



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

Technical paper

Summary

This updated technical paper compiles information on the mitigation and sustainable development benefits of actions, initiatives and options to enhance mitigation ambition, with a focus on the four thematic areas of land use, urban environments, carbon dioxide capture, use and storage, and non-carbon dioxide greenhouse gas emissions. It also compiles information on support for actions in these thematic areas and possible actions by the Ad Hoc Working Group on the Durban Platform for Enhanced Action. Information for the update was provided in submissions from Parties and observer organizations, in relevant literature, and at the technical expert meetings held during the sessions of the Ad Hoc Working Group on the Durban Platform for Enhanced Action, held in June and October 2014 in Bonn, Germany. This technical paper builds on the previous version of the technical paper, contained in documents FCCC/TP/2014/3 and Add.1.

This technical paper consists of the main document and four addenda. The addenda are focused on mitigation action in the four thematic areas of land use, urban environments, carbon dioxide capture, use and storage, and non-carbon dioxide greenhouse gas emissions. The addenda elaborate on mitigation potential, progress, benefits, costs and barriers, as well as on good practice policies, key opportunities and options for catalysing action in the four thematic areas.

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I. Background

A. Mandate

1. This update 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 third part of its second session.¹ The first and second versions of this technical paper were published on 28 May and 30 October 2013, respectively, and are contained in documents FCCC/TP/2013/4 and FCCC/TP/2013/8 and Add.1 and 2.

2. In 2014, the technical paper was updated to compile information on actions with high mitigation potential, drawing on information provided in the submissions from Parties and observer organizations made by 30 March 2014 and at the technical expert meetings (TEMs) on unlocking mitigation potential for raising pre-2020 ambition through renewable energy deployment and energy efficiency improvements, held in March 2014 in Bonn, Germany, during the fourth part of the second session of the ADP.² The first update of the technical paper for 2014 was published on 29 May 2014³ and is contained in documents FCCC/TP/2014/3 and Add.1.

3. This update of the technical paper compiles information on actions with high mitigation potential, drawing on information provided in the submissions from Parties and observer organizations, in relevant literature, and at the TEMs on unlocking mitigation potential for raising pre-2020 ambition through land use, urban environments, carbon dioxide capture, use and storage (CCUS) and non-carbon dioxide (non-CO₂) greenhouse gas (GHG) emissions, held in June and October 2014 in Bonn, Germany, during the fifth and sixth parts of the second session of the ADP.⁴ The two updates of the technical paper prepared in 2014 do not supersede the documents referred to in paragraph 1 above, but rather build on the findings, information and options to enhance mitigation ambition contained therein.

4. The submissions referred to in paragraphs 2 and 3 above and the discussions held at the TEMs focused on the following considerations:

(a) Opportunities for actions with high mitigation potential, including those with adaptation and sustainable development co-benefits, with a focus on the implementation of policies, practices and technologies that are substantial, scalable and replicable;

(b) Ways to promote voluntary cooperation on concrete actions in relation to identified mitigation opportunities in accordance with nationally defined development priorities;

(c) Mitigation actions, policies, practices and technologies, including their mitigation benefits, costs and co-benefits, as well as barriers to their implementation and strategies to overcome those barriers;

¹ FCCC/ADP/2013/3, paragraph 30(c)(ii).

² Detailed information on the TEMs held in March 2014, including the initial summaries of the discussions at the meetings, is available at <<http://unfccc.int/bodies/awg/items/8112.php>> and <<http://unfccc.int/bodies/awg/items/8113.php>>.

³ FCCC/TP/2014/3 and Add.1. Available at <<http://unfccc.int/resource/docs/2014/tp/03.pdf>> and <<http://unfccc.int/resource/docs/2014/tp/03a01.pdf>>.

⁴ Detailed information on the TEMs held in June and October 2014, including the initial summaries of the discussions at the meetings, is available at <<http://unfccc.int/bodies/awg/items/8171.php>>, <<http://unfccc.int/bodies/awg/items/8170.php>>, <<http://unfccc.int/bodies/awg/items/8421.php>> and <<http://unfccc.int/bodies/awg/items/8420.php>>.

(d) Finance, technology and capacity-building support for mitigation action in developing country Parties.

5. This technical paper is based on the 14 submissions, including the 13 submissions from Parties or groups of Parties and the 1 submission from observer organizations, received by the secretariat by 17 November 2014 and on the information discussed at the TEMs referred to in paragraph 3 above. Information provided by leading international organizations and partnerships specializing in land use, urban environments, CCUS and non-CO₂ GHG emissions was also compiled for this update of the technical paper.

B. Objective and approach

6. The objective of this update of the technical paper is to compile information on the mitigation benefits of actions, initiatives and options to enhance mitigation ambition and other relevant considerations, as requested by the ADP in its conclusions at the third part of its second session, in order to promote action under workstream 2 of the ADP⁵ in the pre-2020 period.

7. It focuses primarily on contributing to shifting the work being conducted within the ADP process from the discussion of mitigation potential to the realization of actions by Parties, subnational governments and a wide range of non-State actors by highlighting substantial, scalable, successful and innovative good practices on the ground and drawing on lessons learned and good practices to support replication and scaling up. Opportunities for mitigation action in the four thematic areas of land use, urban environments, CCUS and non-CO₂ GHG emissions are the primary emphasis of this update of the technical paper.

8. The information presented in this technical paper does not imply that there is consensus among Parties on any of the issues or options covered in the relevant submissions and at the TEMs. Rather, it provides an overview of the information provided, relevant policy options and support, in accordance with the mandate for the technical paper (see chapter I.A. above).

C. Structure of the technical paper

9. This technical paper begins by providing background information (chapter I), elaborating on the relevant scientific and policy context, followed by an explanation of the logical framework used for the paper and its main findings (chapter II). Chapters III–VI present detailed information on mitigation potential, progress, benefits, costs and barriers; and opportunities, practices, policies and actions to unlock mitigation potential in relation to land use, urban environments, CCUS and non-CO₂ GHG emissions. Options related to the means of support for these opportunities undertaken by countries are discussed in chapter VII, while possible next steps to be undertaken by Parties, leading organizations and partnerships, and the secretariat to support actions are presented in chapter VIII. Lastly, chapter IX concludes with possible practical approaches to connect policy needs with support options that could be considered as follow-up activities under workstream 2 of the ADP in 2015.

10. Throughout the paper, a number of specific examples (provided in the spotlight boxes), drawn from experiences discussed during the TEMs and included in the relevant submissions, are presented in order to highlight substantial, successful, scalable and replicable policies and actions on the ground.

11. The four addenda to this technical paper provide a detailed technical summary of the discussion on the examination of opportunities for action in the areas of land use, urban

⁵ Workstream 2 of the ADP addresses matters related to decision 1/CP.17, paragraphs 7 and 8.

environments, CCUS and non-CO₂ GHG emissions. They also provide a technical overview of mitigation potential, progress, benefits, costs and barriers, followed by a chapter focusing on good practice policies, practices and actions to unlock mitigation potential and inspire concrete action, drawing from the discussions at the TEMs, submissions by Parties and relevant literature.

II. Scientific and policy context, logical framework and main findings

A. Scientific and policy context

12. Limiting the increase in the global average temperature to below 2 °C,⁶ as established in the Cancun Agreements adopted in 2010, presents a major challenge for the international community and urgent action is required to move from discussing mitigation potential to realizing action on a significant scale. To demonstrate their dedication to fulfilling the Cancun Agreements, more than 90 Parties made conditional and unconditional pledges to reduce their GHG emissions by 2020, or to limit their growth. Developed countries' pledges include quantified economy-wide emission reduction targets and commitments,^{7,8} while developing countries pledged to pursue nationally appropriate mitigation actions (NAMAs).^{9,10} The pledges represent approximately 80 per cent of total global GHG emissions but, while significant, will not be sufficient to meet the 2 °C limit.

13. While pledges and other voluntary actions have led to considerable progress in emission reductions, the full realization of all pledges and actions would significantly further reduce global GHG emissions. Nevertheless, a sizeable gap remains between the global emission levels consistent with the 2 °C limit and the emission levels expected even if these pledges are fully implemented. Namely, the United Nations Environment Programme (UNEP), in its *Emissions Gap Report 2014*, confirmed its findings from the previous reports published in 2012 and 2013 on the magnitude of such gap that is now estimated at between 8 and 10 Gt CO₂ equivalent (CO₂ eq) by 2020. Looking beyond 2020, a new finding from this report is the estimated emissions gap in 2030, at around 14–17 Gt CO₂ eq (UNEP, 2014).

14. UNEP also described a technical mitigation potential of approximately 17 ±3 Gt CO₂ eq by 2020, with a marginal cost of emission reductions of USD 50–100/t CO₂ eq (UNEP, 2012). However, UNEP noted in its 2014 report that while global GHG emissions will need to peak soon to stay within the 2 °C limit, they are continuing to rise. UNEP further noted that, as we move closer to 2020, it is becoming increasingly difficult to fully utilize the mitigation potential and narrow the gap. Nevertheless, the lower the emissions between now and 2020, the lower are the risks caused by delayed action (see paras. 15–16 below). As regards the emissions gap in 2030, UNEP estimated that the potential to reduce emissions is estimated at 29 Gt CO₂ eq, which means that it is still feasible to close the gap and stay within the 2 °C limit (UNEP, 2014).

15. According to the recent contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2014: Mitigation of Climate Change* (IPCC, 2014), there are multiple pathways that are likely to

⁶ Adopted by Parties in 2010, the Cancun Agreements include the decision to keep the global average temperature increase to below 2 °C (hereinafter referred to as the 2 °C limit).

⁷ FCCC/SB/2011/INF.1/Rev.1.

⁸ Decision 1/CMP.8, annex I.

⁹ FCCC/SBI/2013/INF.12/Rev.2.

¹⁰ FCCC/TP/2013/8.

limit global warming below 2 °C. These pathways are characterized by an established budget of cumulative emissions that in turn defines the increase in global temperature, and would require substantial emission reductions over the next few decades and near zero net emissions of CO₂ and other long-lived GHGs by the end of the twenty-first century. Achieving such reductions poses substantial technological, economic, social and institutional challenges, which increase with delays in additional mitigation efforts if key technologies are not available.

16. Some of the challenges stemming from delayed action include: a greater ‘lock-in’ effect in carbon-intensive infrastructure; higher rates of emission reductions in the medium term at higher cost; greater reliance on negative emissions; and greater risk of failing to meet the 2 °C limit. Conversely, taking more action now and in the lead up to 2020 reduces the need to take more extreme action in the future to stay within the 2 °C limit (UNEP, 2014).

17. In this context, the need for decisive and urgent action to close the pre-2020 ambition gap is universally recognized by Parties.¹¹ To trigger such urgent action, Parties emphasized the need for an immediate and expanded scaling-up of catalytic and game-changing efforts that is aligned with both climate and development goals and brings untapped mitigation potential to fruition. However, significant time and effort is required to establish robust enabling frameworks and to design effective policies and actions that address barriers and ultimately ensure successful and sustainable implementation outcomes.¹²

18. Many developing country Parties continue to emphasize the need for developed country leadership in fulfilling their current commitments to design effective policies and increasing mitigation ambition by 2020, as aligned with the objective and principles of the Convention. Also, there is a recognition that action taken by Parties included in Annex I to the Convention to reduce emissions in line with the ranges referred to in the IPCC Fourth Assessment Report could significantly contribute to closing the pre-2020 ambition gap.¹³

19. An important event since the publication of the previous update of the technical paper is the United Nations Climate Summit held in New York, United States of America, in September 2014. The Climate Summit achieved its highly ambitious objective of raising the political momentum for a meaningful universal climate agreement in Paris in 2015 and of galvanizing transformative action in all countries to reduce emissions and build resilience to the adverse impacts of climate change. As reflected in the Chair’s summary, climate change has become a defining issue of our time and bold action is needed to reduce emissions and build resilience.¹⁴ In response to the call for such bold action, a number of new commitments were announced by global leaders from governments, business, finance and civil society that are critical in order to maintain the global temperature increase under the 2 °C limit.

20. Under the ADP, Parties have drawn attention to many action areas discussed at the Climate Summit that directly relate to the thematic areas with high mitigation potential covered in this technical paper and its previous update. The new initiatives, as well as new coalitions bringing together countries, cities, businesses and citizens, are expected to lead to significant emission reductions and strengthen resilience to the impacts of climate change.

¹¹ As footnote 10 above.

¹² As footnote 10 above.

¹³ As footnote 10 above.

¹⁴ United Nations Climate Summit. 2014. *Climate Change Summary – Chair’s Summary*. Available at <<http://www.un.org/climatechange/summit/2014/09/2014-climate-change-summary-chairs-summary/>>.

Examples of such initiatives related to the thematic examination process are provided in spotlight box 1 below.

Spotlight box 1

A selection of the initiatives announced at the United Nations Climate Summit held in New York, United States of America, in September 2014, related to the thematic examination process

- The **Global Energy Efficiency Accelerator platform** was launched with the aim to scale up energy efficiency towards the goal of doubling energy efficiency improvements globally by 2030, in five sectoral accelerators: vehicles, lighting, appliances, buildings and district energy.
- The launched **Small Islands Developing States Lighthouses initiative** brings together 26 island states, with partners, to mobilize USD 500 million and deploy 120 MW in solar and wind projects by 2019 as an initial step to secure the clean energy future through deployment of renewable energy.
- The **Global Alliance for Climate-Smart Agriculture**, comprising 16 countries and 37 organizations, was announced with the goal of helping 500 million smallholder farmers by 2030 through improvements in agricultural productivity and incomes, and strengthened resilience of farmers, and by addressing greenhouse gas emissions from agriculture.
- The **New York Declaration on Forests** was signed by more than 150 partners, including 32 governments, 20 subnational governments, 40 companies, 16 indigenous peoples groups and 49 non-governmental organizations and civil society groups. The Declaration calls for reducing the loss of forests by half by 2020 and ending it entirely by 2030, and is backed by commitments including pledges of resources and specific actions from the private sector, governments and civil society.
- The new **Compact of Mayors**, representing over 2,000 cities, is an agreement by city networks and their members to reduce city-level emissions, reduce vulnerability and enhance resilience to climate change in a complimentary manner to national-level climate protection efforts. This initiative could result in 3 Gt CO₂ eq of emission reductions by 2030. Organizations supporting the implementation of the Compact of Mayors include Local Governments for Sustainability, Global Leadership on Climate Change, and United Cities and Local Governments.
- The **Compact of States and Regions** represents a commitment by global state and regional government networks, including the Network of Regional Governments for Sustainable Development, R20, the Climate Group and the Carbon Disclosure Project, to provide an annual account of the climate commitments made by governments around the world and report their progress.
- The **Cities Climate Finance Leadership Alliance**. The mission of the Alliance is to catalyse and accelerate additional capital flows to cities, maximize investment in low-carbon and climate-resilient infrastructure and close the investment gap in urban areas by 2030.
- The **Oil and Gas Methane Partnership under the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants** aims to reduce methane emissions in the industry by providing a robust transparent and collaborative approach for businesses, governments and civil society organizations to work together.
- The **Oil and Gas Climate Initiative** announced the building of a platform to share best practices within the industry, address key climate risks, catalyse meaningful action and coordination on climate change in areas such as energy access, renewable energy, energy efficiency and reduction of gas flaring and methane emissions.
- **Phasing-down hydrofluorocarbons**: more than 20 countries and 10 international

organizations announced their support to begin formal negotiations of an amendment to phase down the production and consumption of HFCs under the Montreal Protocol, while emissions accounting and reporting would remain under the UNFCCC.

Source: United Nations Climate Summit. 2014. *Climate Change Summary – Chair’s Summary*. Available at <<http://www.un.org/climatechange/summit/2014/09/2014-climate-change-summary-chairs-summary/>>.

B. Explaining the logical framework used in the chapters on thematic areas

21. The findings contained in this update of the technical paper are based on the second version of the technical paper published in 2013, which discussed thematic areas with high mitigation potential as identified in the relevant submissions, such as energy supply, energy efficiency, renewable energy, transport (including international aviation and shipping), CCUS, fossil-fuel subsidy reform, short-lived climate pollutants (including fluorinated gases (F-gases)), land use and waste. Those areas offer many opportunities for mitigation action that could be employed and scaled up prior to 2020. Reference table 1 (provided at the end of this technical paper) summarizes information on each thematic area in terms of mitigation potential and benefits, sustainable development benefits, barriers that prevent the utilization of potential, examples of national actions and information on cooperative initiatives that help to address barriers and lay a foundation for ambitious action at the national and international levels.

22. A logical framework used in this technical paper emerged from the discussions on the technical examination process for unlocking mitigation potential in the pre-2020 period and the need to move forward from the identification of opportunities to the implementation of actions. The logical framework is based on a number of key elements that are critically important for the acceleration of implementation by 2020, including the assessment of technical mitigation potential by 2020, the identification of good practice policies, options and actions, their mitigation and associated adaptation and sustainable development co-benefits, the estimation of costs, and barriers to further actions and ways to overcome such barriers. Also, it is important to identify the relevant actors involved in implementation work at all levels.

23. In that context, the technical examination process in 2014 aims to promote the immediate and urgent action needed to adopt, scale up and replicate good practices, policies and effective actions and move towards realizing action in the thematic areas with high mitigation potential.

24. It is well recognized that mitigation action brings about co-benefits related to economic growth and sustainable development, which provide important drivers for further action in the thematic areas with high mitigation potential. Such actions should be aligned with development priorities, economic growth and other national circumstances in order to ensure public support and sustainable outcomes. The identification of co-benefits and trade-offs when implementing mitigation potential in the pre-2020 period in the thematic areas with high mitigation potential is thus of high importance.

25. To support the effective implementation of good practice mitigation policies and the rapid diffusion of mitigation technologies, significant barriers must be addressed, mostly through national policies and action, but also through cooperative initiatives and partnerships with the engagement of a broad range of stakeholders, including the private sector. Parties emphasized the need for scaled-up financial support, capacity-building, and

transfer of technology and know-how to address those barriers and needs in a transparent and robust manner.

26. Cooperative initiatives continue to contribute to addressing key barriers and support the achievement of Parties' pledges and other voluntary activities to close the pre-2020 ambition gap. Focused on various thematic areas (e.g. energy and land use), they provide partnership platforms to support political dialogue, peer learning, capacity-building, policy and project implementation, and private-sector engagement to catalyse mitigation action.¹⁵ A great number of such initiatives was launched at the United Nations Climate Summit held in September 2014 (see spotlight box 1 above).

27. Cooperative initiatives are focused at various levels and often support bridging the gap between national and subnational action, and regional and international activities. They contribute to emission reductions and development priorities both directly and indirectly by supporting concrete commitments as well as enabling environments and peer learning. Some developing country Parties highlighted the difficulty of directly attributing emission reductions to cooperative initiatives (given that reductions are accounted for at the national level) and, instead, emphasized their role as voluntary cooperative initiatives that support action in all countries.¹⁶

28. Non-State actors and subnational entities also contribute to supporting mitigation action. For instance, mitigation activities often occur at the subnational level, and local governments are central to the planning and implementation of such work on the ground. Examples of such actions were discussed at the TEM on urban environments held in June 2014. Lastly, non-governmental organizations often have an important and unique understanding of local circumstances and provide crucial input to the planning and implementation of mitigation activities.

29. Multilateral financial institutions, such as the World Bank and regional development banks, UNFCCC support institutions, such as the Green Climate Fund (GCF), the Climate Technology Centre and Network (CTCN) and the Technology Executive Committee (TEC), and the Global Environment Facility (GEF), provide necessary means of financial support, as well as support to facilitate technology transfer and capacity-building and training based on their vast global experience and opportunities given by their mandates (see chapter VII below).

30. The technical examination process started in March 2014 with the examination of two thematic areas, namely renewable energy and energy efficiency, as the large mitigation potential locked in these two areas could play a major role in raising pre-2020 ambition and contribute to achieving the 2 °C limit (UNEP, 2013; International Energy Agency (IEA), 2013a; International Renewable Energy Agency (IRENA), 2013; IPCC, 2011). After that the technical examination process continued by examining four additional thematic areas at the TEMs organized in June and October 2014, as follows: land use, urban environments, CCUS and non-CO₂ GHG emissions.

31. The topics of this update of the technical paper are cross-sectoral and much broader in scope, and partly overlap in terms of coverage of actions and sectors discussed at different TEMs throughout 2014. The intrinsic differences between the thematic areas are reflected in the technical paper, which demonstrates, in a balanced way, the information provided in the submissions, at the TEMs and in relevant technical literature.

32. At the TEMs held in June and October 2014, as part of the discussions on opportunities, barriers and the next steps in unlocking mitigation potential, key policy

¹⁵ The secretariat developed a portal on cooperative initiatives to support governments and institutions in connecting with relevant initiatives. The portal is available at <<http://unfccc.int/7785>>.

¹⁶ As footnote 10 above.

options were identified for each thematic area. These policy options are presented in tables 1–6 below.

C. Main findings¹⁷

33. Keeping the global average temperature increase below 2 °C agreed under the UNFCCC is achievable at a relatively low cost (IPCC, 2014), but only if concrete and transformative policies and actions are immediately implemented and reinforced by robust leadership and adequate support. During the technical examination process, Parties emphasized the need for an immediate and expanded scaling-up of catalytic and game-changing effort that aims to achieve significant transformation towards low-carbon development, is aligned with both climate and development goals, and brings untapped mitigation potential to fruition.

34. To be successful, actions to achieve such transformation should be aligned with national development priorities, overall political context and circumstances. Political, technical, economic, institutional and capacity-related barriers, such as high costs for renewable energy and CCUS projects, still hamper the translation of ambition into action and the full utilization of mitigation potential. Nevertheless, there are many opportunities to overcome such barriers, which can bring multiple co-benefits.

