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Updated compilation of information on mitigation benefits of actions, initiatives and options to enhance mitigation ambition

Technical paper

Addendum

Information on mitigation pledges, mitigation benefits of actions and initiatives to enhance mitigation ambition, and finance, technology and capacity-building to support implementation

Summary

This updated technical paper compiles information on the mitigation and sustainable development benefits of actions, initiatives and options to enhance mitigation ambition identified in the submissions by Parties and accredited observer organizations submitted to the secretariat under the Ad Hoc Working Group on the Durban Platform for Enhanced Action workstream 2 on pre-2020 ambition. This technical paper comprises three separate documents: the main text, contained in document FCCC/TP/2013/8, and two addenda, contained in documents FCCC/TP/2013/8/Add.1 and FCCC/TP/2013/8/Add.2. The main text contains a summary of the main findings, which are substantiated with more detailed information in the two addenda. Addendum 1 provides an overview of existing mitigation pledges by Parties and the emissions gap and summarizes information on the mitigation benefits of actions and initiatives to enhance mitigation ambition, on barriers to enhancing mitigation ambition and ways to overcome them, and on incentives for actions. It also covers options related to finance, technology and capacity-building for supporting implementation of mitigation action by developing country Parties.

Contents

I. Introduction

1. This second version of the technical paper on mitigation benefits of actions, initiatives and options to enhance mitigation ambition was requested by the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) at the second part of its second session.[1] The first version of this technical paper was published on 28 May 2013 as document FCCC/TP/2013/4.

2. This technical paper comprises three separate documents: the main text, contained in document FCCC/TP/2013/8, and two addenda, contained in documents FCCC/TP/2013/8/Add.1 and FCCC/TP/2013/8/Add.2. The main text contains a summary of the main findings, which are substantiated with more detailed information provided in the two addenda. Addendum 1 starts with an overview of the existing emission reduction pledges made by developed and developing countries under the Cancun Agreements and the emissions gap (chapters II and III). It then provides a compilation of information on mitigation potential, benefits, barriers and incentives, and provides examples of national policies and cooperative initiatives grouped by thematic areas with high mitigation potential (chapter IV). This addendum also provides views on finance, technology and capacity-building to support implementation of mitigation action by developing countries (chapter V).

3. Addendum 2 provides an overview of the options to enhance mitigation ambition and next steps under workstream 2 of the ADP in advancing the workplan on enhancing mitigation ambition.

II. Existing mitigation pledges by Parties

4. Central to the Cancun Agreements adopted by Parties in 2010 is the decision to hold the increase in the global average temperature below 2 °C (the 2 °C goal), or below 1.5 °C above preindustrial levels.[2] In order to reach this goal, more than 90 Parties made conditional and unconditional emission reduction pledges by 2020 under the Cancun Agreements. For developed countries, these pledges encompass quantified economy-wide emission reductions targets under the Convention for all developed countries[3] and quantified emission limitation or reduction commitments under the second commitment period of the Kyoto Protocol for developed countries assuming commitments for this period.[4] For developing countries, these pledges are in the form of nationally appropriate mitigation actions (NAMAs).[5] Many Parties in their submissions elaborated on these pledges and their implementation.

5. The existing emission reduction pledges can be categorized into the following types:

(a) National quantified targets to reduce emissions: these targets state an end result and do not necessarily specify measures to achieve them, for example:

(i) Absolute emission reductions relative to a reference year; for example, to achieve a 20 per cent reduction in greenhouse gas (GHG) emissions by 2020 compared with 2000, to achieve carbon neutrality;

[1] FCCC/ADP/2012/3, paragraph 33, and FCCC/ADP/2013/2, paragraph 36(a).
[2] Decision 1/CP.16, paragraph 4.
[3] FCCC/SB/2011/INF.1/Rev.1.
[4] Decision 1/CMP.8, annex I.
[5] FCCC/SBI/2013/INF.12/Rev.1.

(ii) Emission reductions relative to the 'business as usual' scenario; for example, to achieve a 30 per cent reduction below the 'business as usual' scenario emissions by 2020;

(iii) Emission reductions expressed relative to another indicator; for example, to reduce carbon dioxide (CO_2) emissions per unit of gross domestic product (GDP) by 30 per cent by 2020 compared with 2005;

(b) Targets expressed in non-GHG terms with impact on emissions: these were expressed as absolute targets, for example "reduce net deforestation of primary forests to zero" or in relative terms, for example "reach a 15 per cent share of non-fossil fuels in primary energy consumption by 2020";

(c) Strategies: these encompass comprehensive plans of measures and actions undertaken by governments that aim to achieve long term mitigation objectives. They provide the overarching framework to undertake a set of mitigation measures;

(d) Programmes and policies: these encompass concrete measures undertaken by governments to achieve a specific objective that are linked to public budgets and legislative processes;

(e) Projects or portfolio of projects: these usually refer to specific investments undertaken by the private or public sectors with fixed project boundaries, clearly defined activities and a financial investment in services, infrastructure or machinery.

III. The emissions gap

6. There is a recognition that the full implementation of the pledges made by Parties under the Cancun Agreements can bring sizeable emission reductions and that rapid progress has been made by many Parties recently in taking action and implementing policies to underpin these pledges. However, a significant emissions gap remains between the expected aggregate emissions reduction effect of Parties' pledges in terms of global annual emissions by 2020 and aggregate emission pathways consistent with a likely chance of holding the increase in the global average temperature below 2 °C (the 2 °C goal) or 1.5 C above pre-industrial levels. The United Nations Environment Programme (UNEP), in *the Emissions Gap Report 2013*, quantified the gap to the 2 °C goal based on pledges and not on the total effect of all global climate action, to be between 8 and 12 billion tonnes of carbon dioxide equivalent (Gt CO_2 eq) in 2020.[6] This estimate is based on the evaluation of several modelling groups that estimated the expected emissions in 2020 assuming that Parties will implement their emissions reduction pledges under the Convention and its Kyoto Protocol and using least-cost emission reduction pathways. Since pledges were first analysed in 2009, the analysis presented in the *Emissions gap reports* indicate that the gap is getting larger, rather than smaller and that the global emissions total is increasing.

7. The window of opportunity to narrow the emissions gap by 2020 is closing. Although the estimations of the emissions gap in 2020 have not changed significantly, the available mitigation potential to close the gap is diminishing as time passes. This is because it takes time to incentivize further emission reductions and to overcome the numerous political and economic barriers to the fulfilment of the potential, which can only be done if the right policies and incentives are put in place. Once implemented, it takes time for such policies to fulfil their mitigation potential and achieve their objectives. Time to close the emissions gap is therefore running out and many Parties stress the need for urgent action.

8. Several developing Parties have emphasized that developed countries should take the lead in narrowing the gap by 2020. These developing Parties also expressed the view

[6] UNEP, 2013.

that Parties included in Annex I to the Convention (Annex I Parties) would increase their ambition to reduce emissions in line with the ranges referred to in the IPCC Fourth Assessment Report the gap could be almost closed by 2020.[7] However, it was also mentioned that the emissions gap assessments are uncertain owing to data uncertainties, the various assumptions used and a dependency on scenarios based on multiple emission pathways.

9. According to the UNEP *Emissions Gap Report 2012*, technical mitigation potential is available for the gap to be closed by 2020. The technical potential for reducing emissions by 2020 is estimated to be about 17 ± 3 Gt CO_2 eq, at marginal costs below United States dollars (USD) 50–100/t CO_2 eq reduced.[8] This would be enough to close the gap between the "business as usual" scenario emissions and emissions that meet the 2 °C goal.[9] The UNEP *Emissions Gap Report 2013* uses the latest scenarios developed for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report.[10]

10. Limiting the warming caused by anthropogenic GHG emissions to less than 2°C will require limiting cumulative emissions from all anthropogenic sources to a quantity, which has been estimated for different degrees of certainty of staying under the warming limit for CO_2 emissions only, as well as factoring in other emissions.[10] More emissions today and in the past means fewer emissions in the future. This means that not closing the gap by 2020 and still meeting the 2°C goal is in theory possible (the temperature increase is determined by emissions accumulated over a period of time)[10] but with higher costs compared to the least-cost scenarios and with greater risks and serious consequences, such as the following:

(a) A need for much higher rates of global emission reductions in the medium term;

(b) A greater "lock-in" of carbon-intensive infrastructure;

(c) A limited choice of low-carbon technologies in the medium term;

(d) A greater risk of economic disruption owing to the need for more expensive policy and technological solutions in the medium and long term;

(e) A greater risk of irreversible climate impacts.[11]

11. In addition to the emissions gap, Parties highlighted other gaps such as the following:

(a) The ambition gap between the ultimate objective of the Convention to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system and the agreed 2 °C goal, which, in the view of the proposing Party, is relevant, because the 2 °C goal is not sufficiently ambitious to ensure the objective of the Convention;

(b) The means of implementation or financing gap between the resources necessary to limit climate change and those that are being provided;

(c) The accountability gap describing the need for enhanced accountability and transparency.

[7] The IPCC Fourth Assessment Report provided a range of the differences between emissions in 1990 and emission allowances in 2020 for various greenhouse gas concentration levels for both Annex I Parties and Parties not included in Annex I to the Convention (non-Annex I Parties) as a group. For Annex I Parties the range is –25 per cent to –40 per cent by 2020, while for non-Annex I Parties there should be substantial deviation by 2020 from the baseline level of emissions (IPCC, 2007).

[8] All cost estimated presented in this paper are expressed in USD using market exchange rates.

[9] UNEP, 2012.

[10] IPCC, 2013.

[11] UNEP, 2013.

IV. Mitigation benefits of actions, initiatives and options to enhance ambition

12. This chapter focuses on thematic areas that were featured prominently in many submissions and at ADP workshops and round table discussions held in 2013. Parties and observers have highlighted the technical mitigation potential by 2020 in the thematic areas and emphasized the mitigation and adaptation benefits of actions and initiatives, including resilience to the impacts of climate change, as well as the sustainable development benefits resulting from such actions and initiatives that could help Parties to build national support for stronger action.

13. Based on the submissions, in presenting mitigation benefits of actions and initiatives, this technical paper follows a broad definition of such benefits, which include the following:

(a) Potential for emission reductions;

(b) Contributions to long term transformational change, for example technology developments that will enable deep emission reductions in the future;

(c) Mitigative capacity, which covers the social, political, institutional and economic structures and conditions that are required for effective mitigation;[12]

(d) Avoidance of need for adaptation, owing to a reduction in emissions.

14. In addition to mitigation benefits, there are other benefits of actions that contribute to sustainable development goals, including poverty eradication, economic development, environmental protection, reduction of local air pollution or increased energy security. In some cases these benefits, referred to as sustainable development benefits, are not really co-benefits, but are the main drivers of and incentives for the action, with mitigation effects being a co-benefit. Additional benefit of mitigation actions could also be motivation for political and substantive engagement of various stakeholders.

15. The submissions included some information, as reflected in this technical paper, on the adaptation benefits of actions and initiatives, related, for example, to food security, natural resources management and environmental protection.

16. Cost assessment is essential to any consideration of mitigation potentials and barriers and policies needed to overcome those barriers. However, considerable variation in national contexts makes direct and indirect mitigation cost assessment at a global level very challenging. Reliable data are not always available owing to variation in local factors and differences in economic structures. Moreover, costs vary widely between regions.

