Guidance for national planning to reduce short-lived climate pollutants and promote integrated air pollution and climate mitigation strategies

CCAC Initiative on Supporting National Action & Planning on short-lived climate pollutants (SNAP)
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Supporting National Action and Planning on Short-Lived Climate Pollutants (SNAP)

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Supporting National Planning for Action on Short-Lived Climate Pollutants (SNAP)

Guidance for national planning to reduce short-lived climate pollutants

Summary

**Background:** The UNEP/WMO assessment from 2011 outlined the opportunity to significantly reduce the rate and amount of near-term warming and at the same time reduce health impacts from air pollution by implementing measures focusing on reducing Short-Lived Climate Pollutants. The Paris Agreement goal of achieving ‘well-below’ 2°C, and the findings of the IPCC 1.5°C report, emphasise the need not only to reduce CO2 emissions rapidly, but at the same time concentrate on taking action on sources of black carbon, methane and HFCs. The recent increasing focus on air pollution in all countries has also increased political interest in solving this problem.

The Climate and Clean Air Coalition was formed in 2012 as the first global collaborative effort to address SLCPs and undertakes its work through a number of different initiatives. SNAP, the CCAC initiative on Supporting National Action & Planning to reduce SLCPs, is one of the cross-cutting initiatives established by the CCAC to help countries developing and implementing SLCP strategies. CCAC Partner countries have highlighted a need for support at the national scale to understand and assess the scope of their SLCP issues, the benefits of action and mitigation potential, and identify actions that they can prioritise.

**Aim:** SNAP supports rapid and large-scale implementation of SLCP mitigation at the national level. The national SLCP planning process aims to identify nationally-appropriate actions that can be taken to increase implementation of mitigation measures that will simultaneously reduce air pollution and mitigate climate change in the near-term.

**Process:** This SNAP guidance document outlines a tried and tested process for developing national planning to improve air pollution and mitigation climate change through reduction of SLCPs within the context of ongoing activities for climate change mitigation, air pollution abatement and sustainable development. It is designed to provide advice and help to countries that wish to identify and implement actions to increase the rate of emission reductions to achieve the multiple benefits for health, crop yield and near-term climate change. It is intended to be a flexible process that can be adapted to the context and policy environment within each country interested in taking action on SLCPs.

The national SLCP planning process involves prioritising measures and sectors that are subject to different planning processes, under the control of different ministries and implementing agencies, and also subject to different international planning processes. At its core, the national SLCP Planning process aims to:

- Identify ways in by which measures that will reducing emissions from major SLCP sources can be promoted and implemented.
- Consider supporting relevant actions within existing national strategies and development agendas to reduce SLCPs.
- Add the SLCP dimension into existing plans and activities where it is not currently considered.
- Initiate new programmes where these are lacking in a country within which SLCP mitigation can be taken forward.
Identify strategies that can more broadly address air pollution and climate change in an integrated way.

The guidance document is organised by considering the main steps that need to be taken to develop the SLCP planning process, as outlined in Figure 1 which provides a number of steps that countries may choose to take in developing their SLCP and integrated air quality and climate change mitigation plans.

**Figure 1: Developing the national SLCP planning process**

| STEP 1. Set up the national planning process & engage stakeholders | Set up architecture of NAP process – leadership group / institutional set-up
| | Develop stakeholder engagement process
| | Employ consultants or engage existing personnel to develop the work
| STEP 2. Raising awareness about SLCPs | Develop awareness raising strategy
| | Develop awareness-raising materials
| | Use media, meetings, meetings with stakeholders (e.g., ministries), etc.
| STEP 3. Assessing SLCPs in the national context | Undertake baseline SLCP assessment, including institutional and legal frameworks, current initiatives related to SLCP strategies
| | Identify main emission sources and quantify emissions
| STEP 4. Identify opportunities to reduce SLCPs and estimate benefits of emission reductions | Identify relevant measures
| | Develop baseline scenarios and quantify benefits of implementing measures in relation to these (using LEAP-IBC, if desired)
| STEP 5. Developing national planning identifying priorities for SLCP mitigation | Identify likely implementation pathways for measures, and quantify benefits (using LEAP-IBC - if required)
| | Get feedback from stakeholders & develop consensus on measures and strategies
| | Develop national SLCP plans: sectoral mitigation plans and identifying priorities
| | Stakeholder assessment of pathways, plans and priorities
| | Finalise national planning document
| STEP 6. Mainstreaming the SLCP planning process in national processes & structures | Embedding SLCPs into ministerial/ sectoral plans, policies and programmes
| | Enhancing capacity to implement measures
| | Monitoring and evaluation of implementing national SLCP plans
Outcomes: The objective of this process is to embed the SLCP planning as a living process in the country, rather than a one-off activity, and promote the widespread implementation of those priority measures that are identified in the national planning process. The optimal way to do this may change between countries, but and the goal of the National SLCP Planning process within countries may not be to develop a separate National SLCP Plan, but to embed measures to reduce SLCPs and achieve simultaneous air pollution and climate change benefits in existing climate change, air pollution or development planning processes. The idea would be that there is continuous upgrading of data and information underpinning the plans and also monitoring and evaluation of progress in implementing the plans and reducing emissions.
1 Introduction

1.1 Integrated Air Pollution and Climate Change Mitigation

In 2015, the Paris Agreement was signed by parties to limit global temperature increases to well below 2°C, with the ambition of limiting increases to 1.5°C. According to the Intergovernmental Panel on Climate Change (2018) report on the impacts of global warming at 1.5°C, even an increase in global average temperatures of 1.5°C will lead to significant increases in climate extremes, including extreme temperatures, increases in the frequency, intensity and amount of heavy precipitation, and increases in the intensity of droughts. At 2°C of warming, sea-level rises, ocean acidity, biodiversity and species loss, and climate risks to health, food security, water supply and human security are predicted to increase compared to limiting global temperature increases to 1.5°C of warming. The emission reductions required to limit global temperature increases to 1.5°C are large and need to be implemented quickly, according to the report. For example, a 45% reduction in carbon dioxide emissions would be required by 2030, compared to 2010 levels, and a 35% reduction in emissions of methane and black carbon are needed by 2050, compared to 2010 levels.

Currently, air pollution is the largest environmental risk factor for human health. Globally, 4.9 million premature deaths were attributed to air pollution exposure in 2017, resulting from exposure to fine particulate matter (PM$_{2.5}$) from outdoor and household sources, and from exposure to tropospheric ozone (REF, 2017). In addition to its impact on mortality, exposure to air pollution is associated with an increasingly varied range of negative health impacts, including non-fatal cardiovascular and respiratory effects, diabetes, asthma exacerbation, and adverse pregnancy outcomes including the incidence of pre-term birth.

