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In-depth review of critical environment and development challenges and response strategies in Asia and the Pacific

Emerging challenges and trends in energy resources management

Note by the secretariat

Summary

The world is at an energy development crossroads. The combination of (a) waning fossil fuel resources that are increasingly concentrated and difficult to exploit, (b) large populations of rural poor people without access to energy, which keeps people in poverty, (c) concerns over climate change and other ill effects of the use of fossil fuels, and (d) unprecedented growth in energy consumption in large developing countries makes it clearer than ever that the historical pattern of energy use is unsustainable.

A transition to a low-carbon development path is urgently needed to produce co-benefits from sustainable energy consumption for economic development, poverty alleviation and the environment. In addition to mitigating climate change, a low-carbon development path may provide access to clean energy and development in poor rural areas through the expansion of energy services, alleviating the poverty of over a billion people.

A major challenge associated with moving towards a low-carbon development path will be to create an enabling environment where energy resources management takes full advantage of the market economy. Further analysis is required in order to develop an appropriate policy framework, financing mechanisms that take into consideration the creation of a level playing field of energy prices, and fiscal instruments designed to enhance the use of clean energy and energy efficiency, which are critical to meeting developmental priorities. Such an analysis could be useful at the regional level by making possible an exchange of experiences on various strategies and instruments used to transform the energy sector.

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I. Introduction

1. Asia and the Pacific is at a development crossroads on energy. The more than two billion in rural areas living on less than $2 per day lack access to clean, quality energy sources. The poor also suffer the most from degraded environmental quality due to pollution generated by energy use. At the same time, rapid economic growth in Asia and the Pacific has brought a huge rise in the aggregate energy use and has alleviated poverty to some extent.

2. Increased use of high-carbon energy fuels, causing noxious emissions, threatens public health and the environment. On the positive side, urbanization and industrialization, which accompany economic growth, present a wide range of opportunities to increase energy efficiency.

3. Global supplies of conventional high-carbon fuels are dwindling. Technological advances are making renewable energy more economically viable, and the global financial crisis has created a need for governments to stimulate renewed economic activity. These factors point to a need and a unique opportunity to redirect the region towards a low-carbon development path. A new synergy is now needed between technology and public policy to bring about a green energy

revolution that will set the region and the world on a low-carbon energy development path, which will be mutually beneficial both for poverty alleviation and for the environment and, thus, long-term economic sustainability. It will provide access to energy and gainful employment in the rural regions, where poverty is most persistent, while mitigating greenhouse gas emissions.

4. The transition to a low-carbon development path will require not only the involvement of the private sector but also national Governments and multinational and regional bodies. The objective of the present document is to sketch a sustainable and economically, technically, and politically feasible low-carbon development path for Asia and the Pacific, one that will have co-benefits for poverty alleviation, economic growth and the environment.

A. Development and energy

5. Although the region is on track to halve poverty by 2015, and, despite its rapid development, it is home to more than half of the world's poor. Over 900 million people are without access to electricity, and 1.7 billion rely on traditional biomass. Average per capita energy consumption in the region is approximately half the world average. Under the business as usual scenario, approximately $344 million will be required annually for energy infrastructure development in the region.[1] It would be critical for the region to formulate policy frameworks to develop the most appropriate strategies for countries to address the multitude of challenges involving poverty and global environmental sustainability.

B. Dwindling resources

6. As the region relies heavily on imported fossil fuel, the finitude of non-renewable coal, oil and gas is a major concern. Some projections suggest that worldwide supplies of oil are either at or nearing their peak and will decline soon.[2] Although indigenous coal in several countries of Asia and the Pacific seems to be plentiful, coal deposits actually appear very limited in view of current usage levels.

7. Unless new fossil fuel deposits are discovered at the same rate as the use of fuel increases, alternatives to the burning of fossil fuels as the primary energy source must be developed and in place within 30 to 50 years. For the total transformation and construction of a massive industrial infrastructure, this is a very short time period.

C. Environmental concerns

8. In addition to the energy issues raised above, concern about the impact of carbon dioxide (CO_2) on the global environment is greater than ever before.[3] Recent research and measurements suggest that climate change may occur more

[1] ESCAP, *Energy Security and Sustainable Development in Asia and the Pacific, 2008* (United Nations publication, Sales No. E.08.II.F.13).

[2] Steve Connor, *Warning: Oil supplies are running out fast*, The Independent, 3 August 2009, available at http://www.independent.co.uk/news/science/warning-oil-supplies-are-running-out-fast-1766585.html, accessed 23 June 2010.

[3] *Climate Change 2007: Synthesis Report*, Section 1. Observed changes in climate and their effects, Intergovernmental Panel on Climate Change, accessed on 8 June 2010 from http://www.ipcc.ch/publications_and_data/ar4/syr/en/spms1.html.

rapidly than previously expected[4] due to a rise in the level of greenhouse gases in the atmosphere, primarily CO_2 from the burning of coal, oil, natural gas and wood. Projections of economic loss due to climate change if nothing is done to avoid it – including losses from declining crop yields, rising sea levels and increased risks of floods and drought, among other damaging effects – range from 5 to 20 per cent of future per capita global consumption.[5] Burning of fossil fuels also has other negative environmental and social impacts, including severe air pollution affecting both human and ecological health.