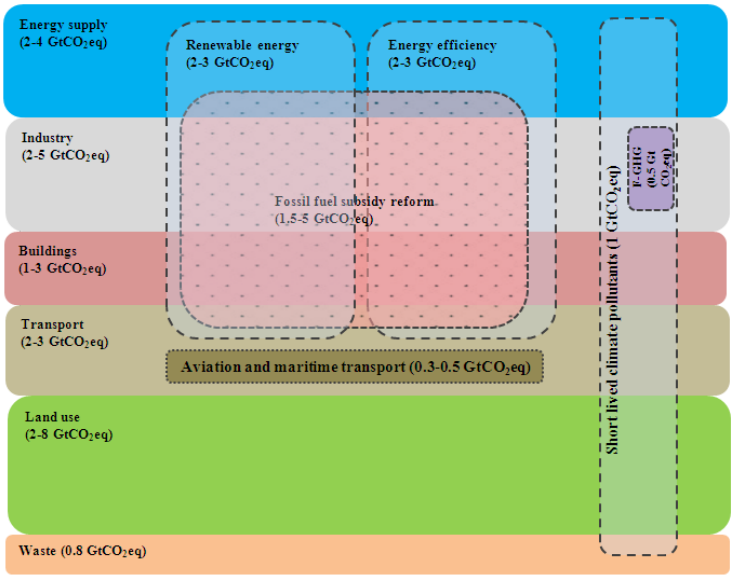
17. The thematic areas, and the actions and initiatives identified within them are overlapping as they address the challenge of reducing emissions from various perspectives. Hence, owing to an overlap in the coverage and uncertainty of estimations, the estimated emission reductions that could be possible in each thematic area cannot be simply added up. So far, only a few preliminary estimates of the potential mitigation impact of some cooperative initiatives are available in literature. These estimates suggest that the initiatives with the highest mitigation potential might trigger emission reductions of around 10 Gt CO_2 eq per year by 2020.[13] However, in most cases these initiatives do not necessarily generate emission reductions by themselves and their effects are accounted for in the national GHG inventories. In this sense there is little value in accounting for cooperative initiatives separately from national actions. Figure 1 provides an overview of thematic

[12] Yohe, 2001.

[13] Blok et al., 2012.

areas, their indicative mitigation potential as given in the sections that follow and illustrates areas of potential overlap.

Figure 1
Mitigation potential by 2020 and possible areas of overlap[a]



Abbreviations: Gt CO_2 eq = Gigatons of carbon dioxide equivalent, F-GHG = Fluorinated greenhouse gases

[a] Size of the boxes gives an indication of the mitigation potential provided in this paper.

18. Many Parties acknowledged in their submissions the barriers, such as political and economic barriers and those related to the access to information and capacity-building, as a major impediment to taking further action. They also acknowledged that putting in place suitable policies and providing financial, technological and capacity-building support for mitigation actions can address many of these barriers and can lead to stronger action at all levels. Examples of existing national policies, including best practices and success stories, were highlighted in the submissions and reflected in this paper for each thematic area.

19. Parties acknowledged that the access to market-based mechanisms and related offsets, such as clean development mechanism (CDM) and related certified emission reduction (CERs) could provide an added incentive towards pledges with higher ambition. In particular, the CDM provides Parties with an important tool to assess impact of mitigation actions, while engaging the private sector and promoting sustainable development. A group of Parties provided an estimate that current CDM projects could achieve approximately 6.5 Gt CO_2 eq of emission reductions and removals. One Party proposed to promote the voluntary cancellation of CERs arising from CDM projects as an option to increase short term mitigation ambition.

20. In their submissions, Parties and observers have identified many cooperative initiatives. These initiatives are very broad in terms of coverage of purpose (e.g. leading to political and technical dialogues and/or focused on implementation), participation (e.g. involving the public and private sectors, organizations and public-private partnerships, cities and/or local governments, etc.), geographical coverage (e.g. regional and/or international) and thematic coverage (e.g. energy efficiency or waste).[14] The initiatives can support emission reductions directly (e.g. by specifying emission reduction commitments

[14] Weischer and Morgen, 2012 and Blok et al., 2012.

for the participants) or indirectly (e.g. creating the enabling environment for increased action). There is still no agreed definition of what constitutes an initiative, although Parties provided a number of examples in their submissions.

21. Cooperative initiatives could help Parties to enhance actions and deliver greater emission reductions, as they engage a broad spectrum of stakeholders, such as central and local governments, private sector, industry and civil society, taking climate action at all levels. Since they are voluntary in nature, as emphasized by some developing country Parties, such initiatives should follow the principles of the Convention and not impose new or additional commitments on developing countries.

22. Preliminary assessment suggests that there are some thematic areas with an impressive number of such initiatives, for example energy efficiency, renewable energy and transport, in contrast to areas, such as waste, for which there are a few initiatives. To facilitate access to information on the initiatives, the secretariat has prepared an online portal, which includes a database of selected cooperative initiatives containing information on type, coverage, participation and other aspects of those initiatives.[15]

A. Energy supply

23. Energy supply represents a broad area of energy production and transformation, but the compilation of information in this section of the technical paper covers only fuel switching, carbon capture and storage (CCS) and methane from fossil-fuel production. In view of their significance for climate mitigation, energy efficiency and fossil-fuel reform are covered in a separate section as are renewable energy and biofuels (see chapters II.B, C and E below).

1. Mitigation potential and benefits

24. According to the UNEP *Emissions Gap Report 2012*, mitigation potential in the area of energy supply is estimated at around 2.2–3.9 Gt CO_2 eq. This includes potential from fuel switching (0.5–1 Gt CO_2 eq), renewable energy sources (1.5–2.5 Gt CO_2 eq) and CCS (0.2–0.4 Gt CO_2 eq).[16] Further mitigation potential is also available in the increased use of nuclear power and efficiency improvements in fossil-fuel power plants.

IEA suggests that gross domestic product-neutral mitigation (no macroeconomic costs) of 0.7 Gt CO_2 eq in limiting inefficient coal use and 0.6 Gt CO_2 eq in reducing methane emissions from fossil-fuel production is possible by 2020 with positive impact on local air pollution and energy security.

Source: IEA, 2013.

25. The International Energy Agency (IEA) sees CCS as a key technology for decarbonization of the energy sector in the long term, with the potential to contribute one sixth of CO_2 emission reductions in 2050 from the energy sector.[17] According to the Department of Energy and Climate Change of the United Kingdom of Great Britain and Northern Ireland,[18] CCS in the industrial sector could reduce emissions at a cost of USD 49–244/t CO_2 eq reduced in 2030. Other sources report emission reductions at a cost of USD 17–91/t CO_2 eq.[19]

[15] Portal will be made available at <http://unfccc.int/7785>.
[16] UNEP, 2012.
[17] IEA, 2012.
[18] DECC, 2012.
[19] Singh U., 2013.

2. Sustainable development benefits

26. In general, there are a number of sustainable development benefits associated with developing and implementing mitigation actions, such as sustainable access to energy for all, sustainable economic growth, job creation, poverty alleviation, cost savings, environmental protection, improved public health, etc. These benefits represent a major driving force behind a wide range of national actions that also bring sizeable mitigation benefits. More specifically, reducing inefficient use of coal and reducing methane emissions from fossil-fuel production has significant benefits for local air pollution and energy security. The diversification of the energy mix also increases economic diversity and resilience.

3. Barriers

27. Parties at the ADP round tables held in 2013 highlighted the barriers which they encountered as they sought to undertake more ambitious national actions in the area of energy supply. One such barrier is the lack of affordable alternatives to fossil fuels in some countries, which are essential to meet large increases in demand for electricity and dependency on energy resources to promote sustainable development. In addition, transition to market economy in some countries and price distortions through, e.g. fossil-fuel subsidies, create barriers to low-carbon technologies.

28. A number of specific barriers to implementation exist in relation to CCS. Firstly, demonstration plants are required in order to develop experience and bring costs down. Secondly, CCS requires market incentives which are currently lacking. Thirdly, industry is reluctant to invest in CCS owing to the lack of a market for the technology and a lack of public awareness of the benefits.

4. Examples of national policies

29. Countries are implementing many policies that impact GHG emissions from energy supply, a few of which are described in this section. More prominently, Parties highlighted experience with implementing carbon-pricing mechanisms (emissions-trading systems (ETS), offsets and carbon taxes) that cover energy supply. The World Bank recently surveyed ETSs and concluded that there are many new systems emerging.[20]

> Today, jurisdictions with carbon pricing mechanisms implemented and scheduled emit roughly 10 Gt CO_2 eq per year, equivalent to about 21 per cent of 50 Gt CO_2 eq emitted globally. If China, Brazil, Chile and the other emerging economies eyeing these mechanisms are included, carbon pricing mechanisms could reach countries emitting 24 Gt CO_2 eq per year, or almost half of the total global emissions.
>
> *Source*: World Bank, 2013.

30. In addition, some countries are implementing carbon standards for fossil-fuel power plants which incentivize low-carbon fuels or CCS. For example, as part of its recent President's Climate Action Plan aimed at reducing emissions by up to 17 per cent by 2020, the United States of America directed its Environmental Protection Agency to work closely with the States, industry and other stakeholders to establish carbon pollution standards for both new and existing power plants. Canada has already implemented an emission standard for new power plants.

31. Countries are also implementing policies to support research and development and demonstration plants for specific technologies, for example for piloting CCS to help remove the barriers to both public and private investment. Options for overcoming these barriers include securing public funding for demonstration plants, providing market

[20] World Bank, 2013.

incentives at a level comparable with that for renewable energy, addressing environmental concerns in relation to CCS, including CCS as a viable technology in international climate agreements, and undertaking public awareness-raising campaigns.

5. Cooperative initiatives

32. A large number of cooperative initiatives cover this thematic area, including intergovernmental political and technical forums as well as initiatives at subnational level. Here are a few examples: (i) the Secretary-General's Sustainable Energy for All initiative provides a platform for leaders from governments, businesses, finance and civil society aimed at doubling the rate of energy efficiency gains by 2030 along with ensuring universal access to modern energy services (e.g. household access to electricity and clean cooking facilities) and doubling the share of renewables in the global energy mix; and (ii) the Clean Energy Ministerial, that convenes economies representing over 80 per cent of global GHG emissions, was launched by the United States of America and has a mandate from the Major Economies Forum on Energy and Climate, which includes an action group on CCS.

33. At the 2013 Pacific Energy Summit, the European Union, the European Investment Bank and the African Development Bank agreed at the highest political level to reinforce a dialogue on sustainable energy investments in the Pacific region.

34. Parties highlighted a number of initiatives, which were presented at the ADP workshops held in 2013, such as the C40 Cities Climate Leadership Group on initiatives of cities, the Low Emission Development Strategies Global Partnership and the Carbon Sequestration Leadership Forum. Another example mentioned by a group of Parties is the work of the Covenant of Mayors in bringing together a network of more than 2,000 municipalities in Europe to boost integrated energy planning in cities in order to achieve 29 per cent emission reduction by 2020.

B. Energy efficiency

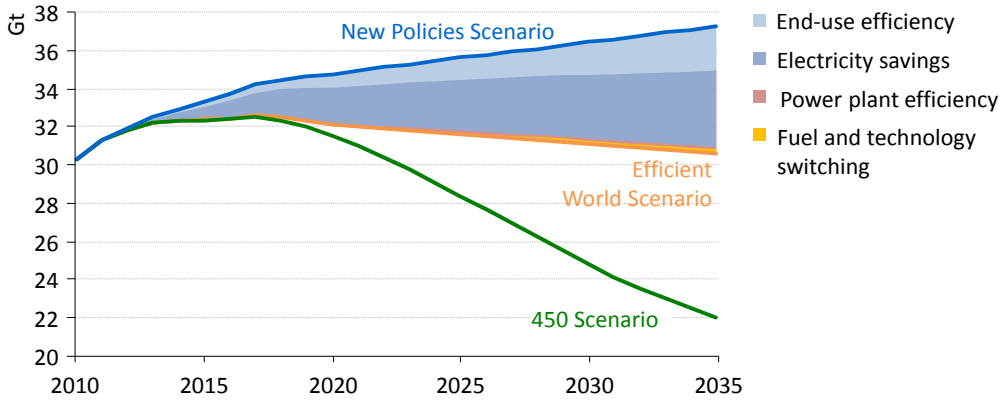
35. Energy efficiency covers a broad range of issues across practically all sectors of the economy, only some of which are addressed here. This section focuses specifically on energy efficiency in buildings, appliances and industrial processes. Energy efficiency in transport is covered in chapter I.D below.