Climate change and air pollution are two closely linked problems because, i) some of the same substances contribute to climate change, and to air pollution impacts, such as methane, black carbon and tropospheric ozone, which are the so-called Short-lived Climate Pollutants (SLCPs), and ii) in many cases greenhouse gases and air pollutants are emitted from the same sources. This provides substantial opportunity to design strategies and identify mitigation measures that can simultaneously mitigate air pollution and climate change. These opportunities have been explored and identified in global and regional assessments, such as:

The UNEP/WMO 2011 Integrated Assessment of Black Carbon and Tropospheric Ozone

The UNEP/WMO (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone was a landmark global assessment of the benefits of taking actions to reduce black carbon and tropospheric ozone. Mitigation measures that targeted the main sources of black carbon and the main sources of methane (a precursor of tropospheric ozone) were evaluated in terms of their impacts on air quality and on climate. As black carbon is always emitted with a number of co-emissions, some of which warm the atmosphere and others that cool the atmosphere, only those measures providing a net reduction in warming were included. In total, 16 measures were identified that provided 90% of the climate benefits from the hundreds of measures that were evaluated. These included 9 measures that targeted black carbon, and included measures in the residential, agriculture, transport and industry sectors; and 7 measures that targeted methane in the agriculture, oil and gas and waste sectors. The Assessment calculated that the full implementation of these measures would yield substantial air quality and climate benefits, estimating that by 2.4 million premature deaths would be avoided in 2030 compared to the baseline, as well as 52 million additional tonnes of 4 staple crops (rice, wheat, maize and soy) due to less crop damage from ozone exposure. These air quality benefits are disproportionately achieved locally, in those countries and regions where the emission reductions occur. At the same time, implementation of these measures would also avoid 0.5°C of global temperature increase by 2050, making an important near-term contribution to limiting global temperature rises when combined with fast and ambitious CO$_2$ mitigation (Figure 1).
Black carbon, methane and tropospheric ozone, together with hydrofluorocarbons, have been called 'short-lived climate pollutants' (SLCPs) because of the relatively short time they spend in the atmosphere once emitted (days to a two decades), and their impacts on climate and air quality (except for HFCs, which just impacts climate). This means that actions on SLCPs can quickly produce multiple benefits for air quality and climate change (Shindell et al., 2012). Therefore, SLCP mitigation can help to provide near-term reductions in warming.

It is important to note that the benefits that are achieved by the measures that target SLCP source sectors are achieved for two reasons. Firstly, it is because they reduce SLCPs themselves, which, in the case of black carbon and methane have direct impacts on both air quality and on climate. But it is also because many of the SLCP source sectors are also major sources of greenhouse gases (e.g. CO₂) and other air pollutants. Therefore, the implementation of mitigation measures in these sectors can also reduce emissions of greenhouse gases and other air pollutants, in addition to reducing SLCPs, especially through the choice of mitigation actions in different sectors, especially those that are transformations – e.g. integrated strategies promoting low carbon or renewable electricity combined with electric mobility.

![Figure 1: Progression of global average temperature change from 2010 to 2070 for a reference scenarios (purple), implementation of CO₂ mitigation measures (red), implementation of 16 black carbon and methane measures (blue), and implementation of CO₂, black carbon and methane measures together (green) (Source UNEP/WMO 2011).](image)

**Air Pollution in the Asia-Pacific: Science-Based Solutions**

Air pollution in the Asia-Pacific region is the most serious of any region of the world, with less than 8% of people in the Asia-Pacific region breathing air where the concentration of fine particulate matter (PM₂.₅) is below the World Health Organisation ambient air quality guideline of 10 µg m⁻³. In the report ‘Air Pollution in the Asia-Pacific: Science-Based Solutions’, published in 2018, mitigation measures
were identified and prioritized based on the extent to which they improved air quality in the Asia-Pacific region, reducing PM$_{2.5}$ concentrations (CCAC, 2018).

Twenty-five measures were identified in the report that provided the largest air quality benefits. These were categorized as conventional clean air measures (e.g. industrial emission controls, vehicle emission standards), next-generation clean air measures (e.g. related to emissions reduction from distributed sources including crop residue burning, open burning of waste, fertilizer application, livestock, brick kilns etc.), and measures that are development priorities with clean air benefits (e.g. clean cooking and heating, renewable electricity generation, energy efficiency etc.). Full implementation of these 25 mitigation measures would allow 1 billion people to breathe air with PM$_{2.5}$ concentrations below the WHO guideline of 10 µg.m$^{-3}$ in 2030, and could reduce crop loss of maize, rice, wheat and soy by 45% in 2030.

Despite these 25 measures being selected and prioritized on the basis of their benefits for reducing air pollution, the implementation of these measures would also reduce greenhouse gases, including CO$_2$ emissions by 20%, methane emissions by 40% and HFC emissions by 80% (Figure 1.2). This means that in 2050 actions to improve air quality in Asia could result in avoiding 0.3°C of warming globally.

**Figure 2:** Summary of the air quality and climate benefits that could result from implementation of the top 25 clean air measures in Asia.

**Air quality benefits of climate commitments**

As part of the Paris Agreement, almost all countries have submitted a Nationally Determined Contribution (NDC) to the UNFCCC that outlines their commitment to reduce greenhouse gases as a contribution to meeting internationally agreed targets on limiting global average temperature rise. A global study has concluded that there are substantial air quality benefits that could result from the implementation of measures and achieving the mitigation ambition that is included in country’s NDCs. Vandyck et al. (2018) calculated that implementation of NDC commitments in all countries could avoid
77-91,000 premature deaths attributable to air pollution exposure globally in 2030, compared to a baseline. Even greater ambition to reduce greenhouse gas emissions to a level that is compatible with limiting global temperature increases to 2°C could yield even larger benefits of 178-346,000 avoided premature deaths in 2030.

1.2 The Climate and Clean Air Coalition (CCAC)

The substantial near-term climate and clean air benefits from implementation of the 16 measures from the UNEP/WMO assessment created substantial interest, especially in some countries, and the CCAC was launched in February 2012 by UNEP and the governments of Bangladesh, Canada, Ghana, Mexico, Sweden and the United States, who came together to initiate a voluntary network of state and non-state partners to initiate the first global effort to treat these pollutants as a collective challenge. The CCAC has grown to include over 60 state partners and a similar number of non-state partners, including the World Bank, UNDP and WHO, as well as NGOs from around the world. The Coalition’s objectives are to address SLCPs by:

- Raising awareness of SLCPs, and benefits associated with adopting SLCP mitigation strategies;
- Enhancing and developing new national and regional actions, including by identifying and overcoming barriers, enhancing capacity, and mobilizing support;
- Promoting best practices and showcasing successful efforts; and
- Improving scientific understanding of SLCP-related impacts and mitigation strategies.

The CCAC serves as a forum for assessing progress in addressing the challenge of SLCPs and for mobilizing resources to accelerate action. It works to catalyse new actions as well as to highlight and bolster existing efforts on near-term climate change and related public health, food and energy security, and environmental issues.

The CCAC works through initiatives – some along sectoral lines (e.g., oil and gas, diesel, brick kilns, cookstoves, waste, agriculture, HFCs) – and others that are cross cutting (finance, national planning, regional assessments and health).

1.3 The SNAP Initiative

SNAP, the CCAC initiative on Supporting National Action & Planning to reduce SLCPs, is one of the cross-cutting initiatives established by the CCAC to help countries developing and implementing SLCP strategies. This is to support rapid and large-scale implementation of SLCP mitigation at the national level. CCAC Partner countries have highlighted a need for support at the national scale to understand and assess the scope of their SLCP issues, the benefits of action and mitigation potential, and identify actions that they can prioritise. The 16 ‘SLCP’ measures that were identified in the UNEP/WMO (2011) Assessment were identified as being those with the largest climate and air quality benefits globally. However, at the national scale the SLCP narrative is relatively new and there are significant barriers to the implementation of these identified measures, and depending on the national context, additional mitigation measures may be more appropriate, that also provide integrated solutions to air pollution and climate change.