35. In many cases, co-benefits related to growth and sustainable development, such as cost savings, poverty reduction, food security, energy security, improved public health, reductions of pollutants, and biodiversity improvements are significant and present the main driving force for action. The examples provided in this technical paper show that assessing and communicating the multiple co-benefits and trade-offs of mitigation action is essential to ensuring alignment with a country's broader development context (IEA, 2014).

36. Significant scale of GHGs emissions mitigation could be achieved through enhanced climate actions in the thematic areas with high mitigation potential discussed during the technical examination process, such as renewable energy deployment, energy efficiency improvements, land use, urban environments, CCUS and non-CO₂ GHG emissions. Scaling up action now and in the lead-up to 2020 that allows this potential to be utilized will reduce the need to take more extreme and expensive action in the future to stay within the 2 °C limit.

37. To support renewable energy deployment and utilize the significant mitigation potential, countries have successfully implemented various policies, including: renewable energy targets and quotas; pricing policies, such as feed-in tariffs, carbon pricing and establishing price stabilization funds; and fiscal incentives, such as direct subsidies and tax credits, among others.¹⁸

38. To realize significant energy efficiency improvements and utilize the significant mitigation potential, countries have deployed various policies, including: standards and labelling programmes; fiscal incentives; pricing policies; and nationally tailored research and development initiatives, among others.¹⁹

39. In land use, policies and actions with climate mitigation and adaptation co-benefits could be integrated into sustainable development frameworks that address important

¹⁷ These key messages are inclusive and based on the findings of the update of the technical paper contained in documents FCCC/TP/2014/3 and Add.1 as well as on the findings contained in this update of the technical paper.

¹⁸ These policy options are discussed in the previous update of the technical paper contained in documents FCCC/TP/2014/3 and Add.1.

¹⁹ As footnote 18 above.

national development objectives beyond climate goals. Examples of such policies and actions in the land use sector include: improved agricultural practices nested in geographic and social scales; effective cropland and grazing land management; research, development and deployment (RD&D) and application of efficient land-use management and planning; improved land-use productivity and resilience; improved livestock productivity; reduction of food loss and waste; implementation of REDD-plus;²⁰ improved forest management; and afforestation and reforestation.

40. A plethora of technically and economically feasible policies and actions are available at the city level in the context of improving the urban environment that have sizeable mitigation potential, but also adaptation co-benefits. These policies and actions include: strengthening institutional arrangements and legal and regulatory frameworks; increasing the use of spatial planning instruments and financial instruments; and enhancing capacity-building efforts. A variety of good practice policy options could be implemented at the city level in a holistic manner across different sectors, such as energy, transport and waste.

41. CCUS can play a significant role in mitigating CO₂ emissions in the future and is an important option in most of the IPCC emission scenarios (IPCC, 2014). Scoping and agenda-setting, strengthening institutional arrangements and legal and regulatory frameworks, and design and implementation of multifaceted policy portfolios based on available technical potential are among the policies and actions that could be implemented depending on the national circumstances and the phase of CCUS development.

42. Non-CO₂ GHGs are emitted from a broad range of sectors and sources, and, as such there exist a diverse set of policies and actions to reduce non-CO₂ GHG emissions, for example: promotion of recovery, capture and reuse, and limiting leakage of methane from several sources; integrated waste management policies; policies and practices aimed at a more efficient use of nitrogen fertilizers; development of techniques and implementing policies to improve sustainable land and livestock management; creation of market conditions for technology development, transfer and deployment of climate-friendly alternatives to HFCs; and voluntary emission reductions from industry.

43. At the national and subnational levels a host of options exist to enable the implementation of policies and actions to reduce emissions from land use and urban environments; emissions can also be reduced by applying CCUS and addressing non-CO₂ GHGs, including through public-sector leadership, flexible policy design that allows for adjustments over time, diverse stakeholder engagement, long-term institutional arrangements and regulatory and financial frameworks and actions to support change.

44. At the international level, cooperative initiatives and partnerships with the engagement of Parties, UNFCCC institutions and other relevant intergovernmental organizations, finance institutions, the private sector and other non-State actors can play a critical role in promoting key mitigation actions, provided that they do not burden developing countries. The UNFCCC could play a catalytic role to facilitate such cooperation process.

45. Cooperative initiatives were among the key deliverables of the 2014 United Nations Climate Summit that raised political momentum for a meaningful universal climate agreement in Paris in 2015 and galvanized transformative action in all countries to reduce GHG emissions and build resilience to the adverse impacts of climate change. They helped

²⁰ In decision 1/CP.16, paragraph 70, the Conference of the Parties encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: reducing emissions from deforestation and forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks.

to mobilize governments, civil society, and the private sector, in addition to finance, to advance climate action and address GHG emissions in critical sectors, which are broadly consistent with the thematic areas addressed in the TEM process, and support adaptation and resilience.

46. Meaningful mitigation action can be further strengthened through the implementation of good practice policy options, including those identified through the six TEMs held in 2014, which also bring about growth and sustainable development co-benefits. The policy option menus were identified on the basis of the information and examples provided during the TEMs and aligned with internationally available support as a means of achieving key climate and development goals. As shown in this technical paper, organizing and presenting such policy options as menus for various thematic areas can lead to a meaningful outcome of the technical examination process under workstream 2 of the ADP.

47. Many Parties have highlighted the need for the TEM process to move further towards catalysing the implementation of specific mitigation policies and actions, while recognizing the diversity of national circumstances and national development agendas. The policy option menus could thus assist the UNFCCC support institutions, other intergovernmental organizations, financial institutions and cooperative initiatives to better focus and target support to the implementation of the selected policies, ensuring country ownership and a clear, results-oriented focus with regard to cooperation and provision of support.

48. Overall, in the context of workstream 2 of the ADP, Parties expressed their strong support for the accelerated implementation of the existing commitments, actions and pledges towards the full implementation of the decisions that constitute the agreed outcome pursuant to decision 1/CP.13 (the Bali Action Plan). Parties and other stakeholders participating in the TEMs also supported the continuation of the technical examination process in 2015 and beyond in the lead-up to 2020, with a view to closing the mitigation gap to remain under the 2 °C limit.

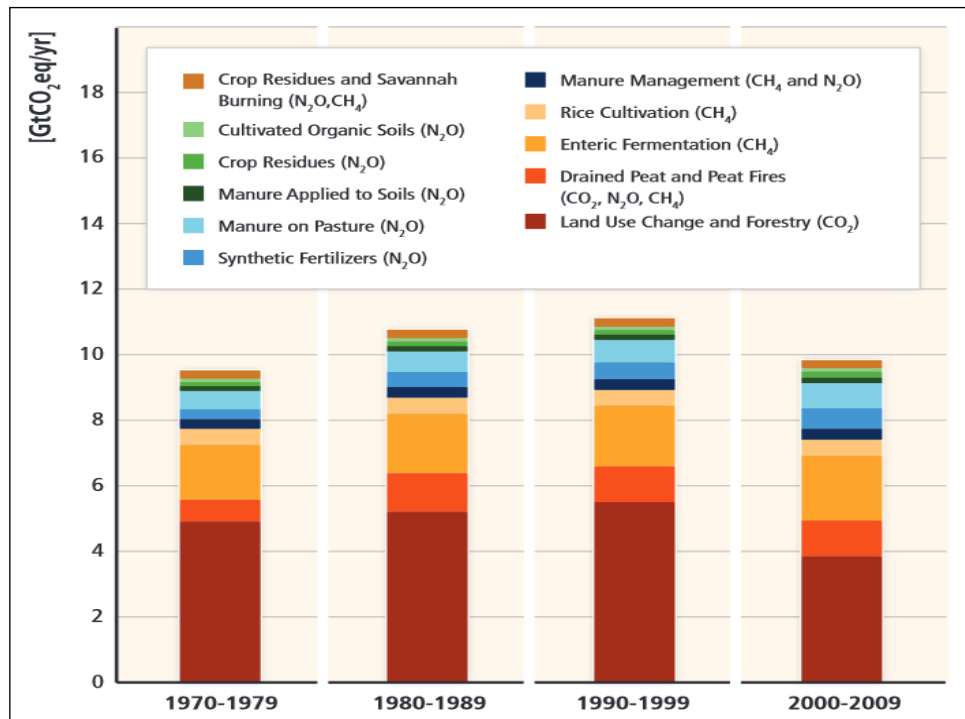
III. Land use

A. Mitigation potential, progress, benefits, costs and barriers

49. Emissions from the agriculture, forestry and other land use sector amounted to nearly 25 per cent of global GHG emissions (10–12 Gt CO₂ eq/year) in 2010, including direct emissions from agriculture alone that contributed 10–12 per cent of global GHG emissions (5.4–5.8 Gt CO₂ eq) and emissions from forestry and other land use contributing around 12 per cent of global GHG emissions (Tubiello et al., 2013; IPCC, 2014).

50. Most assessments demonstrate that during the period 2000–2009 land as a whole has been a net carbon sink. In 2010, the agriculture, forestry and other land use sector was the second largest emitter after the energy sector (IPCC, 2014). Figure 1 below illustrates the emissions from agriculture, forestry and other land use by activity over the last four decades.

Figure 1
Agriculture, forestry and other land use emissions by source over the last four decades



Source: Intergovernmental Panel on Climate Change. 2014. *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

51. The role of agriculture as one of the major sources of emissions has been growing. During the period 1990–2010, non-CO₂ GHG emissions from agriculture grew by 0.9 per cent per year and since the mid-2000s these emissions have become a larger source of GHG emissions than deforestation. Looking to the future, emissions from land use are expected to be an increasingly important source of emissions in the coming decades (Kissinger et al., 2012).

52. There are significant low-cost opportunities in the agriculture, forestry and other land use sector that link food security, environmental sustainability, climate adaptation needs and socioeconomic development into a coherent package. UNEP (2013a) estimates that in 2020 at marginal costs of less than USD 50–100/t CO₂ eq, the direct emission reduction potential of agriculture lies in the range of 1.1–4.3 Gt CO₂ eq/year and of forestry in the range of 1.3–4.2 Gt CO₂ eq/year. The IPCC estimates the economic mitigation potential of supply-side measures (i.e. measures aimed at reducing GHG emissions per unit of land/animal, or per unit of product) below ‘business as usual’ levels at between 7.18 and 10.6 Gt CO₂ eq in both agriculture and forestry by 2030 at a cost up to USD 100/t CO₂ eq (IPCC, 2014).

53. The effective implementation of land-use actions with climate benefits requires the consideration of multiple objectives to maximize the positive linkages with sustainable development and climate adaptation needs. Such actions that mainly aim at the prevention of emissions to the atmosphere and carbon dioxide sequestration, can also help to fulfil important national development objectives beyond mitigation, such as improved livelihood

opportunities for rural and local communities, provision of environmental services, and cost savings gained through efficiency improvements.

54. Designing and implementing effective land-use actions with climate benefits requires consideration of the inherent complexities associated with land use. These include contextual actions which prohibit the scaling-up of actions, long implementation lag times, emergent stressors (e.g. tenure issues, competition for resources) and multilevel governance challenges. Barriers to the replication and scaling-up of land-use mitigation actions are discussed in more detail in document FCCC/TP/2014/13/Add.1, table 1.

B. Practices, policies and actions to unlock mitigation potential in relation to land use

55. Good governance across multiple levels is central to reducing barriers to land-use actions with climate benefits and ensuring that multiple benefits for rural development are achieved. Institutional arrangements and legal and regulatory frameworks can be further strengthened by a cross-sectoral approach that recognizes the critical role of land use in food security and the provision of ecosystem services. While designing and implementing land-use actions with climate benefits, the consideration of relevant safeguards could avoid negative impacts on food security, environmental pollution, biodiversity conservation, etc.

56. Examples of good practice land use actions with climate benefits in the agriculture sector, which could be replicated in the pre-2020 period, include: improved agricultural practices nested in geographic and social scales, effective cropland and grazing land management, RD&D, improved land-use productivity and resilience, improved livestock productivity through improvements in quality and digestibility of forage and fodder, and reduction of food loss and waste. These policy options are discussed below and presented in table 1 below. Some of the good practice cases presented at the TEM on land use are included in spotlight box 2 below.

Spotlight box 2

Actions to promote low-carbon agriculture in Brazil and New Zealand

Brazil: As an important food producer, Brazil faces challenges in balancing agricultural production with environmental protection. To meet this challenge, using various policies and incentives, Brazil has been promoting sustainable practices for agricultural production systems through extensive research and policies. The Low-Carbon Agriculture Plan (ABC Plan) has been developed to stimulate specific activities such as no-tillage agriculture; recuperation of degraded land; integration of crops, livestock and forest; planting of commercial forests; biological nitrogen fixation; and treatment of animal residues. Through the provision of tailored credit lines under the ABC Plan, around 24,000 properties received financing of approximately USD 3 billion between 2010 and 2014. Between 2005 and 2013, national crop production increased by 64 per cent, while the area used for agriculture increased by only 9 per cent. However, these achievements could be at risk depending on future climate change impacts.

New Zealand: About 90 per cent of the agricultural production of New Zealand is exported, generating nearly 56 per cent of the country's export earnings. This makes both mitigation and adaptation to climate change a very high priority. The focus of mitigation efforts is on increasing the productivity of agriculture, while reducing the emissions per unit of produce. Absolute emissions from agriculture have increased by 15 per cent since 1990, and the emissions intensity has decreased by 20 per cent. New Zealand seeks to share the skills and expertise gained through the implementation of

policies focused on emissions reduction, domestic action, scientific research and innovation, and economic development programmes. The country actively engages in national and international research and collaboration to scale up the reduction of emissions intensity.

Sources: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on land use; presentations by Brazil and New Zealand, June 2014.

57. **Improved agricultural practices nested in geographic and social scales** can unlock large mitigation potential, while at the same time contributing to addressing adaptation needs and promoting rural development. Some examples of such practices include conservation agriculture, improved livestock and manure management, more carbon-efficient and profitable livestock production systems, reduced fertilizer use, agroforestry and pest control. Other examples of agricultural practices with mitigation impacts include no-tillage practices, improved nutrient and water management in rice production, agroforestry, and the introduction of legumes into farming systems.

58. **Effective cropland and grazing land management** centres mainly on actions that aim at both improvements in resource management on productive lands as well as long-term retirement of environmentally sensitive cropland. Measures for productive lands that have proven to be cost-effective include: nutrient management actions to protect water quality; soil-conserving strategies to minimize run-off and soil loss; water conservation and drainage control; livestock grazing regimes that help to sustain grassland and riparian systems; wildlife enhancements that improve habitat and forage conditions; and the preservation of farmland and open space in urban fringe areas. Other examples of cost-effective land retirement from cropland include: cropland with very erodible soils, where erosion costs exceed the crop value; restoration of wetlands, cropland subject to risk from severe flooding, farm and forest land that provide critical habitats for species recovery; forest regeneration on sensitive cropland; and irrigated production areas with acute water issues (e.g. declining aquifers) (United States Department of Agriculture, 2006).

59. **Research and development, and the application of efficient land-use management and effective planning:** national land-use planning and enhanced knowledge of land use and land cover have become increasingly important, not only in the context of climate mitigation and adaptation, but also to overcome broader issues of uncontrolled development, loss of prime agricultural land and irrational natural resource management.

60. **Improved land-use productivity and resilience** can be effective in protecting carbon-rich areas such as forests if they are based on context-specific, holistic approaches to food security, adaptation and mitigation with evidence-based practices, strategies, policies, planning and investment.

61. **Improved livestock productivity, including improvements in quality and digestibility of forage and fodder,** leads to the reduction of methane emissions from enteric fermentation, but also to improvements in weight gain, so that livestock can go to market sooner. Strategies with high mitigation potential include feed additives and physical treatment methods (e.g. processing, chopping and thermal treatment), forage management (e.g. rotational grazing), breeding of forage and increased efficiency in the age structure of herds.

62. On the demand side actions, the **reduction of food loss and waste** can have an impact on GHG emissions from the food production life cycle. There is a very high level of inefficiency throughout the supply chain that can be identified and corrected.

63. In the forestry sector, the policies such as the REDD-plus programme, improved forest management, and afforestation and reforestation have been identified as the key

mitigation options with high mitigation potential. Some examples of forestry policies are included in spotlight box 3 below.

Spotlight box 3

Deforestation in Amazonia in Brazil

Emissions from land-use change and forestry were responsible for about 80 per cent of Brazil's emissions profile in 2000. In 2003, a permanent inter-ministerial working group proposed actions aimed at reducing deforestation in the Amazonia biome. In 2004, the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon entered into force. The Action Plan focused on three main areas: robust forest monitoring and law enforcement; territorial planning; and promotion of sustainable production activities. By 2012, Brazil had achieved a reduction in the deforestation rate of approximately 79 per cent compared with 2004. Brazil was the first developing country to submit a REDD-plus forest reference emission level for technical assessment in the context of results-based payments to the UNFCCC.

Forest carbon enhancement actions in China

In order to achieve the ambitious goal of increasing the net increment of forest area by 40 million ha by 2020 compared with 2005, China combines a number of afforestation, forest protection and sustainable forest management policies and practices. Newly established forests provide a number of additional benefits, including offering an effective method of sandstorm source control. China uses different means to incentivize the participation of farmers, including financial support in the form of subsidies and tenure reform. The intention is to further increase the forest area and also integrate forest carbon into China's national emissions trading system pilot programme.

Experience of implementation of land-use actions to reduce emissions from deforestation and forest degradation in Ghana and Mexico

Ghana anticipates that it will achieve emission reductions of 18.5 Mt CO₂ eq by 2020 through its REDD-plus efforts. In a subnational approach covering 25 per cent of the national land area, the programme focuses on increased productivity and resilience of agricultural production. Combined with efforts to monitor and legally protect forests, these measures can reduce emissions from deforestation (reducing deforestation is included in REDD-plus). At the same time, Ghana aims to conserve biodiversity in this global biodiversity hotspot and improve the livelihoods of the local population.

Mexico: in June 2010, the Governments of Mexico and Norway signed a memorandum of understanding on cooperation in the field of the environment, forest and climate change to promote Mexico as a leader in South-South cooperation to exchange experiences on REDD-plus, in particular measurement, reporting and verification. Mexico's approach to REDD-plus implementation includes the use of special programmes, which constitute institutional efforts that seek to direct resources to specific areas with high rates of deforestation and forest degradation.

Woodland Carbon Code in the United Kingdom of Great Britain and Northern Ireland

The Woodland Carbon Code addresses the lack of confidence, lack of standards and disrepute previously prevailing in the United Kingdom forest carbon markets. The standards developed under the Code promote mitigation through the enhancement of carbon stocks and require an assessment of resilience to climate change. The programme gained strong support from the Government and the national forestry sector and made woodland creation more attractive to landowners. In total, 202

projects were registered under the Code, encompassing 15,401 ha and with a potential of 5.7 Mt CO₂ eq lifetime sequestration. The United Kingdom is currently considering the development of a peatland code.

Sources: Presentations at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on land use in June 2014.