1. Mitigation potential and benefits

36. Increasing energy efficiency is an area of significant mitigation potential. A number of Parties cited in their submissions the IEA *World Energy Outlook 2012*, which states that, globally, around 2 Gt CO_2 eq of emissions can be reduced by 2020 through additional energy efficiency improvements (see figure 2 below).[21] The IEA special report entitled *Redrawing the energy-climate map* highlights a slightly different set of energy efficiency measures that can be implemented quickly, which add up to 1.6 Gt CO_2 eq by 2020.[22] According to the UNEP *Emissions Gap Report 2012*, the total mitigation potential in 2020 for buildings alone, compared with the "business as usual" scenario, is within a range of 1.4–2.9 Gt CO_2 eq.[23] In the longer term, the estimate of the potential is higher.

[21] IEA, 2012.
[22] IEA, 2013a.
[23] UNEP, 2012.

Figure 2
Emissions savings from energy efficiency



Source: International Energy Agency, 2013a. World Energy Outlook Special Report 2013. Redrawing the Energy-Climate Map.

Abbreviation: 450 scenario = stabilization of the concentration of greenhouse gases in the atmosphere at 450 parts per million.

37. The 25 energy-efficiency measures published by the IEA in 2011, such as establishing market signals to motivate effective action, accelerating the introduction of new technologies, and strengthening the enforcement of minimum energy-performance standards for appliances, lighting, equipment and building energy codes could, if implemented straight away, save as much as 7.6 Gt CO_2 eq per year by 2030.[24]

> The IEA *World Energy Outlook 2012* assessed that by unlocking cost-effective energy-efficiency options, cumulative global economic output would increase by USD 18 trillion by 2035, resulting in the greatest GDP gains in India (3.0 per cent), China (2.1 per cent), the United States of America (1.7 per cent) and the European members of the Organisation for Economic Co-operation and Development (1.1 per cent). Additional investment of USD 11.8 trillion in efficient end-use technologies is more than offset by a USD 17.5 trillion reduction in fuel bills and a USD 5.9 trillion cut to supply-side investment.
>
> *Source:* IEA, 2012.

38. Overall costs of energy efficiency measures are generally low compared to other options. Many of these measures have low or negative net costs and often a very short payback time. Various studies found that energy savings of around 30 per cent were feasible with a payback time of less than 3–4 years.[25,26] For example, the marginal mitigation costs of energy efficiency in the industrial sectors is estimated to be less than USD 25/t CO_2 eq.[27] Another study notes that 90 per cent of mitigation potential could be achieved at less than USD 50/t CO_2 eq and the remaining 10 per cent at between USD 50–100/t CO_2 eq.[28]

2. Sustainable development benefits

39. Energy efficiency measures have multiple sustainable development benefits such as the following:

[24] IEA, 2011.
[25] IIASA, 2012.
[26] UN-Energy, 2009.
[27] McKinsey & Company, 2010.
[28] IPCC, 2007.

(a) Macroeconomic benefits and technological innovation: energy efficiency measures improve trade balances through increased competitiveness and reduce the burden on public budgets, for example through lower fossil-fuel import bills. They also enhance energy security and energy independence, and contribute to diversification of energy services and reduced need for investments in energy supply;

(b) Cost-effectiveness: upfront investment is generally more than compensated for by savings in energy costs and, hence, reducing energy bills of households and industry;

(c) Improvements in social wellbeing: energy efficiency measures can lead to energy affordability and contribute to addressing poverty alleviation, enhanced employment opportunities, access to reliable energy sources and increased disposable income and comfort of energy users;

(d) Reduction of air and water pollution: environmental quality improvements result in improved public health and reduced public health costs;

(e) Avoiding high carbon "lock-in" in technology and infrastructure at energy supply side with lifetime of more than 30 years;

(f) Climate adaptation: for example, improving building insulation to reduce energy consumption in winter can also reduce heat entering a building in the summer, thus reducing additional costs (and emissions) from air cooling.[29]

3. Barriers

40. Increases in energy efficiency face a wide range of barriers that are broadly common to all countries. Major barriers include:

(a) High project development costs relative to energy savings, high upfront capital costs and perceived capital risk, and high transaction costs;

(b) Lack of affordable energy efficiency technologies that are suitable to local conditions and capacity to maintain energy efficiency investments;

(c) Market organization, price distortions, split incentives and a large number of entities that could and need to implement energy efficiency measures;

(d) Information barriers and a lack of awareness of the benefits among financial institutions and consumers that prevent them from making informed consumer decisions;

(e) Institutional bias towards supply-side investment and energy tariffs that discourage energy efficiency investments;

(f) Increased efficiency can lead to increased consumption, in order to provide increased comfort levels, for example for heating (rebound effect).

4. Examples of national policies

41. Policies aimed at overcoming barriers to increased energy efficiency have been implemented widely. Minimum performance standards, regulations and labelling for buildings and appliances as well as for cars and trucks have been successfully used by governments around the world for decades. For example, minimum energy performance standards such as Japan's Top Runner Programme and the European Union Directive on Ecodesign of Energy-related Products are estimated to have so far led to energy savings from the residential sector of 11 per cent in Japan and 16 per cent in the European Union. Australia's phase-out of incandescent lamps between 2007 and 2010 is estimated to have reduced the country's emissions by around 0.14 per cent.

[29] IEA, 2012.

42. Standards and labelling programmes are also being increasingly successfully deployed in many developing countries. For example, in Ghana, the implementation of minimum energy performance standards for air conditioners is expected to reduce emissions by around 2.8 Mt CO_2 eq over 30 years and save consumers around USD 64 million annually in energy bills.[30]

43. Introduction of innovative policies that attach a price to carbon, such as emissions trading and carbon taxes, and realistic, unsubsidized energy prices are a major driver of energy efficiency improvements and low-emission development. As was presented at the ADP workshop on the pre-2020 ambition: low-emission development opportunities held on 30 April 2013 in Bonn (the workshop on low-emission development opportunities), China implemented several pilot projects at the provincial and city level to test low-carbon development approaches and explore carbon market opportunities to increase the level of financing for energy efficiency projects, among other objectives. Contributions made by energy efficiency measures to their successful low-emission development strategies of Mexico, Vietnam and Ethiopia were also mentioned. In addition, some countries, including Denmark, France, Italy, India, the United Kingdom and some States in the United States, have or had in place, or plan to put in place, systems for trading of "white certificates" for energy efficiency.

44. The value of proactive industry-led initiatives was highlighted by one observer. These include self-determined contributions with peer reviews, energy efficiency and conservation measures (e.g. an energy performance partnership), action plans and, in the case of Japan, the Japanese bilateral offset mechanism.

45. Action by a group of countries can have positive impacts on other countries. For example, the European Union regulations for electric industrial products (motors, circulators, fans and water pumps) has an effect beyond its borders as China, United States of America and Saudi Arabia are using or considering to use the European Union regulation for motors as a basis for their national legislation.

5. Cooperative initiatives

46. Several submissions mentioned organizations and initiatives that aim to improve energy efficiency though policy advice and implementation of concrete actions and activities. The following examples were mentioned: (i) the International Partnership for Energy Efficiency Cooperation supported by IEA is a high-level international forum of developed and emerging economies providing global leadership on energy efficiency by identifying and facilitating implementation of policies and promoting information exchange among policymakers on best practice to improve energy efficiency; and (ii) the Super-efficient Equipment and Appliance Deployment initiative, as a flagship United States-led initiative under the Clean Energy Ministerial, is a global market transformation effort for efficient equipment and appliances.

47. There are many other international and regional initiatives also working to increase energy efficiency, as well as dedicated working groups of broader dialogue platforms such as the Low Emission Development Strategies Global Partnership, which has a dedicated working group on energy, and the Sustainable Energy for All, which also covers energy efficiency actions, among other priority areas (see para. 32 above).

C. Renewable energy

48. Renewable energy is emphasized as a priority thematic area by many Parties and observers. Although this area cuts across energy supply, industry and transport, it is

[30] UNEP, 2012.

discussed here separately because of the scale of its mitigation potential and similarities of policies and approaches used in the above-mentioned areas. In this paper, this thematic area includes renewable energy supply for electricity and heat production as well as biofuels for industry and transport.

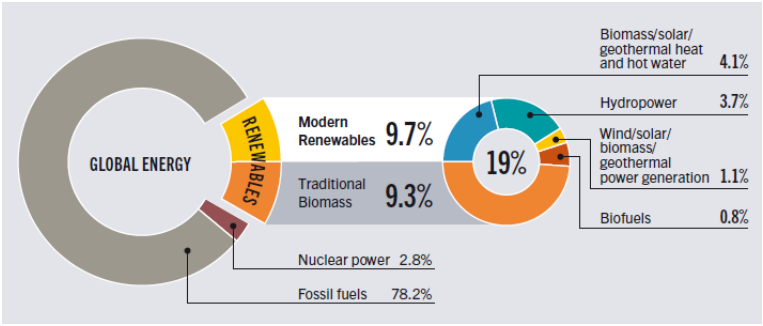
1. Mitigation potential and benefits

49. A number of Parties cited the IEA *World Energy Outlook 2012*, which states that current policies on renewable energy can be enhanced to deliver emission reductions of around 1 Gt CO_2 eq by 2020 and 3 Gt CO_2 eq by 2030. The UNEP *Emissions Gap Report 2012* suggests a potential of 1.5–2.5 Gt CO_2 eq from renewable energy only considering its possible use for electricity production of 4,000 TWh in 2020.

> According to the IEA, the growth of renewable power technologies continued in 2012 despite economic, policy and industry turbulence. […] Solar PV capacity grew by an estimated 42 per cent and wind by 19 per cent compared with 2011 cumulative levels.
>
> *Source:* IEA, 2013b.

50. According to the International Renewable Energy Agency, doubling the renewable energy share of the global energy mix by 2030 is achievable with currently available and new renewable energy technologies, but requires an accelerated rate of deployment, as current and planned policies will only suffice to increase the share from almost 18 per cent in 2010 to around 21 per cent in 2030 (see figure 3 below).[31]

Figure 3
Renewable energy share in global final energy consumption in 2011



Source: Renewable Energy Policy Network for the 21th Century (REN21), 2013. Renewables 2013 Global Status Report.