The SNAP initiative aims to overcome the significant barriers that exist to achieving increased action on integrated air pollution and climate change mitigation in partner countries, including, i) a lack of information on opportunities to address SLCPs and a lack of quantitative assessments of the multiple benefits of relevant mitigation measures, ii) the need to create stronger linkages between relevant national, regional and global stakeholders for air pollution and climate change mitigation, and iii) a lack of institutional capacity for national SLCP planning.
The SNAP Initiative aims to provide support to partner countries to develop and enhance national policies and action plans to reduce SLCPs, and actively facilitate peer-to-peer engagement by focusing on:

- **Achieving integrated air pollution and climate change mitigation in countries**: Applying emission inventory and scenario analysis tools to support partner countries to identify and prioritise actions that will simultaneously improve air quality and mitigate climate change to achieve SLCP mitigation.

- **Maximising existing and on-going national planning processes to achieve SLCP mitigation**: Many countries have existing planning processes within which SLCP mitigation may already be, explicitly or implicitly, included. There are cases where a parallel, standalone National SLCP Planning process may have substantial overlap with ongoing activities related to, e.g. stakeholder engagement, resource mobilisation, monitoring and evaluation, and reporting. A flexible approach to the model for national SLCP planning is therefore promoted in the support that SNAP provides that helps countries to identify the optimal pathway to promote and achieve SLCP mitigation in the country based on national circumstances.

- **Disseminating and sharing best practices to achieve SLCP mitigation**: Since the inception of the SNAP initiative, a wide range of experience has been gained by country partners, SNAP lead partners, CCAC initiatives and key international partners relating to key aspects of SLCP planning. SNAP provides a forum for the sharing of the knowledge, to ensure that i) existing best practices can be applied as widely as possible among existing SNAP countries, ii) new knowledge and experience of SLCP mitigation gained through National SLCP Planning in one country is captured and communicated to others and iii) that the knowledge generated through the SNAP initiative can motivate and engage other non-CCAC countries of the benefits of SLCP mitigation and the practical means by which these can be achieved.

- **Building institutional capacity for SLCP mitigation**: Many institutions in partner countries are under-resourced and therefore lack the additional capacity required to undertake coordination, planning and analytical activities related to SLCP Planning. A key component of the SNAP initiative is therefore to identify the additional capacity needed in each country that can most effectively increase action for SLCP mitigation, and provide institutional strengthening support.

1.4 Why undertake National Planning for Reduction of Short-Lived Climate Pollutants (SLCPs)?

The National SLCP Planning process aims to identify nationally-appropriate actions that can be taken to increase implementation of mitigation measures that will simultaneously reduce air pollution and mitigate climate change in the near-term. It was originally envisioned as a process by which countries could identify how specific SLCP-focused measures could be implemented in different national contexts. However, as shown in Section 1.1, a wider range of measures may be considered to achieve air pollution and climate change benefits, even though SLCP strategies tend to be important in most cases to achieve the near-term benefits. As demonstrated through country examples in this document, the National SLCP Planning process has been adapted to national circumstances, to align with existing climate and air quality planning processes where these exist, as well as with overall national development plans and align also with individual sectoral plans. The process allows the identification of nationally-appropriate actions to increase reductions in pollutants that contribute to near-term air pollution and climate change impacts. However, across all countries that have undertaken national SLCP planning so far, a number of common goals and aims from the national SLCP planning processes have been defined, including:

- **Achieving simultaneous air pollution and near-term climate benefits**: Short-lived climate pollutants are substances that contribute to both air pollution, and its associated impacts on
human health and vegetation and climate change. HFCs are included as SLCPs although these mainly only affect the near-term climate. Implementing the black carbon measures reduces emissions of black carbon and co-emitted substances and this will reduce exposure to fine particulate matter (PM$_{2.5}$) that is the pollutant most associated with negative health effects. Reducing emissions of methane and other precursors of tropospheric ozone will reduce exposure of humans and plants to ozone which has respiratory effects in humans and reduces crop and forest yields and damages natural vegetation. Reducing these pollutants therefore offers a real opportunity to improve public health, reduce crop-yield losses, and slow the rate of near-term climate change, thereby aiding sustainable development.

- **Target common sources of greenhouse gases, SLCPs and air pollutants:** In addition to the direct benefits that result from reducing the SLCPs themselves, many of the major sources of SLCPs are also sources of greenhouse gases and other air pollutants. For example, in the transport sector diesel vehicles are a major source of black carbon and also a major source of greenhouse gases like carbon dioxide, and other air pollutants such as NO$_x$. Therefore, the benefits for human health, crop yield and climate by taking action to reduce emissions from major SLCP source sectors are not just realised by reducing emissions of the SLCPs themselves, but also because these actions in many cases simultaneously reduce greenhouse gases and other air pollutants from these sources.

- **Contribute to achieving sustainable development goals:** In addition to the reduction in climate and air pollution impacts that are at the core of the motivation for implementing measures to reduce SLCPs, the specific mitigation measures in many cases also yield other sustainable development benefits related to poverty alleviation, gender equality, affordable and clean energy, sustainable cities, and responsible consumption and production. Therefore, the national SLCP planning process can identify strategies that can contribute to the wider achievement of sustainable development goals in the country.

It is important to acknowledge that countries are, in many cases, already undertaking substantial activities to try and improve air quality and mitigate climate change, but these may not be well aligned. Therefore, in many countries the National SLCP Planning process has been used to build on existing activities being taken for air pollution and climate change mitigation to achieve:

- **Integrated, coherent and aligned planning on air quality and climate change:** the national SLCP planning process presents an opportunity to undertake an integrated assessment of the air pollution and climate change benefits of the mitigation measures included in current air quality and climate change plans. Understanding the emission reduction potential (of SLCPs, air pollutants and greenhouse gases) that could be achieved from current air quality and climate plans allows country-specific gaps and additional mitigation measures for sources that are not currently being considered to be identified. As stated above, the implementation of a particular mitigation measure aimed at reducing black carbon, methane or other short-lived climate pollutants may also reduce greenhouse gases and air pollutants, further increasing the emission reductions and benefits associated with that mitigation measure. Therefore, it is important that an SLCP strategy is not developed in isolation to existing plans and strategies related to climate change mitigation and air pollution abatement.

- **Local benefits from actions that meet global climate goals:** the air quality benefits that result from implementing black carbon-focused mitigation measures disproportionately occur in those countries/regions where the emission reductions take place. Reducing methane emissions, as it is a globally mixed pollutant contributes to reducing hemispheric background ozone concentrations. Therefore the air quality benefits from reducing methane emissions are spread more widely. Therefore, an SLCP strategy can contribute to meeting climate mitigation goals while yielding local or regional benefits for air quality and human health. In addition, measures included for climate mitigation, e.g. those included in a countries NDC, also result in
SLCP and air pollution emission reductions in many cases. The National SLCP Planning process can be used to quantify the local benefits of these climate mitigation measures, providing additional motivation for their implementation.

- Identification of the ‘Multiple Benefits Pathway’ for low emission development: the approach of considering SLCP mitigation in an integrated analysis of all existing plans that affect emissions has been developed by the CCAC into a ‘Multiple Benefits Pathway Framework’. The CCAC’s multiple benefits pathway framework is an integrated approach that links strategies to reduce emissions of CO₂, Short-Lived Climate Pollutants (SLCPs), and other air pollutants. It allows for the identification of mitigation strategies that can maximise health improvements and achieve many other key local development priorities, and at the same time significantly reduce the rate of warming in the near-term (next 25 years) and long term (to 2100), contributing to the achievement of the Paris Convention’s global average temperature goals. This framework highlights the benefits of taking action immediately on strategies that significantly reduce climate and air pollution impacts in the near term – saving lives and reducing health impacts immediately – and every year after action is taken. These actions complement rather than replace strategies that will safeguard the climate over the longer term (end of century). The multiple benefits pathway framework focuses on identifying the most effective holistic strategies to reduce air pollution and limit global temperature increases at short and long timescales, rather than on the mitigation of a subset of the pollutants that contribute to these impacts.