D. A low-carbon development path

9. The looming question is how to divert development efforts towards economic development that both facilitates growth and poverty alleviation, and is environmentally sustainable. Such a development path needs to be increasingly based on low-carbon energy that will address both economic growth and poverty alleviation as well as environmental concerns, and therefore ensure long-run sustainability that is economically competitive, secure and stable.

10. A low-carbon development path provides an opportunity to identify a role for the energy sector favouring sustainable development that supports economic growth and social development in an environmentally sustainable manner.

11. Strategies to this end will involve a number of facets that would need to be tailored to the needs and circumstances of individual member States. One element that has been clearly highlighted as a barrier to clean energy is the subsidization of fossil fuels which occurs in many member States. This issue is challenging as it is often politically sensitive and may have a considerable impact on the poor if it is not managed carefully.

12. A public investment programme for the deployment of renewable energy technologies in developing countries, similar to the Green Revolution in agriculture, which largely involved South-South transfer of technology, may also assist the transition.[6]

13. However, any strategy for a transition to a low-carbon development path will require a thorough analysis of the financing options. More innovative financing schemes at micro and macro-levels will be needed in order to implement strategies for access to energy services, improving energy efficiency and scaling up renewable energy use. A mechanism to complement these strategies—through closer links to the emerging carbon market and domestic financing schemes—needs to be developed at the national level.

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[4] I. Allison et al, *The Copenhagen Diagnosis: Updating the World on the Latest Climate Science*, available at http://www.ccrc.unsw.edu.au/Copenhagen/Copenhagen_Diagnosis_LOW.pdf, accessed 18 June 2010.

[5] *Stern Review: The Economics of Climate Change Executive Summary*, available at http://siteresources.worldbank.org/INTINDONESIA/Resources/226271-1170911056314/3428109-1174614780539/SternReviewEng.pdf, accessed 23 June 2010.

[6] Tariq Banuri and Hans Opschoor, "Climate change and sustainable development", Department of Economic and Social Affairs Working Paper No. 56, October 2007.

E. Low carbon technology development options

14. With appropriate strategies that address developmental issues in an environmentally sustainable manner, low-carbon energy technologies can be effectively utilized given the wide range of options, however varied they may be in terms of cost, developmental stage and commercial readiness. Moreover, there are non-technical measures – such as changes in development patterns – that can bring major reductions in carbon emissions.

15. In most applications of energy, opportunities abound to increase energy efficiency by reducing energy use while achieving the same or at least equally desirable end results. Smart and efficient use of energy can decouple economic growth from energy demand.

16. Numerous and diverse technologies exist for capturing the virtually inexhaustible energy of the sun, either directly from solar radiation or from biomass, wind, tides, waves, rivers or oceanic temperature and salinity differences. Many of these technologies rely on forms of energy that are intermittent or difficult-to-store. Hence, further development of energy storage technologies is needed in order to maximize their total market potential. Abundant geothermal energy can be tapped also.

F. The problem of cost

17. A low-carbon development path is technically feasible given current technologies. Its feasibility will increase as those technologies are further refined and new ones are developed, and non-technical measures to improve development patterns are applied in tandem to maximize low-carbon outcomes.

18. The principal impediments to a low-carbon development path are financial. In many locations and applications, low-carbon alternatives cost more than high-carbon energy. Low-carbon systems, including energy efficiency, can incur more of their costs at the front end in capital costs and less in operating costs than high-carbon energy systems. Hence, they have a greater need for financing, but they also incur less cost uncertainty and offer greater energy security, since their costs do not depend on the unknown future costs of carbon fuels.

19. The *World Development Report 2010* states that “most renewable energy technologies are economically viable but not yet financially viable.”[7] That is, neither the economic benefits of low-carbon energy nor the deficits of high-carbon energy are fully internalized in their costs.

20. High-carbon energy is, in fact, subsidized in three ways: conventional subsidies, common resource subsidies, and a “natural inventory” subsidy, or failure to consider the replacement cost. If these subsidies that mask the economic costs of high-carbon energy were removed, or the costs were internalized into the cost of fossil fuels, low-carbon alternatives would probably be less costly in the long run. However, as mentioned above, the removal of subsidies needs to be managed in a careful manner to ensure that the poor are not overly burdened with the higher prices.

[7] World Bank, *World Development Report 2010* (Washington, D.C., 2009), p. 208.

II. Issues and challenges in the current energy sector

21. There will almost certainly be a need for a major Asian energy transition over the next 30 to 50 years. The path of the last 10 to 20 years, heavily dependent on coal and imported oil and gas, is unsustainable at the levels of growth currently seen in Asia. As identified in the ESCAP publication *Energy Security and Sustainable Development in Asia and the Pacific*,[8] there is a need to focus on the quality of growth rather than its quantity. Such a shift requires reviewing the fundamental structure of the energy sector.

A. Principal issues creating a need to restructure the energy sector

22. The energy sector, as currently constructed in virtually all developed and rapidly developing countries, is on an unsustainable path. Lack of access to clean, quality energy is a key factor helping to keep as many as 2 billion people in poverty. And given the danger of global climate change, CO_2 emissions from fossil fuels alone are enough to raise serious concerns, while other by-products pose health and economic development hazards as well.