51. Importantly, energy markets are ready to scale up technology deployment and investments in renewable energy, which attracted record high investments in 2012. The investments in renewable energy are already comparable in scale to those in conventional energy sources: USD 279 billion in 2011 and 244 billion in 2012, half of it in developing countries.[32] Renewable energy is already cost competitive with conventional energy in a growing number of countries and regions, e.g. wind energy in Denmark. In Spain, there are plans to install photovoltaic systems with a total capacity of 30 GW without the support of a feed-in tariff.[33] Figure 4 shows that the cost of energy produced using selected

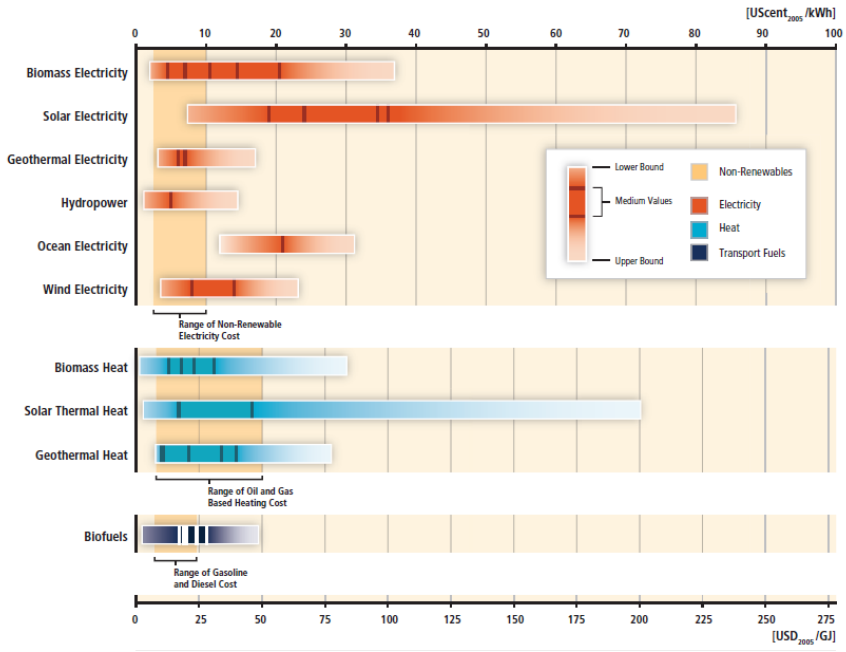
[31] IRENA, 2013.
[32] Frankfurt School-UNEP Centre/BNEF, 2013.
[33] IRENA presentation at the workshop on pre-2020 ambition: low-emission development opportunities held on 30 April 2013 in Bonn during the first part of the second session of the ADP. Available at <http://unfccc.int/files/bodies/awg/application/pdf/adp2_workshop2_irena_30042013.pdf>.

commercially available renewable energy technologies is in the range of recent non-renewable energy costs.[34]

52. Over the longer term, by mid-century, close to 80 per cent of the world's energy supply could be met by renewable energy if backed by enabling public policies, according to the IPCC.[35] This is because the total global technical potential for renewable energy is substantially higher than global energy demand.[35] Renewable energy technologies are already fit to provide adequate access to energy to all, in particular to the most vulnerable groups.[36]

Figure 4

Range in recent levelized cost of energy for selected commercially available renewable energy technologies in comparison to recent non-renewable energy costs



Source: Intergovernmental Panel on Climate Change, 2011. Special Report on Renewable Energy Sources and Climate Change Mitigation. Prepared by Working Group III of the IPCC.

2. Sustainable development benefits

53. Promotion of renewable energy has multiple benefits in addition to mitigation benefits. In many ways these benefits are similar to those listed for energy efficiency (see para. 39 above).

54. Some of the benefits that are specific to renewable energy include: (i) macroeconomic benefits include enhanced energy security and energy independence, fostering technological advancement and competitiveness, enhancing diversity of energy services and reducing vulnerability to international oil price shocks; and (ii) employment opportunities: according to International Labour Organization (ILO), rapid employment growth in renewable energy, improvements in energy efficiency and enhanced access to energy can lead to major gains in employment and income opportunities.

[34] IRENA, 2012.
[35] IPCC, 2011.
[36] Energy for a Sustainable Future, 2010.

55. The ILO estimates that the worldwide employment in the wind energy sector could grow from 0.7 million jobs currently to 1.9 million by 2020.[37] The European Union provided information in its submission on the potential to create up to three million new jobs by 2020 through its renewable energy policies.

3. Barriers

56. Barriers to enhancing the use of renewable energy are in many ways similar to those relating to promoting energy efficiency. Barriers specific to renewable energy include: (i) misaligned policy and economic incentives inhibiting "win–win" solutions in energy supply and demand; (ii) insufficient mainstreaming of renewable energy policies in national development strategies stemming from scattered responsibility for the development of renewable energy and technological innovation being distributed across multiple stakeholders with diverse interests; and (iii) constraints resulting from the energy sources and availability of new technologies and materials needed for components, as well as by energy supply system.

4. Examples of national policies

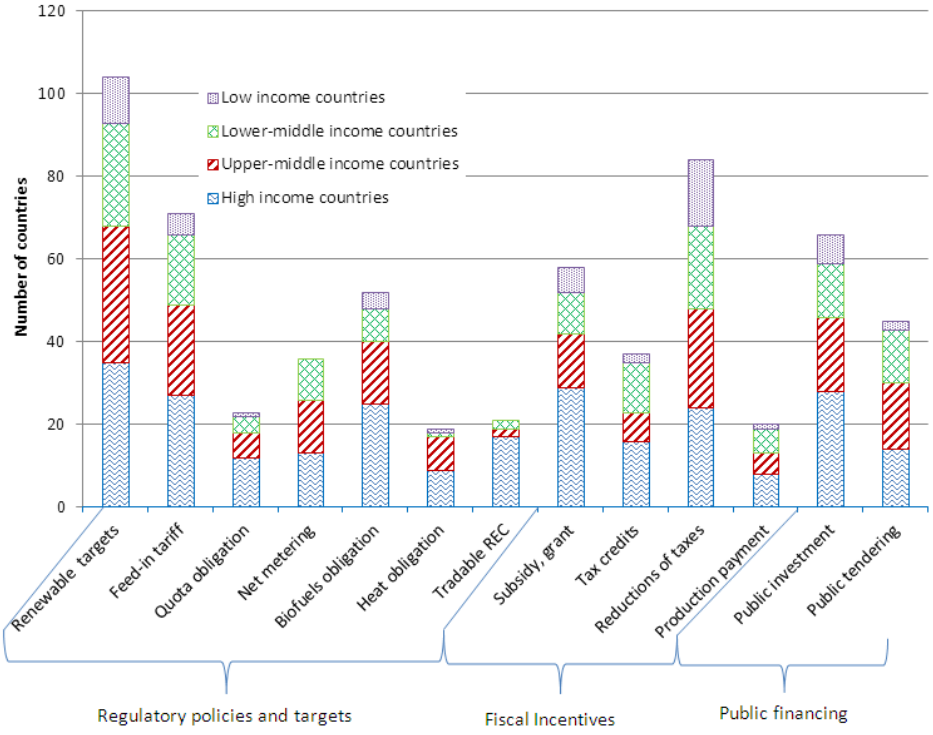
57. There is a wealth of good examples of effective and efficient policies. In an overwhelming majority of countries these policies are driven by emission reduction pledges: over 100 countries, including almost all major economies, have set themselves renewable energy targets,[38] while over 120 countries have put in place policies promoting renewable energy which underpin these targets.[39,40,41,42]

58. Policies to support renewable energy are applied in many forms in different countries (see figure 5 below). They include: (i) regulatory policies and targets, such as renewable energy targets, feed-in tariffs or premium payments, obligatory quotas for electricity, heat and fuels, tradable renewable permits and net metering; (ii) fiscal incentives, including direct payments or tax credits; (iii) public financing that is frequently used; and (iv) a growing number of national ETSs, offset mechanisms and carbon taxes that attach a price to carbon and provide major incentives to promote renewable energy.[43]

59. A prime example of national policy stimulating an increase in renewable energy is Germany's introduction of an Electricity Feed-in Act in 1991, which regulated the purchase and price of electricity generated by hydropower, wind energy, solar energy, landfill gas, sewage gas and biomass. Together with accompanying policies, this act led to a rapid growth of electricity generation from renewable energy, rising from 3.1 per cent in 1991 to 16.9 per cent in 2009. Wind energy experienced the greatest increase, but bioenergy and photovoltaic systems have also grown substantially under this policy.[44] A similar example can be found in Japan, where a feed-in tariff was introduced in July 2012, resulting in a surge in renewable energy investment (excluding research and development) from USD 13 billion to USD 16 billion in the solar market in 2012 alone.[45]

[37] ILO, 2012.
[38] REN21, 2013.
[39] IEA database.
[40] REN21, 2013.
[41] International Partnership on Mitigation and MRV.
[42] UNEP, 2012.
[43] International Carbon Action Partnership for a map of national emissions trading systems.
[44] IPCC, 2011.
[45] Frankfurt School-UNEP Centre/BNEF, 2013.

Figure 5
Number of countries with policies supporting renewable energy



Source: Renewable Energy Policy Network for the 21th Century (REN21), 2013. Renewables 2013 Global Status Report.

60. Policies which remove administrative barriers such as planning restrictions are also increasingly being explored. One such example is the new United States Climate Action Plan which is directing the Department of Interior to permit enough renewable energy development on public lands by 2020 to power more than six million homes.

61. Successful national policies for increasing renewable energy can also be tested and developed at the subnational level and then scaled up. An encouraging example is the Solar Ordinance of the city/state of São Paulo, Brazil. Integrated into the municipal building code, the ordinance required new buildings to install solar water heating systems covering at least 40 per cent of the energy used for hot water. As a result, it has stimulated market demand for an innovative renewable energy technology and resulted in significant net cost savings. By 2015, it is on target to allow for a reduction of around 35 kt CO_2 eq from the city's residential sector and is being currently replicated in cities across Brazil.[46]

62. At the project level, renewable energy projects are typically an integral part of the overall portfolio of support provided to developing countries and are covered by the clean development mechanism. In addition, one Party elaborated on a new mechanism for bilateral offsets as an approach to facilitate the diffusion of low-carbon technologies, including renewable energy.

5. Cooperative initiatives

63. Several submissions by Parties mentioned sector-specific organizations and initiatives that aim to increase the share of renewable energy. Regional initiatives include the Global Renewable Energy Islands Network hosted by the International Renewable

[46] IRENA, 2012.

Energy Agency. There are also high-level political dialogues, such as the Pacific Energy Summit that addresses the issue of investments in renewables developing in the Pacific Region(see para. 33 above). The Sustainable Energy for All also covers renewable energy actions (see para. 32 above).

64. Networks such as the Renewable Energy Policy Network for the 21st Century (REN21) and the Low Emission Development Strategies Global Partnership (which has a dedicated working group on energy*)* aim to enhance coordination, information exchange and cooperation among countries and international programmes.

65. Reporting initiatives such as the Carbon Disclosure Project are beginning to sensitize corporate policy to low-carbon energy opportunities.

D. Transport

66. This section focusses on land-based transport and international aviation and maritime transport. General issues related to energy efficiency are included in chapter IV.B below.

Transport, excluding aviation and maritime transport

1. Mitigation potential and benefits

67. According to the UNEP *Emissions Gap Report 2012*, the mitigation potential for transport (including shipping and aviation) in 2020 compared with the "business as usual" scenario is 1.7–2.5 Gt CO_2 eq.[47]

2. Sustainable development benefits

68. Actions taken in transport can also bring about sustainable development benefits such as: (i) health and safety: reductions in local pollutant emissions and traffic congestion, increased safety and general mobility benefits; and (ii) job creation: according to the ILO estimates, substantial gains in employment can be created by making the shift to mass transportation and more energy-efficient vehicles.

69. For example, the introduction of bus rapid transit systems led to improved air quality, job creation, promotion of social equity and health benefits, and, by reducing vehicle traffic, to a lower number of road traffic accident fatalities.[47] The ILO estimates that spending USD 42 billion on rail and waterways and USD 29 billion on high-speed rail could generate approximately 1.4 million jobs between 2010 and 2030. Investing USD 34 billion in bus rapid transit lanes and subway systems could yield another 3.1 million jobs, for a total employment of 4.5 million person-years over the next two decades.[48] For example, a low-carbon transport strategy for Brazil's cities could be a major job creator.

3. Barriers

70. While many national and subnational policies offer significant opportunities for land transport to make a more active contribution to mitigation, administrative and financing procedures can present barriers to making such contributions.

71. Barriers are often specific to the area of implementation. For example, barriers to the expansion of bus rapid transit, which has lower emissions than many other transit options, include: (i) uncompetitive fare levels; (ii) inadequate analysis of alternatives; and (iii) overcrowding and deterioration of roadways.

[47] UNEP, 2012.
[48] ILO, 2012.

4. Examples of national policies

72. During the workshop on low-emission development opportunities, sustainable transport programmes were highlighted as a key part of successful national strategies for low-emission development in Mexico, Vietnam and Ethiopia. Mexico, for example, has included a range of measures around mass transit, fuel efficiency, pedestrian and cycling infrastructure and restrictions on high-polluting vehicles in its new General Law on Climate Change.