Table 1
Policy options menu of land-use actions with climate benefits

<i>Select policy options</i>	<i>Select examples</i>
Strengthening institutional arrangements and legal and regulatory frameworks	
Promotion of multilevel governance in land use	<ul style="list-style-type: none"> • Colombia – decentralized governance of the forestry and agriculture sectors • Indonesia – decentralized management of natural resources to the district level • Kenya – devolved governance in the 2010 Constitution; for example, the Council of Governors Secretariat and the Committee for Environmental and Natural Resources • Mali – drought risk management at the local level • Yemen – decentralized governance of water resources
Facilitation of land-use planning and consultations with land users	<ul style="list-style-type: none"> • Austria – the forest policy provides the legal basis for stakeholders to increase forest carbon stocks. Supporting replication in Georgia • Bolivia – indigenous property rights and titling of indigenous communally managed territories • Cameroon – satellite monitoring for forest protection • Colombia – expansion of the Serranía de Chiribiquete National Park, and the Amazon Vision initiative • Congo – participatory mapping of land and land uses • Costa Rica – prohibition of conversion of mature forests to other land uses • Guatemala – community concessions in the Maya Biosphere Reserve • European Union – Common Agricultural Policy, enabling coordination between administrations, ministries and agencies • Jamaica – local forest management committees • Rwanda – transition of poachers to rangers
Promotion of interdisciplinary approach linking food security, ecosystem services and sustainable development	<ul style="list-style-type: none"> • Africa – Food, Agriculture and Natural Resources Policy Analysis Network • China – “Grain for Green” Payment for Ecosystem Services (PES) • Costa Rica, Mexico and Viet Nam – PES
Introduction of relevant safeguards to avoid negative impacts	<ul style="list-style-type: none"> • India – landscape scores using set parameters to evaluate forests before permitting mining and other industrial uses • Uganda – UgoCert, organic certification for producers

<i>Select policy options</i>	<i>Select examples</i>
Promotion of international cooperation and partnerships, including public–private partnerships	<ul style="list-style-type: none"> • Forest Carbon Partnership Facility • UN-REDD Programme • REDD-plus Partnership • BioCarbon Fund Initiative for Sustainable Forest Landscapes • Tropical Forest Alliance 2020 • World Bank – Community Development Carbon Fund (e.g. biogas project in Nepal; community-based hydropower project in Pakistan) • Namibia – private-sector participation in drafting the National Rangeland Management Policy and Strategy • New Zealand – Primary Growth Partnership, mobilizing finance for increased productivity/sustainability
Agriculture	
Improved agricultural practices, nested in geographic and social scales, recognizing the context of local ecosystems and cultures	<ul style="list-style-type: none"> • Caribbean Agrometeorological Initiative – improved weather forecasting, and pest and disease information • Niger – agroforestry techniques to ‘re-green’ degraded farmland in the Sahel. Farmer-managed natural regeneration • Rwanda – Land Husbandry Water Harvesting and Hillside Irrigation Project to increase the productivity of hillside agriculture’ • Uganda – Climate-smart agriculture practice on Mount Elgon coffee farms
Effective cropland and grazing land management that maintains and improves habitats	<ul style="list-style-type: none"> • Kenya – linking pastoralism and conservation, Keekonyoki conservation meat enterprise • Namibia – Community-based Rangeland and Livestock Management programme • Zimbabwe – Africa Centre for Holistic Management
Research, development and application to improve efficiencies and reduce costs	<ul style="list-style-type: none"> • Botswana – research and development and demonstration on more efficient beef production • “C4 Rice” project of the International Rice Research Institute • Eastern and Southern Africa – International Maize and Wheat Improvement Center for the development of drought-tolerant maize varieties and hybrids • India – Nutrition Masters programme for increased dairy production, development of computer software from the National Dairy Development Board • Kenya – systematic client consultation in policy research • Philippines, Thailand and Viet Nam – Genetic Improvement of Farmed Tilapia programme
Improved land-use productivity and resilience	<ul style="list-style-type: none"> • Africa – Lusaka Declaration on Mainstreaming Organic Agriculture • China – Loess Plateau projects • Ethiopia – Koraro Village, Millennium Villages Project, improved water sources and micro dams • Ghana – strengthening the cocoa supply chain in the Juabeso-Bia landscape • Kenya – agricultural commodity exchange (KACE) as a market price mechanism • Madagascar – system of rice intensification, Confédération

<i>Select policy options</i>	<i>Select examples</i>
	<p>Nationale Koloharena Sahavanona</p> <ul style="list-style-type: none"> • Sri Lanka – research, irrigation and crop diversification measures
Improved livestock productivity through improvements in quality and digestibility of forage and fodder	<ul style="list-style-type: none"> • Nigeria – cultivation of dual-purpose dry season cowpea • Latin America – vertical integration/contract farming of poultry and eggs • United States of America – 1977–2007 feed efficiency conversion gains
Reduction of food loss and waste	<ul style="list-style-type: none"> • Association of South-East Asian Nations (ASEAN) – Save Food Asia and the Pacific Campaign • Mongolia – Think-Eat-Save: Reduce Your Food Print programme
Forestry	
REDD-plus	<ul style="list-style-type: none"> • Support for REDD-plus readiness (e.g. through the UN-REDD Programme and the Forest Carbon Partnership Facility) • Center for International Forestry Research – ten principles for a landscape approach • Germany – REDD Early Movers Programme • Norway – Forest and Climate Initiative
Improved forest management	<ul style="list-style-type: none"> • Brazil – Real-Time System for Detection of Deforestation • Brazil (São Paulo), Colombia (Bogotá), Ecuador (Quito), United States of America (New York) – payments for watershed services • Cambodia – Research on reduced-impact logging with special silvicultural treatments • France, Hungary – new financial instruments to overcome the investment barrier of unknown return on investments in relation to the forestry sector • Republic of Korea – Forest Ecosystem Restoration Initiative to support Aichi Biodiversity targets • Sweden – voluntary forest management certification systems, active in an area of over 22 million ha • Suriname – management system for harvesting tropical rainforest developed at the Centre for Agricultural Research
Afforestation and reforestation	<ul style="list-style-type: none"> • China – sandstorm source control in the Beijing–Tianjin region. Fast-growing and high-yielding timber base development

Source: Many of the policy options and examples provided in this table are taken from the presentations made during the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on land use, held in June 2014. Detailed information on this meeting is available at <<http://unfccc.int/bodies/awg/items/8171.php>>. Other sources are included in the list of references, provided at the end of this paper.

Note: Many examples reference ongoing activities at the local and national levels. The list is not exhaustive and the examples are for informational purposes only.

IV. Urban environments

A. Mitigation potential, progress, benefits, costs and barriers

64. Rapid urbanization has been one of the defining socioeconomic developments of the past 50 years and is expected to play a defining role in the next 50 years. In 1975, only 38 per cent of the world's population lived in cities and towns. By 2007, a historic milestone was achieved when more than half of the global population lived in cities and towns (United Nations Human Settlements Programme (UN Habitat), 2012).

65. The process of urbanization has created a dramatic shift in how human societies are organized and in the way in which they interact with the natural environment. Cities have now become a major factor in economic development and sustainability processes. Urban areas currently account for up to 76 per cent of global energy use and are estimated to be responsible for 71–76 per cent of energy-related CO₂ emissions (IPCC, 2014; UN Habitat, 2013).

66. While urban GHG emission reductions have a global impact that will benefit future generations, mitigation policies also provide a variety of important social, economic and environmental co-benefits that are perceptible by the current generation at the local and regional levels. These co-benefits, such as new job creation, and cleaner air, with associated reductions in health risks, can be crucially important decision-making criteria in analyses by policymakers (IPCC, 2007).

67. A recent study demonstrates that aggressive mitigation actions by cities in the buildings, transportation and waste sectors could result in GHG emission reductions of 3.7 Gt CO₂ eq in 2030 but are expected to rise to 8.0 Gt CO₂ eq in 2050. This would equate to approximately 6 per cent of global 'business as usual' GHG emissions in 2030 and 11 per cent in 2050 (Erickson et al., 2014).

68. It is well recognized that the investment required to meet the infrastructure demand for rapid urbanization is significant. The World Economic Forum and the World Bank estimate that more than USD 1 trillion per year is needed to finance the urban infrastructure growth in low- and middle-income countries. The Organisation for Economic Co-operation and Development (OECD) puts the figure much higher, at an estimated USD 53 trillion that will need to be invested in the development of new urban infrastructure by 2030 (OECD, 2012). This unprecedented demand for infrastructure stemming from fast urbanization provides a major window of opportunity to enable transformation and build new urban systems that avoid the 'lock-in' of carbon-intensive infrastructure.

69. Urban GHG mitigation strategies can provide important co-benefits including public funds savings, improved food security, equitable sustainable development opportunities, reduced air pollution and associated public health benefits, as well as productivity increases in urban centres that together provide additional motivation for undertaking more ambitious mitigation activities. However, it should also be recognized that climate policy can have side effects on societal goals as well. Therefore, it is important to maintain close management and interdisciplinary, cross-sectoral monitoring to maintain robust policy support (Seto et al., 2014).

70. While thousands of cities are defining climate action plans and taking relevant actions, their actual total impact on urban GHG emissions is not clear. To date, there has been little systematic assessment of the impact of city climate action plans on overall city-wide emissions and climate change (IPCC, 2014). The majority of urban climate plans and actions are based primarily on strategies to improve energy efficiency, rather than on land-

use policies or cross-sectoral measures to reduce urban area expansion. Comprehensive and consistent data sets of urban GHG emissions do not currently exist (IPCC, 2014).

71. There are many social, political and institutional, financial, capacity- and skills-related factors and information- and knowledge-related challenges that can be significant barriers to the implementation of policies and actions at the city level. For a more detailed description of the existing barriers, see document FCCC/TP/2014/13/Add.2, table 2.

B. Practices, policies and actions to unlock mitigation potential in relation to urban environments

72. Many cities have identified comprehensive, integrated and innovative approaches to climate mitigation and implemented actions that have significant mitigation and adaptation co-benefits. Around the world, cities and subnational governments are increasingly taking a leadership role, realizing significant work to ensure that local climate action is compatible with the action taken to mitigate and adapt to climate change at the global and national levels. Experience has demonstrated that the development of low-carbon, climate-resilient cities can effectively drive mitigation action at the local level.

73. **Strengthening institutional arrangements and legal and regulatory frameworks:** cities have implemented a variety of arrangements, models and approaches to deliver essential urban services, which impact their ability to reliably and efficiently provide services to citizens and design their long-term development pathway. City and subnational climate action plans for low-carbon, climate-resilient development supported by effective institutional arrangements and regulatory frameworks have a direct influence on sustainable economic development and are critical to attracting financing. Such plans provide a longer-term vision and specific metrics for development pathways and public investment that also build investor confidence and mobilize the private-sector financing needed to ensure action on the ground. The example of the city of Malmo demonstrates good practice in promoting economic revival at the local level (see spotlight box 4 below).

Spotlight box 4

Economic revival and transition to an ‘eco-city’ in Malmo

Malmo took a bold step to transition from an industrial city to a community of information and knowledge, turning its shipyard into a sustainable housing development. Under the leadership of the Swedish national government, Malmo has continued to develop as a sustainable city. A number of key policies provide the framework for continued transformation, including: the local Agenda 21 programme; the Environmental Programme; and the Urban Development Master Plan (2014–2032). Some of the objectives of the city include carbon neutrality by 2022, and 100 per cent renewable energy consumption by 2030. As a result of this transformation, energy consumption will decrease by at least 20 per cent by 2020 and by another 20 per cent by 2030, and GHG emissions will decrease by at least 40 per cent below the 1990 level by 2020.

Malmo’s success can be attributed to factors such as significant guidance and financial support from the national government and the European Union; local implementation of national policies through local policies, plans and regulations; and creation of an attractive and dynamic business environment.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments; presentation by Malmo, June 2014.

74. National government support is critical to ensure the successful implementation of innovative policy measures to address implementation barriers at the subnational level. There are many examples of successful vertical integration between national governments, regions and cities, including subnational actions as part of efforts to develop and implement NAMAs. Subnational integration and multilevel governance entails effective collaboration and coordination between different levels of government (see spotlight box 5 below).

Spotlight box 5

Decentralizing green growth in Viet Nam

The Green Growth Strategy of Viet Nam represents the determination of the national government to drive the transformation of the economy. Specific targets include reducing greenhouse gas emissions, lowering the intensity of gross domestic product (GDP) by 8–10 per cent by 2020 compared with the 2010 level, and reducing BTUs/GDP by 1.0–1.5 per cent per year. In order to achieve these goals, all 63 provinces have been given the mandate to formulate their respective Provincial Green Growth Action Plans, which will then be integrated into each province’s local five-year and annual Socioeconomic Development Plan.

Source: Nguyen M H and Muller S. 2014. *The Subnational Integration of the Viet Nam Green Growth Strategy*. Low Emissions Development Strategies Global Partnership, Working Group on Subnational Integration.

Abbreviation: BTU = British thermal unit.

75. **Strengthening spatial planning efforts:** many of the key drivers for energy and GHG emissions are related to urban form, namely population density, land-use mix, connectivity and accessibility. Spatial policy instruments cover a range of issues, including promotion of compact cities, provision of green spaces, retrofitting of existing buildings, green infrastructure, distributed generation of renewable energy sources, increasing non-motorized and public transportation coverage, and payment for urban ecosystem services that link demand for key services in the city that are sourced from outside the city boundary, such as water provision or flood control.

76. **Design and implementation of policy options by sector:** through strong mitigation actions aimed at low-carbon, climate-resilient development at the local level across the key sectors such as buildings, transport and waste, cities in aggregate could reduce their GHG emissions in these core sectors by an estimated 24 per cent by 2030 and by 47 per cent by 2050 (Erickson et al., 2014). The policy instruments that have proven to work well at the local level range from regulations, standards and labels for buildings, to management and incentives for transport, and framework targets and regulations for waste.

77. The options for **strengthening financial instruments** include policies such as: (i) improvements in municipal financial management and creditworthiness; (ii) the introduction of direct subsidies and financial incentives; (iii) economic instruments to leverage private-sector financing; and (iv) the promotion of public–private partnerships to attract climate-friendly investments. Enabling a rapid low-carbon development transformation in urban environments is highly dependent on a city’s financial and governance capacity and capability across all sectors. While the mitigation options in urban areas are contextual and depend on a city’s financial capacity, the most effective approach is to bundle a number of policy instruments to maximize the benefits (IPCC, 2014).

78. As clearly demonstrated by the example of Kampala, highlighted in spotlight box 6 below, improving the creditworthiness of cities improves and strengthens their revenue base and provides cities with access to low-cost finance. This is important because at

present only 4 per cent of the 500 largest cities in developing countries are considered creditworthy by international standards.²¹

Spotlight box 6

Moving towards creditworthiness in Kampala

The World Bank, through its Public–Private Infrastructure Advisory Facility’s City Creditworthiness Initiative, is supporting a large number of cities and is committed to making 350 cities around the world creditworthy. The city of Kampala has embarked on this programme to improve its financial sustainability. The city was able to restructure and improve its treasury management systems and put in place a new accounting manual. As a result, revenue collections increased by 110 per cent in a period of three years. The city also completed a review of its asset register, which established that fixed assets had been undervalued by 800 per cent.

The increased revenue, coupled with prudent financial management, helped the city to finance projects such as the introduction of eco-stoves, solar street lighting, flood-proofing, recycling of drainage water, waste to energy projects, overhauling the transport system through the introduction of a bus rapid transit (BRT) system, and increasing green space. Resilience to climate change impacts has been incorporated into all infrastructure design projects. To address congestion in the city, in addition to putting in place the BRT system, the city also plans to develop satellite towns around Kampala to avoid the need for commuters to travel into the city.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments; presentation by Kampala, June 2014.

79. Many cities with the requisite capacity and authority are starting to successfully use innovative financial mechanisms, such as green bonds, to finance low-carbon urban infrastructure directly and utilize such instruments to manage the challenges caused by rapid urbanization and climate change. An example of the use of innovative instruments by city authorities is Tokyo, which put a price on carbon through the use of an urban cap-and-trade programme and set priorities on the financing of low-carbon initiatives, as highlighted in spotlight box 7 below.

Spotlight box 7

Pioneering the urban carbon cap-and-trade programme in Tokyo

Launched in April 2010, the Tokyo cap-and-trade programme requires carbon dioxide emission reductions from large commercial, government and industrial buildings. The city authorities established a carbon price and prioritized the flow of financing to low-carbon initiatives. This is the world’s first urban cap-and-trade programme and accounts for 20 per cent of Tokyo’s total greenhouse gas emissions and aims to reduce emissions by 25 per cent by 2020 compared with the 2000 level. The astounding success of Tokyo’s cap-and-trade programme provides compelling evidence that this emerging innovative instrument can be used by cities to achieve major emission reductions. Recently, the Tokyo metropolitan government proposed a nationwide cap-and-trade programme to the Japanese Government, thereby demonstrating that cities can be climate-action leaders and increase the ambitions of national governments to undertake aggressive mitigation actions.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments; presentation by Tokyo, June 2014.

²¹ ADP TEM on urban environments; presentation by the World Bank, June 2014.

80. To create sustainable cities, city officials need to use municipal budgets to leverage financing from a wide range of sources through public–private partnerships. Private-sector funds already account for substantial investment in infrastructure development. Such investments are frequently made in the form of public–private partnerships and the launching of such partnerships has become a growing trend in recent years.

81. National governments depend on **capacity–building and knowledge management at the local level** to deliver mitigation actions at the necessary scale. An example of the building of such skills and capacity is the establishment of a special-purpose company of the Brazilian Development Bank and eight financial groups that work with public institutions in all stages of the bidding and procurement processes, conduct studies and assessments to ensure compliance with government regulations and help with economic and financial structuring of innovative projects (Casey, 2013). Another example is the establishment of a national training centre in Bangladesh for local waste management programmes (GIZ, 2013).

82. International institutions and partnerships, such as Global Leadership on Climate Change (C40) and Local Governments for Sustainability (ICLEI) are providing important networks, platforms and forums for collaboration that enable shared learning and exchange of experiences between cities. One example of cooperative initiative is the Compact of Mayors, recently launched at the United Nations Climate Summit in New York, United States of America, in September 2014 (see spotlight box 1 above).

83. While the initiatives and support provided by international organizations to developing countries is of critical importance, the GHG emission reductions achieved by cities, subnational governments and specific sectors are part of national inventories and NAMAs. The integration of national and subnational climate strategies is a high priority. Examples of effective policies implemented at the local level are presented in table 2 below.

Table 2

Policy options menu of climate actions for cities and subnational governments

<i>Select policy options</i>	<i>Select country and city examples</i>
Strengthening institutional arrangements and legal and regulatory frameworks	
City-level strategies, action plans and regulations to promote low-carbon, climate-resilient development aimed at the mitigation of greenhouse gas (GHG) emissions and adaptation to climate	<ul style="list-style-type: none"> • Brazil, Fortaleza – community GHG inventory • China, Hong Kong – guidelines to account for GHG emissions and removals in buildings • Japan – Low Carbon City Act 2012 • New Zealand, Wellington – Climate Change Action Plan 2013 • South Africa, Cape Town – Action Plan for Energy and Climate Change • Sweden, Malmo – Local Agenda 21 programme and Urban Development Master Plan for the period 2014–2032 • United States of America, New York – “PlaNYC” is New York’s blueprint for sustainability and resiliency aimed at 30 per cent GHG emission reductions by 2030

<i>Select policy options</i>	<i>Select country and city examples</i>
Multilevel collaboration and cross-learning among different levels of government, as well as between city/national governments through national and regional programmes	<ul style="list-style-type: none"> • Association of South-East Asian Nations (ASEAN) – Environmentally Sustainable Cities Programme • Serbia – expansion of existing heating network in the city of Valjevo, as a nationally appropriate mitigation action (NAMA), with the support of the Japan International Cooperation Agency • United Kingdom of Great Britain and Northern Ireland – devolution and low-carbon growth in British cities. Support for localism and the devolution of government • United States of America, California – the CivicSpark partnership, an initiative by the Governor of California to provide climate change related technical assistance and capacity-building support to local governments in nine regions of California • Viet Nam – subnational integration of the national Green Growth Strategy
Support for good governance and leadership by encouraging and recognizing good practice action	<ul style="list-style-type: none"> • Philippines – national government support of local governments, Galing Pook Awards
Spatial planning instruments	
Promotion of compact cities and high-density urbanization with concentrated zoning of areas for services and facilities and housing areas close to transportation hubs	<ul style="list-style-type: none"> • Japan – Low Carbon City Development Guidance 2010, Kyoto Protocol Target Achievement Plan • Mexico – Integrated Sustainable Urban Development Guidelines on Infrastructure, Equipment and Services (Housing Aid) • Republic of Korea – National Comprehensive Development Plan 2011
Provision of green spaces in the urban environment by integrating green infrastructure with the built environment to respond to mitigation and adaptation needs	<ul style="list-style-type: none"> • Australia, Melbourne – Green Infrastructure Regulations • Colombia, Medellín – “Green Belt” of open space around the city to restrict future sprawl and create recreational space • Malaysia – National Physical Plan, Green Township Policy, National Urbanization Policy, Iskandar Greenery Plan • Singapore – Green Plan 2012, Sustainable Singapore Blueprint 2030 • Thailand, Chiang Rai – land-use and flooding buffer zones
Distributed generation of renewable energy to reduce reliance on large, centralized power plants	<ul style="list-style-type: none"> • Barbados, Chile, Denmark, Germany, Jamaica, Mexico, Spain and United States of America – these countries have all adopted measures to permit and promote distributed generation at the subnational and individual building levels

<i>Select policy options</i>	<i>Select country and city examples</i>
Increased non-motorized and public transportation routes and access by shifting away from motorized modes of transport and individual vehicles within the framework of sustainable urban transport	<ul style="list-style-type: none"> • Argentina, Buenos Aires – Metrobus bus rapid transit (BRT) system, walking and cycling infrastructure, Sustainable Mobility Plan • China, Lanzhou – BRT and integration of transit-orientated development • India, Indore – iBus BRT • Indonesia, Jakarta – TransJakarta BRT • Peru, Lima – Metropolitan BRT, Metro de Lima (electric train), “Ciclodía”, whereby a major avenue is closed to motor vehicles every Sunday • Republic of Korea, Suwon – cycling and walking infrastructure
Enhancements in the provision of urban ecosystem services to increase the adaptive capacity of cities by providing an incentive mechanism for adaptation to climate change	<ul style="list-style-type: none"> • Bolivia, Costa Rica, Ecuador, India, Mexico, South Africa and United States of America – payments for watershed services • Brazil, Paraná – Public Redistribution Mechanism to protect forested watersheds and rehabilitate degraded areas
Effective policies, instruments and measures by sector	
Promotion of energy efficiency in buildings through building sector development strategies and regulations	<ul style="list-style-type: none"> • Canada, Edmonton – green building policy and plan • Germany – Conservation Act, EnEV-Energy Conservation Ordinance • Philippines – Green Building Initiative, Mandaluyong City (mandatory) and Quezon City (voluntary) • Paris, France – programme for energy retrofitting historical buildings covering 25,000 apartments, resulting in energy reductions of 30 per cent and the creation of 2,000 jobs
Promotion and improvement of efficiency of mass passenger and freight transportation systems	<ul style="list-style-type: none"> • European Union – European Rail Traffic Management System • Brazil, Czech Republic, Estonia, France, Germany, United States of America – “zero fares” and free public transport • Netherlands – improving freight operation efficiencies • Norway – electric vehicle car-sharing programme, electric vehicle benefits such as tax exemption, no parking fees, no road tolls • South Africa, Cape Town – green taxi fleet
Integrated solid waste management plans/wastewater treatment, including:	<ul style="list-style-type: none"> • Brazil – integrated solid waste management and carbon finance project implemented in cooperation with the Caixa Bank and the World Bank • China, Beijing – conversion of landfill gas to electricity and direct use of methane in the Gaoantun landfill • El Salvador, San Salvador – Nejapa landfill, gas to energy (electricity) • Poland, Krakow – Barycz landfill, gas to energy (electricity) • Ukraine, Mariupol – landfill flare with transition to electricity generation • United Republic of Tanzania, Dar Es Salaam – flaring methane in closed landfills

<i>Select policy options</i>	<i>Select country and city examples</i>
Organic waste composting	<ul style="list-style-type: none"> • Ghana, Accra – small-scale composting of domestic waste • Indonesia, Surabaya – accelerated decomposition with fermentation • Malaysia, North Kuching – “Bokashi” home food waste composting system • Thailand, Muangklang – conveyor belt system
Wastewater recycling	<ul style="list-style-type: none"> • Japan, Tokyo – urban reuse applications • Mexico, Tijuana – “Purple Pipe” project that recycles wastewater through separate pipes for appropriate purposes such as street washing or irrigation • Singapore – NEWater advanced wastewater recycling project • South Africa, Johannesburg – water recycling programme
Strengthening financial instruments	
Improving municipal financial management and creditworthiness of cities	<ul style="list-style-type: none"> • Brazil, Rio de Janeiro – low-carbon city development programme • Malawi – Lilongwe’s programme to improve its financial sustainability with the assistance of the Public–Private Infrastructure Advisory Facility’s City Creditworthiness Initiative of the World Bank • Uganda – Kampala’s programme to improve its financial sustainability with the assistance of the Public–Private Infrastructure Advisory Facility’s City Creditworthiness Initiative of the World Bank • World Bank Low-Carbon, Liveable Cities Programme, City Creditworthiness Training Programme
Introduction of special direct subsidies or financing mechanisms to finance low-carbon urban infrastructure	<ul style="list-style-type: none"> • India – National Programme for Urban Development and Renewal • Germany – National Climate Initiative Fund
Introduction of innovative economic instruments to attract climate-friendly investments	<ul style="list-style-type: none"> • Brazil – Estruturadora Brasileira de Projetos, a special-purpose company that helps federal, state and municipal governments to prepare and tender infrastructure projects • Canada, British Columbia – carbon tax and tax shift, Climate Action Dividend, Climate Action Tax Credit • Japan, Tokyo – urban carbon cap-and-trade programme • Thailand – Energy Efficiency Revolving Fund • United Kingdom, London – vehicle congestion charge • United States of America – Regional Greenhouse Gas Initiative
Promotion of new approaches to public–private partnerships to leverage financing from the private sector	<ul style="list-style-type: none"> • Abu Dhabi, Masdar City, and Myanmar – special economic zones and initiatives such as the Infrastructure Development Project in the Thilawa special economic zone • Africa – Low Carbon Financing Coalition • India, Gujarat – 5 MW rooftop solar project with 25-year concessions • South Africa, Northern Cape Province – 150 MW concentrated solar power plants

<i>Select policy options</i>	<i>Select country and city examples</i>
Capacity-building and knowledge management	
Targeted programmes of national governments providing support for skills and knowledge development	<ul style="list-style-type: none"> • Bangladesh – national training centre for local waste management programmes • Nepal, Ministry of Education – integrating disaster risk reduction and climate change education into the school curricula • Sweden – economic revival and redevelopment of Malmö
Mobilization of support from local and international institutions and partnerships for local actions and learning	<ul style="list-style-type: none"> • ASEAN – Environmentally Sustainable Cities, Model Cities Programme • Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants, impact of short-lived climate pollutants on health in urban areas • European Union – Covenant of Mayors

Sources: Many of the policy options and examples provided in this table are taken from the presentations made during the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on urban environments, held in June 2014, in submissions from Parties and in relevant technical literature. Detailed information on this meeting is available at <<http://unfccc.int/bodies/awg/items/8170.php>>. Other sources are included in the list of references provided at the end of this paper.