23. It has been frequently noted that rapidly developing countries in Asia are massively increasing their fossil fuel use, while developed countries in Asia and the Pacific have been using large quantities of these fuels for some time.

24. But the energy growth of other Asian and Pacific nations, which are at earlier growth stages, may present the prospect of much higher carbon fuel use. Without a focus on contributing to poverty alleviation goals, there is a risk of undermining efforts to switch to a low-carbon intensity path. People should be at the centre of energy consumption due to the need to develop socially and economically. Therefore, if energy policies do not adequately address the needs of the people, there is a risk of creating a low-carbon society without having met the needs of the people, further exacerbating poverty.

25. Given the need to ensure the proper linkage between the energy sector and poverty reduction, projected increases in fossil fuel demand, supply constraints and environmental constraints could become serious problems. While the use of fossil fuels needs to be managed in a more environmentally sound manner, there is a general concern over the limited deposits of fossil fuels, especially oil, the premiere transport fuel, and the safe transport of those fuels. As a result, supplies may become increasingly insecure, entailing political tensions and price volatility. All of these indicators point to an urgent need to restructure the energy sector.

B. Challenges to restructuring

26. The first challenge is to introduce an appropriate policy framework with clear targets based on studies that quantify the energy efficiency and renewable energy potential. Such a process will enable policymakers to clearly identify the benefits at the national level and lead to a better chance to ensure strong political commitment in promoting energy efficiency and renewable energy.

27. Under such a policy framework, the main goal in pursuing a low-carbon development path will be to decouple energy demand from economic growth. In

[8] United Nations publication, Sales No. E.08.II.F.13.

many cases, with appropriate policies and institutional arrangements, energy efficiency is financially highly viable. The challenge is to provide case-by-case information and analysis of financial and technical feasibility. Financial and technical analysts need to work together closely to understand the benefits of energy efficiency and to find ways to finance and implement it. Information needs to be made widely available on a range of energy efficiency improvements that can be made in industry, urban and transport planning, building design, electric power systems and motor vehicles, among other things. Regional bodies and cooperative organizations, such as those governing voluntary collaborations among cities, can help to compile and disseminate this information as well as good practices.

28. The second challenge is to implement low-carbon energy supply technologies. Although costs are coming down, the financial cost of low-carbon technologies is, in most cases, still higher than the cost of continuing to use carbon-based fossil fuels for power development. The cost of low-carbon alternatives also tends to be concentrated in capital costs at the front end of the project cycle, creating a greater need for long-term financing. Solar power plants that produce electricity, for example, have high front-end costs but essentially no cost associated with their "fuel" for decades thereafter. By contrast, for high-carbon energy plants, fuel presents the bulk of the cost.

29. Furthermore, in most countries, fossil fuel-based energy is already embedded in the infrastructure design and use. The conventional wisdom that alternative energy sources entail higher costs compared with carbon-based fuels needs to be challenged. Are carbon-based fuels truly cheaper in an economic sense? Their lower costs can be attributed in large part to three kinds of subsidies:

(a) *Conventional subsidies*. From price controls to producer subsidies to government-subsidized research to armed protection of transport routes, these are difficult to identify and value. They stem from the historically central role of fossil fuels and they help to continue the momentum towards keeping those fuels central. The International Energy Agency estimated that these subsidies amount to $557 billion per year;[9]

(b) *Common resource subsidies*. CO_2 emissions and other by-products that entail an expected long-term cost for the global population and the environment are, for the most part, not internalized in carbon-based fuel prices;

(c) *"Natural inventory" subsidies*. Once fossil fuels—a non-renewable resource—are used up, finding alternative reserves or resources becomes increasingly expensive and possibly unviable economically.

30. There are challenges to internalizing all of these unaccounted-for costs. Direct subsidies to the poor would need to be instituted to smooth the way through the increase in carbon-based fuel costs to the eventual improved development path using low-carbon energy. Since it is mainly the middle class, not the poor, in developing countries that use significant quantities of carbon-based fuels,[10] these

[9] Javier Blas, "IEA counts $550bn energy support bill", Financial Times, 6 June 2010, http://www.ft.com/cms/s/0/27c0ff92-7192-11df-8eec-00144feabdc0.html?ftcamp=rss, accessed on 6 June 2010.

[10] GTZ, *International Fuel Prices 2009* (6th Edition), GTZ Transport Policy Advisory Services, p. 2.

subsidies would be lower than is commonly assumed, but they would be significant.

31. Beyond the issue of national energy pricing, further financing is required to ensure a smooth transition to alternative energy sources. Many of these sources are technically viable, need no demonstration and are slowly becoming more affordable. A range of financing mechanisms is needed to stimulate investment at various levels nationally and internationally. Funds are often available but not accessible for a number of reasons. For example, private investors do not often finance energy efficiency projects in many countries because dedicated sources of financing are lacking and local banks are generally unfamiliar with such investments. Financing energy efficiency projects tends to be unattractive in the absence of policy and institutional support for their implementation. The lack of knowledge and experience of how to select and formulate energy efficiency investment projects is often a challenge for local experts and a barrier to market formation.

