihood of access for several reasons: (a) those in remote areas are more likely to be poor, owing to less economic activity in the region; (b) in cases where energy is technically available, it may be too expensive to be accessible to the poor; and (c) in a vicious cycle, lack of access impedes economic productivity, reinforcing poverty in inaccessible regions. In such areas, women are primarily responsible for acquiring biomass for fuel, a time-consuming and physically draining undertaking. This detracts from time that could be spent on other productive activities including wage employment, education and social or political interaction outside the household. Additionally, women and children are more likely to suffer from the consequences of cooking with unclean fuels that cause health problems. By addressing these critical inequality issues, new policies can help elevate those who are most at risk of being left behind.[2]

8. 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, leaving nearly 2.1 billion people 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 least developed countries, such as Kiribati, the Lao People's Democratic Republic and Timor-Leste, where access was less than 5 per cent. Figure II shows a comparison of progress in electricity access to progress in clean cooking access.

Figure II
Access to electricity has increased in Asia and the Pacific, but access to clean cooking lags



Source: ESCAP calculations based on data from International Bank for Reconstruction and Development/World Bank, *Sustainable Energy for All 2017: Global Tracking Framework – Progress toward Sustainable Energy* (Washington, D.C., 2017). Available from http://gtf.esmap.org/data/files/download-documents/eegp17-01_gtf_full_report_for_web_0516.pdf.

9. Finding good, reliable data to measure progress on universal energy access, particularly for clean cooking, remains a challenge. Even statistics from international organizations on electricity access sometimes differ by as much as 200 million people.[5] 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.[6]

10. Furthermore, statistics do not currently capture the quality of access, which has a tremendous impact on social well-being. Energy inequality can refer to differences in access to electricity and clean fuels, but also to differences in prices, reliability and quality of energy access, among and within countries. Rather than treat energy access as binary, the multi-tier framework proposed by the World Bank provides this basis and includes an outline of some related challenges for consideration.[7] 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. Capturing the quality of service will be crucial to reaping the benefits from electricity for its productive use and social benefits.[2]

[5] A comparison can be found in International Bank for Reconstruction and Development/World Bank and International Energy Agency, *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.

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

[7] 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.

11. Defining access to clean cooking is even more challenging, because countries define the term differently and, accordingly, promote different fuels and technologies through policies and programmes. Evidently, the view on what constitutes a clean cooking solution differs for each country.

12. Attracting private investment for energy access may also prove challenging. Private sector participation in infrastructure projects in Asia and the Pacific amounted to $20.4 billion in 2016. Bangladesh spends 2 to 3 per cent of GDP on financing electricity access, and more than 40 per cent is domestically sourced. The largest investors in electricity access worldwide are India ($8 billion), the Philippines (more than $2 billion) and Bangladesh (just less than $2 billion).[8] Public sector support, including the development of policies to align private sector investments with energy needs, will be particularly important for improving access.

B. Pathways for transition

13. Having access to affordable, reliable, sustainable and modern energy is a precursor to many other development activities, because it leads to direct benefits as well as indirect benefits beyond the impact of the energy itself. Direct benefits refer to the immediate positive impacts attributable to the energy transition, such as jobs created by the shift. Indirect benefits refer to the positive impacts that are one step removed from the transition, but are still attributable to it. For example, the transition may lead to better-lit streets at night, which in turn may lead to greater safety; safety, in this case, would be an indirect benefit of the transition.

14. The indirect benefits of the energy transition are particularly important for development and poverty alleviation. Energy access can enable productive economic activity, improve health, improve agriculture, increase gender equality and lower inequality overall. For example, regular access to light enables residents to work and study after dark, improving both economic development and education. Eliminating the need to gather biomass frees up women's time for other productive activities. The introduction of energy in agriculture can vastly improve production. Additionally, if coupled with infrastructure and/or information and communications technology, energy access can provide social and economic benefits by facilitating domestic communication and trade.

15. Achieving these indirect benefits, however, requires targeted policy planning. For example, coupling energy access with programmes to incentivize school attendance may accelerate education benefits, as residents, particularly women, have more time to attend school when they are no longer otherwise engaged searching for biomass.