Note: Many examples reference ongoing activities at the local and regional levels. The list is not exhaustive and the examples are for informational purposes only.

V. Carbon dioxide capture, use and storage

A. Mitigation potential, progress, benefits, costs and barriers

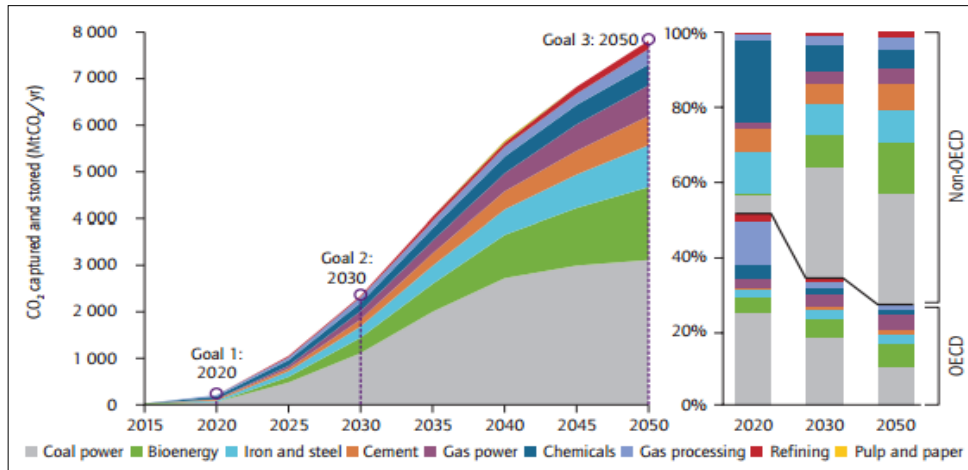
84. Carbon dioxide capture and storage (CCS) entails the capture of carbon dioxide from facilities in the power and several energy-intensive sectors (e.g. oil and natural gas refining/upgrading, chemical industry, iron and steel production, cement production and fertilizer production) followed by its transport and storage in geological formations (IPCC, 2005). The origin of carbon dioxide can be fossil or biological. Utilization of carbon dioxide, referred to as CCUS, has been proposed as a possible alternative or complement to geologic storage of carbon dioxide. An important use of carbon dioxide is to enhance hydrocarbon (i.e. oil or gas) production next to other potential uses of carbon dioxide, including synthetic fuel production; agriculture for enhanced crop production or algae growth; and production of chemicals and plastics (IEA, 2013).²²

85. CCS is an important mitigation option in the future emissions scenario (IPCC, 2014). This is also the case in the most recent scenario prepared by the IEA, which aims for an 80 per cent probability of limiting the average global temperature increase to 2 °C (hereinafter referred to as the 2DG scenario) (IEA, 2014). In this scenario, IEA (2014) estimates global deployment of CCS at a level capable of capturing 1.5 Gt CO₂ in 2030, increasing to 6.3 Gt CO₂ in 2050. In 2050, the power sector would be responsible for 49 per cent (3.1 Gt CO₂) of captured carbon dioxide and the industry sector for the remaining 51 per cent (3.2 Gt CO₂). CCS is currently still in the pre-commercial phase, and is likely to

²² ADP TEM on CCUS; presentation by Germany, October 2014.

continue being so until 2020; commercial uptake of the technology might occur after 2020²³ (see figure 2 below).

Figure 2
Carbon dioxide capture and storage applied in various sectors and regions in the 2 °C scenario between 2015 and 2050



Source: International Energy Agency. 2013. *Technology Roadmap Carbon Capture and Storage*.
 Abbreviation: OECD = Organisation for Economic Co-operation and Development.

86. During the TEM on CCUS, the participants noted that 55 large-scale CCS projects are in different stages of development; 22 are ‘active’ CCS projects, including 12 operational and 10 under construction. The cumulative CO₂ expected to be captured amounts to around 40 Mt CO₂/year by 2017. According to the IEA forecast, large-scale CCS projects are expected to capture almost 70 Mt CO₂/year by 2020 (IEA, 2014). Spotlight box 8 below provides detailed information on some of the projects, including the main drivers of project development. This information suggests that carbon dioxide for enhanced hydrocarbon recovery is an important economic driver of such projects.

Spotlight box 8

Examples of carbon dioxide capture and storage projects

The Sleipner project in Norway: Sleipner was the world’s first commercial carbon dioxide storage project. The carbon dioxide has been removed since 1996 from the hydrocarbons produced offshore before being stored in a deep saline reservoir. The project results in storage of 0.9 Mt CO₂/year, amounting to 15 Mt CO₂ in total. The project was driven by a carbon tax introduced in 1991 creating the economic incentives to store carbon dioxide.^a

The Boundary Dam project in Canada: this is the world’s first power station with large-scale post-combustion capture inaugurated in October 2014. The 110 MW retrofit of a coal-fired power plant in Saskatchewan, Canada, is designed to store around 1 Mt CO₂/year. The captured carbon dioxide will be injected into nearby oilfields, where it will also be used to enhance oil recovery. The main drivers of this project are federal and provincial government support and revenues from enhanced oil recovery.^b

The Quest Carbon Capture and Storage (CCS) project: this project expects to begin operation in 2015 and is expected to capture carbon dioxide (>1 Mt CO₂/year) from crude oil processing and permanently store it deep underground. The main drivers of

²³ ADP TEM on CCUS; presentation by GCCSI, October 2014.

this project are government funding and revenues from greenhouse gas credits (e.g. carbon tax).^c

CCS demonstration projects in the United States of America include projects capturing carbon dioxide from power production, hydrogen and methanol production, industry and agricultural processing (ethanol production). The captured carbon dioxide ranges from 1 to 4.5 Mt CO₂/year. Various applications of the captured carbon dioxide are foreseen, including storage in saline reservoirs, storage with enhanced oil recovery and use of carbon dioxide for the production of urea/urea ammonium nitrate. The main drivers of these projects are government funding, tax credits and revenues from enhanced oil recovery.^d

The Masdar–ADNOC CCS project in the United Arab Emirates shows that solutions exist in the iron and steel sector. The project captures 0.8 Mt CO₂/year at a steel plant from where it is transported by a pipeline to oilfields for enhanced hydrocarbon recovery. The main driver of the project is the revenue from enhanced hydrocarbon recovery. Commissioning is expected in the first quarter of 2016.^e

Carbon dioxide capture and use projects in Germany include the Dream Production project, which is expected to launch the first carbon dioxide-based polyols on the market, used for the production of polyurethane foam, and the Sunfire project, which is aimed at the production of liquid fuels from carbon dioxide and water using renewable energy. The main driver of the projects is government funding.^f

Sources: ^a Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) technical expert meeting (TEM) on CCUS; presentation by Statoil, October 2014. More details are available at <<https://sequestration.mit.edu/tools/projects/sleipner.html>>.

^b ADP TEM on CCUS; presentation by SaskPower, October 2014. More details are available at <<http://www.saskpowerccs.com/ccs-projects/boundary-dam-carbon-capture-project/carbon-capture-project/>>.

^c ADP TEM on CCUS; presentation by Shell, October 2014.

^d ADP TEM on CCUS; presentation by ADM, October 2014.

^e ADP TEM on CCUS; presentation by the United Arab Emirates, October 2014.

^f ADP TEM on CCUS; presentation by Germany, October 2014.

87. Recent studies show that both the total investment cost and the cost of emissions reduction are higher for various scenarios when CCS/CCUS is excluded from the list of mitigation options (Global Energy Assessment (GEA), 2012; IEA, 2012, 2014). Costs of CCS/CCUS projects differ significantly per project, location and application. Costs in the power and industry sectors range from about USD 30/t CO₂ to USD 150/t CO₂ avoided (GEA, 2012; IPCC 2014). However, low-cost opportunities exist in some niche cases in the industry sectors where the purer streams of carbon dioxide emitted can be captured at relatively low cost.

88. In addition to the overall lower cost of emission reductions, a benefit highlighted during the TEM was that CCS deployment allows for the delivery of a broad range of low-carbon energy options, which allows Parties to maintain the diversity of energy supply.²⁴ In addition to benefits, there are important CCS/CCUS-related trade-offs that were identified, mostly in relation to public health, safety, environmental pollution (e.g. air, water, waste) and economic issues. Specific attention during the TEM on CCUS was given to the long-term permanence of carbon dioxide stored in geological formations, and health and safety concerns related to CCS with regard to risks of carbon dioxide release during transportation and storage (GEA, 2012; IPCC, 2014; IEA, 2014).

²⁴ ADP TEM on CCUS; presentation by the United Kingdom of Great Britain and Northern Ireland, October 2014.

89. Technical, social, economic, policy, organizational and political factors may limit deployment of CCS/CCUS if not adequately addressed. Key barriers include:

- (a) The lack of a regulatory framework;
- (b) The absence of adequate financial incentives (e.g. carbon price, carbon tax, or emissions cap-and-trade systems);
- (c) A low level of public financing;
- (d) The high upfront cost of infrastructure and finance;
- (e) The need for safe operational procedures and long-term liability inclusion in regulatory frameworks;
- (f) The technical complexity of system integration and difficulties in obtaining accurate cost estimates;
- (g) Uncertainty about the potential scale and contribution to climate change mitigation.

B. Practices, policies and actions to unlock mitigation potential in relation to carbon dioxide capture, use and storage

90. Based on the experiences gained with global developments in CCS/CCUS, lessons can be learned to develop and scale up CCS/CCUS. Localised national circumstances greatly affect the potential and likelihood of CCS/CCUS deployment. Important elements of such circumstances include: geological resources, energy and industry systems, existing human and research capacity related to CCS/CCUS technologies, regulatory frameworks and market conditions. Given the importance of national circumstances and the fact that the CCS/CCUS is a policy-driven technology, commitment is needed from governments and other stakeholders to establish an optimal set of policies, actions and practices that fit the needs of a country or region and the phase of technology development.

91. Various policy options, actions and technologies that can assist countries in addressing the challenges and removing the barriers faced in scaling up the deployment of CCS/CCUS were raised by the participants and presenters at the TEM. They could be structured into three groups of policy options: (i) scoping and agenda-setting; (ii) strengthening institutional arrangements and legal and regulatory frameworks; and (iii) design and implementation of effective and multifaceted policy portfolios (see table 3 below).

92. **Scoping and agenda-setting:** an important basis for developing and deploying CCS/CCUS projects is to establish the technical potential of the technology in a certain country or region. Building CCS/CCUS expertise is also key to any policy that aims to advance CCS/CCUS. Examples of expertise-building are the creation of national RD&D programmes to stimulate the creation and sharing of knowledge among stakeholders. Access to international research and knowledge-sharing initiatives is imperative to accelerate capacity-building in countries where CCS/CCUS development is currently in an early phase. Part of this policy option is stakeholder engagement, which is crucial in the acceptance of CCS/CCUS technology (IPCC, 2014).

93. **Strengthening institutional arrangements and legal and regulatory frameworks:** there is a strong need for comprehensive and transparent regulatory frameworks for carbon dioxide storage (IEA, 2013). Experience with the development of these frameworks is growing, but in many cases they need to be developed in parallel with the operation of the first major projects, incorporating lessons learned from these projects

and ensuring that the concerns of local populations have been recognized and addressed. Institutional capacity-building for this purpose is needed and may be based on the experience gained with the development and deployment of existing CCS/CCUS projects.

94. **Design and implementation of effective and multifaceted policy portfolios:** policies are required to improve the cost-competitiveness of CCS/CCUS compared to other technologies and to ensure investor confidence. The provision of investment grants and tax credits, credit guarantees and/or insurance are considered to be suitable means to support CCS/CCUS technologies, as long as they are in the early stages of development (IPCC, 2014). Policies stimulating CCS/CCUS should take into account the need to maintain a stable, long-term policy environment and reach a level playing field. Depending on the phase of CCS/CCUS development and the country circumstances, there are several policy options that are already available and have been practised globally that stimulate or regulate the deployment of CCS/CCUS. These include economic and financial instruments, but also regulating instruments, or a mix thereof.

Table 3

Policy options menu for carbon dioxide capture, use and storage

<i>Select policy options</i>	<i>Select specific examples</i>
Scoping and agenda-setting	
<ul style="list-style-type: none"> • Identify technical potential (e.g. storage atlas) • Investigate the potential role of CCS/CCUS in relation to energy systems and industry structure • Identify and engage key stakeholders • Raise awareness among governments and industry • Build CCS/CCUS expertise through RD&D and knowledge-sharing • Develop an action plan or road map with a (long-term) strategy for CCS/CCUS 	<ul style="list-style-type: none"> • Storage atlases – North America, Norway, South Africa, United Kingdom of Great Britain and Northern Ireland • Leading countries and regions with advanced scoping and agenda-setting – Australia, Canada, China, European Union, Japan, Norway, Republic of Korea, United Arab Emirates, United States of America • Pre-competitive geological exploration data – Australia, China • Advancing countries or regions: Algeria, Botswana, Brazil, China, Egypt, India, Indonesia, Jordan, Kenya, Maghreb region, Malaysia, Mexico, Philippines, South Africa, Thailand, Trinidad and Tobago, Viet Nam • Examples of CCS technology road maps (see FCCC/TP/2014/13/Add.3, spotlight box 2)
Strengthening institutional arrangements and legal and regulatory frameworks	
<ul style="list-style-type: none"> • Review existing legal and regulatory frameworks • Enhance knowledge-sharing in institutions with a clear role in legal and regulatory frameworks for CCS/CCUS • Implement frameworks that ensure safe and effective carbon dioxide capture, transport, storage and use 	<ul style="list-style-type: none"> • The International Energy Agency's CCS Review collects contributions from national, regional, state and provincial governments, at all stages of CCS regulatory development • The Global CCS Institute has performed an extensive review of the permitting process of the (planned) CCS demonstration projects in the Netherlands and Romania as well as in a number of developing countries • The European Union's CCS directive (2009/31/EC) is an example of Europe's strengthening of the regulatory framework for CCS • Review of legal and regulatory frameworks for nine developing economies – China, Chinese Taipei, Indonesia, Malaysia, Mexico, Philippines, Republic of Korea, Thailand and Viet Nam (Asia-Pacific Economic Cooperation, 2012)

<i>Select policy options</i>	<i>Select specific examples</i>
<ul style="list-style-type: none"> • Ensure well-aligned permitting procedures for CCS/CCUS projects 	
Design and implementation of effective and multifaceted policy portfolios	
<ul style="list-style-type: none"> • R&D policy • Project demonstration support • Government provision of public goods or services (e.g. a common carrier infrastructure) 	<ul style="list-style-type: none"> • Canada – the Alberta CCUS Fund, the Clean Energy Fund, and the Climate Change and Emissions Management Fund • China – research programmes on utilization of carbon dioxide for enhanced oil recovery and geological storage, and a programme on technology research for carbon dioxide capture and storage • European Union – public R&D funding via framework programmes and Horizon 2020. Demonstration project funding via New Entrants’ Reserve (NER) 300 (which was renewed in October 2014 re-named as the NER400) programme and European Energy Programme for Recovery • Norway – State enterprise for development and deployment of CCS (Gassnova) • United Arab Emirates – a joint venture project funded by Abu Dhabi National Oil Company (ADNOC), the United Arab Emirates’ State-owned oil company, and Masdar, a wholly owned subsidiary of the Abu Dhabi Government, which is owned by the Mubadala Development Company • United Kingdom – CCS commercialization programme and funding from the European Union • United States of America – Department of Energy’s Industrial Carbon Capture and Storage Project (ICCS), the Clean Coal Power Initiative (CCPI) and the American Recovery and Reinvestment Act
<ul style="list-style-type: none"> • Financial instruments for the deployment of CCS/CCUS 	<ul style="list-style-type: none"> • Public R&D funding – Australia, Canada, Japan and the United States of America are together responsible for 75 per cent of cumulative public funding from 1974 to 2011 • Canada – government funding and (State-dependent) carbon tax • Japan – government funding • European Union – European and national public funding and emissions trading scheme • Norway – government funding and carbon tax • United Kingdom – government funding, emissions trading scheme and contract for difference • United States of America – loan guarantees, grants and tax credits
<ul style="list-style-type: none"> • Regulating instruments for the deployment of CCS/CCUS 	<ul style="list-style-type: none"> • Canada – emissions performance standard (Electricity Performance Standard for coal-fired electricity) • European Union – mandatory carbon dioxide capture readiness • United Kingdom – emissions performance standard • United States of America – emissions performance standard

Note: Many examples reference ongoing activities. The list is not exhaustive and the examples are for informational purposes only. A selection of policy options and examples highlighted during the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on carbon dioxide capture, use and storage, held in October 2014, in submissions from Parties and in relevant technical literature. Detailed information on this meeting is available at <<http://unfccc.int/bodies/awg/items/8421.php>>.

Abbreviations: CCS = carbon dioxide capture and storage, CCUS = carbon dioxide capture, use and storage, R&D = research and development, RD&D = research, development and demonstration.

VI. Non-carbon dioxide greenhouse gas emissions

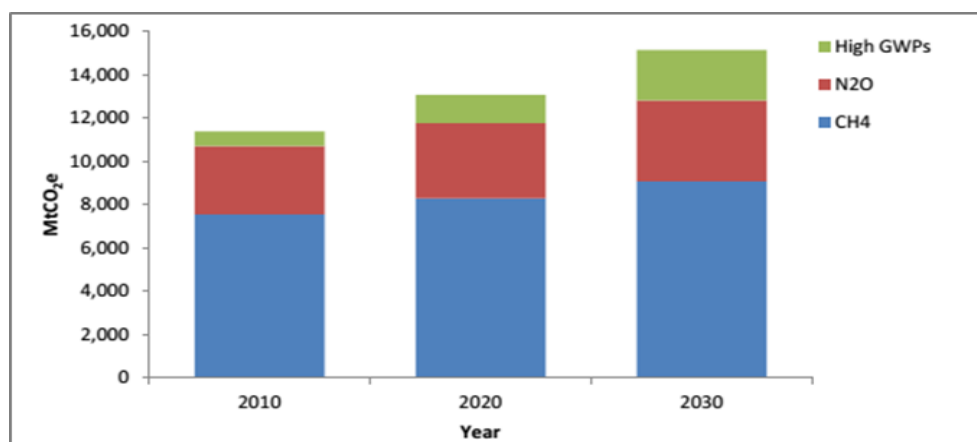
A. Mitigation potential, progress, benefits, costs and barriers

95. In 2010, non-CO₂ GHG emissions amounted to around 12 Gt CO₂ eq and accounted for about 25 per cent of total anthropogenic GHG emissions, with methane (CH₄) (contributing 16 per cent) and nitrous oxide (N₂O) (contributing 6 per cent) as the next main contributors (IPCC, 2014). The other non-CO₂ GHGs include fluorinated gases (F-gases) such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆). These gases are emitted from a broad range of sectors and sources, namely: CH₄ is mostly emitted from extraction, distribution and combustion of fossil fuel, industrial processes, enteric fermentation, rice cultivation, manure management, other agricultural sources, and the waste sector; N₂O is mostly emitted from industrial processes, agricultural soils, manure management and wastewater; and F-gases are mostly emitted from industrial processes.