73. Three inter-linked strategies such as "avoid", "shift" and "improve" are promoted to utilize significant mitigation potential in transport. According to the UNEP *Emissions Gap Report 2012*, the examples of policies based on these strategies include the following:

(a) "Avoid" policies that promote transit-orientated development in order to reduce travel time or frequency, thereby reducing emissions. An example of such a policy is Curitiba in Brazil, where, in the 1970s, high-density transit corridors were integrated into the city's master plan;

(b) "Shift" policies that promote shifts to the low-emission modes of transportation and improve the quality of public transport. An example of such a policy is the introduction of bus rapid transit in Mexico City, where 10 per cent of bus rapid transit riders have shifted from private cars. Another example is Jaipur City Transportation Service, which increased bus rapid transit ridership by over 100 per cent in one year as a result of improved fare structure, colour-coding of bus routes and better analysis of operation and cost data;

(c) "Improve" policies aimed at improving the energy efficiency of vehicles. An example of such a policy is a vehicle performance standard for new light-duty vehicles, which is being implemented in Australia, Canada, China, the European Union, Japan, the Republic of Korea and the United States of America. These standards are expected to reduce the fuel consumption and GHG emissions of the new light-duty fleet in these countries by over 50 per cent from 2000 by 2025. More specifically, the new European Union legislation for improving the efficiency of new cars (95 g/km – 40 per cent improvement compared to 2007) and vans (147 g/km – 28 per cent improvement compared to 2007) is saving users of cars and vans EUR 3,000–4,500 in fuel costs over the lifetime of the vehicle.

74. In addition, the UNEP *Emissions Gap Report 2012* covers a range of key incentives for delivering emission reductions, such as implementing high standards early, improving accessibility through integrated transport systems, and ensuring strong institutional support and industry engagement. For vehicle performance, this includes action in relation to standards ensuring that they are technology-neutral and increasingly stringent, include all vehicle classes, are footprint- and not weight-based; as well as the action to improve testing procedures and combining standards with fiscal mechanisms and scrap page schemes.

5. Cooperative initiatives

75. A range of initiatives exist to address transport-related emissions; for example, the Global Fuel Economy Initiative, which is a partnership of six organizations that promotes research, discussion and action to improve fuel economy, and the UNEP Partnership for Clean Fuels and Vehicles, which promotes cleaner fuels and vehicles, particularly in developing countries and countries with economies in transition. A number of other initiatives focus on transport-specific interventions, while many more deal with transport along with other thematic areas.

International aviation and maritime transport

1. Mitigation potential and benefits

76. A group of Parties and observers referred to the reduction levels for international aviation and maritime transport contained in the UNEP *Bridging the Emissions Gap* report. Both thematic areas combined have a mitigation potential of about 0.3–0.5 Gt CO_2 eq in 2020.

77. Overall, the abatement cost for aviation and maritime transport is relatively high compared to the other thematic areas. An aviation marginal cost curve produced for the United Kingdom Department of Transport,[49] for example, estimates costs from USD –109/t CO_2 eq to USD 2,596/t CO_2 eq[50] across a range of measures, including the following:

(a) Technology measures such as the introduction of regulatory CO_2 standard for aircraft emissions (USD 1,705/t CO_2 eq); regulations/incentives to accelerate early retirement of less efficient aircraft (USD 2,596/t CO_2 eq), or retrofitting more fuel efficient technologies to existing aircraft (USD 595/t CO_2 eq);

(b) Operational and other measures such as constraining airport capacity (USD 125 /t CO_2 eq); reducing inefficiencies in air traffic movement (USD –109/t CO_2 eq); incentives to better match aircraft to mission (USD 71/t CO_2 eq); regulation to mandate the use of biofuels (USD 13/t CO_2 eq); and promoting behavioural change aimed primarily at the leisure market (USD–16/t CO_2 eq).

78. An aviation marginal abatement cost curve produced by International Council for Clean Transportation estimates costs for a range of available mitigation options in shipping from USD –220/t CO_2 eq to USD 2,050/t CO_2 eq.[51]

2. Sustainable development benefits

79. Additional benefits from measures to reduce emissions within the maritime and aviation sectors also include: (i) development and diffusion of new technologies; (ii) air quality improvement; and (iii) job creation.

80. According to the ILO, for example, India is projecting that up to 5 million jobs could be created through village-based biofuel production, and another 5 million from full-scale industrial biofuels (although it is unlikely that this will be driven by demand solely from the aviation sector).[52]

3. Barriers

81. Improving fuel efficiencies represent both mitigation potential and an incentive for operational cost savings. However, measures to deliver such efficiencies face a number of barriers in both the aviation sector and the shipping sector, including the following:[53]

(a) Improving air traffic management can potentially facilitate reductions in aviation fuel burning, but increasing airport traffic volumes makes it harder to optimize operations in this direction;

(b) Current technologies could improve the fuel efficiency of new aircraft and shipping engines, but they could also force trade-offs between reduced CO_2 emissions versus increased emissions of nitrogen oxide;

[49] EMRC/AEA, 2011.
[50] These numbers are specific to the fleet which serves the United Kingdom.
[51] ICCT, 2011.
[52] ILO, 2012.
[53] UNEP, 2011.

(c) Biofuels may offer a low-carbon alternative to aviation kerosene, but associated indirect emissions (e.g. from land-use change) may even lead to an overall increase.

4. Examples of national (and international) policies

82. Owing to the transboundary nature of shipping and aviation, examples of international policies are included here. Broadly, policies to reduce emissions from shipping and aviation fall into three main categories: operational, technical and market-based instruments.[54]

83. In the aviation sector:

(a) Operational policies: there are two major initiatives to improve air traffic management: the Single European Sky Air Traffic Management Research programme, which aims to achieve a 10 per cent reduction in emissions per flight by 2020, and the Next Generation Air Transportation System of the United States of America, which aims to save an average of 1.6 Mt CO_2 eq per year to 2018, or 0.7 per cent of the annual total aviation emissions of the United States;

(b) Technical policies: the International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection is currently developing a CO_2 emissions standard for aircraft;

(c) Market-based instruments: two types of market-based instruments attach a price to emissions: (i) charges such as taxes/levies; and (ii) cap-and-trade instruments such as tradable emissions rights/allowances/permits/offsets. In the aviation sector, cap-and-trade schemes are currently being implemented at both the national and international level. These include domestic flights in the New Zealand ETS and both domestic and international flights in the European Union ETS, although the regulation on international flights is currently temporarily suspended.

84. In the shipping sector:

(a) Operational policies: the International Maritime Organization (IMO) has mandated ships to carry a Ship Energy Efficiency Management Plan from July 2012. It provides operators with a framework for the planning, implementation, monitoring, self-evaluation and improvement of operational measures appropriate to the ship, but will also assist in identifying possible technical improvements;

(b) Technical policies: IMO introduced a mandatory CO_2 standard in 2011, known as the energy-efficiency design index, for major classes of new ship built from 2013, covering 72 per cent of emissions from new ships;

(c) Market-based instruments have been discussed within IMO; they can be classified into three groups: (i) levy-type proposals; (ii) cap-and-trade proposals; and (iii) a baseline-and-credit trading scheme, setting a fleet average fuel efficiency target.

5. Cooperative initiatives

85. Several Parties and observers referred to the work of IMO and ICAO, although they are not cooperative initiatives in the same form as many of the initiatives referred to in this technical paper. Their work is deemed essential in addressing emissions from the international aviation and maritime transportation and described in paragraphs 83 and 84

[54] UNEP, 2011.

above. The most recent resolution of the General Assembly of ICAO is noteworthy as it paves the way for market-based measures in international aviation.[55]

86. The aviation industry trade association – the International Air Transport Association – has made voluntary commitments to CO_2 emission reduction efforts. It aims to improve fuel efficiency by 1.5 per cent per year by 2020, achieve "carbon-neutral growth" from 2020 and reduce CO_2 emissions by 50 per cent, relative to 2005, by 2050.[56]

E. Fossil fuel subsidy reform

87. Reform of fossil-fuel subsidies is a cross-cutting thematic area and has a potential impact on the above-mentioned thematic areas related to energy. Still, reform in the fossil fuel subsidies is treated in a separate section in view of its potentially significant mitigation impact.

1. Mitigation potential and benefits

88. Long-term government subsidies for fossil-fuel use and also for other areas, such as agriculture, are implemented to support economic development and/or for social reasons, but they may lead to market distortions. Many Parties highlighted fossil-fuel subsidy reform in particular as an area of high mitigation potential requiring further discussion.

> The IEA suggests that implementing a partial phase-out of fossil-fuel consumption subsidies and other key policies could keep emissions within reach of a 2 °C pathway to 2020 with no net economic cost.
>
> *Source*: IEA, 2012.

89. Several Parties provided an estimate of 1.5 Gt CO_2 eq–2 Gt CO_2 eq in 2020 of emission reductions from enabling fossil-fuel subsidy reforms in the context of alleviating poverty and enhancing growth. The International Monetary Fund (IMF) has found that removing all post- and pre-tax subsidies for fossil fuels could reduce emissions by up to 13 Gt CO_2 eq annually worldwide. They also estimate that raising energy prices to levels that would eliminate tax-inclusive subsidies for petroleum products, natural gas and coal could lead to emission reductions of 4.5 Gt CO_2 eq, representing a 13 per cent decrease in global energy-related CO_2 emissions.[57]

2. Sustainable development benefits

90. In 2011, estimations of global fossil-fuel subsidies ranged from USD 480 billion[58] to USD 523 billion[59]. Reforming such subsidies offers a range of benefits beyond reducing GHG emissions, such as:

> IEA highlighted that in 2011 fossil-fuel subsidies were USD 523 billion compared to renewable energy subsidies of USD 88 billion.
>
> *Source*: IEA, 2013b.

(a) Enhancing the development and diffusion of new technologies (e.g. by providing further incentives for and improving the economics of investing in energy efficiency, renewable energy and sustainable resource management);

(b) Promoting economic growth (e.g. through encouraging investment in the energy sector and increasing longer-term competitiveness of the private sector);

[55] Available at <http://www.icao.int/Meetings/a38/Documents/WP/wp430_en.pdf>.
[56] UNEP, 2011.
[57] IMF, 2013.
[58] IMF, 2013.
[59] IEA, 2013.

(c) Providing environmental and health benefits (e.g. reductions in local air pollution, traffic congestion, accidents and road damage);

(d) Improving social welfare (e.g. welfare gains and increases in real income);[60]

(e) Enhancing the resilience of the economy (e.g. through reduced exposure to energy import price fluctuations).

3. Barriers

91. Recent assessments by the IMF of country experiences in energy subsidy reform have identified six main barriers:[61]

(a) Lack of information regarding the magnitude and shortcomings of subsidies;

(b) Lack of government credibility and administrative capacity;

(c) Concerns regarding adverse impacts on the poor, inflation, international competitiveness and volatility of domestic energy prices;

(d) Opposition from specific interest groups benefiting from the status quo;

(e) Weak macroeconomic conditions.

92. One group of Parties noted that barriers to such reform vary worldwide, owing to variations in national legislation, the stage of social and economic development and national policy choices and priorities.

4. Examples of national policies

93. Promoting reform aimed at phasing out inefficient fossil-fuel subsidies is a politically complex matter; views by Parties on the feasibility of the reform differ substantially. However, according to the IMF, examples of successful fossil-fuel subsidy reforms can be found in a range of countries, including Armenia, Brazil, Chile, Kenya, Philippines, Poland, South Africa, Turkey and Uganda. Key policy elements of many of these successful reform processes include the following: (i) a comprehensive reform plan; (ii) a far-reaching communications strategy, aided by improvements in transparency; (iii) appropriately phased energy price increases, which can be sequenced differently across energy products; (iv) improved efficiency of State-owned enterprises to reduce producer subsidies; (v) targeted mitigating measures to protect the poor; and (vi) depoliticizing energy pricing to avoid the recurrence of subsidies.[61]

5. Cooperative initiatives

94. The Group of 20 largest economies (G20) has put subsidy reforms on its agenda. Following a commitment in 2009 “to phase out over the medium term inefficient fossil-fuel subsidies”, the G20 leaders have annually renewed this pledge and established a working group on energy and commodity markets to monitor and report member country progress in this area. Next steps currently under discussion include the peer review of fossil-fuel subsidy reform progress, standardizing reporting and engaging with other groups making similar commitments, such as Asia-Pacific Economic Cooperation and the Friends of Fossil Fuel Subsidy Reform Group.[62]

95. However, one observer noted that although the G20 and the Group of Eight (G8) have agreed to phase out “inefficient” fossil-fuel subsidies, thus far, very little progress has been made.