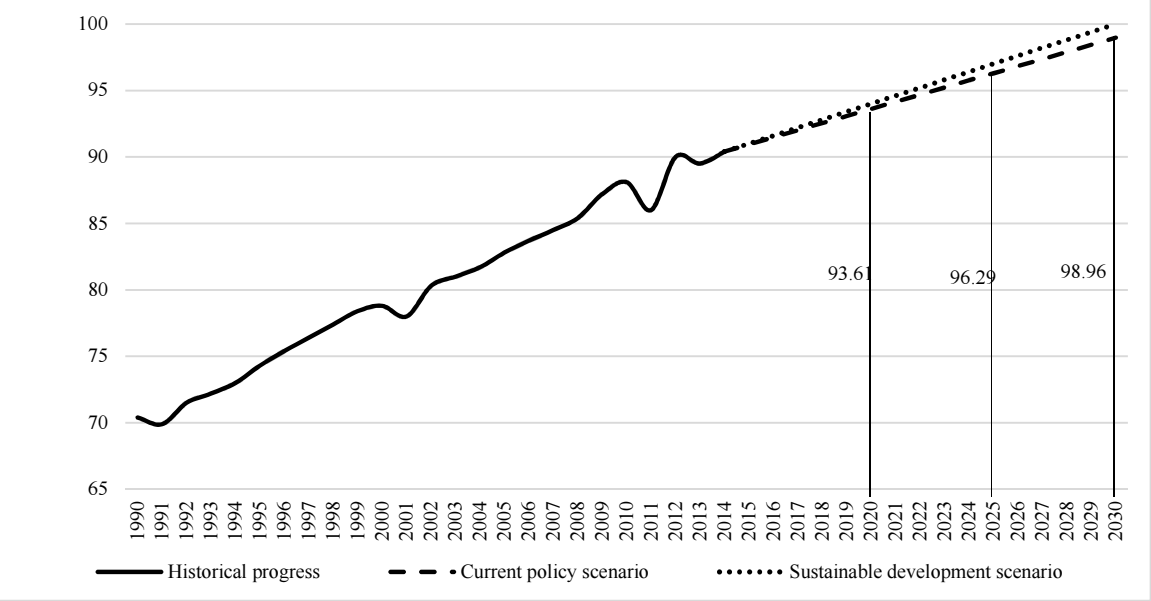
16. Though rates of access have improved since 2000, simultaneous increases in income inequality have left those without access further and further behind, particularly in rural areas. Without energy, these communities are left with little means to close this gap. Attaining universal access is a critical development priority. Coupled with targeted pro-poor policies, it can catalyse economic activity and generate many other benefits.

17. 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

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

of people without electricity short of the Goal 7 target. Figure III 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.

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



Source: ESCAP analysis based on national electrification targets.

18. 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 next 10–15 per cent. Given that global data shows that half the progress will come from traditional grid connection, the processes for which are well known, policies should prioritize such projects immediately.[9] The other half of the progress will come from decentralized, off-grid or mini-grid systems, which need be customized based on the local context.

19. In remote areas where total energy demand is low, it may not be feasible or sustainable to extend the existing grid. In these areas, if population density is moderate, mini-grids using renewables will provide reliable sustainable energy. Where demand is particularly low and/or residences are sparse, off-grid solutions such as solar home systems are preferable. Because decentralized renewables require additional planning and targeting, extension of the traditional grid should receive immediate priority, while decision makers take the time to strategize on methods and plans to connect those who have the least access shortly thereafter.

20. Although projections demonstrate that there is a need to lower demand compared with business as usual, it is estimated that universal access will increase global demand by only 0.23 per cent.[9] Clearly, providing access to poor people is not the primary driver of rising demand or the associated

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

environmental detriment. Accordingly, providing access should receive priority. Wherever possible with new energy systems for poor people, overcoming inequalities that entrench poverty and accentuate underdevelopment should be prioritized.[10]

21. Providing access to clean cooking systems is even more challenging because there is no one-size-fits-all strategy. The best solution depends on local factors, including stove cost, fuel cost, reliability, health impact, gender implications, environmental implications and fuel availability. Traditional and improved biomass, coal, kerosene, liquefied petroleum gas, electricity, biogas and biogas digesters each have advantages and disadvantages. Biogas digesters rank highest in terms of socioenvironmental benefits, but they require high upfront investment and function only if there is sufficient livestock in the area.[11] Absent the necessary resources, liquefied petroleum gas has lower start-up costs and works well where distribution networks are sufficient. It is frequently more feasible among poor people in urban areas. Indonesia stands out as the world leader in this regard. By building strong liquefied petroleum gas distribution networks and 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 is more complex and requires a diversified combination of technologies.[9] In cases where neither biogas digesters nor liquefied petroleum gas is feasible, improved cookstoves present a better alternative to traditional cookstoves, though they still rely on traditional biomass.

22. It will be essential to involve women in the design process of the energy transition. Women are end users of energy, and frequently hold primary responsibility for many household tasks and decisions. Accordingly, they can provide valuable insights into important factors including preferred methods of delivery, communication plans and pricing systems prior to the roll-out of delivery. Energy systems will greatly benefit from the inclusion of more comprehensive perspectives.[12]

III. Renewable energy: pathways to emissions reduction, access and economic opportunities

A. Current status and trends

23. After energy efficiency, renewable energy has the highest potential for reductions in carbon dioxide emissions globally (approximately 35 per cent).

[10] Stephen Karekezi and others, "Energy, poverty, and development" in *Global Energy Assessment: Toward a Sustainable Future*, Thomas B. Johansson and others, eds. (Cambridge, United Kingdom, and New York, Cambridge University Press; and Laxenburg, Austria, International Institute for Applied Systems Analysis, 2012). Available from www.iiasa.ac.at/web/home/research/Flagship-Projects/Global-Energy-Assessment/Chapter2.en.html.