96. The report by the United States Environmental Protection Agency (EPA), *Global Anthropogenic Non-CO₂ Greenhouse Gas Emissions* (EPA, 2012) provides projections that indicate that non-CO₂ GHG emissions could rise to 15 Gt CO₂ eq (ranging between 9 and 17 Gt CO₂ eq) by 2030 under a ‘business-as-usual’ scenario; this level is expected to correspond to a 50 per cent increase compared with 1990 levels. In the same report, EPA shows that CH₄ and HFCs are projected to be the largest absolute contributors to the growth of non-CO₂ GHG emissions between 2010 and 2030, as demonstrated in figure 3 below.

Figure 3

Projections of non-CO₂ emissions growth by 2030, by gas



Source: United States Environmental Protection Agency. 2013. *Global Mitigation of Non-CO₂ Greenhouse Gases 2010–2030*.

Abbreviation: GWPs = global warming potentials.

97. The mitigation potential of non-CO₂ GHG emissions is estimated by EPA at 1.8–3.0 Gt CO₂ eq by 2030 compared with the baseline emissions in 2005. According to EPA, 12 per cent of the 2005 baseline for non-CO₂ GHG emissions can be mitigated by 2030 at no cost or at financial gain (EPA, 2012), and 24 per cent can be abated at a cost below USD 20/t CO₂ eq, including mitigation potential at no cost (EPA, 2013).

98. Mitigation actions addressing non-CO₂ GHG emissions are associated with co-benefits linked to the promotion of economic growth, sustainable development, poverty eradication and adaptation to climate change, as explained in document FCCC/TP/2014/13/Add.4, table 2. Many of these co-benefits are, in fact, the main drivers

for policies and actions that lead to GHG mitigation; for example, reducing air, soil and underground water pollution through efficient waste management usually leads to reductions in the scale of CH₄ emissions from waste.

99. Non-CO₂ GHG mitigation options span a wide range of sectors, which each have their own unique barriers to implementation. These barriers are also specific to certain regions, evolve over time and depend on national circumstances. Socioeconomic, institutional and technological barriers are among the key barriers that prevent the full utilization of the mitigation potential of non-CO₂ GHGs. Examples of such barriers include: high (investment) cost and limited access to capital and finance; lack of market drivers; lack of stakeholder awareness; lack of regulatory framework and institutional capacity; lack of capacity-building and technology transfer; and technical limitations of (alternative) technologies (see document FCCC/TP/2014/3/Add.4, table 3).

B. Practices, policies and actions to unlock mitigation potential in addressing non-carbon dioxide greenhouse gas emissions

100. For successful implementation of non-CO₂ policy options, it is important to consider the following success factors, which are essential to overcome barriers and deliver significant co-benefits: identifying land-use activities with synergies between food security, adaptation and mitigation and designing strategies for disseminating knowledge among farmers and local communities; maintaining or increasing the competitiveness of industrial products in the market; safety considerations and standards; and developing markets for alternative low-HFC refrigerants. Also, replication of good practices, policies and actions on non-CO₂ GHG mitigation requires recognition and adjustments of policy design to the national circumstances of a country, sector or stakeholder.

101. **Mitigation options to address CH₄ emissions** are implemented in the fossil-fuel extraction, distribution and combustion, agriculture and waste sectors (see table 4 below). Mitigation actions related to CH₄ emissions from extraction, distribution and combustion of fossil fuels aim at providing financial incentives to overcome high initial investments and enable market creation. An example of such action is the Coal Mining Abatement Technology Support Package established in Australia, with a capitalization of 80 million Australian dollars from government and business, focusing on emissions from flaring, pre-drainage, ventilation and avoidance.²⁵ There are many examples of development and demonstration of new technologies to capture and use fugitive CH₄ emissions from coal mining, including in India, Mexico and the United States of America (see table 4 below).

102. The mitigation of CH₄ emissions from agriculture could be achieved through improved management of agricultural land (e.g. rice irrigation) and livestock (e.g. feeding, breeding and manure management). Examples of good practice policies are provided by China and the Philippines on the irrigation practices of rice paddies (UNEP, 2011). New Zealand has established the Agricultural Greenhouse Gas Research Centre, an internationally renowned centre for research and development working on mitigation solutions in the agriculture sector. Australia has developed the Carbon Farming Initiative where farmers can earn credits by reducing CH₄ (and N₂O) emissions from land and livestock.²⁶

103. The mitigation of CH₄ emissions from waste could be achieved through integrated waste management systems, including waste prevention, separation, reuse and recycling (IPCC, 2014; UNEP, 2011). The cross-sectoral policies could be complemented by specific policies aimed at reducing emissions from specific sources, for example CH₄ emission

²⁵ ADP TEM on non-CO₂ GHG emissions, presentation by Australia, October 2014.

²⁶ As in footnote 25.

reductions from landfills. Examples of good practice policies were presented at the TEM on non-CO₂ GHG emissions (see spotlight box 9 below).

Spotlight box 9

Greenhouse gas emission trends in the waste sector in Australia, the European Union and the United States of America

The **European Union** Landfill directive (1999/31/EC) led to a doubling of energy production from municipal solid waste between 2000 and 2009 and reduction in methane emissions. During the period 1990–2010, net greenhouse gas emissions from landfills in the **United States of America** decreased by approximately 27 per cent due to changes in waste composition, increased landfill gas collection and combustion, and increased rates of waste recovery and recycling.^a During the same period, **Australia**'s landfills emitted about 18 per cent fewer emissions.^b

Sources:

^a Intergovernmental Panel on Climate Change. 2014. *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

^b Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions; presentation by the International Solid Waste Association, October 2014.

104. **Mitigation options to address N₂O emissions** are implemented mostly in the industrial processes (e.g. fertilizer production and adipic acid production) and agriculture (e.g. fertilizer application) sectors (see table 5 below). A large mitigation potential in nitric and adipic acid production can be effectively realized by using economic mechanisms, for example clean development mechanism (CDM) and joint implementation (JI) projects (see spotlight box 10 below). Other examples of economic instruments used in industry are the European Union Emissions Trading System, which has resulted in an 85 per cent reduction in N₂O emissions from nitric acid plants, and the Climate Action Reserve, implemented in North America to stimulate voluntary carbon offset credits by companies.

Spotlight box 10

Mitigation of N₂O emissions from adipic acid production

Until 2009, clean development mechanism/joint implementation (CDM/JI) projects were instrumental in reducing N₂O emissions from adipic plants worldwide. It was estimated that about 95 per cent of the mitigation potential could be achieved per plant. However, the funds generated through the CDM/JI projects led to a more rapid production growth above the global average in countries hosting CDM projects. Therefore, the European Union adopted a regulation to ban emission reductions from new plants through CDM projects. As a result, N₂O emissions have increased again since 2009.

Existing plants face challenges in covering the operational costs associated with N₂O mitigation. It was recognized that a price signal is needed to relaunch the reduction of N₂O emissions and to reach record low levels, for example through the CDM, a new market mechanism or a cap-and-trade system.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions; presentation by Solvay, October 2014.

105. Improvement of nutrient management is one of the priority areas of the World Bank Group's investments in agriculture. These investments account for around half of the overall investments in agriculture, which have increased from USD 4.1 billion in the period

2003–2005 to USD 10 billion in the period 2013–2015. At the national level, good practices are exemplified by the financial incentives for farmers established in offset credit schemes, such as the Nitrous Oxide Emission Reduction Protocol for Carbon Offsets in Alberta, Canada. The scheme aims to reduce N₂O emissions from fertilizer use, manure management and crop residues. New Zealand demonstrated an efficient approach to nutrient management in the form of a farm-level nutrient management model that can estimate both GHGs and product life cycle emissions on farms.²⁷

106. Another example of an effective mitigation policy targeting N₂O emissions is the introduction of taxes on the nitrogen content in synthetic fertilizers introduced by the EU nitrates directive (91/676/EEC), limiting the use of nitrogen fertilizers and animal manure in nitrate-vulnerable zones.

107. **Mitigation options to address F-gas emissions** are implemented mainly in industries producing solvents (HFCs), HCFC-22 production (HFCs) and primary aluminium production (PFCs). Good practice policies include: (i) creating market conditions for technology development, transfer and deployment of climate-friendly alternatives to high global warming potential (GWP) HFCs and PFCs; (ii) responsible management of existing equipment and gas recovery at the end of the life of equipment or products and better design of future equipment in order to minimize leaks; and (iii) encouraging uptake of climate-friendly alternatives to reduce reliance on high-GWP HFCs²⁸ (see table 6 below).

108. In summary, several policies and actions were identified at the TEM on non-CO₂ GHGs emissions as crucial to enabling the significant mitigation of non-CO₂ GHG emissions. They include:

- (a) Policies to promote recovery, capture and reuse, and reduce leakage of CH₄ from several sources;
- (b) Integrated waste management policies;
- (c) Policies and practices aimed at a more efficient use of nitrogen fertilizers;
- (d) Development of techniques and policies to improve sustainable land and livestock management;
- (e) Creation of market conditions for technology development, transfer and deployment of climate-friendly alternatives to HFCs;
- (f) Voluntary emission reductions by industry.

Table 4
Policy options menu for the mitigation of CH₄ emissions

<i>Select policy options</i>	<i>Select specific examples</i>
Sector: fossil-fuel extraction, production and transport	
Degasification and recovery of methane from venting in coal mines	<ul style="list-style-type: none"> • Australia – coal mining abatement technology support package • India, Mexico and the United States of America – pilot projects on the mitigation of coal-mine emissions
Recovery, capture and use of fugitive CH ₄ emissions from the oil and gas sector	<ul style="list-style-type: none"> • Global Methane Initiative – multiple countries and organizations • Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC): Oil and Gas Methane Partnership • Oil and Gas Climate Initiative

²⁷ Submission from New Zealand to the ADP, 2014.

²⁸ Submission from UNEP to the ADP, 2014.

<i>Select policy options</i>	<i>Select specific examples</i>
Reduction of gas leakage from transmission pipelines	<ul style="list-style-type: none"> • Russia – Gasprom energy conservation programmes • Global Methane Initiative – multiple countries and organizations
Sector: agriculture	
Livestock management, including feeding and breeding practices	<ul style="list-style-type: none"> • Australia – Carbon Farming Initiative and Emission Reduction Fund • European Union (EU) – Common Agricultural Policy • New Zealand – Agricultural Greenhouse Gas Research Centre and Primary Growth Partnership
Sustainable manure management, including through on-farm manure management systems, better application methods and treatment technologies	<ul style="list-style-type: none"> • EU – nitrates directive, 2010 • United States Environmental Protection Agency – AgSTAR programme • Multiple Parties and non-State actors: CCAC Agriculture Initiative; workstream on livestock and manure management • Multiple Parties and non-State actors: Global Methane Initiative, Agriculture Subcommittee
Intermittent aeration of continuously flooded rice paddies	<ul style="list-style-type: none"> • China – practice of draining rice paddies • Philippines – alternated wet–dry irrigation of rice paddies
Sector: waste	
Integrated waste management	<ul style="list-style-type: none"> • EU – waste management legislation (waste framework directive (75/442/EEC) and landfill directive (1999/31/EC)), leading to a reduction of methane through better waste management • South Africa – legislation on integration of air pollution and climate policies
Waste reduction, recycling and reuse	<ul style="list-style-type: none"> • Germany – implementation of the EU policy on packaging through its Ordinance on the Avoidance and Recovery of Packaging Waste
Landfill management, including methane capture and energy recovery for heat and electricity generation	<ul style="list-style-type: none"> • Australia – Emission Reduction Fund with capitalization of 2.55 billion Australian dollars covers costs on delivery of abatement • Mexico – public–private partnership gas recovery from landfills • United States of America – successful reduction of emissions from waste and landfills, including through landfill air regulations • World Bank – Pilot Auction Facility for Methane and Climate Change Mitigation

Note: Many of the policy options and examples provided in this table are taken from the presentations made during the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions, held in October 2014, in submissions from Parties and in relevant technical literature. Detailed information on this meeting is available at <<http://unfccc.int/bodies/awg/items/8420.php>>. Other sources are included in the list of references, provided at the end of this paper.

Table 5
Policy options menu for the mitigation of N₂O emissions

<i>Select policy options</i>	<i>Select specific examples</i>
Sector: industrial processes	
Reducing N ₂ O emissions from industry through financial incentives, mechanisms and voluntary agreements	<ul style="list-style-type: none"> • Brazil – clean development mechanism projects • European Union (EU) – European Union Emissions Trading System • North America – voluntary carbon offset credits • Netherlands – Reduction Programme for Non-CO₂ Gases (target of 8–10 Mt CO₂ eq emission reductions by 2020, or a reduction of 50

<i>Select policy options</i>	<i>Select specific examples</i>
	per cent below the 1990 level)
Sector: agriculture	
Integrated sustainable land management	<ul style="list-style-type: none"> Indonesia – five-year plan of the Ministry of Forestry
Efficient use of nitrogen fertilizers through regulations and training of farmers	<ul style="list-style-type: none"> China – training and capacity-building EU – nitrates directive New Zealand – Agricultural Greenhouse Gas Research Centre, Primary Growth Partnership and farm-level nutrient management World Bank Group – investments in agricultural improvements in nutrient management
Reducing N ₂ O emissions from soils through financial incentives	<ul style="list-style-type: none"> Canada – Alberta Nitrous Oxide Emission Reduction Protocol For Carbon Offsets Sweden – tax on the nitrogen content of synthetic fertilizers

Note: Many of the policy options and examples provided in this table are taken from the presentations made during the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions, held in October 2014, in submissions from Parties and in relevant technical literature. Detailed information on this meeting is available at <<http://unfccc.int/bodies/awg/items/8420.php>>. Other sources are included in the list of references, provided at the end of this paper.

Table 6
Policy options menu for the mitigation of fluorinated gas emissions

<i>Select policy options</i>	<i>Select specific examples</i>
Sector: industrial processes	
Creation of market conditions for technology development, transfer and deployment of climate-friendly alternatives to high global warming potential (GWP) hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)	<ul style="list-style-type: none"> Denmark – taxes on fluorinated gases (F-gases) combined with a ban European Union (EU) – law to promote eco design of air conditioners used in small motor vehicles and the F-gas regulation that covers all other applications in which F-gases are used Norway – PFC regulations (phase-out and replacement) Spain – tax on F-gases including SF₆ and PFCs, national tax on F-gases and voluntary agreements with industrial sectors, taxes on F-gases combined with a refund for recovered or eliminated gas PFC Reduction/Climate Partnership for the Semiconductor Industry (United States Environmental Protection Agency, World Semiconductor Council)
Responsible management of existing equipment and better design of future equipment in order to minimize leaks	<ul style="list-style-type: none"> EU – EU directive on mobile air-conditioning bans the use of vehicle refrigerants; EU directive on recycling of waste from electronic equipment containing F-gases; European Management and Audit Scheme for organizations; the Green Public Procurement voluntary instrument; a project (with funding of EUR 5 million) to address the waste treatment of HFCs in the Asia-Pacific region Japan – Act on the rational use and proper management of HFCs United States of America – Voluntary Aluminum Industrial Partnership Voluntary initiatives: Consumer Goods Forum Board Resolution on Sustainable Refrigeration
Encouraging uptake of climate-friendly alternatives to reduce reliance on high-GWP HFCs	<ul style="list-style-type: none"> China – HFC phase-down programmes, including capacity-building to collect and report HFC emissions data; mobilization of financial resources for further actions to phase-down HFCs; research, development and deployment of environmentally sound, effective

<i>Select policy options</i>	<i>Select specific examples</i>
	<p>and safe alternatives and technologies; and multilateral agreements to phase down HFCs</p> <ul style="list-style-type: none"> • EU – legislation on F-gases from 2006, to be superseded by new legislation from 1 January 2015 that introduces more stringent measures (promotion of low-GWP alternatives to high-GWP HFCs) • United States of America – promoting safer low-GWP alternatives to HFCs; providing funding opportunities for HFC alternatives; banning some HFCs; including F-gases in emission reduction targets • Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants – projects to support the preparation of HFC inventories, the establishment of standards, and the implementation of demonstration projects, as well as capacity-building activities

Note: Many of the policy options and examples provided in this table are taken from the presentations made during the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions, held in October 2014, in submissions from Parties and in relevant technical literature. Detailed information on this meeting is available at <<http://unfccc.int/bodies/awg/items/8420.php>>. Other sources are included in the list of references, provided at the end of this paper.

VII. Mobilization and provision of means of support

A. Institutions, arrangements and approaches to finance, technology transfer and capacity-building in four thematic areas with high mitigation potential

109. This chapter summarizes the information provided by Parties at the TEMs and in their submissions in relation to the mobilization and provision of means of support in the four thematic areas covered in this technical paper. In this chapter, common considerations related to institutions, arrangements and approaches to finance, technology and capacity-building are also summarized. Specific activities in the four thematic areas in relation to finance, technology transfer and capacity-building are provided in chapters VII.B–D below.

110. Financial resources, technology transfer and capacity-building are central to achieving significant progress in the development and implementation of mitigation actions in all thematic areas with high mitigation potential, including land use, urban environments, CCUS and non-CO₂ GHG emissions. Support efforts that are scalable, replicable and innovative and leverage complementary funding lead to the most effective and successful outcomes in terms of emission reductions and generating significant sustainable development and adaptation co-benefits.

111. At the TEMs held in June and October 2014, participants noted the need to integrate and mainstream the discussion on access to means of support (i.e. financial resources, technology transfer and capacity-building) in the dialogue between governments and support institutions on the establishment of enabling environments for the provision and implementation of such means by developing countries. Participants stressed that national comprehensive strategies, regulations and plans are instrumental to facilitate the work of international support institutions and the engagement of the private sector in terms of financial support, technology transfer and capacity-building. They also stressed that the NAMAs that developing countries could develop in the relevant thematic areas could constitute a first step in identifying the needs and requests for adequate and targeted financial support for implementation. Examples of successful matching of means of support already exist, conducted through a range of mechanisms including, for example, the

NAMA registry.²⁹ However, lessons learned from the implementation of the NAMA registry should be taken into account, especially with regard to approaches used to match needs and support options.

112. A number of institutions, organizations and partnerships support action in the areas of land use, urban environments, CCUS and non-CO₂ GHG emissions. This includes both institutions that are under the UNFCCC, and other institutions, such as United Nations agencies and partnerships.

113. Under the UNFCCC, several institutions exist to provide means of support to enhance action on climate change by developing countries. The GCF, the GEF, the TEC and the CTCN support developing countries' efforts to scale up mitigation and adaptation action. The Adaptation Committee and the Adaptation Fund also contribute to enhancing adaptation action. A short overview of the institutions under the UNFCCC and a brief description of their programmes, including some information provided by them during the TEMs, is presented in table 7 below.

Table 7
UNFCCC support institutions

<i>Organization</i>	<i>Programme/support</i>
Technology Executive Committee (TEC)	The TEC, as a policy component of the Technology Mechanism, provides technology analysis and policy advice and promotes partnerships by bringing stakeholders together. To date, the TEC has: analysed the success factors of technology needs assessments (TNAs); provided information on the possible integration of TNA processes with nationally appropriate mitigation actions (NAMAs) and national adaptation plans; and promoted the use of the technology road map as a planning tool. See < http://unfccc.int/ttclear/pages/tec_home.html >
Climate Technology Centre and Network (CTCN)	The CTCN began operating in 2013. It is hosted by the United Nations Environment Programme, as the leader of the consortium of partner organizations. Its mission is to stimulate technology cooperation and enhance technology development and transfer. The CTCN operates based on the direct requests of developing countries regarding the preparation and implementation of technology actions. See < http://www.unep.org/climatechange/ctcn/ >
Green Climate Fund (GCF)	Parties decided to establish the GCF in 2010 in Cancun, Mexico, in order to create a central global investment vehicle for climate change finance. The mandate of the GCF is to promote low-emission and climate-resilient development in eligible developing countries, and the GCF will have thematic funding windows for adaptation and mitigation as well as a private-sector funding facility. The GCF is guided by the principles and provisions of the Convention Of particular relevance to the technology expert meetings and relevant support is the GCF readiness work programme, which includes activities such as: the establishment of national focal points; support for strategic frameworks, including NAMAs; the designation of implementing institutions; and the development of an initial pipeline of project proposals. See < http://www.gcfund.org/home.html >

²⁹ Submission from the Independent Alliance of Latin America and the Caribbean to the ADP, 18 October 2014.

<i>Organization</i>	<i>Programme/support</i>
Global Environment Facility (GEF)	The GEF was created in 1991 to support the implementation of the Rio Conventions. It has three main priorities related to the UNFCCC: (i) facilitating innovation and technology transfer; (ii) catalysing systematic impacts through a multi-area focus; and (iii) assisting countries to build capacity for the implementation of the Convention and their relevant obligations, such as intended nationally determined contributions and NAMAs. There are three climate-related trust funds established under the GEF to address these priorities: the GEF Trust Fund, the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). See: GEF: < http://www.thegef.org/gef/ >; LDCF: < http://www.thegef.org/gef/LDCF/ >; SCCF: < http://www.thegef.org/gef/sccf/ >

114. The TEC and the CTCN are the two arms of the Technology Mechanism which was established in 2010 to facilitate enhanced action on technology development and transfer to support action on mitigation and adaptation in order to achieve the full implementation of the Convention. The 2014–2015 workplan of the TEC covers a number of areas of work, including technology needs assessments (TNAs), enabling environments and barriers, climate technology finance, and technologies for adaptation (in agriculture and water management) and for mitigation.