32. A regional programme that focuses on good financing experiences and enables funds to be accessed in a manner that reduces the risk for all parties could assist national efforts. Another option may be to form a regionally and globally managed programme organized and funded by a collaboration of foundations, governments and global institutions.

III. New thinking for the energy sector – technology, policies and financing

33. A common but mistaken assumption—which impairs thinking with regard to sustainable development—is that what is good for the environment is bad for economic growth, and vice versa. If, however, consideration is instead given to which energy path would be best for stable, secure and sustainable economic growth for the next 100 years, the low-carbon path clearly becomes the better option. This judgment holds without even considering environmental implications.

34. The challenge lies in managing the transition. Most important is to bring the 2 billion people who live on $2 per day out of poverty. A new financial mechanism to facilitate a transition to a low-carbon development path will be helpful in this regard. It should promote technologies and knowledge dissemination for cleaner and more efficient energy use and provide increased access to clean energy. Low-income rural dwellers will enhance their incomes and stimulate local economies by being key participants in the manufacture, distribution, operation and maintenance of the technologies, as well as in the dissemination of information.

35. Some fossil fuel use may also play a role in poverty alleviation—for example, when small farmers graduate from rain-fed agriculture to low-cost human-powered irrigation, then to diesel pumps—but it will be small compared to the world's total fossil fuel use. It has been estimated that increasing access to electricity services and clean cooking fuels in many low-income developing

countries, particularly those in South Asia and sub-Saharan Africa, would add less than 2 per cent to global CO_2 emissions.[11]

36. If appropriate economics and policies are pursued, a low-carbon development path can substantially benefit not only the environment but also developing and developed countries in terms of their economic and social development.

37. A transition to low-carbon energy will provide a major economic stimulus, as did many previous transformations of social and industrial infrastructure: the building of railroads in Europe and the United States of America in the nineteenth century; the spread of radio in the early twentieth century; the electrification of homes in the United States in the 1950s; and the development of the Internet in the 1990s. In many of these examples, technology was the key, but well-thought-out policies and programmes catalysed the transformation.

38. A large number of jobs ranging from highly skilled to semi- and low-skilled will need to be created to effect the transition. The Asia-Pacific region is in a unique position to lead for several reasons:

(a) Its need is greatest because of rapid growth in energy demand;

(b) The costs of the transition are lower in the region's developing countries than in more developed countries because a smaller percentage of the required energy infrastructure is already in place;

(c) The region has a large number of motivated and increasingly skilled workers.

39. The technology, policy and financing shifts that will need to be implemented in the future on a much larger scale are reviewed in the present section.

A. Reducing energy demand through more efficient use

40. Energy efficiency improvements should be viewed as a source of energy supply, on par with the discovery or procurement of new fuel sources. Increases in energy efficiency free up supplies that can be used for other purposes, and end-use energy efficiency compounds the primary energy savings, often by a factor of two or three. For example, one kilowatt-hour of final electricity saved often equates to two or three kilowatt-hours of electricity that does not need to be generated.

41. Energy efficiency can be defined as any reduction in energy use that achieves the same or at least equally desirable results. Increased energy efficiency can be achieved either through a change in technology or technological design, a change in management mindset, or a change in development patterns.

42. There are a number of key sectors that have great potential for energy efficiency improvements. According to the *World Development Report 2010*, manufacturing accounts for one third of global energy use, and the potential for

[11] World Bank, *World Development Report 2010*, 2009, p. 191; R. Socolow, "Stabilization Wedges: Mitigation Tools for the Next Half-Century." Paper presented at the World Bank Energy Week, Washington, D.C., 2006.

energy savings in industry is particularly large in developing countries.[12] This potential tends to reflect the level of industrialization of a country, however, as some least developed countries and small island developing States may not have a large manufacturing base. Likewise, some of the more developed economies have shifted towards services, which is generally less energy-intensive. Nevertheless, there is clearly great potential in those industrializing countries that rely on energy-intensive industries for economic development.

43. Targeting energy efficiency programmes at industry allows large, concentrated improvements in energy efficiency if industries are encouraged and are well informed and financing is available. The negative aspect is that improvements are often capital-intensive, and either financing mechanisms are not available or industries do not have sufficient knowledge of how to access financing to fund retrofitting or plant improvements. Some countries have been very successful in involving and building the capacity of local financing institutions in the development of funds and the assessment of loans for this purpose.

44. After industry, urban planning presents one of the most significant opportunities for saving energy. Cities emit 70 to 75 per cent of global CO_2 emissions.[13] The design of infrastructure such as buildings, transport systems and municipal services locks people into consumption patterns for decades. Urbanization leads to increased consumption rates for energy, water, materials and ecosystem services, and to significant displacements in natural ecosystems. Urban infrastructure systems determine the delivery of services to communities and can support or hamper economic growth. For example, traffic congestion costs, including incremental delays, driver stress, vehicle costs, crash risk and pollution resulting from interference between vehicles in the traffic stream, which can be as high as 6 per cent of GDP,[14] and poor-quality transport infrastructure have been found to negatively influence the competitiveness of urban areas.