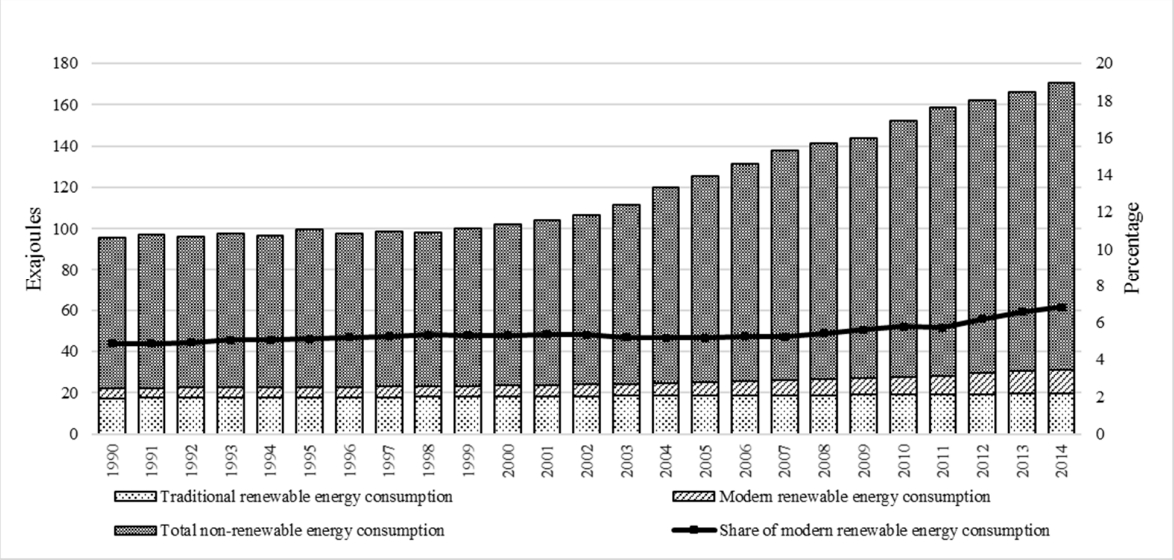
[11] International Renewable Energy Agency, *Biogas for Domestic Cooking: Technology Brief* (Abu Dhabi, 2017). Available from www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Dec/IRENA_Biogas_for_domestic_cooking_2017.pdf.

[12] Kathleen O'Dell, Sophia Peters and Kate Wharton, "Women, energy, and economic empowerment", 18 September 2014. Available from www2.deloitte.com/insights/us/en/topics/social-impact/women-empowerment-energy-access.html.

24. Asia and the Pacific faces significant challenges in increasing the share of modern renewable energy in its energy mix. With rising demand, 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, solar, biomass and, to a lesser extent, geothermal power gain shares (figure IV). Furthermore, the region shows greater levels of renewable energy investment, installed capacity and consumption than any other region in absolute terms.

25. It should be noted that modern renewable energy is distinct from renewable energy production as a whole. Renewable energy as a whole includes solid biofuels, such as wood and charcoal. Solid biofuels represent 72.6 per cent of renewable energy consumption and 13.5 per cent of total final consumption. Their consumption is increasing owing to the increase in the rural population in some countries, especially in South Asia, South-West Asia and South-East Asia, where traditional biomass is used.

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



Source: ESCAP, Asia Pacific Energy Portal. Available from http://asiapacificenergy.org/#en (accessed 15 January 2018).

26. In what is commonly referred to as the "energy ladder", as incomes rise, poor households shift away from using biomass fuels such as fire, animal waste and agricultural waste to transitional fuels such as charcoal, kerosene and coal. As incomes further rise, they shift to cleaner fuels including liquefied petroleum gas, electricity and biofuels.[13] While shifting to transitional fuels may alleviate the burden of searching for biomass such as wood fuel, these fuels also have higher carbon emissions. Though these emissions are likely to be small, policies can help support a transition toward cleaner fuels. Additionally, contrary to the ladder concept, many households use some

[13] Rasmus Heltberg, "Household fuel and energy use in developing countries: a multicountry study", 2003. Available from www.esmap.org/sites/default/files/esmap-files/Report_FuelUseMulticountryStudy_05.pdf.

combination of different fuels as incomes rise, meaning that the adoption of cleaner fuels does not necessarily eliminate the use of biomass or dirtier fuels. To ensure a true transition, policies should make cleaner fuels sufficiently accessible that there is no need to continue using dirtier alternatives.

27. Furthermore, the fact that many poor people still use biomass fuels for cooking contradicts the argument that increased carbon emissions are due to the economic development of those in need. Some studies suggest that the increase in carbon emissions in the region is primarily due to households with very high incomes (the 1 per cent) engaging in carbon-intensive lifestyles, while emissions from poor populations remain very low.[14] While a shift to renewables on a large scale will help to avoid carbon emissions, there is a need for additional frameworks to distribute sustainable energy benefits among poor people.

28. Globally, on- and off-grid renewable energy markets are expanding, which creates jobs in the manufacturing, distribution, installation, operation and service sectors. This implies a strong business case. It is estimated that in 2015, for example, some 4.5 million renewable energy jobs were created in Bangladesh, China, India and Japan.[15] 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.