1.5 Purpose of the SNAP Guidance Document

This SNAP guidance document outlines a tried and tested process for developing national planning to improve air pollution and mitigation climate change through reduction of SLCPs within the context of ongoing activities for climate change mitigation, air pollution abatement and sustainable development. It is designed to provide advice and help to countries that wish to identify and implement actions to increase the rate of emission reductions to achieve the multiple benefits for health, crop yield and near-term climate change. It is intended to be a flexible process that can be adapted to the context and policy environment within each country interested in taking action on SLCPs.

The national SLCP planning process involves prioritising measures and sectors that are subject to different planning processes, under the control of different ministries and implementing agencies, and also subject to different international initiatives, e.g. Nationally Determined Contributions (NDCs) submitted to the UNFCCC, Low Emission Development Strategies (LEDS), the Montreal Protocol, the Sustainable Development Goals (SDGs), and/or the United National Environment Assembly Resolution on Air Quality. In most countries there are existing planning processes (e.g. related to climate change mitigation or air pollution abatement) that may already be taking action on SLCPs, or taking actions that would bring simultaneous air pollution and climate change benefits. The SLCP national planning process is therefore designed to avoid duplication and build on existing processes, regulations and activities within countries to identify promising areas for early action and to engage the relevant stakeholders right from the beginning. At its core, the national SLCP Planning process aims to:

- Identify ways by which measures reducing emissions from major SLCP sources can be promoted and implemented.
- Consider supporting relevant actions within existing national strategies and development agendas to reduce SLCPs.
- Add the SLCP dimension into existing plans and activities where it is not currently considered.
- Initiate new programmes where these are lacking in a country within which SLCP mitigation can be taken forward.
Identify strategies that can more broadly address air pollution and climate change in an integrated way.

Many of the approaches for developing strategies to address either air pollution or greenhouse gases can also be used as elements of national action planning for SLCPs. The actual implementation may be mainstreamed into different sectors of relevance to an SLCP strategy, such as transport policy, energy policy, industrial policy or national development strategies. Each country interested in taking action to reduce SLCPs can usefully develop an approach that is appropriate to their national circumstances.

**Development of National Planning for SLCPs**

To support rapid and large-scale implementation of SLCP mitigation at the national level, CCAC partner countries have highlighted the need for programmes to help the countries understand and assess the scope of their SLCP issues, mitigation potential and the benefits of action. To meet this need, the CCAC, agreed to support the development of an initiative Supporting National Action and Planning (SNAP) for action on SLCPs, which will allow countries to identify:

- major emission sources on which action could begin immediately;
- sources where action could occur further into the future;
- the information, capacity and finance gaps which would need to be filled to ensure effective mitigation.

It is important that the SNAP activities build upon on-going programmes, initiatives and activities in any country to avoid duplication and take advantage of synergies. As SLCPs strategies can address many different sectors and policy domains, one of the important parts of national planning is to bring together the information and get an overview of where emissions are being adequately addressed, and where there are gaps. National SLCP planning will allow decision makers to develop an overview of the entire SLCP issue in their country, develop priorities for further action and track progress in reducing emissions. In many cases the calculation of local benefits can provide the motivation for increased climate mitigation ambition, and the process of national planning can provide practitioners with the knowledge of the benefits of action which they can use to motivate policy development.

**2. Approach to national planning**

This guidance document outlines an approach that can be used to motivate increased action on sources of emission and achieve near-term air quality, climate and development goals. This can include: i) identifying the major sources of SLCPs, as well as greenhouse gases and other air pollutants in a country; ii) identifying the emission control measures that are relevant in that country; iii) undertaking an integrated assessment to identify the priority measures for national action, and iv) identifying the pathways that are likely to lead to successful implementation and the different issues that would need to be addressed to give a high chance of success.

The guidance document is mainly targeted at the stages in the national planning process when a country initiates its planning for action on different source sectors. Typically, such a process would be expected to deliver pilot plans within a 12-month period, outlining subsequent action that can be promoted and taken in the national context.

The analysis of the relevant measures needs to be mindful of the approach developed by the UNEP assessments (WMO/UNEP, 2011; UNEP, 2011a), described above, to identify measures that would provide joint climate and air quality benefits, and deliver significantly reduced human health impacts, crop yield losses, and near-term warming. When identifying the mitigation measures that could be considered as part of the national SLCP planning process, a starting point is to consider those 16
measures identified by the UNEP/WMO Assessment process (UNEP/WMO, 2011) that, on a global scale, would provide benefits according to these criteria. In the national context, other sectors, sources and measures may be more important than those identified at a global scale.

It is also important to consider those mitigation measures that are already included in current national planning activities (e.g. climate change planning, air pollution abatement strategies or sectoral policies and measures), and therefore where there are gaps to increase mitigation ambition or to support faster, more effective implementation. Where additional measures are identified they need to fulfil the criteria that underpin the agenda promoted by the CCAC where the implementation of the measure reduces net warming, especially in the near-term, and simultaneously improves air pollution.

A tool has been produced to support the development of national SLCP planning. The LEAP-IBC tool (see later sections of this document, especially in Annex 2) developed with support from CCAC, by SEI and US EPA can be used by countries to develop emission scenarios for the key sectors and quantify SLCP, GHG and air pollutant emission reductions for different levels of implementation of identified measures relative to a baseline, or business as usual, scenario. It can also estimate likely air pollution health, crop yield and climate benefits of emission reductions. Countries can choose to use this tool or rely on existing information and knowledge available to the countries undertaking the planning.

The guidance document is organised by considering the main steps that need to be taken to develop the SLCP planning process, as outlined in Figure 1 which provides a number of steps that countries may choose to take in developing their SLCP and integrated air quality and climate change mitigation plans. The objective of this process is to embed the SLCP planning as a living process in the country, rather than a one-off activity, and promote the widespread implementation of those priority measures that are identified in the national planning process. The optimal way to do this may change between countries, and the goal of the National SLCP Planning process within countries may not be to develop a separate National SLCP Plan, but to embed measures to reduce SLCPs and achieve simultaneous air pollution and climate change benefits in existing climate change, air pollution or development planning processes. The idea would be that there is continuous upgrading of data and information underpinning the plans and also monitoring and evaluation of progress in implementing the plans and reducing emissions.

The SNAP programme also helps countries to coordinate the implementation of the plan developed and take action on priority measures. This includes helping countries to interact with the CCAC sectoral initiatives providing advice on which measures are most appropriate in different sectors under different circumstances, and which can also provide advice on how to implement the measures in different sectors (see http://www.ccacoalition.org/en), or which finance models would be appropriate to use to promote implementation of a measure in a given sector.