115. The CTCN includes a network of 20 institutions and has a budget of USD 15 million for 2015. The CTCN has provided assistance to around 60 developing countries to date. Its operations are driven by developing country requests (currently around 20 requests) for technical assistance submitted by countries through their national designated entities. In relation to the TEMs on land use, the CTCN has already received three requests: (i) transfer of technology and local capacity-building for monitoring and protection of mangrove forests in coastal zones in Honduras; (ii) establishment of a national network for monitoring biodiversity in Chile; and (iii) establishment of a unified system for monitoring of national efforts on adaptation to measure impacts and assess benefits of adaptation in Colombia. In addition, the CTCN is currently assisting Colombia to develop alternatives to landfill disposal of solid waste by installing a mechanical biological pilot treatment plant in Cali.

116. At the United Nations Climate Summit held in New York, United States of America, on 23 September 2014, USD 2.3 billion was pledged by many governments towards the GCF’s initial capitalization, with more funds expected to be pledged by November 2014. At the TEMs held in 2014, many developing countries urged developed countries to ensure that the initial resource mobilization of the GCF reaches a significant scale to address the needs and challenges faced by developing countries and to enable them to enhance their pre-2020 ambition. The GCF concluded its first Pledging Conference on 20 November 2014 in Berlin, Germany, with governments pledging a total of up to USD 9.4 billion equivalent.

117. Several proposals that were deemed important for the success of the GCF were put forward at the TEMs, including: (i) the identification by developing countries of their immediate needs in 2015 and 2016, and also for the remainder of the pre-2020 period, in relation to the thematic areas that are relevant to them; and (ii) linking the future role of the GCF to the pre-2015 agreement.

118. Since 1991, the GEF has provided USD 13.5 billion in grants and leveraged USD 65 billion in co-financing for 3,900 projects in more than 165 developing countries to assist the implementation of all three Rio Conventions. Under its strategy for the period

2015–2018, namely the sixth replenishment of the GEF Trust Fund, USD 4.3 billion has been pledged to support the implementation of multilateral environmental agreements, including USD 1.26 billion for the climate change focal area.

119. In addition to the UNFCCC institutions, there are many United Nations and other international organizations and partnerships that aim to provide means of support in one or more of the thematic areas covered in this technical paper. An overview of a selection of international organizations and partnerships is presented in table 8 below and in documents FCCC/TP/2014/13/Add.1–4.

Table 8

Overview of a selection of United Nations and other international organizations and partnerships that provide means of support for enhanced mitigation efforts in a broad number of areas, including land use, urban environments, carbon dioxide capture, use and storage, and non-CO₂ greenhouse gas emissions

<i>International organizations/partnerships</i>	<i>Climate-related programmes</i>
United Nations Environment Programme (UNEP)	UNEP acts as a catalyst, advocate, educator and facilitator to promote the wise use and sustainable development of the global environment. UNEP’s work encompasses: assessing global, regional and national environmental conditions and trends; developing international and national environmental instruments; and strengthening institutions for the wise management of the environment. See < http://www.unep.org/ >
United Nations Human Settlements Programme (UN-Habitat)	UN-Habitat’s mission is to promote socially and environmentally sustainable human settlements development and the achievement of adequate shelter for all. UN-Habitat has therefore developed a holistic and global approach towards urbanization that embraces much more than just technical considerations. Through its global advocacy platforms such as the World Urban Campaign and its events, including the World Urban Forum, UN-Habitat also establishes think tanks and networks that enable governments, experts, civil society groups, multilateral organizations, the private sector, and all other development partners to jointly address present and future urban predicaments The Greener Cities Partnership (2014–2016) aims to mainstream environmental perspectives into urban policymaking and incorporate urban perspectives into environmental policymaking, as well as highlight the local–global linkages of environmental issues. Priority areas include resilient, resource-efficient cities; sustainable transport and mobility; and waste and wastewater management. UN-Habitat has published assessment plans from over 22 countries. See < http://unhabitat.org/unep-and-un-habitat-greener-cities-partnership/ >
World Bank Group (WB)	WB has made tackling climate change part of its mission, helping recipient countries identify mitigation opportunities and the linkages with co-benefits for resilience, adaptation, sustainable development and growth. WB remains fully committed to scaling up support to help identify, develop and finance actions with high mitigation potential for the benefit of low-carbon and climate-resilient development. See < http://www.worldbank.org >
Food and Agriculture Organization of the United Nations	FAO has three main goals: the eradication of hunger, food insecurity and malnutrition; the elimination of poverty and the driving forward of economic and social progress for all; and the sustainable management and utilization of natural resources, including land, water, air, climate and genetic resources

<i>International organizations/ partnerships</i>	<i>Climate-related programmes</i>
Nations (FAO)	<p>for the benefit of present and future generations. FAO's overall programme of work is funded by assessed and voluntary contributions. The total FAO budget planned for 2014–2015 is USD 2.4 billion. FAO states that climate change is central to achieving a sustainable future for the planet's growing population, and food security must lie at the heart of that effort</p> <p>Examples of FAO's work relevant to land use include a multi-donor project, the Livestock, Environment and Development Initiative, aimed at developing and promoting ecologically sustainable livestock production strategies and practices while reducing poverty. FAO can assist in monitoring climate change effects on livestock, provide early warnings in various climatic zones, and assist countries in adapting livestock policies. FAO is also involved in the implementation of the UN-REDD Programme, a collaborative initiative on reducing emissions from deforestation and forest degradation in developing countries, and Climate-Smart Agriculture activities together with other United Nations and partner organizations. See <http://www.fao.org/></p>
International Energy Agency (IEA)	<p>The IEA is an autonomous, intergovernmental organization which works to ensure reliable, affordable and clean energy for its 28 member countries and beyond. IEA's four main areas of focus are: energy security, economic development, environmental awareness and engagement worldwide. It is at the heart of the global dialogue on energy, providing authoritative statistics, analysis and recommendations</p> <p>Through its broad range of multilateral technology initiatives (Implementing Agreements), IEA enables member and non-member countries, businesses, industries, international organizations and non-governmental organizations to share research on breakthrough technologies, fill existing research gaps, build pilot plants, and carry out deployment or demonstration programmes across the energy sector. There are currently 41 Implementing Agreements covering all aspects of energy supply and demand, as well as technology transfer, knowledge transfer and modelling. IEA participates in and supports the Technology Executive Committee and the Climate Technology Centre and Network. See <http://www.iea.org/></p>
World Business Council for Sustainable Development (WBCSD)	<p>WBCSD brings together over 200 members across regions and sectors and is a key player in ensuring the active and engaged role of the private sector in climate change action. Building on the longer-term WBCSD Vision 2050 study, the WBCSD Action 2020 initiative provides a forum for private-sector support of sustainable development up to 2020 and beyond</p> <p>WBCSD supports action in relation to sustainable cities, electrifying cities towards zero emissions, energy efficiency in buildings, low-carbon electrification of remote areas and resilient power systems. For example, WBCSD's Urban Infrastructure Initiative is a platform that aims to further accelerate ambitious climate-related measures in urban environments by bringing business and city leaders together. See <http://www.wbcsd.org/></p>
Local Governments for Sustainability (ICLEI)	<p>ICLEI is an association of over 1,000 metropolises, cities and urban regions dedicated to sustainable development. Its mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability with a specific focus on environmental conditions through cumulative local actions. Its Bonn Center for Local Climate Action and Reporting – carbon<i>n</i> aims to expedite the transformation of cities into low-carbon communities. ICLEI works with a number of</p>

<i>International organizations/ partnerships</i>	<i>Climate-related programmes</i>
	<p>programmes that provide technical support for subnational action, namely: the Green Climate Cities programme (<www.iclei.org/gcc>); the Global Protocol for Community-Scale Greenhouse Gas Emissions (<www.ghgprotocol.org/city-accounting>); HEAT+, a greenhouse gas (GHG) quantification and monitoring tool (<http://heat.iclei.org>); the Urban Low Emission Development Strategies project (<www.urban-leds.org>); the Procura+ Campaign for green public procurement (<www.procuraplus.org>); the Local Renewables Initiative and Conferences (<www.local-renewables-conference.org>) and facilitates the global advocacy of local and subnational governments under the Local Government Climate Roadmap (<www.iclei.org/climate-roadmap>). See <http://www.iclei.org/></p>
<p>Global Leadership on Climate Change (C40)</p>	<p>C40 is a network of world megacities committed to addressing climate change. Acting both locally and collaboratively, C40 Cities is having a meaningful global impact in reducing both GHG emissions and climate risks. C40 offers cities an effective forum where they can collaborate, share knowledge and drive meaningful, measurable and sustainable action on climate change. See <http://www.c40.org/></p>
<p>Clean Energy Solutions Center (CESC)</p>	<p>CESC is an initiative of the Clean Energy Ministerial, and works in partnership with UN-Energy. It provides a web portal for decision makers in the area of clean energy to access, at no cost, remote expert assistance to support clean energy policy design and implementation. CESC also provides best practice resources, data and tools, policy reports and other training forums focused on supporting decision- and policymaking in relation to clean energy. See <https://cleanenergysolutions.org/></p>
<p>Sustainable Energy for All (SE4All)</p>	<p>In partnership with more than 80 countries and a number of international and private-sector institutions, SE4All supports the achievement of universal access to modern energy by 2030 and a doubling of the share of renewable energy and energy efficiency gains globally. To achieve that outcome, SE4All supports: gap analyses; the development of national action plans focused on enabling environments and capacity-building; and catalysing investment and implementation. See <http://www.se4all.org/></p>
<p>Carbon Sequestration Leadership Forum (CSLF)</p>	<p>CSLF, established in 2003, is a ministerial-level international climate change initiative focused on the development of improved cost-effective technologies for the separation and capture of carbon dioxide for its transport and long-term safe storage. The mission of CSLF is to facilitate the development and deployment of such technologies via collaborative efforts that address key technical, economic and environmental obstacles. CSLF also promotes awareness and the legal, regulatory, financial and institutional environments conducive to such technologies. See <www.cslforum.org/></p>
<p>Global Carbon Capture and Storage Institute (GCCSI)</p>	<p>GCCSI, established in 2009, is an independent, not-for-profit company. The Institute accelerates the development, demonstration and deployment of carbon dioxide capture and storage (CCS) globally through knowledge-sharing activities, fact-based influential advice and advocacy, and work to create favourable conditions to implement CCS. See <www.globalccsinstitute.com/></p>

<i>International organizations/partnerships</i>	<i>Climate-related programmes</i>
Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC)	<p>Since CCAC's launch in February 2012, its partners have been working to identify quick-start actions that will ensure rapid delivery of scaled-up climate and clean air benefits by reducing key short-lived climate pollutants (SLCPs), including methane, black carbon and hydrofluorocarbons.</p> <p>The partnership launched a number of initiatives addressing non-CO₂ GHG emissions and seeks to promote near-term reductions at a substantial scale worldwide, and to engage high-level stakeholders. Such initiatives include: Mitigating SLCPs from Municipal Solid Waste; Promoting HFC Alternative Technology and Standards; Accelerating Methane and Black Carbon Reductions from Oil and Natural Gas Production; and Addressing SLCPs from Agriculture. See <http://www.ccacoalition.org/></p>

B. Financial resources

120. A number of institutions and international organizations provide financial support through their various actions, initiatives and programmes. For example, the World Bank launched a range of mitigation initiatives and programmes to assist developing countries in relation to the thematic areas discussed in this technical paper (see spotlight box 11 below). In addition to the initiatives implemented by the World Bank, other initiatives and programmes developed by a number of international organizations to improve access to financial resources were discussed during the TEMs or were put forward in the submissions from Parties and stakeholders.

121. The private sector has an important role to play in the mobilization and provision of financial resources, and a variety of actors and mechanisms are involved in the mobilization of large-scale funding for climate change action. This requires enhanced coordination among governments, the private sector, local and indigenous communities, civil society and other stakeholders through various programmes and partnerships.

122. To that end, several Parties have created new financial instruments and partnerships for mitigation options to unlock private-sector and pension-fund finance for developing economies. For example, the Global Innovation Lab for Climate Finance, launched by Germany, the United Kingdom of Great Britain and Northern Ireland and the United States of America, aims to bring together the public and private sectors from both developed and developing countries to design, stress-test and pilot instruments and approaches targeted at catalysing private investment in climate-friendly, low-carbon projects and infrastructure in developing countries. Another similar instrument is the Agricultural Supply Chain Adaptation Facility.³⁰

123. In this context, it was also noted that the CDM has raised at least USD 138 billion,³¹ probably considerably more, mostly from private-sector sources. The invitation from the ADP to Parties to use certified emission reductions from the CDM as means of contributing to closing the pre-2020 gap was also mentioned as an opportunity to further accelerate pre-2020 ambition, including as a ready-made solution for attracting additional financing.

³⁰ Submission from the European Union to the ADP, 2014, 20 May 2014.

³¹ FCCC/KP/CMP/2013/5 (Part I).

Spotlight box 11

World Bank: examples of climate-related initiatives

The World Bank Group and the World Economic Forum together with their partners are creating a **Carbon Pricing Leadership Coalition** as a ‘readiness platform’ to assist both national and subnational governments as well as the private sector to work together to implement existing carbon pricing policies to better manage investment risks and opportunities; and enhance cooperation to share information and expertise on and lessons learned in developing and implementing carbon pricing through ‘readiness’ platforms.^a

The World Bank’s **Creditworthiness Programme** aims to assist cities in developing countries in their efforts to plan low-carbon, climate-smart development and access low-cost financing to implement the plans. The initiative aims to support 300 of the largest developing country cities in the next four years and has so far covered 66 of those cities. It offers a comprehensive suite of tools and activities tailored to cities’ specific needs and their level of progress in relation to their climate-smart development path, ranging from support for preparation of greenhouse gas (GHG) inventories and assessments to low-carbon investment planning and financing solutions. For example, through the programme, Lima was able to achieve creditworthiness in five years, and was able to raise USD 90 million from local banks to invest in the bus rapid transit (BRT) system. The BRT system is improving the quality of service to the citizens of Lima and health conditions in the city, while also helping to reducing the city’s GHG emissions. Other World Bank initiatives include the Low-Carbon, Liveable Cities Initiative.^b

The World Bank’s activities provide financial resources to mitigation projects in developing countries through financial instruments such as the commitments through the replenishment of the International Development Association to support at least 25 countries to implement multisectoral plans and investments for managing climate and disaster risk that are currently in development. In addition, the World Bank’s **Carbon Partnership Facility** focuses on scaling up its work through the clean development mechanism on, inter alia, solid waste management and biogas.^c

The World Bank’s **Pilot Auction Facility for Methane and Climate Change Mitigation** (PAF) envisages the use of auctions to allocate scarce public resources in an efficient manner for maximum impact and efficiency. Since the market price for emission reductions collapsed in 2011, around 1,200 mitigation projects were ‘stranded’ with a total emissions reduction potential of 0.9 Gt CO₂ eq until 2020. To sustain their methane abatement, PAF guarantees a floor price for future emission reductions. If the market prices increase, the participant has the option to forfeit the price guaranteed at no penalty. Multiple auction rounds will target different sectors, countries and auction approaches. The initial budget is USD 100 million. This pilot initiative could be replicated on a larger scale by institutions such as the Green Climate Fund.^d

Sources:

^a <<http://www.worldbank.org/en/news/feature/2014/09/22/governments-businesses-support-carbon-pricing>>.

^b <<http://www.worldbank.org/en/topic/urbandevelopment>>.

^c Submission from the World Bank Group to the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP), October 2014.

^d ADP technical expert meeting on non-CO₂ greenhouse gas emissions; presentation by the World Bank Pilot Auction Facility, October 2014.

124. In terms of financial support for the specific thematic areas, support for the promotion of sustainable urban environments is provided by various institutions, including the World Bank and the GEF. More specifically, support for integrated low-emission urban systems is one of the areas eligible for funding provided by the GEF. There is a new window under the GEF 6 replenishment (for the period 2014–2018) for Sustainable Cities, an integrated pilot approach, which will mobilize USD 100 million in grants from the GEF to showcase several innovative cities and ways of replicating and scaling up their efforts. This approach recognizes the significant role of cities in sustainable development, and aims to help cities address the drivers of mega-trends of global environmental degradation in an integrated manner. In addition, the Least Developed Countries Fund and the Special Climate Change Fund are also available to support projects related to resilience in cities.

125. While the GCF is undergoing its initial resource mobilization process, its business model framework includes areas that are highly relevant to urban environments. Support is available for the design and planning of cities to enable them to undertake mitigation and adaptation measures; for example, energy efficiency in buildings and appliances and low-emission transport measures. A number of other initiatives and programmes aim to provide support to local actions (see spotlight box 12 below).

Spotlight box 12

A selection of initiatives to support actions by cities and subnational authorities

- The European Commission launched the **Covenant of Mayors** in 2008 to endorse and support the efforts of local authorities in the implementation of sustainable energy policies. To date, more than 623 cities in Europe with populations between 50,000 and 8 million people have signed the Compact of Mayors. See: <http://www.covenantofmayors.eu/index_en.html>.
- The **Resilient Cities Acceleration Initiative** is supported by several international organizations with the objective of accelerating the design and implementation of integrated strategies that strengthen the resilience of urban systems, thereby reducing the vulnerability of cities and inhabitants to climate and disaster risks and ensuring sustainable, equitable urban development. See: <<http://www.un.org/climatechange/summit/action-areas/resilience-resilient-cities-acceleration-initiative/>>.
- **Cities initiative to reduce short-lived climate pollutants:** the mayor of the city of Johannesburg presented an initiative undertaken in collaboration with 30 cities to exchange knowledge and views with the aim of reducing short-lived climate pollutants from solid waste. The target is to reach the participation of 1,000 cities. See <<http://www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/05/INDUSTRY-PR.pdf>>.

126. The Food and Agriculture Organization of the United Nations (FAO), the World Bank and the GEF are actively engaged in mitigation work in land use, and the GCF has also initiated some work in this area. In particular, during the TEM on land use, FAO suggested that NAMAs in the agriculture sector could be aligned with overall agricultural development and food security priorities, built upon evidence of the potential for capturing mitigation co-benefits from actions that generate food security and adaptation benefits, and linked to monitoring and financing mechanisms already operating in the agriculture sector, such as national GHG inventories.³²

127. The GEF 6 Sustainable Forest Management Strategy (2014–2018) aims to assist governments to address their specific technical and institutional capacity challenges in

³² Submission from FAO to the ADP, 2014.

order to achieve multiple environmental benefits from improved forest management.³³ The strategy is based on a simplified incentive programme that makes USD 700 million available for governments to maintain, restore and manage their forests more sustainably by directly addressing the drivers of deforestation and forest degradation with special consideration given to the least developed countries and the small island developing States.

128. Access to finance and capital is a key barrier for CCUS projects, which was clearly recognized by both developed and developing countries during the TEM. The lack of understanding of CCUS in the financial sector also negatively affects access to the relevant finance. To address this barrier, the IEA Carbon Capture and Storage Roadmap suggests that governments, industry and the finance community work together to develop a framework that would encourage adequate CCS investment.

129. For developing countries, access to finance for CCS has been made, or is in principle available, through the following channels: the CDM; the Carbon Capture and Storage Fund under the Clean Energy Financing Partnership Facility administered by the Asian Development Bank; the World Bank Carbon Capture and Storage Capacity Building Trust Fund; the Global Carbon Capture and Storage Institute Capacity Development Programme; and the Carbon Sequestration Leadership Forum Capacity Building Fund. A 2011 World Bank report suggests that NAMAs could provide a framework for combining options for CCS support, bringing together domestic financing and policy support with international support through climate finance (World Bank, 2011).

130. In relation to non-CO₂ GHG emissions, the Multilateral Fund for the Implementation of the Montreal Protocol is a good example of an effective mechanism for the financing of projects to address ozone-depleting substances.³⁴ As part of the implementation of the provisions of the Montreal Protocol, many developing countries have prepared and are implementing national hydrochlorofluorocarbon (HCFC) phase-down management plans, which contain a degree of uncertainty as regards the possible conversion to low-GWP solutions in all sectors. This was carried out with support from the Multilateral Fund and its bilateral and implementing agencies.

131. The United Nations Industrial Development Organization assists countries in many ways to lower HFC consumption and the number of solutions and examples of available and lower-cost technologies to address HFCs is growing. However, it is also recognized that the current technological solutions do not yet allow for the complete avoidance of the use of high-GWP HFCs in some specific cases, namely in countries that experience high ambient temperature conditions. An example of project-level initiatives financed by the EU is provided in spotlight box 13 below.

Spotlight box 13

Provision of support by the European Union to address fluorinated gases

To address barriers related to the reduction of fluorinated gases, the European Union is financing two projects coordinated by the United Nations Environment Programme (UNEP). The first is a EUR 3 million project to maximize the climate benefits of the phase-out of hydrochlorofluorocarbons under the Montreal Protocol funded through the Multilateral Fund, with the aim of reducing the use of high global warming potential hydrofluorocarbons as replacements for ozone-depleting substances, especially in Africa and the Pacific islands. The second is a EUR 5 million project implemented in the Asia-Pacific region (Bangladesh, Cambodia, Malaysia, Sri Lanka, Pakistan and Viet Nam). The European Union is also funding the UNEP pilot projects and is involved in the Climate and Clean Air Coalition to Reduce Short-Lived Climate

³³ <http://www.thegef.org/gef/sites/thegef.org/files/publication/GEF_Forests-2014.pdf>.

³⁴ Submission from the European Union to the ADP, 14 October 2014.