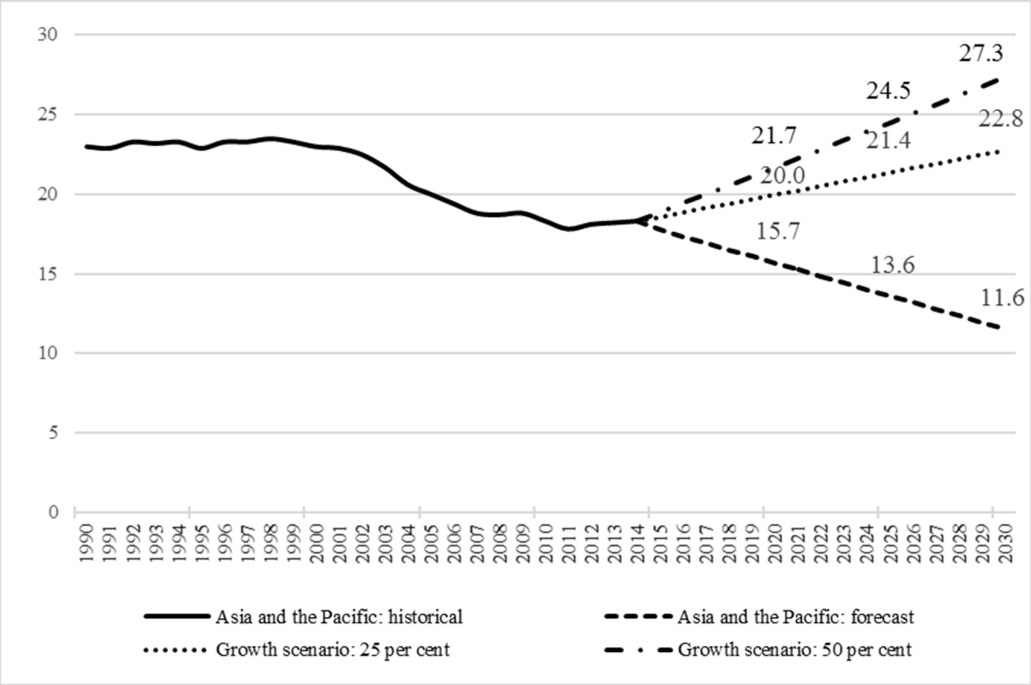
B. Pathways for transition

29. An examination of national energy plans and strategies reveals that with existing policies, renewable energy in total final energy consumption is set to decline (figure V). This is an obvious gap with the Goal 7 target, and achieving a significant increase will require important efforts.

[14] Shoibal Chakravarty and M. V. Ramana, "The hiding behind the poor debate: a synthetic overview", in *Handbook of Climate Change and India: Development, Politics and Governance*, Navroz K. Dubash, ed. (New Delhi, Oxford University Press, 2012). Available from www.princeton.edu/~ramana/HidingBehindPoor-SyntheticOverview-MVR-Shoibal-2011.pdf.

[15] 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.

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



Source: ESCAP analysis.

30. Setting renewable energy targets is the first step towards 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.[16] Increasing renewables would also help to increase energy security and reduce the import bill for fuel, especially for some Pacific islands with ambitious targets of 100 per cent renewable energy. While high prices may hamper the uptake of renewables, the policy framework can accelerate progress. The power sector is the most promising for initiating the energy transition because quick, large-scale deployment of renewable energy is possible and policy options are available.

31. Lessons learned from other countries provide valuable insights into the various policy options. Declining prices are of critical importance as they make 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

[16] 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.

in the past year alone.[17] Similarly, average wind turbine prices declined by 38 per cent between 2009 and 2016.[18] Thailand is one of the subregional leaders in renewable energy in South-East Asia, and there are indications that this was owing to policy reform. Since the launch of the Energy Policy and Development Plan in 2006, the share of modern renewable energy in total final energy consumption has increased steadily, and it has nearly tripled since the adjustment to feed-in tariffs in 2009.

32. That said, an important factor to consider if pursuing tariffs is that of ensuring an equitable distribution of the costs. In Germany, for example, the Government issued an electricity surcharge to fund feed-in tariffs supporting the expansion of wind and solar. This surcharge was largely seen as regressive because lower-income households were less likely to have efficient appliances and therefore used more energy. Additionally, with less disposable income, their energy usage was likely to be more inelastic, and expenditure on energy constituted a higher percentage of income. Furthermore, many energy-intensive industries were exempt from the surcharge, leaving residential consumers with most of the burden.[19] To ensure equity, policymakers may consider distributing costs so as not to unduly burden low-income users.

33. On a smaller scale, renewables offer one of the best solutions to the access problem. In remote areas, low energy demand may not justify the high costs of grid extension. Mini-grid solutions in cases of moderate demand and off-grid solutions in cases of very low or dispersed demand are best in these cases. These solutions prevent the use of dirty fuels and provide greater energy security against natural disaster or attack since systems can be repaired and maintained locally. Deployment of renewables will also create new jobs.

34. Job creation is an important direct benefit of transitioning to renewables, and policymakers may leverage this opportunity to rectify inequality issues. Project-level evidence from the International Renewable Energy Agency suggests that renewables are generally more labour-intensive than fossil fuels and therefore create more jobs per kilowatt-hour.[20] Policymakers may implement programmes to train and hire local residents to maintain and repair decentralized renewable energy systems. In addition to ensuring the systems' longevity, this would create jobs in areas where economic development is most needed, particularly since renewables are known to create more job opportunities than traditional energy sources.[15] To further address issues of inequality, policymakers may prioritize offering these positions to those who are at a disadvantage, such as women or other marginalized groups. A study of a programme training solar engineers to provide installation and repair services in rural Afghanistan found that

[17] 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.