In the sections following Figure 1, each step is outlined in more detail providing ideas to countries about how they could proceed with their national planning processes. These are not prescriptive and each country needs to determine who their process should proceed.
### Figure 1: Developing the national SLCP planning process

| STEP 1. Set up the national planning process & engage stakeholders | Set up architecture of NAP process – leadership group / institutional set-up |
| | Develop stakeholder engagement process |
| | Employ consultants or engage existing personnel to develop the work |
| STEP 2. Raising awareness about SLCPs | Develop awareness raising strategy |
| | Develop awareness-raising materials |
| | Use media, meetings, meetings with stakeholders (e.g., ministries), etc. |
| STEP 3. Assessing SLCPs in the national context | Undertake baseline SLCP assessment, including institutional and legal frameworks, current initiatives related to SLCP strategies |
| | Identify main emission sources and quantify emissions |
| STEP 4. Identify opportunities to reduce SLCPs and estimate benefits of emission reductions | Identify relevant measures |
| | Develop baseline scenarios and quantify benefits of implementing measures in relation to these (using LEAP-IJC, if desired) |
| STEP 5. Developing national planning identifying priorities for SLCP mitigation | Identify likely implementation pathways for measures, and quantify benefits (using LEAP-IJC - if required) |
| | Get feedback from stakeholders & develop consensus on measures and strategies |
| | Develop national SLCP plans: sectoral mitigation plans and identifying priorities |
| | Stakeholder assessment of pathways, plans and priorities |
| | Finalise national planning document |
| STEP 6. Mainstreaming the SLCP planning process in national processes & structures | Embedding SLCPs into ministerial/sectoral plans, policies and programmes |
| | Enhancing capacity to implement measures |
| | Monitoring and evaluation of implementing national SLCP plans |
STEP 1: Setting up the National SLCP Planning Process and Engaging Stakeholders

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<th>Step 1</th>
<th>Setting Up the National SLCP Planning Process and Engaging Stakeholders</th>
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| **Key Aims** | ● Identify and put in place a process for national SLCP planning  
● Identify core team who will implement the project  
● Identify key stakeholders from ministries, private sector, NGOs and civil society relevant for integrating air pollution and climate change mitigation  
● Engage stakeholders and get buy-in to national SLCP planning process  
● Develop overall goal and outcome of project and workplan/timeline to achieve it |
| **Key Questions** | ● What is the overall goal of the national SLCP Planning process?  
● What activities are on-going that could contribute to achieving this goal?  
● How could the SLCP planning process interact with existing air quality and climate planning processes?  
● What additional activities will be undertaken in the National SLCP Planning process to achieve this goal?  
● What organisations need to be involved to achieve this goal, and what is their role?  
● How will these organisations be engaged and motivated to join the National SLCP Planning process?  
● Can existing stakeholder engagement processes (e.g. for NDC/ climate change planning) be used/adapted for the national SLCP planning process? |
| **Key Challenges** | ● Lack of knowledge about SLCPs  
● Lack of institutional capacity to contribute to national SLCP planning  
● Lack of capacity to identify most effective method of engaging different stakeholders and develop bespoke communication strategy to reflect this  
● Coordination between organisations responsible for air quality and climate change and energy planning in national SLCP planning processes |
| **Key Outputs** | ● Core SNAP Unit in place with roles and responsibilities clearly defined  
● Project initiation report detailing National SLCP Planning process, activities and timelines  
● Desk officer identified in relevant ministries, departments and agencies responsible for engagement with national SLCP planning process  
● Role of each stakeholder in national SLCP planning process clearly defined |

In most countries, the SLCP issue is a relatively new concept and by engaging in the SNAP Initiative, a process of addressing SLCPs, and promoting integrated air pollution and climate change mitigation in a coherent way can be initiated. The planning process is intended to take about 12 months. Through the planning process, integrated air pollution and climate change mitigation strategies will become mainstreamed into different sectoral plans and programmes and will begin to embed within government thinking more generally. For this to happen, the SNAP process must be owned by, and embedded within, countries and championed by the CCAC Partner, most likely a ministry or department of the environment. Therefore, it is important to set up the national planning process to
promote action on integrating air pollution and climate change mitigation in a way that promotes buy-in and ownership of action on SLCPs, GHGs and air pollutants across the institutions in the country. The national planning process needs to develop broad engagement and interest in simultaneously mitigating air pollution and climate change in order to embed action on SLCPs (and GHGs and air pollutants) into national processes and to convene relevant stakeholders.

**Developing the structure of the national SLCP planning process**

It is important at the beginning of the national planning process to frame and formulate the institutional structure, ownership and content of national SLCP planning. The outcome of this framing will be a detailed plan of how, when and who will develop the national SLCP planning, and what will be produced. The following questions will help to develop and plan the process:

- Who owns the process within government?
- Who else will be involved in leading the planning process? Should a steering group be established?
- Who needs to be included to develop the planning and in which phase will they be included?
- What needs to be included in the national action planning?
- What other planning processes are ongoing at national level that this process needs to be linked to?
- Who will undertake the bulk of the work in developing the planning?
- For whom is the planning being developed?
- What is the level of political support for the process? How can it be enhanced?
- Who are the best-placed consultants / university personnel / departments / other experts that can undertake the assessment required to underpin the planning?
- What are the phases in development of the planning?

The national planning process will be initiated by a relevant ministry or department in the country, usually the ministry or department of environment, or equivalent. It is important for them to secure high-level buy-in to the process at an early stage. The ministry will have primary ownership of the strategy that is developed and oversight of its further development and implementation. This can involve employing consultants to prepare the required inputs and documents for the planning process, but control and knowledge needs be embedded in government.

Consideration of those aspects that will be covered by the national SLCP planning process, linkages to ongoing climate change and air pollution planning, as well as outlines and format of planning documents, can be usefully undertaken at this stage. A project initiation report produced at this stage can describe the intended process, stakeholder engagement and expected outputs. This could include the proposed format and status of the national SLCP plan, and can be used as a basis for discussion during initial consultations.

**Developing a stakeholder engagement process**

If the planning is to be successful then the SLCP issue, and integrated climate change and air pollution mitigation, needs to be mainstreamed and prioritised across government, the private sector, civil society organisations, and organisations that need to be involved in implementation, such as professional bodies representing key industrial sectors. Therefore, the planning cannot be isolated in any one ministry or government department but has to be embedded within the planning of the many different sectors whose emissions give rise to SLCPs (GHGs, and air pollutants). It is good practice to inform all relevant ministries and departments in the government that this process is being undertaken to engage them from the beginning, developing national coordination mechanism for the process and raising awareness of the issues with relevant stakeholders. In many countries such inter-ministerial coordination mechanisms already exist (e.g. as part of climate change planning such as
development of a country’s NDC) and the SLCP planning can be included within their remit. Relevant questions include:

- Which stakeholders need to be engaged in the process of developing the plans?
- How will the stakeholder engagement process be organised?
- Are there existing stakeholder engagement processes/coordination mechanisms that can be leveraged?

The stakeholder engagement in the initial phase will inevitably differ in its approach in different countries, given the different cultural and political circumstances, and ongoing engagement as part of existing climate change and air pollution planning. In past implementation, countries have contacted relevant ministries and held a project initiation workshop in the first month or two of the start of the project. These meetings included broad stakeholder participation, including ministries responsible for different sectors which were sources of SLCP emissions (transport, industry, etc.) as well as municipal government and planning organizations. In many cases this has usefully included cross-cutting ministries such as planning and finance ministries. Countries have also included consultation with further stakeholder groups, even at this early stage, including NGOs, youth movements, associations representing different industries and stakeholder groups. Getting these people together required informal contacts through existing channels with different ministries and the pre-existence of relationships with key stakeholders. The advantage of this approach was that a variety of stakeholders were engaged from the very beginning of the process, and they came back to subsequent meetings, considering this process to be important to them. In the other countries, due partly to circumstances in the country, stakeholder engagement was developed more informally on a one-to-one basis through contact by Ministry officials or the consultants engaged in the process of developing the planning.
Stakeholder Engagement in Nigeria

In Nigeria, the National SLCP Planning process was coordinated by the Climate Change Division in the Ministry of Environment. At the start of the process, representatives from all key ministries, departments and agencies (MDAs), the private sector, and civil society groups were convened for a stakeholder engagement workshop. The aims of the National SLCP Planning process were outlined and the contribution that each stakeholder could make was described. Desk officers were identified in each MDA with responsibility for engaging in and providing input to the National SLCP Planning process from that MDA. The early engagement of each stakeholder, and the identification of a responsible person at each MDA created a clear line of communication with key stakeholders that could be relied upon throughout the whole National SLCP Planning process.

