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Low Carbon Development
Summary Sheets

Energy systems in a low carbon economy

Key message: There is a significant opportunity for developing countries to leap-frog the carbon-intensive energy pathways of developed countries, thereby helping to mitigate the effects of climate change while generating multiple developmental co-benefits. Growing evidence suggests that the shift to low carbon energy in developing countries can lead to poverty reduction, job creation, economic benefits and increased energy security. In particular, higher energy productivity, the scale-up of renewable energies and off-grid electricity solutions for rural communities can generate triple wins for developing countries.

Introduction

A radical transformation of the energy sector is necessary in developed and developing countries to move to a low carbon future. This requires a shift to energy efficient and low carbon technologies that not only displace inefficient power plants, but also meet the rapid growth in electricity demand, while maintaining an affordable and reliable service to consumers. Radical changes are required on the supply and demand side through a different technology mix and incentivising large-scale energy efficiency improvements.

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1. **A global energy revolution is required to reduce carbon dioxide (CO_2) emissions to under 450 ppm.** To achieve the 450 ppm trajectory, global climate-energy models, such as the International Energy Agency's (IEA) Technology Perspectives, call for aggressive energy efficiency measures that may comprise as much as two-thirds of greenhouse gas (GHG) abatement in 2020[1 2 3 4 5]. In addition, most models project that fossil fuels would need to drop from 80% of energy supply today to between 50% and 60% by 2050 with widespread use of carbon capture and storage (CCS) technology, which would have to be installed in 80% to 90% of coal plants by 2050.

2. **The significant reduction in fossil-fuel use would need to be offset by renewable energy and nuclear power.** According to the above quoted studies, the contribution of renewable energy to the global energy mix would jump from 13% today to between 30% and 40% by 2050, dominated by modern biomass with and without CCS. The remainder would come from solar, wind, hydropower and geothermal. Nuclear would also need a boost - from 5% today to between 8% and 15% by 2050. The power sector would need to be virtually decarbonised[1 2 3 4 5].

3. **According to projections from the IEA, global energy demand will be 36% higher in 2035 compared with 2008 levels.** Non-Organisation for Economic Co-operation and Development (OECD) countries will account for 93% of the increase, experiencing high rates of growth in industrial production, population and urbanisation during the projected period[6]. China contributes 36% to the projected growth in global energy consumption, its demand rising by 75% between 2008 and 2035. India comes second accounting for 18% of the rise by 2035, with its energy consumption more than doubling over the projected period. According to IEA's New Policy Scenario, more than 30% of global abatement between now and 2030 will need to come from large emerging economies such as India, China and Brazil to reach the 450 ppm objective[6].

4. **Low carbon energy solutions can contribute to improved energy security.** Many developing countries, in particular emerging economies such as India and China, are increasingly dependent on fossil-fuel imports to meet their growing energy demand[7]. The scale up of low carbon technologies and decentralised energy solutions in these countries would result in less dependency on politically unstable oil and gas exporting regimes and rapidly depleting resources, and could improve the security of energy supply in the medium to long term.

5. **Energy mitigation pathways in developing countries differ significantly depending on their economic structures, resource endowments, and institutional and technical capabilities.**

A few examples are given below:

- **India**, like China (see case study on the next page), relies heavily on coal, accounting for 53% of its commercial energy demand. To achieve the 450 ppm emissions trajectory, the share of coal in the energy mix would have to be reduced dramatically. A large potential exists for improving energy efficiency and reducing losses in transmission and distribution. Also, hydropower, solar thermal and offshore wind potential is considerable (though insufficient in relation to future energy needs). Untapped possibilities exist to import natural gas and hydropower from neighbouring countries. Some models suggest that India would need to rely on biomass to supply 30% of its primary energy by 2050, though this would have negative impacts on agriculture, forestry and water supply. India has limited CCS sites available[5].

- **Brazil's** power generation matrix, in contrast, is one of the cleanest in the world. Hydroelectric plants account for 85% of all electricity generated. The emissions generated by the power sector account for only 1.5% of the country's total emissions. Future growth will mean that sector emissions will triple by 2030. Despite the relatively high growth, the share of emissions from the power sector in Brazil will be limited to around 3.5%, much lower than the global average[8].

- **Sub-Saharan Africa** (excluding South Africa) contributes just 1.5% of global annual energy related CO_2 emissions today, an amount projected to grow to 2% or 3% by 2050. Providing basic modern energy services to this region should be the top priority[5].

- **Most remaining developing countries**, even Least Developed Countries, would need to boost their production of renewable energy to help maintain global emissions under the 450 ppm CO_2 equivalent threshold. Africa, Latin America and Asia could contribute by switching to modern biomass. Latin America (see Brazil's example above) has substantial hydropower potential, although the amount could be affected by a less reliable hydrological cycle resulting from climate change[5].