Pollutants, while some member States are supporting know-how transfer in relation to alternative technologies.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions; presentation by the European Union, October 2014.

C. Technology transfer

132. Parties reiterated during the TEMs the important role of developed countries in promoting, facilitating and financing the transfer of technology in relation to climate change mitigation and adaptation and related know-how to developing countries. More specifically, they emphasized the need for expanded efforts to support research, development and demonstration of innovative technologies that are aligned with national and regional circumstances, and to enhance local capacities to develop such technologies. South–South cooperation on technology development and transfer was also emphasized in this context.

Spotlight box 14

Technology demonstration projects by the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC)

Under CCAC's hydrofluorocarbon (HFC) Initiative, its coalition partners are currently supporting the development of HFCs inventories and studies, information exchange on policy and technical issues, demonstration projects to validate and promote climate-friendly alternatives and technologies, and various capacity-building activities to disseminate information on emerging technologies and practices to transition away from high global warming potential (GWP) HFCs and minimize HFC leakages. Six inventories on HFC use in developing countries are currently under way or have already been completed; seven more countries will be supported to prepare HFC inventories. Three technology workshops or conferences addressing the availability and emergence of alternative technologies and practices have been held so far. Case studies on alternatives to HFCs have been prepared and three projects have been approved to demonstrate emerging low-GWP HFC alternative technologies in Chile, India and Jordan, as well as a technology feasibility study in the Maldives. The aim of the demonstration projects is to test and validate the new technologies, with a view to enabling their wider adoption globally, particularly in developing countries.

Source: Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on non-CO₂ greenhouse gas emissions; presentation by CCAC, October 2014, <<http://www.unep.org/ccac/Initiatives/HFCs/tabid/794344/Default.aspx#sthash.bsxP4ajA.dpuf>>.

133. The TNA reports submitted by Parties under the UNFCCC contain valuable information on the technologies that developing country Parties have prioritized for enhanced action on mitigation and adaptation to climate change. The third synthesis of TNAs, prepared by the UNFCCC secretariat in 2013, concludes that the land-use sector is the highest prioritized sector by Parties for mitigation technology needs, while the

agriculture sector is identified as the highest priority for adaptation technology needs.³⁵ The TNAs also identified barriers to technology transfer in land use, including finance, policy and regulatory frameworks, and market barriers. Almost all areas of climate finance discussed above are relevant, to a certain degree, to facilitating technology transfer to developing countries. Some international organizations and initiatives aimed at capacity-building and technology transfer implemented by Parties are highlighted in spotlight box 14 above.

D. Capacity-building

134. Capacity-building and technical assistance for developing countries in relation to climate change mitigation and adaptation are important in terms of strengthening institutional capacity, promoting knowledge, and information-sharing and fostering enabling environments, including by creating climate change action frameworks and related measurement, reporting and verification (MRV) arrangements. Different groups of stakeholders, including local communities and actors on the ground in all four thematic areas of the TEMs would greatly benefit from development of climate change action frameworks and related MRV arrangements to support transfer of knowledge and awareness, including through information management platforms.

135. In particular, information management platforms could contribute to increasing the dissemination of knowledge and information, sharing good practices and lessons learned, as well as raising awareness on climate change related issues among stakeholders. Such platforms could allow for greater visibility of successful, cost-effective actions on climate mitigation and facilitate their replication and scaling up.

136. South–South cooperation is seen as an important opportunity for accelerating climate actions. There are significant benefits to collaborating with other countries in the same region or stage of development because of the similarity in the national circumstances. Developing countries often share the same challenges in policy implementation, for example with regard to land-use policies, natural resource management, land tenure, and needs for equipment and infrastructure. The benefit of South–South cooperation is that actions undertaken in such a context can be cost-effective and provide an opportunity for direct information exchange, and for building networks to develop effective solutions to shared problems.

137. Capacity-building forms an integrated part of most programmes, initiatives and projects undertaken by the institutions and partnerships listed in the chapter above. For example, capacity-building, including institutional strengthening, is often integrated into World Bank activities at the project level, through instruments such as the Energy Sector Management Assistance Program, which has supported countries to assess opportunities for economy-wide emissions reduction. In addition, the Climate Investment Funds have integrated strategic planning and investment processes across their programmes.³⁶

138. Some of the highlighted capacity-building needs in the land-use sector include preparing GHG inventories, strengthening geospatial information systems and putting in place consistent monitoring methods. Mitigation actions in the forestry sector refer to the protection of carbon stocks in existing ecosystems, in particular forests, but also coastal wetlands, mangroves and peatland. In recent years, international REDD-plus readiness initiatives have been launched to support countries in identifying the most suitable set of policy measures, technology transfer and capacity-building actions to reduce emissions

³⁵ The third synthesis of TNAs is available at <http://unfccc.int/resource/docs/2013/sbsta/eng/inf07.pdf>.

³⁶ Submission from the European Union to the ADP, 14 October 2014.

from deforestation and forest degradation (e.g. the UN-REDD Programme, the Forest Carbon Partnership Facility, Norway's International Climate and Forest Initiative and Germany's REDD Early Movers Programme). Depending on the national circumstances, these initiatives usually contain capacity-building components which directly address the drivers of deforestation and forest degradation, such as promotion of energy-efficient cookstove programmes to reduce firewood consumption, or integrated forest fire prevention systems.

139. The discussions during the TEM on CCUS and the submissions received from Parties in 2014 in relation to the four TEMs suggest that at the international level, many initiatives have been launched to actively share information, knowledge, skills and technology in relation to CCS among stakeholders. During the TEM on CCUS, several delegates expressed the view that existing institutions under the UNFCCC, in particular the TEC and the CTCN, need to be actively engaged in assisting countries to scale up the development and deployment of CCUS by providing information thereon, as well as by supporting the participation of Parties not included in Annex I to the Convention in existing international partnerships.

140. The countries and organizations that have indicated the importance of sharing lessons learned (from successes and failures) and capacity-building include Canada, the European Union and Norway, all of whom are willing to disseminate information and lessons learned through international forums such as the Carbon Sequestration Leadership Forum and Clean Energy Ministerial, bilateral dialogue platforms, IEA and the Global CCS Institute.³⁷

141. The trust funds operated by the Asian Development Bank and the World Bank support developing countries to develop both the technical and institutional knowledge and other forms of capacity necessary to enable the deployment of CCS technologies. The trust funds support, inter alia, pilot and demonstration projects in China, Indonesia, Mexico and South Africa (see spotlight box 15 below).

Spotlight box 15

Capacity-building activities aimed at the promotion of carbon dioxide capture and storage

The Asian Development Bank (ADB)'s Energy Policy 2009 supports the promotion of carbon dioxide capture and storage (CCS) as a greenhouse gas mitigation option, wherever appropriate. ADB established a CCS Fund in partnership with the Global CCS Institute in 2009 to implement strategies to support developing countries to develop CCS projects. The Fund is aimed at capacity-building activities, scoping analyses and capital grants to be combined with ADB's lending products. Support activities for governments, the private sector and research institutes have been conducted, for example in China, India, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam.

Source: Presentation by ADP on Contributing to Enabling CCS Demonstration in Developing Asia. 2014 Available at:
<<http://www.csforum.org/publications/documents/seoul2014/Seiler-Workshop-Seoul0314.pdf>>.

³⁷ Submissions from Canada and Norway to the ADP, 2014.

VIII. Possible next steps to support action in relation to four thematic areas with high mitigation potential

A. Cross-cutting suggestions

142. A range of specific suggestions to support the realization of mitigation ambition in four thematic areas were examined at the TEMs held in June and October 2014 and proposed during the discussions at the TEMs and in submissions from Parties in 2014. The suggestions included proposed actions by Parties, UNFCCC institutions and the secretariat. Participants discussed how to improve the TEM process in 2015 and beyond, and suggested continuing this process and focusing future TEMs on practical options to achieve action-oriented sustainable and lasting impacts. The suggestions made by the participants that are relevant to all four thematic areas covered in this technical paper are summarized in this chapter, while proposals that are specific to each thematic area are presented in chapters VIII.B–E below.

143. Overall, participants in the TEMs considered the discussions and sharing of lessons learned to be very positive experiences. The exchange of experiences, information and knowledge, as well as the follow-up of progress after each TEM, were recognized as important. Participants deemed the technical examination conducted in 2014 to be a critical and necessary foundation for the implementation of identified policies and options with high mitigation potential to bridge the pre-2020 gap and to prepare for the post-2015 agreement.

144. On the basis of engagement in and learning from the TEM process, Parties were encouraged to launch new and ambitious policies and actions to demonstrate concrete progress prior to and beyond 2020, and to implement those policies and actions outlined in the policy menus provided in tables 1–6 above.

145. It was highlighted by some Parties that enhancing the ambition of developed Parties was an essential first step in closing the pre-2020 gap, and that developing countries could further increase ambition on the basis of predictable finance, technology and capacity-building support.

146. In terms of the follow-up work after each TEM, Parties highlighted the valuable contribution of specialized international organizations and partnerships in following through on the actions identified in the TEM process. These organizations were encouraged to lead the process intersessionally and also to provide direct assistance to Parties, taking into account the scope of their mandates in moving this process forward towards effective implementation.

147. Parties encouraged the UNFCCC institutions to further engage in supporting mitigation actions in all thematic areas with high pre-2020 potential. To scale up deployment of actions, Parties stressed the importance of the role that the GCF would play in the future, and encouraged the TEC and the CTCN to work together with other international organizations to advance the development of identified policy options and ensure the alignment of their work to support Parties in this area. Parties also recognized the important role that the GEF has played for more than 20 years, and continues to play, in providing support to developing countries in the areas related to the TEM thematic priorities.

148. One of the suggestions was that, based on the policy options identified at the TEMs, the UNFCCC institutions could construct a pipeline of projects for future funding and technology support. In turn, the UNFCCC institutions called on Parties to provide clear instructions and guidance on the scope of assistance and types of services required from

them. In particular, representatives from the CTCN reminded participants that the work of the CTCN is carried out on the basis of specific country requests and, therefore, Parties are encouraged to identify actions with high mitigation potential in the thematic areas in their countries and use effectively the support available through the UNFCCC institutions to assist them.

149. The role of the UNFCCC was deemed important in catalysing political will and actions by Parties to realize pre- and post-2020 transformation. Namely, the UNFCCC could continue to function as a platform for action-focused discussion, facilitating dialogue between Parties, international organizations, support institutions and the private sector. Future in-depth discussions could continue to focus on successful examples, creative and innovative actions and opportunities for replication and accelerated implementation.

150. In terms of the secretariat's engagement, participants proposed updating, on a regular basis, the technical paper on the mitigation benefits of actions, initiatives and options to enhance mitigation ambition in order to include the discussions of the TEMs and the suggestions provided in the submissions from Parties. The secretariat was invited to make the technical paper a dynamic tool supported by an online web-based platform, which compiles information on policy options, country-specific policies, challenges, successes, failures and solutions discussed within the TEM process (see paras. 188–189 below).

B. Land use

151. Looking forward, the TEM participants agreed that, understandably, in many countries, land-use priorities will continue to be focused on increasing land productivity, given the increasing urban populations and food security concerns. This, however, is not necessarily incompatible with the adoption of practices that limit agricultural expansion and productive activities into carbon-rich areas (assuming that trade-offs, synergies and local contexts are taken into consideration).

152. Bilateral and multilateral channels to share scientific research, skills and expertise developed through implementing land use actions with climate benefits may support Parties in finding their particular optimum balance between adaptation, mitigation and rural development needs. In this regard, a number of existing and developing multilateral collaborations and partnerships were highlighted, particularly in forest monitoring and in the field of research on agricultural practices and climate change.

153. It was suggested that efforts be focused on those activities that have the largest mitigation potential for short-term results; for example, awareness-raising, aligning fragmented efforts, identifying land-use activities that promote mitigation and adaptation and rural development, and identifying barriers that are relatively easy to address (e.g. acquiring satellite images for land-use monitoring).

154. Several Parties called explicitly for a role for REDD-plus to enhance pre-2020 ambition. In this context, developing country Parties emphasized the need for continuing and scaled-up support, while developed country Parties highlighted their existing and ongoing bilateral and multilateral support for REDD-plus.

155. In terms of technical assistance provided to Parties, international organizations and partnerships, including FAO, World Bank and GEF, were commended for the support that they provide to countries. They were encouraged to continue their efforts to assist countries in scaling up the implementation of land-use actions with climate benefits and in adopting better land-use management practices.

C. Urban environments

156. Participants agreed that national and local governments have a mutually reinforcing relationship in incentivizing action in cities through robust, long-term regulatory frameworks and financing mechanisms. Parties were encouraged to continue to identify opportunities to develop a multilevel governance context that encourages cities and subnational authorities to accelerate low-carbon urban transformations and develop the systemic capacity necessary to scale up and replicate successes from around the globe.

157. At the TEM on urban environments and the Forum on experiences and best practices of cities and subnational authorities in relation to adaptation and mitigation, appreciation was expressed for international organizations, such as the World Bank and the United Nations Human Settlements Programme, and international partnerships, such as the C40 Cities Climate Leadership Group, ICLEI, the Low Emissions Development Strategies Global Partnership, the World Business Council for Sustainable Development, the Climate Group and others, for their efforts. These organizations were encouraged to continue to support cities in achieving creditworthiness and to facilitate demonstrations of low-carbon city transformations and scaling-up of good practices.

158. Parties greatly appreciated the dialogue during the TEM and the Forum between Parties, subnational authorities and cities, and called for continuation of this dialogue within the UNFCCC process to facilitate enhanced actions on climate change in cities and share best practices for implementation. Engaging subnational actors, as well as additional private-sector and technical agencies, could broaden and deepen the discussions on policy successes and failures.

159. Parties emphasized the need to focus discussions and related technical work on practical action and implementation rather than on potential, especially in the follow-up to the United Nations Climate Summit, held in New York, United States of America, in September 2014. Participants expressed a need for enhanced structure in the engagement of subnational authorities in the UNFCCC process.

160. The need to understand the diversity of locally designed responses to climate change, including those involving communities and citizens, and to provide recognition of such actions was underscored. It was proposed that this could be achieved through a system for the recognition of initiatives and actions by non-State actors. Some interventions specifically highlighted the need to provide access for city and subnational authorities to UNFCCC services in order to support policy implementation and the recognition of approaches developed at the subnational level. In this regard, the importance of ensuring accountability and transparency of action in a manner consistent with the requirements of the Convention was highlighted.

161. The need for enhanced interaction of the UNFCCC process with subnational authorities, potentially through future meetings, was emphasized. Parties proposed to further engage on the means and impacts of coordinating and facilitating actions at the subnational level, recognizing that the diversity of governance approaches in individual Parties requires specific approaches to be nationally determined. There was broad support for the creation, within the UNFCCC process, of a platform for practitioners to directly interact and share experiences.

162. The participants in the Forum considered the potential for establishing an action programme under the Conference of the Parties (COP) to support the integration of action through established governance structures and to guide the support work of various UNFCCC institutions. The importance of such an action programme in catalysing the development of climate targets by those subnational authorities without current targets was emphasized, in addition to the potential for enhancing existing targets.

163. The need to catalyse and incentivize action within two broad areas was identified during the TEM and the Forum on experiences and best practices of cities and subnational authorities in relation to adaptation and mitigation:

(a) At the level of subnational authorities, a means for global recognition of targets and achievements would catalyse political momentum for enhanced target-setting and implementation;

(b) At the level of on-the-ground implementation, a means of creating effective pricing of GHG emissions would encourage sustainable development and renewal of urban environments.

164. Additionally, the discussion by Parties generated suggestions as to how the UNFCCC process can help to catalyse and scale up climate actions at the city and subnational levels. These included:

(a) Establishing a formal work programme that encourages national governments to work closely with city and subnational governments to achieve mitigation objectives;

(b) Creating specific mechanisms for the participation of civil society and the private sector.

D. Carbon dioxide capture, use and storage

165. At the TEM, participants discussed the key role that national governments could play in addressing the challenges of CCS/CCUS, recognizing that the main challenges and barriers do not lie within the technology itself. Participants suggested that there is a need to go beyond justifying CCS/CCUS and initiate actions to mobilize support for further technology development and deployment. This includes supporting CCS/CCUS pilot projects, developing regulations and removing legal barriers, capacity-building, and RD&D work.

166. The creation of a stable regulatory environment coupled with an effective carbon price signal would allow the private sector to move beyond demonstration projects into at-scale deployment of existing technology, which would, in turn, encourage enhanced technology development. In this respect, the CDM was identified as a potential mechanism to create incentives for a broad range of actors.

167. It was suggested that technical institutions working on CCS/CCUS be engaged through the relevant United Nations organizations and agencies and their initiatives in promoting discussions on the critical role of clean fossil-fuel energy. Participants spoke about the need to improve understanding of the role of CCS/CCUS, and to recognize the role of CSS/CCUS in enhancing pre-2020 mitigation. To do so, some key activities were proposed:

(a) Formation of partnerships that build synergies with CCS/CCUS-related organizations;

(b) Engagement of funding mechanisms, such as the GCF, as well as other institutions under the guidance of the COP such as the TEC and the CTCN;

(c) Involvement of policymakers at the national and international levels;

(d) Establishment of an effective price signal for emission reductions or removals through taxation regimes or emissions trading.

E. Non-carbon dioxide greenhouse gas emissions

168. To intensify mitigation actions at the national level and as part of commitments to reduce non-CO₂ GHG emissions, Parties considered relevant policy options that span a wide range of sectors in which these gases originate. Parties were encouraged to announce specific national commitments and to prepare NAMAs addressing emissions from those sectors. In line with their commitments related to the provision of support, developed countries are expected to provide adequate financing for the implementation of such NAMAs.

169. In the light of the political momentum generated by the United Nations Climate Summit and the significant number of initiatives launched at the Summit targeting non-CO₂ GHGs, participants called upon Parties to accelerate the implementation of these initiatives and engage subnational actors and civil society in such work. New non-State actors could be mobilized through the expansion of existing multilateral partnerships, such as the International Solid Waste Association and the Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants (CCAC) Municipal Solid Waste Initiative, that bring together city-level partners.

170. To strengthen global cooperation, international organizations and partnerships could develop innovative solutions and expand services provided to Parties. For example, the CCAC could be used to conduct technology-neutral work on the feasibility of a HFC phase-down in countries with high-temperature ambient conditions. The European Union mentioned that it is already working, through CCAC, on know-how transfer and support for the development of technologies based on low-GWP HFCs. Existing knowledge management platforms of the partnerships with broad geographic outreach, such as CCAC and the Global Methane Initiative, could be used for intensified information exchange and sharing of good practices.

171. Given the large contribution of the agriculture sector in terms of non-CO₂ GHG emissions, Parties would benefit from seeking technical support on practices linking mitigation objectives to food security and rural development. FAO would be in a good position to provide such technical support according to the needs of Parties.

172. Participants identified the need to utilize the existing mechanisms of the CDM/JI in extending mitigation activity to a broader scale. Examples of innovative global financial mechanisms addressing non-CO₂ GHGs are the World Bank Pilot Auction Facility (see spotlight box 11 above) and Australia's Emissions Reduction Fund. Another important global solution would be the development and extended deployment of market mechanisms under the 2015 climate agreement, as experience under the Kyoto Protocol has demonstrated the capacity of such mechanisms to stimulate the private sector.

IX. Possible action by the Ad Hoc Working Group on the Durban Platform for Enhanced Action to unlock mitigation potential in the pre-2020 period

A. Overview

173. During the discussions at the contact group held during the session of the ADP in October 2014, and at the TEMs organized during the ADP sessions in March, June and October 2014, as well as in their submissions, Parties made a number of concrete proposals on how the ADP could advance its work under workstream 2. The proposals refer to the political and technical aspects of workstream 2 and reflect broad support for its

continuation in 2015 and beyond, up to 2020. A view was expressed about the need to enhance linkage between pre-2020 and post-2020 work under the ADP. Most of the proposals suggest that accelerated implementation of mitigation and adaptation actions is critical to enhancing pre-2020 ambition and to building strong political momentum for the 2015 agreement.

174. In this respect, Parties welcomed the outcomes of the United Nations Climate Summit held in New York, United States of America, in September 2014 and its significant impact on mobilizing the political will of world leaders and non-State actors and on catalysing climate action on the ground to reduce emissions and build resilience to the adverse impacts of climate change.

175. With respect to the accelerated implementation of existing commitments and actions, many Parties emphasized the need to make further progress in addressing the issues raised in decision 1/CP.19, paragraphs 3 and 4, on acceleration of the full implementation of the decisions constituting the agreed outcome pursuant to decision 1/CP.13 (the Bali Action Plan) and enhancing ambition in the pre-2020 period. They called upon all Parties to consider technical, collaborative and solutions-focused processes to identify and explore options for a range of actions that can close the ambition gap with leadership from developed countries. Developing country Parties also called for the full implementation of previous commitments made by developed country Parties under the Kyoto Protocol and the agreed outcome of the Bali Action Plan in relation to mitigation, finance, technology transfer and capacity-building.

176. With regard to the Kyoto Protocol, many Parties called for the ratification of the Doha Amendment to the Kyoto Protocol as soon as possible to allow its timely entry into force. It was noted that in order to enter into force, the Doha Amendment to the Kyoto Protocol requires ratification by 144 Parties. By mid-November 2014, only 18 Parties had ratified the amendment.

177. Many developing countries further called for developed country Parties to implement their commitments for the second commitment period of the Kyoto Protocol and their targets under the Convention without delay, and to increase such commitments to reach a level of aggregate emission reductions of at least 25–40 per cent below 1990 levels by 2020. All Parties that have not yet done so were requested to communicate an economy-wide emission reduction target or a NAMA under the Convention as soon as possible.