This early engagement of key stakeholders provided the basis for input and engagement of MDAs and other implementing agencies throughout the national SLCP planning process. In particular, following the identification of mitigation measures to mitigation air pollution and climate change in key sectors, each MDA was sent a draft copy of the National SLCP Planning document, and requested to provide feedback, from their perspective, on:

1. Measures included in existing plans that could reduce SLCPs, GHGs, and air pollutants
2. Additional measures that could also reduce SLCPs, GHGs and air pollutants
3. Current activities, plans, and strategies in your organisation that are relevant for implementation of measures to reduce emissions in the sector.
4. Additional actions to increase implementation of measures nationwide are needed.
5. Using the suggested implementation pathways in the draft report as a base, suggest the best implementation pathways and strategies to achieve emission reductions relating to your sector.
6. The challenges/barriers that may present themselves in the process of implementing the measures and what do you think could be done to solve/overcome the problems/barriers?
7. Actions to mainstream SLCPs abatement activities in your sector into governmental system?

The MDAs provided detailed written and oral contributions before, during and after peer-review workshops, that were incorporated into the final Action Plan, creating a nationally owned plan with buy-in from all major stakeholders. Further guidance on stakeholder engagement is provided in Annex 6.
### STEPS: Raising Awareness about SLCPs

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<th>Step 2</th>
<th>Raising Awareness about SLCPs</th>
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| **Key Aims** | ● Ensure key stakeholders are aware of opportunity for simultaneous air pollution and climate change mitigation through implementation of specific mitigation measures;  
● Ensure that tailored country-specific narrative for integrated air pollution and climate change is clearly communicated as the national SLCP planning process progresses (i.e. country-specific measures, emission reduction potential, benefits and actions to achieve them are communicated to stakeholders needed for implementation) |
| **Key Questions** | ● What is the key information that different stakeholders need to be motivated to take action on integrated air pollution and climate change mitigation?  
● How can outcomes from analysis of SLCP, GHG and air pollution source sectors, priority measures, emission reductions, benefits assessment, and implementation pathways be effectively communicated to different stakeholders? |
| **Key Challenges** | ● Developing country-specific analyses of integrated air pollution and climate change mitigation opportunities to develop a tailored national narrative on how to integrate air pollution and climate change mitigation in the country.  
● Identifying what outputs and messages will be most effective in engaging different stakeholders to engage and take actions as part of the National SLCP Planning process. |
| **Key Outputs** | ● Communication materials outlining country-specific narrative on integrated air pollution and climate change mitigation  
● All key stakeholders engaged and motivating to take action to implement integrated air pollution and climate change strategy. |

The opportunity to achieve considerable climate, air pollution and development benefits by implementing a set of specific measures may not be widely known by stakeholders in a country, even among those who are directly engaged in climate change and air pollution planning. The process of preparing national planning is a great vehicle for increasing awareness on near-term climate change and air quality in a country, and one important function of the process of national planning is to increase awareness inside the country on these issues and the benefits through consultation with different ministries, stakeholders in different sectors, NGOs and academics.

The process of stakeholder engagement will provide a platform for awareness raising about short-lived climate pollutants (SLCPs), and integrated air pollution and climate change mitigation. This can be enhanced by distributing communication materials before, during and after meetings. In doing this, countries can get help from the SNAP partners and implementers and the CCAC more generally.

Broader awareness raising is also important – to engage with different stakeholders not directly involved with the national SLCP planning process, yet are still important for progress to be made. During the planning, a media strategy is important, and stakeholder meetings provide a focus for media attention to the issue. The CCAC can provide materials which can be used to help countries to develop their awareness-raising as part of the national SLCP planning process.

Raising awareness is an on-going process that can be done through the national SLCP planning process. Initially, awareness raising and stakeholder engagement may be based on generic materials that explain in general the opportunity for multiple climate and clean air benefits from taking specific actions. However, as the national SLCP planning process develops through Steps 3-6, it becomes possible to develop and communicate an increasingly country-specific message about the particular
mitigation measures that should be prioritised in the country to mitigate air pollution and climate change. This national story can communicate the SLCP, GHG and air pollutant emission reductions, and the expected air pollution and climate change benefits expected from the implementation of these measures. It can also communicate the key actions that stakeholders need to take to increase the implementation of these measures.

In addition to developing a more focussed, country-specific narrative on the benefits of air pollution and climate change, awareness raising activities should also be tailored to engage different stakeholders. For example, a climate change division may be most interested in the contribution that mitigation measures with climate change and air pollution benefits make to achieving GHG emission reduction targets described in their Nationally Determined Contribution (NDC). The Ministry of health may be more interested in the health benefits from reducing air pollution exposure in the country. Other stakeholders may be more interested in the associated development benefits, job opportunities, of the contribution that the mitigation measures can make to sectoral plans or the national development strategy. The key point is that the national SLCP planning process should identify a set of mitigation measures which can achieve all of these goals, and through the planning process information should be developed to raise awareness and engage all of these stakeholders to motivate a wide coalition of actors to promote and take actions for their implementation.

Raising Awareness on integrated air pollution and climate mitigation in Peru

As part of the National SLCP Planning process in Peru, substantial attention was invested in developing effective communication materials so that the benefits of integrated air pollution and climate change mitigation could conveyed to key stakeholders. This includes the development of a website (http://www.aireyclimaperu.com/), and communication materials from the key results from national analyses of SLCP, GHG and air pollution sources and mitigation measures (see below). These communication materials provided the basis for raising awareness and engaging with key ongoing climate and air quality processes in Peru, including the Multisectoral Working Group for the implementation of the NDC.
### Step 3: Assessing SLCPs in the National Context

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<th>Assessing SLCPs in the National Context</th>
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| **Key Aims** | • Identify main sources of SLCP, GHG and air pollutant emissions to identify target sectors for simultaneous air pollution and climate change mitigation  
• Identify existing plans, strategies, regulations and activities that are being undertaken in the country that are relevant for air pollution and climate change mitigation |
| **Key Questions** | • What analytical tool will be used to estimate emissions and scenarios of SLCPs, GHGs and air pollutants?  
• How will analysis of major emission sources be linked to existing emission inventories (e.g. GHG inventory)?  
• What activities are being undertaken for climate change planning that are relevant for integrated air pollution and climate change mitigation?  
• What activities are being undertaken for air quality planning that are relevant for integrated air pollution and climate change mitigation?  
• What activities are being undertaken under national development planning that are relevant for integrated air pollution and climate change mitigation?  
• What activities are being undertaken under sectoral plans that are relevant for integrated air pollution and climate change mitigation? |
| **Key Challenges** | • Availability of activity and emission factor data to estimate emissions of SLCPs, GHGs and air pollutants  
• Data that can be used to develop emission scenarios  
• Ensuring acceptability of emission inventory results and alignment with existing emission inventory activities  
• Ensuring sustainability of emission inventory revision and updating so assessment of major sources continues to be revised and improved |
| **Key Outputs** | • Emission inventory quantifying magnitude of SLCP, GHG and air pollutant emissions from all major source sectors  
• Business-as-usual scenarios for emissions of key SLCPs, air pollutants and GHGs that can be used to estimate the likely progression of emissions and act as a reference scenario to which mitigation scenarios can be compared  
• An understanding of all activities being undertaken in the country relevant for integrated air pollution and climate change mitigation |

This step is needed to map existing knowledge that is relevant for developing integrated air pollution and climate change strategies in each country. The framing of the SLCP issue can help to initiate this, as many of the main SLCP sectors and emission sources are already known, and are also sources of GHGs and other air pollutants. They are therefore relevant for the development of an SLCP strategy. For example, cooking indoors using biomass is an important source of black carbon, as are diesel vehicles. The initial baseline assessment should collect information relevant to these sources and itemise the current situation, knowledge on emissions and any relevant plans or legislation.