6. **Significant financial flows are needed to make the low carbon transition, requiring policy measures that facilitate private-sector investment as well as public-sector initiatives.** Developing countries, in particular, will require significant financial flows to enable them to make the necessary investments, and technical and capacity building assistance. Estimates suggest that the required annual sum of investments range from about USD100 billion to USD160 billion between 2010 and 2020[9]. Funding to developing countries could be channelled through market-based mechanisms (such as the Clean Development Mechanism), multilateral financing (such as the World Bank Climate Investment

Case study
China

Since 1990, China's economy has grown fourfold, resulting in more than a doubling of energy use.

China's transition to a low carbon economy will require significant decarbonisation of the power sector. A mix of nuclear, more efficient coal technologies, CCS, wind, solar and other renewable generation technologies is needed. With coal accounting for around 65% of total primary energy supply today, attention should be given to using coal more efficiently in power generation and industry, and CCS.

Further energy efficiency improvements could save an additional 3.9 Gt CO_2 in 2050 compared with the baseline scenario. Targeted energy policies will be needed to realise these savings. Deploying these technologies will help to improve China's energy security as it reduces the need for imported fossil fuels. In IEA's BLUE Map Scenario, which envisages a 50% reduction of global emissions by 2050 through the deployment of existing and new technologies, oil demand in 2050 is less than half the level of the baseline scenario. Coal demand drops by 70%.

Achieving these changes in China will require additional investments of USD10.2 trillion between 2010 and 2050. Many of the investments will result in reductions in fuel consumption and total fuel savings are estimated at USD19 trillion.[1]

Funds directed through state, public and private finance sectors) and policy frameworks that direct private investments towards cleaner energy sources.

7. **Efficiency gains in energy production and consumption will have huge potential to drive down emissions in developing countries.** This is particularly the case in emerging economies such as China, India and South Africa. Apart from reducing emissions, the deployment of energy efficient technologies can deliver significant co-benefits. Recent analysis by McKinsey's Global Institute shows that by deploying existing energy efficient technologies, which would pay for themselves through future energy savings, consumers and businesses could save around USD600 billion a year by 2020. Annual energy efficiency investments of USD90 billion over the next 12 years - only about half of what these economies would otherwise need to spend on their energy supply infrastructure to keep pace with higher consumption - would deliver these positive returns[10].

8. **Investment in low carbon energy systems can lead to substantial job creation and growth.** Research by the United Nations Environment Programme's Green Economy Initiative shows that, globally, projected investments of USD630 billion in the renewable energy sector by 2030 would translate into at least 20 million additional jobs - 2.1 million in wind energy, 6.3 million in solar photovoltaic (PV), and 12 million in biofuels-related agriculture and industry[11]. Projections and examples for green jobs created or sustained in the developing world include:

- **Nigeria** - a biofuels industry based on cassava and sugar cane crops could provide jobs for 200,000 people.

- **India** - projections indicate the creation of 900,000 jobs by 2025 in biomass gasification.

- **Bangladesh** - at least 20,000 jobs have been created with the uptake of PV solar home systems, biogas facilities and improved cooking stoves.

The technologies mentioned in the latter example have the added benefit of improving the health of the rural poor, especially women[12].

9. **Small-scale, off-grid renewable solutions can be a flexible and easy-to-use option to increase electrification rates in rural areas.** Due to the remoteness of these areas and the low levels of population, the extension of the grid is often economically unfeasible. Off-grid electrification is based on the installation of stand-alone systems – PV, wind, small-scale hydropower, biomass (in rural households), or setting up electricity distribution mini-grids fed either by renewables or hybrid (renewables–LPG/diesel) systems. Small-scale, off-grid solutions have a considerable potential for poverty reduction and job creation in areas where they are used (e.g. through the provision of solar cookers for basic cooking needs[6]).

10. **The critical inter-linkages between resources need to be considered.** Some low carbon energy solutions, such as biofuel production, wind power and hydropower have a significant potential to drive down GHG emissions, but could be accompanied by negative environmental and social impacts, including water scarcity, and loss of forest land and biodiversity. Expansion of these sectors in developing countries needs careful environmental planning to avoid negative impacts on essential ecosystem services for the local communities[13,14].

11. **More systematic research is needed to provide robust macro-economic evidence on how low carbon energy investments in energy technologies impact on economic growth, poverty reduction and job creation in developing countries.** Best practice analysis for urban and rural electrification, and different energy technologies would help to identify how to generate win-win options in those areas.

    The broader linkage between resources needs to be analysed further to consider low-carbon development in connection with other critical resources shortages, including water, minerals and land.

    Furthermore, more detailed methodologies (e.g. on land requirements for different energy technologies, assessment of ecosystem impacts, co-benefit impact and the costs of energy technologies, including the articulation of capacity loads) need to be developed.

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Definitions
Low carbon climate resilient development combines key elements of mitigation, adaptation and development strategies. A 'triple win' is where low carbon development brings benefits in mitigation, adaptation and poverty reduction/economic development. A 'double win' is where benefits are seen in only two of these areas.

Climate resilience is used in this document to mean: The capacity of households and communities to manage change and maintain or transform their living standards in the face of climate induced stresses and shocks without compromising long term prospects.

USD is the US dollar

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