[60] Burniaux and Chateau, 2011.
[61] IMF, 2013.
[62] G20, 2012.

96. The United States of America recently joined Denmark, Finland, Iceland, Norway, and Sweden in committing to end public financing for new coal-fired power stations internationally and to secure the support of other countries and multilateral development banks to adopt similar policies.

F. Reducing short-lived climate pollutants, including fluorinated gases

97. Short-lived climate pollutants comprise substances with a relative short lifetime in the atmosphere compared to that of CO_2. They include black carbon, methane, tropospheric ozone and some hydrofluorocarbons (HFCs).

Reducing short-lived climate pollutants

1. Mitigation potential and benefits

98. UNEP estimates that fully implementing measures to reduce these three short-lived climate pollutants by 2030 could achieve reductions in the global temperature increase between 2010 and 2050 of 0.4–0.5 °C. However, UNEP acknowledges that although this is likely to make only a modest contribution to longer-term climate goals. For example, assuming full implementation of measures by 2020, the impact of the emission reductions achieved in that year on global temperature over a 100-year time horizon would be about 1.1 Gt CO_2 eq. Therefore, reduction efforts must be viewed as a strategy that complements but does not replace CO_2 emission reductions.[63]

99. Many of the mitigation measures required to reduce short-lived climate pollutants are already being implemented around the world. In terms of cost, measures range from those with low or negative cost, such as separation and treatment of biodegradable municipal waste (USD 29/t CO_2 eq) or the introduction of more efficient brick kilns 9 USD –7/t CO_2 eq), to those with high to very high cost such as intermittent aeration of continuously flooded rice paddies (USD 130/t CO_2 eq) or the introduction of high emissions standards for off-road mobile machinery (USD 1,400/t CO_2 eq).[61]

2. Sustainable development benefits

100. According to UNEP, sustainable development benefits from reducing short-lived pollutants include: (i) improving national and local health and air quality: mitigating short-lived climate pollutants by 2030 could prevent around 2.4 million premature deaths annually (from indoor and outdoor air pollution); and (ii) improved agriculture and ecosystems: mitigating short-lived climate pollutants by 2030 could reduce annual crop losses by around 32 million tonnes.[63]

3. Barriers

101. There are many barriers to implementing measures for reducing short-lived climate pollutants across a range of sectors, including the following:

(a) In the residential sector: high fuel and technology costs; limited fuel supplies; low awareness of the health impacts of established cooking practices; limited durability of improved stoves; the high cost of technology; and lack of harmonized standards;

(b) In agriculture and forestry: weak enforcement of regulations; low stakeholder awareness; adherence to traditional practices; and the high costs of modified feed;

(c) In industrial processes: limited access to finance and skilled personnel; limited community awareness; and lack of relevant regulations and enforcement;

[63] UNEP, 2011b.

(d) In the fossil-fuel industry: high upfront investment costs; technical constraints; lack of infrastructure, lack of nearby markets; and the cost of monitoring and maintenance;

(e) In transport: unavailability of ultra-low sulphur fuels and lack of regular inspection and enforcement;

(f) In waste management: high capital costs; low prices for methane; complex permitting schemes and liability issues; and the high cost of upgrading primary water treatment facilities.[64]

102. Another barrier to reducing short-lived climate pollutants is the lack of reliable data, as there are no requirements for the measurement and reporting under the UNFCCC process of aerosols such as black carbon.

4. Examples of national policies

103. A range of national policies and practices contribute to reducing short-lived climate pollutants.

104. Developing national action plans for reducing short-lived climate pollutants, building on existing institutions and policies that address air quality management, development and climate change is one example of national policies. Also, implementation of key actions, including strengthening national regulations in industry, transport, agriculture and waste could further reduce these pollutants.[62] Measures to reduce air pollution from vehicles and traditional brick kilns through a combination of regulations and economic incentives have proved effective. For example, in Mexico, improved kiln designs boosted fuel efficiency by 50 per cent and reduced particulate pollution by 80 per cent.[64]

According to UNEP, from 2007, new diesel trucks intended for use in the United States of America have been equipped with diesel particulate filters, a measure which is estimated to cut particulate and black carbon emissions by over 90 per cent.

Source: UNEP, 2011b.

5. Cooperative initiatives

105. Many Parties are engaging in the Clean Air and Climate Coalition, a fast-growing coalition of over 60 partners coordinated by UNEP. This Coalition is taking action by organizing technology conferences to highlight available alternative technologies, carrying out inventory work, including trend assessment and evaluation of barriers to change, and funding demonstration projects to show the feasibility of new technologies.

106. Additionally, UNEP notes that regional initiatives and intergovernmental networks for air pollution management have a potential to provide a basis for cooperative action as well as enhancing and supporting national action for various reasons:

(a) Regional agreements could become platforms for policy action on controlling short-lived climate pollutants, such as the Convention on Long-Range Transboundary Air Pollution and the Agreement on Transboundary Haze Pollution of the Association of Southeast Asian Nations;

(b) Intergovernmental initiatives with established structures and a focus on monitoring and scientific research could become platforms for developing scientific information, awareness-raising and capacity-building on short-lived climate pollutants, such as the Malé Declaration on Control and Prevention of Air Pollution and its Likely

[64] UNEP, 2011b.

Transboundary Effects for South Asia, and the Acid Deposition Monitoring Network in East Asia, covering North-East and South-East Asia;

(c) Agreements or initiatives with no existing structures for pursuing knowledge or policies could become forums for awareness-raising, capacity-building, exchange of scientific information and implementation of policy action regarding short-lived climate pollutants, such as the Southern African Development Community Regional Policy Framework on Air Pollution (known as the Lusaka Agreement) and the Intergovernmental Network on Air Pollution in Latin America and the Caribbean.[65]

Reducing emissions from fluorinated gases

107. This section focuses on reducing emissions from fluorinated GHGs. Fluorinated gases such as HFCs are extremely powerful global warming gases widely used in industrial processes and refrigeration. The most commonly used HFC (tetrafluoroethane (HFC-134a)) is 1,430 times more damaging to the climate system than CO_2.

1. Mitigation potential and benefits

108. The UNEP *Bridging the Emissions Gap* 2011 report was referred to by several Parties in relation to its estimate of a potential to reduce global emissions by 0.5 Gt CO_2 eq per year by 2020 through new actions on fluorinated gases and its estimate of additional costs of using climate-friendly alternatives when implementing the phase-out of ozone depleting substances under the Montreal Protocol of less than EUR 1/t CO_2 eq.[65]

> It is estimated that action under the Montreal Protocol on HFCs proposed by a group of countries would lead to avoiding cumulative emissions estimated at 2.2 Mt CO_2 eq from now until by 2020 and 85 Mt CO_2 eq by 2050.
>
> *Source*: EPA, 2012.

109. Although HFCs currently represent around 1 per cent of global GHG emissions, their contribution is expected to soar in the coming decades as they replace ozone-depleting substances. Emissions are predicted to increase at a rate of 10–15 per cent per year, according to a number of Parties and observers. Emissions are projected to rise from about 3.5 Gt CO_2 eq to 8.8 Gt CO_2 eq by 2050.[66]

2. Sustainable development benefits

110. Additional benefits from reducing the use of fluorinated gases, for example when switching refrigeration and air-conditioning systems to use low global warming (GWP) potential substances include: (i) energy savings: such systems have equal or better energy efficiency than systems using high GWP HFCs and, hence, using such systems will help to save energy;[66] and (ii) adaptation: refrigeration and air-conditioning systems produce heat that in extreme weather events warms urban areas (thus increasing the need for further air conditioning). Increasing the efficiency of refrigeration and air-conditioning systems is vital for climate adaptation as an increase in global temperatures may lead to an increase in their demand.

3. Barriers

111. A number of barriers prevent changes in technology to avoid the use of HFCs, such as: (i) the need for technical developments; (ii) flammability and toxicity risks;

[65] UNEP, 2011c.
[66] UNEP, 2011a.

(iii) regulations and standards that inhibit the use of alternatives; (iv) insufficient supply of components; (v) investment costs; and (vi) lack of relevant skills among technicians.[67]

112. A particularly significant difficulty, as emphasized by Parties during the ADP round tables held in 2013, was encountered when trying to raise national ambition through regulation of industrial processes. A key problem is that companies prefer to relocate to countries with less stringent emission reduction standards, thereby providing a competitive advantage to products imported from such countries versus those produced in countries with ambitious standards.

4. Examples of national policies

113. Many countries address fluorinated gases through regulations. For example, the United States' Environmental Protection Agency plans to remove HFC-134a from the list of acceptable gases for new passenger cars and light-duty vehicles and a national programme of CO_2 emission reduction targets for vehicle fleets will allow credits for HFCs reductions.[67] In the European Union, commercialization of alternatives is also expected following a directive that bans the use of vehicle refrigerants with a GWP above 150 in all new vehicles from 2017.[67]

114. In some cases, such regulations target a phase-down of HFCs production and consumption, for example in the European Union, Switzerland, Australia and Japan. Ghana is planning related national legislation, while other developing countries are looking into taking national action.

115. Incentives and capacity-building efforts under the Montreal Protocol could help countries to make the transition to alternatives to fluorinated gases. For example, the Montreal Protocol supports technology transfer to developing countries, helping industry to replace chemicals and equipment, reorganizing production processes and stimulating the redesign of products, including through funding for developing countries through the Multilateral Fund.

5. Cooperative initiatives

116. Proposals were made to consider the broader benefits of involving initiatives from industry as well as local authorities, intergovernmental organizations and non-governmental organizations (e.g. the International Organization for Standardization). One example of an industry-led initiative is "Refrigerants, Naturally!", a global initiative led by a number of large international food and drink manufacturers to employ natural refrigerants. Another example is the Consumer Goods Forum, an international coalition of 650 retailers, manufacturers and other groups in 70 countries in favour of phasing out HFC refrigerants by 2015.[67]

117. The involvement of expert groups under the Montreal Protocol, such as the Technology and Economic Assessment Panel, technical options committees and the Scientific Assessment Panel, was encouraged by many Parties in addressing fluorinated gases.

G. Land use

118. Land use covers a broad range of issues and activities in relation to climate change mitigation and adaptation, including land-use changes, forestry, carbon sequestration in agricultural soils and non-CO_2 emissions from agricultural production. A number of Parties provided information on national actions in this thematic area at the ADP workshop on the

[67] UNEP, 2011a.

pre-2020 ambition: opportunities for mitigation and adaptation related to land use held on 1 May 2013 in Bonn (the workshop on land use opportunities). Only some of these issues are addressed here and this section focuses specifically on the issue of mitigation potential from land-use change, agriculture and forestry (including REDD[68]).

1. Mitigation potential and benefits

119. According to the UNEP *Emissions Gap Report 2012*, the forestry sector has the potential to reduce emissions by 1.3–4.2 Gt CO_2 eq by 2020, while mitigation potential from agriculture is reported to range from 1.1 to 4.3 Gt CO_2 eq.[69] However, the uncertainty of these estimates are much higher than those for energy, transport and short-lived pollutants.

120. Specifically on REDD-plus, the potential to reduce net global emissions by 2030 is estimated around up to 3 Gt CO_2 eq per year, as was noted by some Parties.[66] It was also acknowledged that further work to identify cost-effective REDD-plus mitigation potential is essential as part of the global mitigation effort.