45. Urban planners have to consider the numerous interconnections among housing, water, energy, solid waste, telecommunications and transport, which have not yet been adequately recognized. First, there is little integration of environmental and social aspects into the stages of infrastructure development from planning, financing and building to management and operation. In addition, there is limited coordination among economic, environmental and social aspects in policies and institutions. Another dimension is fragmentation between sectors,

[12] World Bank, *World Development Report 2010*, 2009, p. 211; and *Energy Technology Perspective 2008: Scenarios and Strategies to 2050*. Paris: International Energy Agency 2008.

[13] C40 Cities, http://www.c40cities.org/climatechange.jsp, accessed 18 June 2010; Timothy Gardner, "NYC among 21 cities to disclose carbon output", Reuters, 11 August 2008, available at http://www.reuters.com/article/idUSN0831199520080811, accessed 18 June 2010; United Nations Environment Programme, Local Authorities Statement, Eleventh Global Major Groups and Stakeholders Forum, 22 February 2010, available at http://www.unep.org/civil-society/LinkClick.aspx?fileticket=5K38DQP4vg8%3d&tabid=2910&language=en-US, accessed 18 June 2010.

[14] Report on the First Asia-Pacific Mayors' Forum on Environmentally Sustainable Urban Infrastructure Development, Ulsan City, Republic of Korea, 21-23 April 2008.

which causes distortions in the allocation of public resources. The result is a waste of natural resources, duplication of efforts and inefficient coverage.[15]

46. Means of encouraging and facilitating efficiencies and shifts to low-carbon energy use should include both technology and lifestyle/work-style solutions. The goal of energy efficiency should be embedded in city planning, building codes and standards. Transport planning should coordinate city planning with the planning of rails, highways and other transport systems, and should facilitate relatively low-carbon transport forms, such as mass transport, bicycles and plug-in hybrid, electric and other low-carbon-emitting vehicles.

47. Furthermore, collaborative efforts among city governments to achieve highly efficient cities, such as the C40 Cities (Climate Leadership Group), can supplement collaboration and coordination among countries. This is especially true since the spread of geographically linked metropolitan areas and other urban configurations is creating what the United Nations Human Settlements Programme calls "mega-regions" — urban configurations that are the new engines of global and regional economies.

B. Rural development and agriculture

48. If inefficiency and fragmentation are concerns for urban infrastructure, the challenges for rural areas are more fundamental. Electricity grids are often too expensive to be extended to remote areas. Decentralized systems for energy have failed in some instances due to limited training and lack of the skills needed in order to use these technologies. Failure to consider the role of these services in people's lives leads to poor policy formulation and inadequate service provision.

49. In addition, as the rapid growth of the past three decades has been driven mainly by industrial activity, agriculture has been neglected. Stagnant agricultural productivity, lack of rural infrastructure, incomplete land reform and poor basic service delivery are some of the manifestations that form a vicious circle of agricultural neglect.[16] Changing agricultural practices can substantially reduce energy use and even sequester CO_2. Providing better services for rural areas will not just help cover the basic needs of the rural population; it will also lead to increased agricultural production for improved food security and will control increasing income inequality, thus improving social cohesion as well as the rural ecological system.

C. Lowering carbon intensity within the fossil fuel sector

50. A significant way to lower carbon intensity within the fossil fuel sector is to switch from coal to natural gas. Natural gas emits about half as much CO_2 per unit of energy output as coal, making it an ideal fuel for a transition to a low-carbon future. Natural gas already provides a large and growing share of the primary fuels for electric power. Better internalization of the expected cost of CO_2 emissions into the prices of fuels could help speed this increase.

[15] ESCAP, "Report on the Expert Group Meeting on Sustainable Infrastructure Development in Asia and the Pacific", Bangkok, 11-13 June 2007.

[16] ESCAP, *Economic and Social Survey of Asia and the Pacific 2008* (United Nations publication, Sales No. E.08.II.F.7), p. 124.

51. Interregional development of stranded gas wells through pipeline expansion can help facilitate a shift from coal to natural gas. Cooperation in the planning and construction of multi-country energy infrastructure is a crucial function of supranational bodies. The Association of Southeast Asian Nations (ASEAN) has played a major role in the planning of the Trans-ASEAN Gas Pipeline and ASEAN Power Grid. In addition, regional cooperation is required in order to coordinate and harmonize pricing, taxation, regulation and standards, and can be expanded to other trans-energy systems, such as electricity networks.

52. Another way of lowering CO_2 emissions from fossil fuels is to capture them from the exhaust stream of coal-fired power plants and store them in underground caverns or perhaps in some other form, secured by chemical bonds. Continued research and pilot projects are needed to develop this technology, lower its cost, and increase its efficiency. It has the long-term potential to allow the continued use of relatively abundant coal, while also mitigating global climate change.

D. Renewable energy

53. An array of technologies is available to capture the renewable energy of the sun, as well as the developed technology of geothermal energy. None of these rely on limited fossil fuel deposits or release appreciable CO_2.

54. Renewable energy sources include direct solar, wind, biomass, ocean energy (waves, tides, salinity gradient and ocean thermal), hydropower and geothermal. None of these energy sources emit net greenhouse gases; even biomass, which emits CO_2, recaptures it if the biomass is regenerated.