[18] 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 (accessed 16 January 2018).

[19] Jochen Diekmann, Barbara Breitschopf and Ulrike Lehr, "Social impacts of renewable energy in Germany: size, history, and alleviation", June 2016. Available from www.gws-os.com/discussionpapers/gws-paper16-7.pdf.

[20] International Renewable Energy Agency, *Renewable Energy and Jobs: Annual Review 2017* (Abu Dhabi, 2017). Available from www.irena.org/documentdownloads/publications/irena_re_jobs_annual_review_2017.pdf.

women's participation improved programme implementation and elevated the status of women.[21] Thus, with the appropriate policies, renewable energy can lead to the important indirect benefit of improving gender equality.

35. Countries would benefit from taking a more integrated view of renewable energy and energy efficiency. One sector where the link 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. Action is therefore required. First and foremost, integrated solutions should follow the principle of avoid-shift-improve.[22] This involves first searching for solutions to avoid transport altogether, such as through city planning and telework. If this is not possible, the principle encourages a shift to more efficient modes of transport, such as public transport. 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, it is possible that electric motors will ultimately replace the internal combustion engine, exemplifying the intersection of renewables and efficiency.

IV. Energy efficiency: greater need to pick the low-hanging fruit

A. Current status and trends

36. 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), and ultimately results in cost savings owing to lower energy usage.

37. The Asia-Pacific region has demonstrated a long-term, steady decline in energy intensity, resulting in a decoupling of energy use from GDP. Meeting the Sustainable Development Goal targets, however, will require scaled-up action. Between 1990 and 2014, energy intensity fell from 9.1 to 6.0 megajoules per United States dollar. However, the region continues to rank the highest among global regions in terms of energy intensity.

38. 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 efficiency 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.

39. 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 of Goal 7. Furthermore, it is one of

[21] K. Standal, "Lighting the path towards gender equality: the troublesome implementation of a solar electrification project in rural India", PhD dissertation, University of Oslo (forthcoming).

[22] "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).

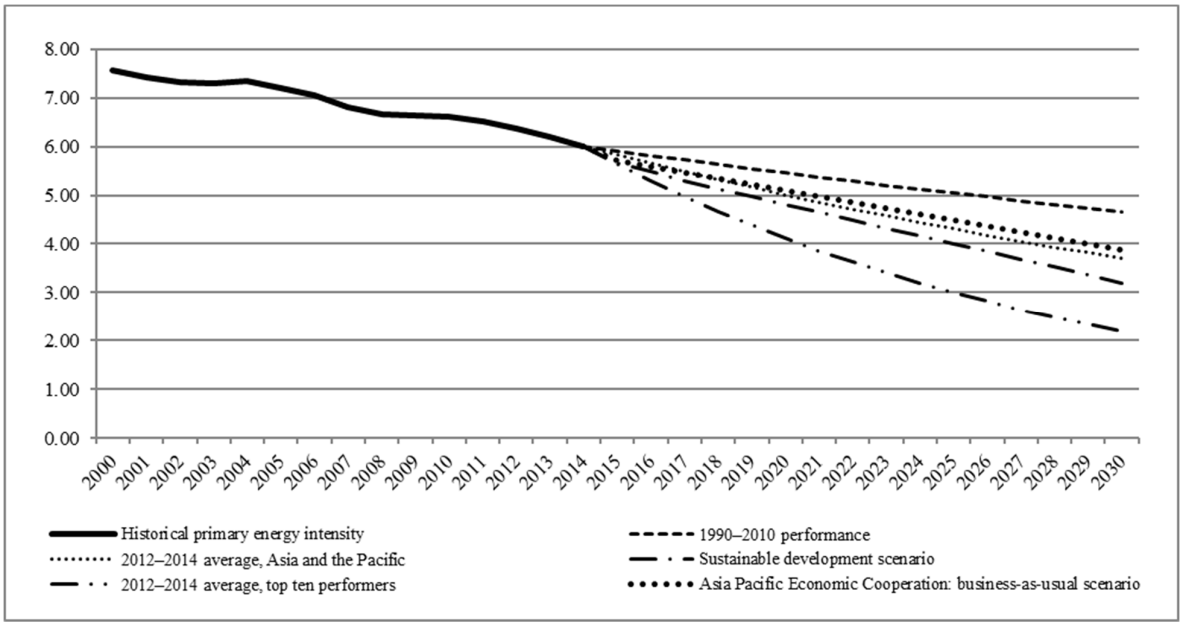
the cheapest and easiest ways to lower fossil-fuel usage, and it makes energy cheaper and therefore more accessible for low-income users.

B. Pathways for transition

40. Energy efficiency is often referred to as the low-hanging fruit of the energy transition because it is easy to deploy, it is cheap (and usually even profitable in the long run) and it has strong potential to mitigate greenhouse gas emissions. Accordingly, energy efficiency action should take place at all levels among both high-intensity and low-intensity users.

41. Energy efficiency has been steadily advancing in the Asia-Pacific region. By maintaining its average rate of improvement of the last two years, Asia and the Pacific would double its average achievement rate between 1990 and 2010 (one possible reading of the Goal 7 target) and even go beyond (figure VI). This would mean that the Asia-Pacific region would reach similar energy intensity levels to that of Europe today shortly before 2030.