121. The UNEP *Bridging the Emissions Gap report 2011* estimates the cost of implementing this mitigation potential for forestry at USD 20–27/t CO_2 eq. For agriculture, the cost estimates within a broader range from USD 20/t CO_2 eq to USD 100/t CO_2 eq.[70]

2. Sustainable development benefits

122. Parties highlighted multiple benefits that represent major driving forces behind national action on land use in the areas of food security, sustainable livelihoods, economic and productivity gains, biodiversity conservation, and poverty alleviation.

123. Several Parties referred to benefits from REDD-plus beyond reducing GHG emissions, including strengthening sustainable forest management, providing financial revenues and enhancing the participation of stakeholders. In a number of countries, the legislation on reducing deforestation recognizes the benefits of protecting natural forests, such as water management, soil erosion and storm protection.[71] Sustainable forest management provides both essential environmental services and renewable raw material to other sectors, while also providing jobs. An annual investment of USD 30 billion into reduced deforestation and degradation of forests could sustain up to 8 million additional full-time workers in developing countries.[72]

124. Reducing deforestation via REDD-plus could also have significant local adaptation benefits. For example, trees and densely vegetated areas bind soils, prevent leaching of vital nutrients and in some cases can contribute to watershed protection, reduce the risk of extreme flooding and reduce the amount by which a locality will overheat. Another example was provided by New Zealand during the workshop on land use opportunities. New Zealand emphasized that investments by the government of New Zealand and the private sector in improvements in land-use efficiency have had multiple economic and environmental benefits that go beyond climate change mitigation.

[68] Reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.
[69] UNEP, 2012.
[70] UNEP, 2011c.
[71] Townshend et al, 2013.
[72] ILO, 2012.

3. Barriers

125. Barriers identified by Parties and observers as key challenges for land-use and forestry mitigation (in particularly for developing countries) include the following:

(a) Limited access to financial resources and lack of long-term international funding;

(b) Poor enabling environments and institutional readiness for scaling up of successful pilot activities and best practices;

(c) Vulnerability and non-permanence of forest resources and the impact of natural disasters;

(d) Potential impacts on food security if global food production is constrained.

126. Additionally, a number Parties elaborated on further barriers specific to implementing REDD-plus activities, such as the following:

(a) Incomplete methodological guidance (e.g. reference levels, national forest monitoring systems, and measurement, reporting and verification regime);

(b) Poor data on forest inventories and estimated CO_2 emissions and removals (e.g. the rate of deforestation and plant species disappearance);

(c) Lack of sufficient understanding of the drivers of deforestation (e.g. private-sector activities and international markets);

(d) Poor institutional framework (e.g. national forest governance, soil legislation, land-use policy and land tenure structure);

(e) Illegal logging (fuelled by both local and multinational companies).

4. Examples of national policies

127. A number of Parties listed policy priorities and best practices relating to land-use mitigation, including the following:

(a) Promoting sustainable development principles in forest management programmes;

(b) Taking a holistic approach to mitigation and adaptation in land use, in particular on forest management. This includes mainstreaming of adaptation priorities into agricultural land-use efficiency and productivity programmes;

(c) Launching deforestation, reforestation and illegal logging abatement programmes;

New Zealand introduced the forestry sector into its domestic emission trading scheme in 2008. Since then, deforestation has been reversed and 43,000 hectares of new forest have been planted.

Brazil reduced deforestation in the Amazon by 83 per cent between 2004 and 2012 by improving territorial planning, setting up robust monitoring and control, promoting sustainable development and by involving local communities.

Source: ADP workshop on pre-2020 ambition: mitigation and adaptation opportunities related to land use held on 1 May 2013 in Bonn.

(d) Piloting various financial incentive and investment schemes, market and non-market mechanisms, payment for ecosystem services schemes;

(e) Encouraging investments in research and development, knowledge-sharing and capacity-building;

(f) Supporting community forest management and emerging markets support programmes, including bioenergy generation in rural areas;

(g) Launching public-private partnerships and involvement of the private sector;

(h) Providing low-cost energy alternatives to the local communities to help reduce energy dependency on biomass.

128. Policies specifically focused on REDD fall into three broad categories:[73]

(a) Policies to preserve protected areas: the expansion of protected areas in Brazil has significantly decreased both fire incidence and deforestation in the Amazon. In Costa Rica, protected areas now generate more income from ecotourism than livestock exports. New Zealand through its Permanent Forest Sinks Initiative which promotes the establishment of new forests where participants commit to maintain land permanently in forest (via registration on the land title) even if the land is subsequently sold;

(b) Command and control measures: in the Brazilian Amazon, improved satellite-based monitoring has enabled field-based law enforcement to respond to deforestation in real time. Modernizing the federal environment police and implementing innovative enforcement measures, such as confiscation of illegally used assets, area-based trade embargos and making slaughterhouses and supermarkets liable for offences by suppliers involved in illegal deforestation, has also contributed significantly to reducing deforestation;

(c) Economic instruments: in Costa Rica, applying forest conservation and reforestation incentives to private farms, including direct subsidies for farm-level forest conservation and payments for ecosystem services (e.g. protection of watersheds, carbon stocks, biodiversity and natural beauty) have all played a significant role in reducing deforestation. As was presented at the workshop on land use opportunities, Indonesia established the climate change trust fund to coordinate and pool financial resources coming from the private sector and donor organizations to finance mitigation and adaptation policies in land use and other areas.

129. The importance of integrated policy approaches in land use was also highlighted by several Parties in their submissions and during the workshop on land use opportunities, for example:

(a) Brazil is implementing a national plan on mitigation and adaptation in agriculture led to an increase in agricultural production by 28 per cent and an increase in agricultural land area by only 5 per cent. International cooperation was recognized as an important factor in achieving such results;

(b) Indonesia has in place its carbon-efficient farming policy, which targets increased productivity and resilience to climate variability to enhance national food security and alleviate poverty;

(c) New Zealand encourages partnerships with the private sector and capacity-building to ensure that initiatives have long-term commercial viability of policies and are sufficiently simple and flexible for application to all lands and forests;

(d) The Plurinational State of Bolivia operates a publicly funded joint mitigation and adaptation mechanism involving the private sector and local communities to address the drivers of deforestation and forest degradation.

130. A number of countries have a significant body of laws and regulations designed to reduce deforestation: for example such as Bangladesh, Brazil, Indonesia, Mexico, Nepal and Vietnam. The importance of engaging communities was highlighted by a number of Parties at the workshop on land use opportunities. For example, lessons from Tanzania's community-based forest management experience indicate that it is possible to incentivize

[73] UNEP, 2012.

people to take action to facilitate adaptation and mitigation, and that such incentives should be linked to sustainable economic growth and reduced poverty. Since 2002, Tanzania enforces a law on participatory forest management, which provides a legal basis for communities to own and manage forests. At the moment, about 10 per cent of forests are managed by local communities in Tanzania.

5. Cooperative initiatives

131. The Forest Carbon Partnership Facility was highlighted as an important arrangement that has enabled pilot programmes in developing countries. One Party highlighted its support for the work of the Global Research Alliance on Agricultural Greenhouse Gases focussing on the research and development, and extension of technologies and practices that help to identify ways to grow more food without increasing emissions. A number of Parties mentioned the REDD-plus Partnership, under which 50 countries agreed on a framework for the rapid implementation of measures for reducing deforestation.

132. The United Nations-REDD Programme was reiterated in a number of submissions. Further initiatives include the Global Bioenergy Partnership and the Global Partnership on Forest and Landscape Restoration. A Food and Agriculture Organization's programme funded by Finland, Germany and Norway, called Mitigation of Climate Change in Agriculture, provides technical support and facilitates collaboration with international and national organizations.

H. Waste

133. This section covers municipal solid waste and wastewater treatment but does not cover crop residues.

1. Mitigation potential and benefits

134. According to the UNEP *Emissions Gap Report 2012*, the mitigation potential of the waste sector is around 0.8 Gt CO_2 eq.[74]

135. The UNEP *Bridging the Emissions Gap 2011* report estimates that the cost of implementing the mitigation potential for waste ranges considerably, depending on the context and measures utilized. These include landfill gas utilization (USD 20–70/t CO_2 eq), landfill gas flaring (USD 25/t CO_2 eq), composting (USD 240–270/t CO_2 eq), anaerobic digestion (USD 40–430/t CO_2 eq), mechanical and biological treatment (USD 360/t CO_2 eq) and incineration (USD 270/t CO_2 eq).[75]

2. Sustainable development benefits

136. In addition to the mitigation benefits, implementing effective waste management systems brings a wide range of sustainable development benefits, including improved public health and environmental protection.

137. Composting organic wastes in cities and transporting them to agricultural land brings multiple benefits in closing the nutrient cycle by returning the nutrients that are exported from the farm, avoiding methane emissions and increasing the rate of soil carbon sequestration.

[74] UNEP, 2012.
[75] UNEP, 2011.

3. Barriers

138. The following barriers were identified in the submissions that prevent tapping the full potential for emission reductions in the waste sector: (i) a lack of sustainable financing mechanisms as well as adequate regulatory frameworks and institutional arrangements; (ii) insufficient capability to identify the environmental and social benefits of actions; for example, transparent identification of key players and their respective interests and operational limitations critical for waste prevention; and (iii) action to transfer sustainable technology in the waste sector to developing countries.

4. Examples of national policies

139. Since 1990, the European Union has reduced its emissions in the waste sector by 31 per cent, mainly via reduced methane emissions from landfills as the result of regulating waste through the entire life cycle. In many of the megacities of the developing world (i.e. São Paulo, Dhaka, Buenos Aires, Bogota and Rio de Janeiro) landfilling and composting are already resulting in huge GHG emission reductions and contributing to energy generation or to soil recovery processes.

140. During the workshop on low-emissions development opportunities, waste management efforts were highlighted as a key part of successful low-emission development strategies being implemented in Mexico and Vietnam.

5. Cooperative initiatives

141. The Global Methane Initiative is the only international initiative to specifically target methane abatement, recovery and use by focusing on the five main methane emission sources: agriculture, coal mines, municipal solid waste, oil and gas systems, and wastewater.

V. Finance, technology and capacity-building to support implementation

142. As noted in many submissions, successful implementation of national actions by developing countries is linked to access to financial, technological and capacity-building support. For many developing countries, enhanced delivery of support will be a major incentive for the implementation of their pledges and may help these countries to identify and explore further options to reduce emissions. This chapter presents an overview of options to enhance the delivery of finance, technology and capacity-building to support the implementation of mitigation actions at the national level. Further information on the overview of institutional arrangements under the UNFCCC related to finance, technology and capacity-building is provided in document FCCC/ADP/2013/INF.2.

A. Finance

143. Various options and approaches have been proposed by many Parties in their submissions to enhance the delivery of financial support. This includes ensuring and increasing the transparency of financial support made available, delivered as well as examples of ways to deliver it. This also includes enhancing support to Parties to identify financial sources, mobilize and attract further financial support. The importance of improving institutional arrangements and the capitalization of institutions under the Convention, such as the Green Climate Fund, the enhancement of the Adaptation Fund and operationalization of the NAMA registry, was also acknowledged by a number of Parties.

1. Transparency of financial support

144. Several Parties called for more clarity on the support made available, especially with regard to reaching the goal of mobilizing USD 100 billion per year by 2020 as pledged by developed country Parties. Preparation by developed countries of a road map for financial support and finding ways to increase such support was seen as a way to support enhanced mitigation and adaptation actions by developing countries and to achieve the above-mentioned goal. Developed countries could possibly commit climate financing flows through the financial mechanism of the Convention for both the medium term (2013–2020) and the long term (post-2020) on the basis of the implementation of Article 4, paragraphs 3, 4, 5, 7 and 8, of the Convention.

145. In the context of the transparency and clarity of funding priorities and distribution modalities, one Party noted the need to operationalize arrangements for finance under the Convention, especially for the funding of the Green Climate Fund and providing support for the activities under the Adaptation Committee. Such transparency and clarity of financial support is deemed critical to the implementation of NAMAs and could be enhanced through indication in the NAMA registry of the amount of support available for NAMAs. Another Party suggested that near-term financial support for mitigation could focus on actions that advance near-term ambition of finance and assist countries that have demonstrated a willingness to take action and to improve their enabling environments.