55. Asia, especially China, has already become one of the chief global drivers of renewable energy development: manufacturing, installing and exporting wind turbines, solar cell arrays, and other forms of renewable energy technology.

56. Although renewable energy still constitutes less than 10 per cent of all the energy used globally, mostly in the form of large hydropower and traditional biomass, the use of renewable energy has been increasing extremely rapidly in recent years. Since 2004, many indicators of renewable energy have shown dramatic gains.

57. Annual renewable energy investment reached $162 billion in 2009, and renewable sources represented about 25 per cent of global power (electricity) capacity and 18 per cent of global power production. Renewables constitute about 60 per cent of newly installed power capacity in Europe and more than 50 per cent in the United States; the world as a whole should reach or exceed 50 per cent by 2011. New clean energy investments in the first quarter (often the most subdued quarter of the year) of 2010 were up more than 50 per cent on the same three months of 2009.[17]

58. These numbers are impressive, but the starting point was low. Much more renewable energy development will be necessary in coming years to meet the demand for low-carbon energy. The *World Development Report 2010* states that

[17] Renewable Energy Policy Network for the 21st Century, *Renewable Global Status Report 2010* (Paris, REN21 Secretariat), http://www.ren21.net/globalstatusreport/REN21_GSR_2010_full.pdf, accessed 16 June 2010.

"most renewable energy technologies are economically viable but not yet financially viable, so some form of subsidy (to internalize the externalities) is needed to make them cost-competitive with fossil fuels. Adopting these technologies on a larger scale will require that fossil-fuel prices reflect the full cost of production and externalities, plus financial incentives to adopt low-carbon technologies."[18]

E. Nuclear energy

59. Nuclear energy could also be an important part of the low-carbon energy portfolio. Nuclear energy is a large-scale technology with major requirements for highly trained personnel and capital and long lead times from groundbreaking until a power plant comes on line. From the perspective of waste generation, nuclear energy has long-term environmental implications which need to be carefully managed by trained personnel.

60. Due to the slump in the construction of nuclear power plants over the last 30 years, the industry to supply nuclear construction has fallen to a low capacity. To the extent that nuclear energy must contribute to the future low-carbon development path—and research studies need to be conducted on an urgent and continuing basis to help determine the size of that contribution—governments and international development banks may need to play a role in financing not only the nuclear power plants themselves but also the education of skilled technicians who will be needed to build and operate them, and the methods for dealing safely and effectively with the waste those plants generate.

F. Considering a new financing mechanism

61. Financing for low-carbon energy technologies is more complex than rebate or grant programmes. But the benefits of financing, including the potential for leverage and for low subsidization or none at all, provide new opportunities for overcoming barriers to the adoption of energy efficiency measures and increasing the use of renewable energy. In sustaining the transition to a low-carbon development path, it would be necessary to build into national strategies at least one financing mechanism. Financing mechanisms could be approached from two angles: one from domestic resources and another from the regional and international communities.

62. Domestically, funds may be available but not allocated to the best uses or they may be inaccessible by those who require them. Institutional structures play an important role in assessing the flow of domestic funds and ensuring that these funds are utilized in the most effective manner. Energy efficiency, as discussed above, can be considered a source of energy by itself. Many countries have successfully channelled funds saved through energy efficiency actions back into programmes to support energy efficiency. Again, this is often an institutional issue in which a holistic approach to energy sector management is required. Many microfinancing opportunities have also been developed and successfully implemented in Asian developing economies, such as financing clean energy for rural women by Grameen Bank in Bangladesh and providing loans for specific energy efficiency products for households in Mongolia by Xac Bank.

[18] World Bank, *World Development Report 2010*, 2009, p. 208.

63. Larger scale programmes involving the development of a domestic fund can be exemplified by Thailand, which has in place an energy conservation fund based on a small levy on petroleum. China has also developed a fund from a levy of all clean development mechanism activities in the country.

64. Internationally, there is a major increase in development assistance flows for propelling clean energy technologies in developing countries. For example, such flows on renewable energy jumped to over $5 billion in 2009, compared with some $2 billion in 2008. The largest providers are the World Bank Group, Germany's KfW, the Inter-American Development Bank and the Asian Development Bank. Dozens of other development agencies provide growing amounts of loans, grants, and technical assistance.[19]

65. Private sector funding is available for many countries, though barriers often include risk management and the capacity of those seeking funding to develop clear business plans and financing proposals. In 2009, private sector green energy investments in Asia and Oceania, worth $40.8 billion, exceeded those in the Americas, which totalled $32.3 billion, for the first time.[20] There is great potential for working with national financing institutions and governments to improve the investment environment. Regional cooperation can also help through the sharing of experiences in the implementation of successful financing mechanisms.

G. Internalizing externalities in tax and pricing policies

66. Policies for implementing a low-carbon development path must be based on an understanding of social impacts and inequities and sound economic principles. Subsidies for low-carbon energy that are not carefully thought through and are not rooted in economics may prove unsustainable and may hurt low-carbon industries and people.

67. The principle of internalizing externalities is a good guideline. Benefits accruing to low-carbon energy, either through removing subsidies on high-carbon energy or by providing incentives for low-carbon energy, should not be greater than those needed to internalize the economic externalities—in other words the public subsidies or public costs—imposed by high-carbon fuels. Two means have been widely used to address this issue.