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



Source: ESCAP analysis.

42. The first step towards accelerating energy efficiency initiatives is to identify the most impactful sectors. The cases of the top performers – including Uzbekistan, Kyrgyzstan, Sri Lanka, Afghanistan and China – 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. 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 is another priority. Given the lifespan of buildings, strong building performance standards will lock in performance for decades. 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.

43. Energy efficiency can become a driver for development. Worldwide, approximately $2.2 trillion in economic value was created by improved energy intensity, and more than half of this by China.[23] This has direct benefits for households: savings on energy expenditure per household amounted to $370 in Japan and $60 in China.[24] In India, State-owned company Energy Efficiency Services Limited is aggressively investing in energy efficiency. It is clear that there are large gains to be made through energy efficiency. A strong policy framework that incentivizes energy efficiency and equitably distributes the benefits will ensure that initiatives jointly reduce emissions while creating value for all.

44. The high emitters of energy, including energy-intensive industries and wealthy households with carbon-intensive lifestyles, have the greatest potential to lower emissions. Because their net usage is higher, the total avoided energy use as a result of switching to renewables or implementing energy efficiency measures will be much higher. Additionally, these entities are more likely to have the resources needed to invest in the transition.

45. For this reason, encouraging energy efficiency among large corporate consumers, energy-intensive industries and wealthy households will be particularly beneficial for deterring environmental detriment. One of the most effective ways to incentivize energy efficiency is to provide loans for this specific purpose; because energy efficiency is profitable in the long run, loans mitigate the barrier of ensuring sufficient start-up capital, thus aligning business incentives with long-term sustainable energy goals. Thailand, for example, issued an energy efficiency revolving fund in 2003 to provide low-interest debt financing for investment in large-scale energy efficiency and renewable energy projects, particularly for commercial buildings and industrial facilities. Interest was minimal (approximately 0.5 per cent) to cover administrative costs, and the banks used repaid loans to fund new energy projects, hence the revolving design. Evaluations suggest that the project was highly successful, with $521.5 million in total investment resulting in a reduction in greenhouse gas emissions of 0.98 million tonnes of carbon dioxide equivalent.[25] China, India and Brazil provide additional examples of models for energy efficiency financing.[26]

46. Among low-income users, energy efficiency has the direct benefit of reducing the cost of energy, making it more accessible. This is crucial since in some areas – for example, among poor people in urban areas – the limiting factor for reliable access is not necessarily supply, but rather prohibitively

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

[24] 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).

[25] Erica Jue, Brad Johnson and Anmol Vanamali, "Case study: Thailand's Energy Conservation (ENCON) Fund: how financial mechanisms catalyzed energy efficiency and renewable energy investments", October 2012. Available from http://ccap.org/assets/Thailand-Energy-Conservation-ENCON-Fund_CCAP-Oct-2012.pdf.

[26] Robert Taylor and others, *Financing Energy Efficiency: Lessons from Brazil, China, India, and Beyond* (Washington, D.C., International Bank for Reconstruction and Development/World Bank, 2008). Available from www.esmap.org/sites/default/files/esmap-files/financing_energy_efficiency.pdf.

expensive costs. Because energy-efficient technologies have a higher upfront cost, these populations are less likely to be able to afford them, even if they are more cost-effective in the long run. Furthermore, since these populations are financially more vulnerable, they have less access to loans for such purposes. Policies and programmes to address this – by, for examply, subsidizing energy-efficient light bulbs or other appliances – would improve access in low-income households. A prime example of this is Energy Efficiency Services Limited in India, an energy service company that helps replace existing inefficient lights, including incandescent bulbs and compact fluorescent lights, with more efficient light-emitting diodes. The company removes the upfront costs of energy efficiency upgrades, making them possible for low-income users.[27]

47. Another roadblock that disproportionately affects lower-income users is the principal-agent problem. Where energy users rent their accommodation, building owners (the principals) are unlikely to invest in energy efficiency improvements such as better insulation because the benefits would go to the renter (the agent), who pays the electricity bills. This misalignment of the principal's incentives with those of the agent prevents valuable energy efficiency initiatives that would result in emissions reduction and cost savings. Since the wealthy are more likely to own property, the costs disproportionately affect those with a lower income. To prevent this missed opportunity, policymakers may consider implementing measures that would make energy efficiency mutually beneficial. For example, the city of New York produced a clause that can be added to building lease agreements that states that if the building owner implements energy efficient upgrades, the ensuing energy cost reduction will be split between the principal and the agent.[28] This ultimately makes the energy efficiency upgrades mutually beneficial, aligning incentives and solving the problem.

48. On a larger scale, policymakers may consider using energy efficiency to provide cost-effective upgrades to poor urban neighbourhoods. For example, the World Bank's Energy Sector Management Assistance Programme is investing in transforming an urban slum in Buenos Aires through initiatives to improve the energy efficiency of houses and infrastructure. Some of the features include better insulation and street lights. With less need for heating, cooling and lights, this will lower overall energy demand. Additionally, the street lights may have the indirect benefit of increasing safety and social welfare. Such benefits would reduce costs to the city, making the initiative worthwhile for public sector investment.