It is also important during this step to understand more broadly the plans, strategies and activities that are being taken already in the country that will affect emissions. This include the current status of climate change planning, air quality planning, and sectoral plans in major source sectors. Understanding the mitigation measures and activities being promoted in existing plans is important because:
- SLCP-focussed mitigation measures may already be included within these existing plans
- The mitigation measures identified to reduce greenhouse gases as part of climate plans may also reduce air pollutants
- The mitigation measures identified to reduce air pollution as part of an air pollution strategy may also reduce greenhouse gases and SLCPs
- Processes for stakeholder engagement, monitoring and evaluation, resource mobilisation, reporting and communication and raising awareness may already be in place as part of these ongoing planning processes. They could be used for national SLCP planning and avoid duplication and setting up parallel processes with substantial overlap.

During this step, countries also need to develop a quantitative assessment of emissions from key sources in order to quantify the benefit of implementing SLCP strategies. Some countries may already have comprehensive emission inventories, but most developing countries will have patchy emission inventories and this can hamper the assessment of impacts and benefits and limit the promotion of action in a country.

**Baseline assessment of information relevant to SLCPs**

During this initial part of the national planning process, countries can usefully undertake a baseline inventory of information about SLCPs, and GHGs and air pollutants, and relevant sectors producing them. This assessment can include an inventory of source material that can inform the national planning process, mapping of responsibilities for the different sectors producing SLCP, GHG and air pollutant emissions, and identifying policies and programmes that have been undertaken in the country that are relevant to integrated air pollution and climate change mitigation. The following questions can help develop this information:

- What relevant written material exists about SLCPs, sources and control measures in your country, region or internationally?
- Which institutions are involved with air pollution and climate change issues?
- What are the relevant initiatives for air pollution and climate change mitigation?
- What data exists that can be used to characterise the SLCP issue?
- What plans and strategies (i.e., Climate Change Action Plan, Nationally Determined Contribution (NDC), Low Emission Development Strategies (LEDs), air quality management plans etc.) exist that SLCPs, and integrated air pollution and climate change mitigation, could be mainstreamed into?
- What existing legislation, policies, programmes, strategies or projects are relevant to SLCP, GHG and air pollutant mitigation?
- Which institutions are responsible for the sectors where mitigation measures would be implemented?

The baseline assessment needs to include information on the current situation in any country regarding SLCPs including a review of existing literature, various action plans, policies, laws etc. of each country. The result should be an initial understanding of the main emitting sectors involved, a compilation of existing data / reports and other information that can be used for SLCPs, and identification of gaps, on-going activities etc. During the baseline assessment, the country needs to consider the overall planning context and compile information on development programmes, project and policies / legislation that are relevant to SLCPs, and also plans and strategies in the surrounding region.

It is also important to start developing an understanding of the progression of SLCPs, GHGs and air pollutant emissions into the future – compiling information with regard to on-going initiatives to reduce emissions, particularly existing initiatives with the potential to be scaled up. At this stage, it is also important for the country to begin to identify gaps in planning with regard to SLCP-related emissions.
Estimating the contribution of different sources to SLCPs

SLCPs come from incomplete combustion, methane and HFC emissions from different sources, many of which are also sources of GHGs and air pollutants. The sources that are relevant in each country need to be identified, and quantitative estimates of the SLCP, GHG and air pollutant emissions for all relevant substances need to be made in order to identify the relative importance of the different sources in the country. This needs to be undertaken for a recent year where there is sufficient data. In addition, the progression of emissions over time also needs to be estimated, as any benefit of emission reduction will be realised in relation to the emissions that are expected in the absence of reductions in any year. Ideally, emissions from more than one historical year would be estimated in order to look at trends. For some countries, the emissions of certain pollutants or all emissions in certain sectors may already have been estimated by various projects or programmes (e.g. from an official greenhouse gas emissions inventory developed as part of climate planning). In other cases, no emission estimates will be available or they may only have partial coverage. In these situations, the LEAP-IBC tool can be used to estimate emissions and scenarios.

Each country needs to understand the relevant sources of emissions that give rise to SLCPs, GHGs and air pollutants, as any air quality and climate benefit from taking actions to reduce emissions from a particular sector will be based on the extent to which all emissions (SLCPs, GHGs and air pollutants) are reduced. When developing estimates of emissions from different sources, it is important to consider how any new analysis will link to existing emission inventory efforts that are generally undertaken within a country, e.g. the development of a greenhouse gas inventory and/or an air pollution emission inventory.

Linking to inventories that have already estimated emissions of GHGs or air pollutants provides a consistent basis for comparing the relative emissions of these substances. This results in greater efficiency, as much of the activity data required to estimate emissions of SLCPs is in many cases the same as for a GHG or air pollution inventory and greater acceptability because the estimate of SLCP emissions is based as much as possible on official or widely accepted data. In addition, linking an SLCP emission inventory to existing emission inventories will lead to better understanding of the impact of SLCPs on air quality and climate.

Annex 1 provides a description of the major sources of short-lived climate pollutants, including methane, black carbon and hydrofluorocarbons. See Annex 2 and 5 for a description of the LEAP-IBC tool that can be used to estimate emissions and emission scenarios. Annex 3 provides details of the data that are required to populate the LEAP-IBC to calculate emissions.

Estimating SLCP, GHG and air pollutant emissions

To estimate the relative importance of different SLCP-relevant sources in a country, and the magnitude of SLCP, GHG and air pollutant emissions, the first stage is to develop an emission inventory of one, or preferably more than one, historical year for which data are readily available. Having more than one year means that historical trends can be picked up and help in the development of scenarios later on.

The basic method of estimating emissions is simple -- multiply an activity variable (e.g., fuel used each year, km travelled etc.) by an emission factor (average emission of a substance per unit of activity). The challenges will be the availability of activity data and appropriate emission factors.

For some sources it is appropriate to have more detailed methods. This is especially true for the transport sector where the speed, terrain, level of maintenance of vehicles, turnover of the fleet, etc., all affect emissions. However, there are also considerable uncertainties for other sectors, such as emissions from burning wood or other biomass from different cookstoves, where the fuel quality and condition (e.g., moisture content), as well as the design of stove where it is burnt all affect emissions.
The international community has considerable experience in developing emission inventories and this experience can be used to develop a reasonable picture of the emissions from different sectors to identify the important sources in a country for SLCP mitigation. A range of methods also exist for estimating uncertainty and explaining or illustrating this uncertainty to policy makers.