68. The first is to impose a cost on fossil fuels to compensate for, and deter, CO_2 emissions into the atmosphere. This cost can be in two forms: international and national cap-and-trade systems and national carbon taxes.

69. A concern about "green" taxes or their equivalents, which levy a cost on fossil fuels or their emissions, is that they will most detrimentally impact the poor. The World Bank found, however, that green taxes can in fact be either regressive or progressive, depending on a country's economic structure.[21] A recent study in China suggested that, as consumption in poor households is much less carbon-intensive than that of better-off households, recycling carbon tax revenues into the

[19] See note 17.

[20] Ibid.

[21] World Bank, *World Development Report 2010*, 2009, p. 47.

economy would lead a green tax to produce a net progressive effect.[22] Recently, the Government of Indonesia decided to gradually remove subsidies on gasoline and use the funds for poverty reduction.

70. The second means is to provide a subsidy for renewable energy, such as a "feed-in" tariff, instead of (or in addition to) imposing a cost on fossil fuel emissions. Typically, a government requires electric utilities to offer a long-term contract for the purchase of electricity at a high kilowatt-hour rate to anyone who installs equipment for producing electricity based on renewable energy. The programme must be designed with care so that the tariff is sufficient to incentivize renewable energy but not so great as to be financially unsustainable for utilities or government.

71. Some European experiences with feed-in tariffs have been positive. Germany, for example, has become a leader in the installation of photovoltaic arrays. Other experiences, however, have had downsides, as in Spain, where the economic crisis caused the Government to cut back on the programme, delivering a blow to Spain's burgeoning renewable energy industry.[23]

72. Programmes to internalize externalities and either de-incentivize high-carbon or incentivize low-carbon energy should be coordinated through international agreements in order to harmonize tax policies, regulation and pricing across countries. Asia and the Pacific could consider a regional carbon mitigation agreement and process similar to, though in detail different from, the United Nations Framework Convention on Climate Change.

73. For example, the developing countries of Asia that have ratified the Kyoto Protocol[24] could consider creating regional programmes and agreements on carbon mitigation in the form of carbon trading regimes, such as the cap-and-trade mechanism, or internationally harmonized carbon taxes, or some other structure. The creation of such agreements could be guided by both the successes and failures of the Kyoto process as well as by considerations unique to the region.

H. Encouraging private sector participation to facilitate low-carbon energy development

74. The involvement of the private sector in clean energy development has great potential. For example, energy service companies can provide energy-efficiency and renewable energy services as well as financing for these technologies, but, because their revenues depend on energy savings, commercial banks have perceived them as high-risk borrowers. Financing, technical support and favourable policies from governments and international development banks can help strengthen this important energy industry sector. For example, after a decade of support from the World Bank, the energy service company industry in

[22] M. D. Brenner, M. Riddle and J. K. Boyce. "A Chinese sky trust? Distributional impacts of carbon charges and revenue recycling in China". Energy Policy 35 (3): 1771-84. 2007.

[23] Angel Gonzalez and Keith Johnson, "Spain's solar-power collapse dims subsidy model", *The Wall Street Journal*, 8 September 2009, http://online.wsj.com/article/SB125193815050081615.html, accessed 8 June 2010.

[24] FCCC/CP/1997/7/Add.1, decision 1/CP.3, annex.

China grew from three companies in 1997 to more than 400, with $1 billion in energy performance contracts in 2007.[25]

75. Governments can also support some renewable energy demonstration projects in partnership with private companies, especially when these projects are connected national infrastructural plans, such as electrical and transport systems. More importantly, strategies should be scaled up to replicate successful demonstration projects. Governments could also cooperate in public/private advanced planning of interregional electrical networks.

I. Education, training and regional technology transfer

76. The shift to alternative energy sources and realizing energy efficiency potential will require a new army of highly skilled, semi-skilled and low-skilled workers. Educating these workers will require a massive effort that can be nurtured by the public sector but may be carried out largely by the private sector. Education, training programmes, urban and national planning, and policy should also reinforce an energy efficiency culture.

77. Regional centres for joint research and development and regional projects can contribute the diverse perspectives of many countries to the research and development process and facilitate technology innovation and transfer. The development of a network of electric car recharging stations, for example, could be launched in one country but with the cooperation and joint funding of other countries. Such centres should also conduct programmes on interregional integration of energy technologies. Regional programmes and assistance can help in the transfer of technologies both from richer countries to poorer ones and from less poor developing countries to those that are poorer. Highly developed technologies appropriate to wealthy countries are not always those that can help poor countries or regions on their path out of poverty. Frequently, less highly developed, lower cost technologies can help.

J. Taking full advantage of the financial and economic crisis

78. The current global financial crisis presents an opportunity for an entire energy infrastructure to recede and another one to rise and take its place. Perhaps much of the innovative talent formerly used for financial innovation can be channelled into creating the new global energy infrastructure that will be needed urgently, sooner or later.