49. Lastly, given the large potential financial gains from energy efficiency, policymakers may consider leveraging this value added and using policy tools to reallocate resources to poverty alleviation. For example, loan programmes to fund energy efficiency upgrades, such as revolving loans and on-bill repayment schemes, may be designed such that a portion of the interest or energy cost savings is allocated to public programmes or direct cash transfers to poor people. This would help channel the increased value toward alleviating inequality.

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

[28] City of New York Urban Green, "The Energy Aligned Clause: solving the split incentive problem". Available from www.nyc.gov/html/gbee/downloads/pdf/121115_eac.pdf (accessed 9 February 2018).

V. Financing the transition: reallocating resources for sustainability and equity

50. In order to achieve the goals of the Paris Agreement, significant investment is required, estimated at $120 trillion to $144 trillion in energy investment between 2016 and 2050.[29] This requires both public and private sector funding. Governments may consider restructuring energy financing to reallocate resources to more sustainable energy as well as to alleviate inequality issues.

51. With regard to funding the energy transition, investment in energy supply does not necessarily need to increase, but rather needs to shift away from fossil fuels and towards renewable energy.[29] One option is to remove subsidies benefiting fossil fuels because they impede the uptake of the energy transition. Although these subsidies may be intended to protect poor people from rising fuel prices, in reality they are generally regressive because they ignore the fact that poor people consume less energy than rich people.[30] Based on the global average, the wealthiest 20 per cent of households in low- and middle-income countries capture six times more in total fuel product subsidies (43 per cent) than the poorest 20 per cent (7 per cent).[31] Removal of these subsidies has therefore become a policy focus at the national and international levels. Sustainable Development Goal target 12.c calls on Member States to rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions.[30] While the removal of these subsidies would free up valuable public resources, it would also be somewhat damaging to poor households that used the subsidy. Mitigating measures can ease this burden by reallocating resources to pro-poor purposes.

52. As demonstrated by a study conducted by the International Monetary Fund, there are many cases of successful and partially successful energy subsidy reforms,[32] including the reform of fuel in Indonesia and the Islamic Republic of Iran, the reforms of both electricity and fuel in the Philippines and Turkey, and the reform of electricity in Armenia. Most of these reforms were accompanied by specific policies to mitigate harm to poor people, such as investment in other public services, subsidies for poor people only, or cash transfers, ideally targeted at poor people. In Armenia and Indonesia, inclusion of cash transfers as part of the policy is thought to have mitigated political opposition, securing the success of the overall reform. In the case of the Islamic Republic of Iran, although transfers were not targeted, statistical evidence suggests that they still resulted in a reduction of inequality while the reform was in place.[33]

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[29] 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.

[30] *Inequality of Opportunity in Asia and the Pacific*.

[31] International Monetary Fund, "Energy subsidy reform: lessons and implications", 28 January 2013. Available from www.imf.org/en/Publications/Policy-Papers/Issues/2016/12/31/Energy-Subsidy-Reform-Lessons-and-Implications-PP4741.

[32] The term "partially successful" in this case refers to cases in which the subsidy reform remained in place for at least one year, but subsidies either re-emerged later or remain a policy issue.

[33] Djavad Salehi-Isfahani, Bryce Wilson Stucki and Joshua Deutschmann, "The reform of energy subsidies in Iran: the role of cash transfers", *Emerging Markets Finance*

53. Beyond removing subsidies, Governments may even consider taxing certain fossil-fuel items, such as gasoline, in order to encourage efficiency, make renewables more affordable by comparison and raise revenue for other productive uses. Revenue generated from such a tax may be applied towards scaling up renewables, or towards public programmes or cash transfers to poor people to ensure that they are not negatively impacted by the tax.

54. Other potential policies for consideration may include the regulation of emissions, as modelled by the European Union, Japan, Canada and Australia, or subsidies for energy conservation, as modelled by the United States of America.[34]

VI. Connectivity and cooperation as effective and efficient accelerators for Sustainable Development Goal 7

55. There is growing agreement that the best way to address the energy challenges in Asia is through enhanced regional energy connectivity to better share and trade resources in order to even out energy surpluses and deficits. Though the region has adequate energy resources to meet growing demand, most are highly concentrated in a few countries. The top five countries account for over 85 per cent of total resources.[35] Improving connectivity and trade would result in more efficient allocation of resources, improvement of access and potential reduction in inequality, providing mutual benefits to all, as outlined in the following paragraphs.

56. **Addressing energy inequality.** The power sector presents the greatest opportunities for harnessing the benefits of connectivity. Cross-border power connectivity offers connection between those countries with surplus power generation and those that face a deficit, providing mutual benefits to all and lessening inequality. China, for example, has been leading connectivity initiatives to build distribution infrastructure and agreements with countries in the region, including a 30-year contract with the Russia Federation to receive natural gas supplies.

57. **Access to energy.** Cross-border electricity connectivity through comprehensive, integrated planning could increase access to rural communities, a critical development priority. For example, 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. In this case, cross-border connectivity reduced costs as well, because, owing to the geography, generating and transporting the energy within Indonesia would have been costlier than receiving it from Malaysia.

58. **Shared profit for social benefit.** Because connectivity can improve overall wealth and development, Governments may reallocate some of the benefits to help alleviate poverty and improve social welfare. The Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000) has

and Trade, vol. 51, No. 6 (October 2015). Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.646.1816&rep=rep1&type=pdf.