178. Many Parties highlighted the increasing importance and urgency of accelerated work under workstream 2 in the context of the need to close the pre-2020 ambition gap and catalyse efforts by all Parties to reverse current emission trends. Some Parties noted that workstream 2 could serve as a vehicle to constantly review the mitigation gap, identify and recommend options to close the gap, encourage countries to meet their pledges, and revise and increase them.

179. The provision of adequate financial, technology and capacity-building support was deemed essential by developing countries to enable them to implement their commitments and pre-2020 action under the Convention. To that end, the GCF, the GEF, the TEC and the CTCN were requested to enhance their efforts to support Parties, in accordance with their respective functions and mandates, to scale up mitigation action through the implementation of policy options with high mitigation potential. Some Parties specifically proposed that the TEC be more closely involved in the organization of future TEMs.

180. It was suggested by an observer organization that the Technology Mechanism could be useful in identifying existing and new potential mitigation technologies and capacity-building needs, and could assist in matching means of support and the needs for support to facilitate implementation work in developing countries. These issues could be discussed during the TEMs. There was a proposal from Parties that enhanced efforts could include

strengthening of action on REDD-plus and supporting developing countries seeking assistance for the preparation and implementation of mitigation actions through the NAMA registry. The UNFCCC support institutions were invited by some developing country Parties to report by 30 June 2015 on such enhanced efforts and the progress made in the implementation of their mandates and relevant decisions taken by the COP.

181. A group of developing country Parties urged all developed country Parties to ensure an initial resource mobilization of the GCF at a scale reflecting the needs and challenges faced by developing countries. It also urged developed country Parties to provide new, additional and predictable financing, mainly from public sources, to the GCF and the other operating entities of the Financial Mechanism, with a view to providing funding totalling USD 70 billion per year by 2016, USD 85 billion per year by 2018 and USD 100 billion per year by 2020. In this regard, biennial submissions from developed country Parties on their updated strategies and approaches for scaling-up climate finance in the period 2014–2020 could provide updated information.

182. Several proposals were made on modalities to operationalize decision 1/CP.19, paragraphs 3 and 4, including:

(a) A group of developing country Parties proposed to launch, at the beginning of 2015, an accelerated implementation mechanism (AIM) under workstream 2 of the ADP that is envisaged to work in conjunction with the revisit mechanism, aimed at increasing the pre-2020 emission reduction targets of developed country Parties, and the evaluation mechanism, aimed at identifying concrete measures for the removal of the conditions associated with these targets. It is anticipated that AIM would be informed by the relevant work undertaken by the subsidiary bodies under the Convention;

(b) Other developing country Parties proposed to launch work programmes for the period 2015–2020 on the review of the adequacy of the provision of finance, technology and capacity-building support in the pre-2020 period and on the measures, policies and actions to provide such support by developed country Parties;

(c) An observer organization proposed the implementation of a workplan for the period 2015–2017 with concrete steps to close the ambition gap through mitigation actions;

(d) The submission of information from all Parties to the COP through the secretariat on actions taken by them to implement each relevant element of paragraphs 3 and 4 of decision 1/CP.19, in order to examine and evaluate the progress made in the implementation of the elements of that decision.

B. Technical aspects of work under workstream 2

183. Specifically with respect to the TEMs, many Parties recognized that the TEMs have been a successful process for bringing together technical experts from national and subnational authorities, including cities, intergovernmental organizations, civil society, private-sector entities and cooperative initiatives, to share and explore options for a range of actions that could close the pre-2020 mitigation gap. They also recognized that as part of the technical examination process, these stakeholder groups could set even more ambitious goals and further scale up their action to assist Parties to achieve emission pathways consistent with limiting the global average temperature increase to below 2 °C or 1.5 °C above pre-industrial levels.

184. All Parties support the continuation of the technical work under workstream 2 in 2015 and beyond, up to 2020, with the expectation that this work will have a direct effect on catalysing concrete scaled-up mitigation actions at the international and national levels.

Several suggestions were made with regard to the focus of future TEMs to demonstrate continuity of the work after the TEMs in 2014, including:

- (a) Policy areas with significant mitigation potential, including new topics, such as transport, and more in-depth discussions on the topics that are already covered by the TEMs, such as energy efficiency, transportation, renewable energy, short-lived climate pollutants, cities, land use and agriculture, with a view to deepening the discussions;
- (b) Sustainable development benefits associated with certain policies, measures and actions;
- (c) Barriers and challenges to implementation, and finance, technology and capacity-building solutions available for Parties to overcome those barriers, including specific case studies on successful design, development and implementation of mitigation policies and actions;
- (d) Methodologies for quantifying costs and assessing co-benefits of mitigation actions, such as the social value of emission reductions. This could include recognition of the social and economic value of early and additional mitigation actions under the UNFCCC and translation of verified results into units of convertible financial value;
- (e) Possible finance structures and instruments for implementing mitigation policies, actions and measures, including the role of carbon markets;
- (f) Means of implementation for realizing mitigation actions, actions and measures, with potential participation by multilateral financial institutions, national financial authorities and central banks;
- (g) Options to track, follow up and continue to scale up cooperative initiatives and partnerships, including those launched at the United Nations Climate Summit;
- (h) Positive (economic, financial or monetary) incentives for Parties to act as early and as ambitiously as possible, and to consider the relationship between the promotion of early and additional mitigation actions and the recognition of such actions through incentives.

185. To advance the technical work under workstream 2 in a more effective manner, Parties made a number of proposals related to the organization of the meetings, including:

- (a) Preparing an annual calendar of TEMs or a workplan to help Parties and other participants to better prepare and plan for the meetings, with the aim of increasing participation by State and non-State actors who are working to design, implement and support mitigation policies and actions or are involved in relevant initiatives and partnerships;
- (b) Providing advance information on the meetings (at least three months prior to the meetings), including their specific topics, agenda, the names of the facilitators, and framing questions or background papers;
- (c) Calling on Parties to submit to the secretariat, on a rolling basis through the UNFCCC website, suggestions for topics and names of technical experts that could provide input into any of the TEMs;
- (d) Involving a broad range of stakeholder groups, such as Parties, subnational and local governments, civil society and the private sector, and the engagement of specialized agencies;
- (e) Proposing innovative modes of interactive participation among experts in order to examine in-depth policy options and find ways to address identified barriers to

implementation, including the use of other meeting forums to broaden the coverage of the TEMs and engage a larger audience;

(f) Organizing the regional meetings on regional-specific topics;

(g) Sharing information through the TEMs on lessons learned from the existing MRV framework, including biennial reporting, international assessment and review, and international consultation and analysis, to enrich the discussions and possibly agree on an accounting framework;

(h) Allocating the additional resources needed, including funding, to ensure broad participation from technical experts and policy practitioners from developing countries.

186. Parties also suggested that the secretariat continue to support the TEM process by preparing the following papers and documents:

(a) Technical summaries and an updated technical paper on the mitigation benefits of actions, initiatives and options to enhance mitigation ambition after the TEMs;

(b) An annual summary for policymakers, which would reflect the information shared at the TEMs for consideration by Parties and as an input to the ministerial discussions reflected in paragraph 195 below, with a view to supporting Parties to take concrete steps toward enhancing mitigation ambition;

(c) Technical papers on finance, technology and capacity-building support provided by developed country Parties during the period 1994–2014, and on pre-2020 enhanced action on adaptation;

187. Parties called on the secretariat to intensify its efforts in engaging international organizations, initiatives, partnerships and other stakeholders in supporting Parties in the follow-up work after the TEMs and to facilitate greater coherence and engagement of the UNFCCC support institutions in this regard.

188. To complement the technical paper on mitigation benefits, Parties proposed that the secretariat develop an online policy platform, to present relevant information in a centralized, searchable and easily updatable format, which should be regularly updated. This platform should be searchable by policy option, technology or finance provider and contain information on good practices, programmes, initiatives and sources of support. It should draw on existing relevant information-sharing platforms and consolidate them, and could contain the following information:

(a) Successful experiences in sectoral and cross-cutting mitigation policy implementation;

(b) Mitigation impacts, climate benefits and other co-benefits and related methodological approaches;

(c) Barriers and challenges related to implementation, including finance, technology and capacity-building, and suggestions for overcoming those barriers, including support from the UNFCCC support institutions, United Nations agencies and cooperative initiatives;

(d) Information on costs and types of financing required;

(e) Contact information on the experts, institutions and international organizations invited to the TEMs;

(f) Information currently available on the UNFCCC website on each topic covered by the TEMs, but systematized into a comprehensive, dynamic database for public use.

189. The policy platform could contribute to the creation of political momentum, facilitate information-sharing, recognition and engagement of cooperative initiatives, and provide inputs to the UNFCCC support institutions. It should serve to systematize information on existing policies, partnerships and good practices, so that Parties and non-State actors can access information that could be used to support their decisions to enhance pre-2020 climate action and identify opportunities for new cooperative actions, gaps and shortcomings in international support systems. The platform could build on the current portal on cooperative initiatives prepared by the secretariat to create a more dynamic environment for virtual collaboration and networking and real-time information updates, and could highlight and recognize successful, innovative and robust actions and commitments.

C. Continuation of activities under workstream 2 in the lead up to 2020

190. In their submissions, some Parties suggested the consideration during 2015 of the progress under workstream 2 and making recommendations on any follow-up arrangements for the effective extension of this work between 2016 and 2020. Many Parties recalled the progress made under the subsidiary bodies and its relevance to workstream 2, in particular with regard to items such as the NAMA registry, the work programme of the Subsidiary Body for Scientific and Technological Advice (SBSTA) on the clarification of quantified economy-wide emission reduction targets and the work programme of the Subsidiary Body for Implementation (SBI) on understanding NAMAs.

191. In this context, Parties put forward several options for the continuation of activities under workstream 2 in the lead-up to 2020 following the conclusion of the work by the ADP at the end of 2015. This could include the reorganization of workstream 2 as a separate technical process under the Convention or as a technical process under the subsidiary bodies.

192. One specific proposal in relation to the latter option is for the SBI to monitor the progress of the implementation of action towards a level sufficient to achieve an emissions pathway consistent with limiting the global average temperature increase to below 1.5 °C above pre-industrial levels, and to seek additional technical inputs from the SBSTA, as required.

193. Another proposal is to engage the SBSTA to develop guidance and operational modalities by June 2015 by the TEC and the CTCN, including on issues related to enhancing the provision financial support on technology development and transfer in developing countries. In addition, the SBI and the SBSTA could assist Parties in addressing the adverse economic and social consequences of the implementation of response measures in developing countries. To facilitate this consideration, it was proposed that the secretariat prepare, by 30 June 2015, technical papers to identify such consequences and options to address them, in order to provide information to the SBI and the SBSTA.

194. It was also proposed that the TEMs could inform a policy discussion at the sessions of the ADP or the SBSTA during 2015, aimed at further elaborating on the recognition and verification process for early and additional action under the UNFCCC, taking into account the accumulated experience by the UNFCCC and its Kyoto Protocol and flexibility mechanisms.

195. To enhance the political momentum and effectively translate the technical work of the TEMs into increased mitigation ambition, Parties proposed to convene annual ministerial sessions on enhanced pre-2020 action. Such annual sessions should take place in parallel with the high-level segment of the sessions of the COP and the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol to ensure the broadest

possible level of ministerial participation. The sessions could include statements and announcements from ministers and other high-level multilateral, subnational and private-sector actors on actions they will undertake to enhance pre-2020 ambition and give effect to the recommendations from the TEM process. These sessions should provide an opportunity for participants to interact in a moderated setting. The following topics could be addressed:

- (a) Follow-up to the United Nations Climate Summit held in New York, United States of America, on 23 September 2014;
- (b) Outcomes from the TEM process;
- (c) New announcements on enhanced mitigation efforts, increased multilateral cooperation and means of implementation.

196. Parties noted that the expanded activities under workstream 2 outlined in this technical paper will require additional resources allocated to the secretariat. Additional targeted support should also be provided to developing countries to increase the number of technical experts able to participate in the TEMs.

D. Engagement of non-State actors and the role of partnerships

197. A number of Parties suggested that the technical process under workstream 2 and also in enhancing the pre-2020 action should be better linked with existing mitigation initiatives and effective models for cooperative action and initiatives, and should more actively engage subnational authorities, including cities, international organizations, civil society and private-sector entities, and cooperative initiatives. To that end, stakeholders could be invited to undertake relevant activities and submit information on:

- (a) Mitigation actions to assist Parties to achieve an emissions pathway consistent with limiting the global average temperature increase to below 1.5 °C above pre-industrial levels;
- (b) Options and opportunities for actions with high mitigation potential;
- (c) The technical examination of the mitigation options and opportunities from relevant non-UNFCCC events organized by Parties and expert organizations.

198. It was also recognized that workstream 2 can support and facilitate collaborative partnerships between countries and institutions working to move policies forward and provide support and catalyse action on the ground. Cooperative initiatives could play a major role in supporting policy action through deeper engagement with countries that may face political or economic challenges and require substantial support in raising mitigation ambition. To that end, the following actions could be implemented through the TEM process:

- (a) Encouraging cooperative initiatives to set targets and monitor their impact, with robust accounting processes to avoid double counting;
- (b) Further tracking the actions, impact and support of cooperative initiatives at the global level;
- (c) Facilitating knowledge-sharing and collaboration between Parties and cooperative initiatives on specific topics in specific regions.

Reference table 1

Overview of thematic areas presented in the second version of this technical paper (FCCC/TP/2013/8)

<i>Thematic area^a</i>	<i>Mitigation potential by 2020 in Gt CO₂ eq^b</i>	<i>Sustainable development benefits</i>	<i>Barriers</i>	<i>Examples of national actions</i>	<i>Indicative number of cooperative initiatives^c</i>
<i>Energy supply</i>	2.2–3.9	<ul style="list-style-type: none"> • Energy security 	<ul style="list-style-type: none"> • Higher costs of low-carbon options compared to conventional fossil-fuel options 	<ul style="list-style-type: none"> • Emissions trading (pricing carbon) 	23
Fuel-switching limiting inefficient coal use	0.5–1	<ul style="list-style-type: none"> • Economic diversity and resilience 	<ul style="list-style-type: none"> • High increase in the demand for electricity driven by economic growth and the lack of affordable alternatives to fossil fuels to meet such demand 	<ul style="list-style-type: none"> • Carbon taxes (pricing carbon) • Emission standards (avoiding carbon lock-in) 	
Renewable energy sources	1.5–2.5 (electricity and heat only)	<ul style="list-style-type: none"> • Reduced air pollution and health costs 	<ul style="list-style-type: none"> • Market organization and price distortions 	<ul style="list-style-type: none"> • Technology-specific support for research, development and demonstration (enabling future reductions, bringing costs down) 	
Carbon dioxide capture and storage	0.2–0.4				
Methane from fossil-fuel production	0.6				
<i>Energy efficiency</i>	Up to 2.9	<ul style="list-style-type: none"> • Macroeconomic benefits 	<ul style="list-style-type: none"> • High upfront capital costs and perceived capital risk 	<ul style="list-style-type: none"> • Minimum performance standards (overcoming investment risks) 	24
Building heating and cooling	0.5	<ul style="list-style-type: none"> • Often cost-effective • Social improvements 	<ul style="list-style-type: none"> • Lack of affordable technologies suitable to local conditions 	<ul style="list-style-type: none"> • Energy-saving obligations, possibly with certificate trading (overcoming investment risks) 	
Appliances and lighting	0.5	<ul style="list-style-type: none"> • Reduced air and water pollution and health costs 	<ul style="list-style-type: none"> • Market organization, price distortions and split incentives 	<ul style="list-style-type: none"> • Energy audits and negotiated agreements (awareness-raising) 	
Industry	0.4	<ul style="list-style-type: none"> • Positive impact on public budgets and fossil-fuel import bills 	<ul style="list-style-type: none"> • Information barriers 		
Transport	0.2				
<i>Renewable energy</i>	1.5–2.5	<ul style="list-style-type: none"> • Social improvements • Macroeconomic benefits 	<ul style="list-style-type: none"> • High upfront capital costs and perceived capital risk 	<ul style="list-style-type: none"> • Renewable energy targets (providing long-term stability) 	24
Electricity and heat production		<ul style="list-style-type: none"> • Reduced air and water pollution and health costs 	<ul style="list-style-type: none"> • Lack of affordable technologies that are suitable to local conditions 	<ul style="list-style-type: none"> • Feed-in tariffs (lower costs) 	
Biofuels	–	<ul style="list-style-type: none"> • Positive impact on public budgets and fossil-fuel import bills 	<ul style="list-style-type: none"> • Market organization and price distortions 	<ul style="list-style-type: none"> • Obligations to supply a share of electricity, heat and fuels from renewable sources (overcoming investment risks) • Tradable certificates (pricing carbon) • Net metering (overcoming storage) • Direct subsidies or tax credits (bringing costs down) 	
<i>Transport</i>	1.7–2.5				

Land-based transport		<ul style="list-style-type: none"> • Improved health and safety • Job creation 	<ul style="list-style-type: none"> • High upfront capital costs and perceived capital risk • Market organization and price distortions 	<ul style="list-style-type: none"> • Avoid (transport-related land-use policies, avoiding carbon lock-in) • Shift (bus rapid transit, avoiding carbon lock-in) • Improve (vehicle performance standards, overcoming investment risks) 	24
Aviation and shipping	0.3–0.5	<ul style="list-style-type: none"> • Development and diffusion of new technologies • Air quality improvement • Job creation 	<ul style="list-style-type: none"> • Increasing traffic volumes • Trade-offs between reducing carbon emissions and increasing nitrogen oxide emissions • Indirect emissions (from land-use change and biofuel production) • Market organization and price distortions 	<ul style="list-style-type: none"> • Air traffic management (allowing efficient routes) • Shipping energy management plans (awareness-raising) • Aircraft and ship emissions standards (overcoming investment risks) • Emissions trading schemes (pricing carbon) 	5
<i>Fossil fuel subsidy reform</i>	1.5–4.5	<ul style="list-style-type: none"> • Economic growth • Enhancing development and diffusion of new technologies • Environmental and health benefits • Social welfare benefits 	<ul style="list-style-type: none"> • Lack of information • Lack of administrative capacity • Concerns regarding adverse economic impacts • Concerns regarding adverse impacts on the poor • Opposition from specific interest groups 	<ul style="list-style-type: none"> • Reform plan • Communications strategy (obtaining public buy-in) • Phased energy price increases (softening adverse economic impacts) • Improved efficiency of State-owned enterprises (act by example) • Targeted measures to avoid adverse impacts on the poor 	1
<i>Reducing short-lived climate pollutants, including fluorinated gases</i> General	1.1	<ul style="list-style-type: none"> • Improved health and air quality • Improved quality of agricultural production and ecosystems 	<ul style="list-style-type: none"> • Residential: high fuel and technology costs, low awareness of health impacts • Agriculture and forestry: weak enforcement, low stakeholder awareness, high costs of modified feed • Industrial processes: limited access to finance and community awareness • Fossil-fuel industry: high investment costs and technical constraints • Transport: unavailability of ultra-low sulphur fuels 	<ul style="list-style-type: none"> • Regulation (overcoming investments risks) • Economic incentives (pricing emissions) 	3
Fluorinated gases	0.5	<ul style="list-style-type: none"> • Energy savings • Adaptation 	<ul style="list-style-type: none"> • Need for technical developments • Flammability and toxicity risks • Regulations and standards that inhibit the use of alternatives 	<ul style="list-style-type: none"> • Vehicle refrigerant regulation (overcoming investment risks) • National and regional fluorinated gas regulations (overcoming investment 	1

			<ul style="list-style-type: none"> • Insufficient supply of components • Investment costs • Lack of relevant skills 	risks)	
<i>Land use</i>		<ul style="list-style-type: none"> • Environmental protection 	<ul style="list-style-type: none"> • Lack of finance 	<ul style="list-style-type: none"> • Protected areas expansion 	23
Forestry	1.3–4.2	<ul style="list-style-type: none"> • Biodiversity 	<ul style="list-style-type: none"> • Poor enabling environment 	<ul style="list-style-type: none"> • Command and control measures 	
Agriculture	1.1–4.3	<ul style="list-style-type: none"> • Job creation • Adaptation 	<ul style="list-style-type: none"> • Lack of access to effective low-cost technology • Vulnerability of forest resources • Poor data • Drivers of deforestation 	<ul style="list-style-type: none"> • Economic instruments 	
<i>Waste</i>	0.8	<ul style="list-style-type: none"> • Public health improvements • Environmental protection • Closing the nutrient cycle and avoiding methane emissions 	<ul style="list-style-type: none"> • Lack of finance • Lack of capability to assess benefits • Lack of technology transfer 	<ul style="list-style-type: none"> • Composting • Waste regulation (e.g. landfilling) 	11

^a Thematic areas partly overlap. A description of the areas can be found in addendum 1 of the second version of the technical paper, contained in document FCCC/TP/2013/8/Add.1.

^b Mitigation potential estimates for energy efficiency and renewable energy are from the International Energy Agency, 2012. Mitigation potential estimates for fossil-fuel subsidy reform are from International Monetary Fund, 2013. Mitigation potential estimates for reducing emissions from fluorinated greenhouse gases and reducing short-lived climate pollutants are from the United Nations Environment Programme (UNEP), 2011c. Mitigation potential estimates for transport, land use and waste are from UNEP, 2012. Some estimates are probably underestimated compared to others, owing to the use of different sources and methodologies. Potential values are not strictly comparable and are not additive, as they partly overlap.

^c The number of cooperative initiatives is indicative because not all initiatives may be included and for some the coverage is unclear or ambiguous, while other initiatives are cross-cutting in terms of their thematic coverage.

^d Some short-lived climate pollutants are outside of the definition of the emissions gap. Assuming full implementation of measures by 2020, the impact of the emission reductions achieved in that year on the global temperature over a 100-year time horizon would be about 1.1 Gt CO₂ eq.

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