79. The World Bank's *World Development Report 2010* states that "the financial crisis…offers opportunities to shift to a low-carbon economy...First, stimulus investments in energy efficiency, renewable energy and mass transit can create jobs and build an economy's productive capacity. 'Green stimulus' efforts since late 2008 by both developed and developing countries have totalled close to $200 billion, although most were slow to start and less than 10 per cent of green stimulus funds was spent during 2009.[26] Second, falling energy prices provide a unique opportunity to implement programmes to eliminate fossil-fuel subsidies in emerging economies and adopt fuel taxes in advanced economies in ways that are

[25] World Bank, *The Development of China's ESCO Industry, 2004–2007*. Washington, D.C., 2008.

[26] See note 17.

politically and socially acceptable."[27] Furthermore, "low-carbon technologies could generate a net increase in jobs, because they can be more labour intensive than high-carbon sectors."[28]

80. These points are important to reiterate. First, to get economies moving again, nearly all national Governments and some supranational ones, such as the European Union, are providing fiscal stimuli to increase aggregate demand and spur job growth. These programmes should be at least partially coordinated with transnational efforts to transform the global energy infrastructure, and to base it on less fossil fuel-dependent, lower carbon resources.

81. Second, the falling prices for fossil fuels provide a unique opportunity to tackle the sensitive issue of energy pricing, subsidies and taxation. Third, a low-carbon energy infrastructure is likely to provide more jobs, and a wider skill range in job descriptions, than the previous high-carbon energy path. Hence, directing fiscal stimuli towards creating the low-carbon economy is a strategy ideally suited to economic prescriptions that help lift economies out of deep recessions.

IV. Summary and recommendations

82. In the past few decades, the Asia-Pacific region has exhibited impressive economic growth, leading to some poverty reduction success. However, this growth did not necessarily ensure an improvement in the quality of life for all and had direct correlation to the increased consumption of energy resources and degradation of environmental quality. As stated in the ESCAP publication entitled *Energy Security and Sustainable Development in Asia and the Pacific,*[29] the paradigm needs to change to focus on the quality of growth that contributes to reducing poverty in an environmentally sustainable manner.

83. A low-carbon development path provides an opportunity to identify the role of the energy sector towards sustainable development that supports economic growth and social development in an environmentally sustainable manner.

84. The low-carbon development path demonstrates its strengths in having co-benefits in developing and implementing its strategies. Co-benefits contribute to meeting developmental priorities in a sustainable manner while addressing climate change issues (adaptation and mitigation). For example, a contribution towards alleviating poverty can be made by widening access to energy services, reducing the impact on health by improving air quality through the use of clean energy, making the economic sector more competitive through the efficient use of energy and increasing the share of clean energy, including renewables.

85. In moving forward with the low-carbon development path, a major challenge will be to create an enabling environment that takes full advantage of the market economy. Further analysis is required in order to create a level playing field of energy prices combined with fiscal instruments designed to enhance the use of clean energy and energy efficiency, which are critical to meeting

[27] World Bank, *World Development Report 2010*, 2009, p. 190.

[28] S. Fankhauser, F. Sehlleier and N. Stern. 2008; *World Development Report 2010*, World Bank 2009, pp. 58-59; *Climate Change, Innovation and Jobs*, Climate Policy 8: 421–29.

[29] United Nations publication, Sales No. E.08.II.F.13.

developmental priorities. Such an analysis could be useful at the regional level by making possible an exchange of experiences on various strategies and instruments used to transform the energy sector.

86. Regional cooperation can assist member States in building their capacity to develop national strategies towards a low-carbon development path through the sharing of knowledge and experiences and promoting policy dialogue in the following context:

(a) Recognizing that development is the main priority in many developing countries of Asia and the Pacific, a low-carbon development path provides an opportunity to contribute towards this objective in a more sustainable manner. The policy framework to promote a low-carbon development path needs to clearly demonstrate the benefits of both co-benefits and strategies for removing barriers in order to reap the co-benefits. Member States interested in pursuing the low-carbon development path will benefit from more analysis based on existing policies, with a clearer analysis of co-benefits, in particular, the benefits for development;

(b) In order to promote a better understanding of the co-benefit approach towards a low-carbon development path, it would also be necessary to enable interested countries to quantify clearly the developmental challenges in the context of the Millennium Development Goals and other international agreements that the energy sector could address;

(c) Translation of national goals in order to enable wider access to energy services needs to be strategized through innovative policies, financing schemes and the participation of various stakeholders;

(d) Widening access to energy services for the poor may lead to an overall increase in energy consumption for some countries. However, the energy efficiency potential in many of these countries, particularly in urban areas, could go a long way towards offsetting this possible increase in consumption;

(e) It is important to quantify energy efficiency and renewable energy potential at the national level in order to assess the implications for (i) energy security; (ii) climate change; and (iii) a country’s competitiveness;

(f) Application and utilization of appropriate technologies in developing these strategies would be essential in order to assess their financial implications. There is a need to better understand the long-term socio-economic and environmental costs and benefits in the choice of technologies. Technology transfer would be necessary in order to assist developing countries in accelerating the process;

(g) More innovative financing schemes at the micro- and macrolevels will be needed in order to implement strategies for access to energy services and fostering energy efficiency. A mechanism to complement these strategies—through closer links to the emerging carbon market and domestic financing schemes—needs to be developed at the national level.