[34] Thomas Covert, Michael Greenstone and Christopher R. Knittel, "Will we ever stop using fossil fuels?". Available from http://home.uchicago.edu/~tcovert/webfiles/jep_fossil_fuels.pdf (accessed 23 February 2018).

[35] *Towards a Sustainable Future: Energy Connectivity in Asia and the Pacific* (United Nations publication, Sales No. E.16.II.F.24).

provided opportunities to connect 600 communities along the Peshawar-Kabul route. In addition to the benefits of access, the initiative also includes a 1-per-cent transmission charge to support community programmes and social and environmental costs along the transmission line, which helps to distribute the benefits among those most in need.

59. **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.

60. **Energy security.** By connecting resources, it is possible to diversify energy sources, leading to enhanced energy security for the entire region.

61. **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.

62. 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. Through North-South, South-South and triangular cooperation, technologies can flow to the countries most in need.

63. Some of the continuing roadblocks to enhancing connectivity include:

(a) Lack of consensus and fragmented political support;

(b) The significant upfront investment that is required;

(c) Lack of geographic infrastructure;

(d) Lack of regulations and frameworks for cooperation across borders and across public and private sectors;

(e) Uncertainty about overall benefits;

(f) Long payback periods.

VII. Conclusions

A. Planning for equitable and comprehensive policies

64. The energy transition requires holistic energy planning and coordination mechanisms across all levels and parts of Governments. While energy access is a precursor of many social benefits, realizing these benefits requires additional complementary policies or programming. Member States may build complementary policies in areas including education, economic development and health to work towards achieving all the Sustainable Development Goals.

65. The transition provides a valuable opportunity to rectify inequality and alleviate poverty. To reap these benefits, decision makers should strategize on how best to harness the direct and indirect benefits of the transition to help those who are most at risk of being left behind. For example, shifts toward renewable energy and energy efficiency create both jobs and economic value

from avoided costs. To benefit disadvantaged communities, policies and programmes may provide training and employment opportunities for the maintenance of equipment, or may structure energy efficiency loan programmes to transfer part of the value added to poor people. To ensure an inclusive planning process for distribution, roll-out, ongoing operations and maintenance, design teams should involve women and other marginalized local groups at all stages of the process.

66. Improved data and more accurate forecasts are essential to energy planning. The Asia Pacific Energy Portal provided by ESCAP is one potential resource, but agreement is needed on a common measurement framework such as the multi-tier framework.

B. Pathways for an equitable energy transition

67. **Electricity access.** The transition of energy access requires a combination of improved on-grid, mini-grid and off-grid electrification. Extension of the existing grid should take priority in areas where high demand justifies the high initial investment needed. In inaccessible or rural areas where population density and energy usage are low, access is best issued through off-grid or mini-grid renewable solutions. Policymakers may strategize on the best solutions based on the local context and resources available.

68. **Access to clean cooking.** It will be essential to rapidly scale up and deploy clean cooking solutions. Electricity, if produced cleanly, provides a strong long-term option, but in the interest of expediency, the following solutions are easier to deploy quickly. Where resources are available, biogas digesters are highly recommended as they best address health and environmental issues. Absent the necessary resources, liquefied petroleum gas provides the next best option, assuming that distribution is possible. Absent distribution channels, improved cookstoves provide a good alternative to traditional cookstoves.

69. **Renewable energy.** The renewable energy transition requires increased ambition in national policy commitments. Renewable energy portfolio standards, feed-in tariffs, targeted subsidies for modern renewables and auctioning programmes are all 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 a targeted subsidy for solar photovoltaic energy) and India (auctioning programme) are sources of regional lessons to be learned.

70. **Energy efficiency.** Energy efficiency requires greater action at all levels. Industry regulations, building codes, transport regulations and green energy loans could help to improve efficiency among high-intensity users. Among poor people, initiatives such as subsidies will be highly beneficial, improving both energy efficiency and access.

C. Equitable financing of the energy transition

71. Financing the energy transition requires official development assistance, domestic public finance and private sector investment, particularly for the last mile. Public-private partnerships are particularly effective, as demonstrated by the experience of China in building business models such as energy service companies. To support this, Governments can align financial incentives with energy goals and maintain a conducive business environment through long-term, reliable policies.

72. To ensure equity, financial plans should avoid regressive policies that disproportionately burden those with a lower income. Loans are effective tools to encourage high-intensity users to invest in renewables or energy efficiency, while clean energy subsidies provide an equitable solution for those with a low income who cannot take on the risks of a loan.

73. Phasing out untargeted, inefficient fossils fuels is an urgent step in the energy transition. Reforming fossil-fuel subsidies lower their usage and free up resources for the transition to cleaner fuel sources. Structured well, reform can also redistribute benefits to poor people, addressing issues of inequality.

VIII. Matters for the attention of the Commission

74. The Commission may therefore wish to consider providing guidance to the secretariat in the following areas:

(a) Key policies and initiatives to be addressed in its work on regional cooperation for sustainable energy development;

(b) How best to address the issues and challenges of inequality in the implementation of Sustainable Development Goal 7 and interlinkages with other Goals to ensure effective regional follow-up to and review of the 2030 Agenda for Sustainable Development.