146. The importance of measuring, reporting and verification of financial support was acknowledged in order to: (i) ensure accurate accounting of the provision of funds from developed country Parties to developing country Parties; (ii) assess compliance with financial obligations for mitigation, adaptation, transfer of technology and capacity-building; and (iii) ensure robustness and transparency of the financial mechanism of the Convention.

2. Support to Parties to identify financial sources and attract financial support

147. Some Parties suggested that more work should be undertaken by the bodies under the Convention, in particular to identify financial sources of support, including for REDD-plus. To that end, some Parties recalled their engagement in the COP work programme on long-term finance and its aim to inform developed country Parties in their efforts to identify pathways for mobilizing scaled up climate finance to USD 100 billion per year by 2020 from public, private and alternative sources. In this context, the European Union recalled its voluntary contribution of EUR 5.5 billion of climate finance for the coming years, from a number of Member States.

148. Many Parties proposed that specific innovative sources of financial support be examined, such as the Daly-Correa tax, financial transaction taxes, the net avoided emissions mechanism and the use of IMF special drawing rights, the removal of fossil-fuel subsidies, and the ETS and Adaptation Fund levies. These sources could contribute to increasing the ambition of support by developed countries.

149. Several Parties noted the important role that carbon markets could play in attracting finance from the private sector for enhanced action and in catalysing cost-effective mitigation to close the mitigation gap. In this regard, it was suggested that addressing the current low carbon price could incentivize the engagement of developing countries and the private sector. It was also suggested that both market-based and non-market based approaches should be considered as viable solutions to facilitate an increase in the level of ambition.

150. Some Parties invited developing country Parties to make complementary efforts to strengthen their enabling environments to attract support, including private investment. Such efforts could focus on contract enforcement, protection of intellectual property rights,

macroeconomic and political stability, availability of local currency financing, the existence of regulatory requirements and/or incentives or the removal of disincentives to motivate investment.

151. Developed country Parties have been invited to use public finance to leverage and incentivize additional private-sector investment and to support actions in developing countries that cannot attract private-sector investment. According to an observer, the Green Climate Fund can also play a role by supporting initiatives that reduce costs and eliminate barriers and perceived risks, in order to make low- or zero-carbon technologies more competitive.

152. On support in some specific thematic areas, for example transport, a proposal was made to link the voluntary commitment of multilateral development banks made at the Rio+20 conference to additional climate change finance, for example from the Green Climate Fund.

3. Institutional arrangements under the UNFCCC process

153. Some options to enhance the financial support proposed by Parties refer to existing institutional arrangements under the UNFCCC process, including the extended COP work programme on long-term finance, the NAMA registry and the Green Climate Fund. New and non-UNFCCC institutional arrangements are also suggested to enhance the financial support as described below.

154. Many Parties and observer organizations expect the extended COP work programme on long-term finance to prepare recommendations to the COP at its nineteenth session in order to scale up climate financial flows towards the 2020 goal on finance and meet the needs of developing countries to realize proposed pledges and NAMAs and further increase their levels of ambition.

155. For many Parties, the Green Climate Fund and the Climate Technology Centre and Network should be provided with needed financial resources in order to ensure their effectiveness and incentivize actions by developing countries. Many Parties stated at the ADP round tables held in 2013 that the immediate capitalization of the Green Climate Fund would encourage more developing countries to join the global effort to reduce emissions and to submit a NAMA. Engaging a wider cross-section of stakeholders (e.g. international financial institutions, the private sector and academia) was also seen as important in facilitating enhanced action at the international level.

156. The Green Climate Fund is deemed important in promoting a paradigm shift in developing countries on the basis of country-owned strategies, plans and programmes that are developed and implemented through participatory and inclusive processes and that are integrated into developing countries' core development plans. To that end, guidance by the COP to the Green Climate Fund is needed on the policies, programme priorities and eligibility criteria that would be most effective in catalysing the necessary paradigm shift.

157. During the ADP workshops and round tables held in 2013, developed countries were encouraged to indicate in the NAMA registry the amount of support that they intend to mobilize for NAMAs and developing countries to indicate clear budgetary provisions for the NAMAs that they submit to the registry.

158. New institutional arrangements are proposed to facilitate action on finance under the UNFCCC process and beyond it. For the reporting of financial support provided, one Party proposed the establishment of a financial support registry, which will be open and transparent and accessible to all Parties, and the use of a common, internationally agreed format, approved by the COP. It was suggested to establish a working group or framework by the ADP that would include international financial institutions, bilateral donors and partner countries, to develop and assess the costs of NAMAs. Also, the importance of the

regional development banks was acknowledged within the overall financial architecture on climate change.

4. Instruments for financial support

159. Parties referred in their submissions and during the ADP workshops to a range of instruments used to deliver financial support through multilateral and bilateral channels, and regional facilities, initiatives and programmes. An example of such a multilateral instrument is the newly established Sustainable Energy for All Facility that is scaling up resources channelled to the Global Energy Efficiency and Renewable Energy Fund helping to direct investment to energy efficiency and renewable energy.

160. Several regional investment facilities provide support to overcome barriers for improving energy efficiency and promoting renewable energy. These include support provided by the Latin America Investment Facility to Mexico, for low-income groups, for energy efficiency improvements and by the Investment Facility for Central Asia to strengthen Kazakhstan's energy efficiency measures. This also includes the Geothermal Risk Mitigation Facility for Eastern Africa that was established on the basis of EUR 30 million fund from the European Union's Africa Infrastructure Trust Fund to cover a portion of costs related to upfront survey and exploration for geothermal energy development in Ethiopia, Kenya, Rwanda, Tanzania and Uganda.

161. A number of regional cooperation programmes support improvements in energy efficiency, such as: (i) the Euro-Mediterranean Partnership the aim of which is a 20 per cent energy efficiency improvement by 2020; (ii) the SWITCH-Asia cooperation programme geared towards strengthening policy-making capacities in Malaysia, Thailand, Indonesia and the Philippines; and (iii) the Asian Investment Facility pilot project for a carbon-linked incentive scheme to support the implementation of energy efficiency and renewable energy policies in industrial processes and product use in Indonesia.

B. Technology

162. Many Parties highlighted the need to provide support to developing country Parties for the development and transfer of technology, including facilitating access to new technologies to implement adaptation and mitigation actions, including NAMAs. One Party emphasized the specific assistance needs of countries with economies in transition. According to many Parties, technology needs assessments (TNAs)[76] and technology road maps could be instrumental in facilitating development and transfer of technology in developing countries.

163. According to the TNAs synthesized in the third synthesis report on TNAs,[77] 31 developing country Parties identified their national technology needs required to enhance mitigation action, which could be part of possible solutions to contribute to closing the pre-2020 mitigation ambition gap. Most Parties prioritized technology needs for mitigation in energy industries, transport energy, agriculture, forestry and land use. The majority of the mitigation technologies prioritized for energy industries were related to electricity

[76] As per decision 4/CP.7, Annex, paragraph 3, "technology needs and needs assessment" are defined as a set of country-driven activities that identify and determine mitigation and adaptation technology priorities of Parties other than developed country Parties, and other developed Parties not included in Annex II, particularly developing country Parties. They involve different stakeholders in a consultative process, and identify the barriers to technology transfer and measures to address these barriers through sectoral analyses. These activities may address soft and hard technologies, such as mitigation and adaptation technologies, identify regulatory options and develop fiscal and financial incentives and capacity building.

[77] FCCC/SBSTA/2013/INF.7.

generation. Solar photovoltaic and biomass/biogas electricity generation was prioritized by a majority of Parties, followed by technologies for efficient lighting, transformation of waste to energy, wind turbines and hydropower generation.[75]

164. In the same report on TNAs, Parties reported barriers to the development and transfer of the prioritized technologies. The most commonly reported mitigation barriers were economic and financial, and technical. Within the first category (economic and financial), most of the Parties identified inappropriate financial incentives and disincentives as the main barrier. In the technical barrier category, many of the Parties identified system constraints and inadequate standards, codes and certification as the main barriers. Common enablers identified by Parties to address these barriers included measures to provide or expand financial incentives for the implementation and use of the prioritized technology and the formulation of technology regulations and standards. Almost all Parties reported on their technology actions plans (TAPs), which consist of a group of measures to address the identified barriers to a prioritized technology.

165. The diffusion of environmentally sound technologies in developing countries is of paramount importance in increasing pre-2020 ambition to narrow the emissions gap, as demonstrated by the experience in cost reduction of renewable energy technology as was noted by an observer organization.

166. An example of a technology transfer success is the work under the Montreal Protocol, which supports technology transfer to developing countries by helping industry to replace chemicals and equipment, reorganize production processes and stimulate the redesign of products.

167. Various options and approaches have been proposed to enhance the delivery of the technological means of implementation. This includes addressing the issues of intellectual property rights and strengthening the Technology Mechanism.

1. Technology Mechanism

168. Some Parties and observers share the view that the Technology Mechanism must be strengthened in order to ensure its effectiveness and enable and incentivize enhanced actions in developing countries. According to an observer, the Technology Mechanism should be tasked to set a plan to determine how technology can address the 2 °C goal, adopt criteria to help to guide Parties in evaluating the environmental soundness of technologies, facilitate innovation of key environmentally sound technologies and optimize the integration of these actions with the NAMA process. Specific suggestions were also made for the Technology Executive Committee in the areas of technology needs mapping, strategic technology planning, and coordination of technology research, development and diffusion.

169. Several Parties suggested developing facilitative mechanisms and approaches under the Technology Mechanism in order to scale up the transfer of environmentally sound technologies to developing countries and address barriers to such transfers, including cost and policy barriers. This will ensure that such transfers support the objective of eventually developing endogenous capacity in developing countries to produce their own environmentally sound technologies as envisioned under Article 4, paragraph 5, of the Convention.

2. Intellectual property rights

170. According to some Parties, intellectual property rights and the costs associated with accessing technology represent the main barriers for developing countries to move towards a lower emissions pathway, including the implementation of NAMAs, as well as to take effective adaptation actions. Addressing key barriers to technology transfer such as

intellectual property rights is viewed by these Parties as critical to enabling enhanced actions in developing countries.

171. In this context, a view was expressed that a facilitative intellectual property rights regime that balances rewards for innovators with the common good of humankind would help to advance mitigation and adaptation actions at the scale and speed warranted by the Convention.

172. Important in addressing intellectual property rights is the on-going work by the Technology Executive Committee on the barriers to technology development and transfer and its key message conveyed to the subsidiary bodies during COP 18 that "intellectual property rights were identified as an area for which more clarity would be needed on their role in the development and transfer of climate technologies based upon evidence on a case by case basis." COP 18, by decision 13/CP.18, noted the key messages of the Committee, in particular on enabling environments for, and barriers to, technology development and transfer and that further work on these issues is being undertaken by the Committee.

C. Capacity-building

173. Many Parties and observers stress the importance of achieving further progress on capacity-building in the context of the ADP's work in order to provide means to enable the implementation of actions in developing countries, in particular to support NAMAs, REDD-plus and technology development and transfer.

174. Facilitating an enabling environment in developing countries to enhance mitigation and adaptation actions was seen as one of the key objectives of capacity-building. This includes strengthening of national governance and capacities to develop environmentally friendly technologies to measure efforts and emission reductions and to adapt to the adverse effects of climate change. The role of cooperative initiatives becomes important in this regard, for example the Low Emission Development Strategies Global Partnership.

175. A suggestion was made to use lessons learned from the work under the Montreal Protocol to overcome the challenge of insufficient domestic capacity to design and implement the range of programmes and policies (see para. 115 above). In addition, the role of the Renewables Academy was acknowledged in providing training and capacity to integrating renewable sources in the electricity grid, including through Regional Centre for Renewable Energy and Energy Efficiency in the Middle East and North Africa.