In SNAP, all countries that have participated thus far have used LEAP-IBC to estimate historical emissions (e.g., for 2010) and future emissions (for 2030 or 2040) under different scenario assumptions, e.g., ‘business as usual’. The tool has a tree structure that includes all major emitting sectors and branches for each fuel and technology combination. For each fuel/technology combination there is a default emission factor and a place for the relevant activity data to be input. Once the data are input to LEAP-IBC, the resulting emissions are aggregated and can be shown in terms of emissions by sector / fuel / technology for the given year. A large part of developing the emissions is to compile the activity data by sector / fuel / technology.

Annex 3 shows a list of required data for the emission inventory. If data are missing, then estimates can be put in. It is important at all stages to document the sources of all data and any assumptions / best guesses that are made so that these can be traced, understood and modified in subsequent improvements of the inventory. The resulting emissions are for all relevant substances (BC, OC, CH$_4$, other PM$_{2.5}$, NMVOC, NO$_x$, SO$_2$, CO$_2$, NH$_3$). The results may be shown for individual substances or may show more than one substance.

If a comprehensive inventory of air pollutants and GHGs does not exist then the country will need to decide whether they would prefer to:

- undertake a comprehensive inventory;
- undertake a targeted inventory to understand emissions from sources that are likely targets for reducing emissions through the implementation of likely priority measures.

The LEAP-IBC tool developed specifically for the CCAC national planning can be used to estimate emissions. Alternatively, countries may have emission inventory and assessment tools at their disposal, and these could be modified and used.

The emission inventory will enable the country to identify relevant sources with presentation of: (i) emissions of SLCPs, GHGs and air pollutants and current trends in emitting sectors (taking into account current legislation relevant to emissions, efficiency trends in key processes, driving forces in key sectors, etc.); (ii) ‘business as usual’ scenarios; (iii) Mitigation scenarios to inform prioritisation of potential measures and (iii) identify knowledge and data gaps.

Key questions include:

- Is there an air pollution emission inventory? Can the data be accessed?
- Is there a GHG emission inventory? Can the data be accessed?
- Can the data in the data sheet in Annex 3 be provided from national bodies? Or could international data be used?
- How are the emissions distributed in your country? (identify location of point sources; identify the main factors controlling the location of emissions and how they are related – e.g. in urban centres, in relation to urban / rural population, regional GDP, line sources – i.e. roads, etc.).
Assessment of major SLCP, GHG and air pollutant sources in Togo

As part of the national SLCP planning process in Togo, the LEAP-IBC tool was used to develop a comprehensive emission inventory covering all major source sectors of short-lived climate pollutants, greenhouse gases and air pollutants. Activity data was obtained from official national sources such as the GHG emission inventory developed as part of the climate planning processes. In the absence of nationally-derived emission factors, default emission factors for SLCPs, GHGs and air pollutants were used to estimate emissions of these pollutants using a common methodology. The default emission factors can be viewed and downloaded from the LEAP website (https://energycommunity.org/default.asp?action=IBC).

The result, shown below, is a comprehensive overview of the major sources of SLCPs, GHGs and air pollutants in Togo, from which key source sectors can be identified as being necessary to achieve integrated air pollution and climate change mitigation. The analysis shows that the residential sector is a major source of SLCPs (black carbon) and other air pollutants (particularly particulate matter), transport is a major source of SLCPs, (black carbon), GHGs (CO₂) and air pollutants (nitrogen oxides), and charcoal making, waste, and agriculture are also key sources of SLCPs, GHGs and air pollutants.

Contribution from major source sectors to SLCPs, GHGs and air pollutant emissions in 2010 in Togo

![Image showing contribution from major source sectors to SLCPs, GHGs and air pollutant emissions in 2010 in Togo]
STEP 4: Identifying Opportunities to address SLCPs and achieve air pollution and climate benefits

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| Key Aims | • To quantify the SLCP, GHG and air pollution emission reduction potential from mitigation measures included in existing climate change, air pollution, development and sectoral plans  
  • To identify gaps and opportunities for further air pollution and climate change mitigation based on identification of source sectors not considered in current plans or source sectors where further mitigation could be achieved  
  • To identify specific mitigation measures to reduce SLCPs, GHGs and air pollutants to increase mitigation ambition in addition to current plans  
  • To model the emission reduction potential of the additional mitigation measures  
  • To estimate air pollution health, crop yield and climate benefits from the implementation of current and additional mitigation measures |
| Key Questions | • What mitigation measures are included in current climate, air quality, development and sectoral plans that will affect emissions of SLCPs, GHGs and air pollutants?  
  • What information is available about targets and timelines for implementation of current mitigation measures?  
  • What additional mitigation measures could reduce emissions from source sectors not covered in current plans?  
  • What additional mitigation measures could increase emission reduction in major source sectors that are considered in current plans? |
| Key Challenges | • To identify a target and timeline for implementation of the current and additional mitigation measures so that it can be modelled  
  • Identification of nationally appropriate mitigation measures in key source sectors that are not included in current plans  
  • Ensuring robustness and acceptability of analysis of emission reduction potential and air quality and climate benefits of mitigation measures |
| Key Outputs | • Integrated analysis of air pollution and climate change benefits from implementation of current plans, and additional mitigation measures. |

This step aims to identify mitigation measures that can achieve climate change mitigation and air pollution abatement, through the reduction of SLCPs, which affect both air pollution and climate change, or through simultaneous reduction of greenhouse gases, air pollutants and SLCPs by targeting common sources. For the sources of SLCPs other than HFCs, the net climate effect of specific emission control measures, especially related to sources of black carbon, can be positive or negative. This is because in some cases sources emit many different pollutants to the atmosphere, some of which warm and some of which cool the atmosphere. Therefore, the approach to identifying these measures needs to reflect the mitigation measures that are already included in current plans so that i) the extent to which current plans achieve air pollution and climate change mitigation goals quantified, and ii) so that gaps and additional mitigation measures can be identified that target source sectors that are not currently considered or that increase ambition beyond current plans in a particular source sector.

The analysis that is conducted to evaluate the SLCP, GHG and air pollution emission reduction potential of mitigation measures should therefore:
● Compile a database of existing mitigation measures including in current plans (e.g. climate change, air pollution and/or sectoral plans), including a specific target and timeline for implementation. This should be done during Step 3.

● Model the SLCP, GHG and air pollution emission reduction potential of these current measures based on the targets and timelines outlined in current plans.

● Identify the major sources of SLCP, GHG and air pollutant emissions that remain after the implementation of current plans, including sources where no mitigation measures have been identified, and those sources where additional mitigation could be achieved.

● Identify additional mitigation measures that address sources of SLCPs, GHGs and air pollutants in the major source sectors not addressed by current plans.

● Model the SLCP, GHG and air pollution emission reduction potential of these additional mitigation measures.

Identifying additional SLCP measures

The UNEP/WMO Assessment identified those measures that had the main impact at global scale (these measures are described in Annex 4), but at the national scale other sources may be more significant. The key issue is to identify those additional measures that fulfill the criteria of reducing warming and providing benefits to air quality. Any measure that mainly reduces methane alone can be included in the mix of measures that can be assumed to reduce warming and have air quality benefits. For measures reducing incomplete combustion, analysis similar to the UNEP/WMO (2011) report would need to be undertaken to ensure that the emission reductions achieved through implementation of the measure would result in a net climate benefit. Such a procedure would need to consider the change of emissions of all co-emitted substances and estimate the net climate impact considering the GWP of each gas emitted. Assessing the air quality benefit would generally be easier if the measure reduces primary particulates, emissions that lead to secondary particulate matter or precursors of tropospheric ozone.

As a shorter step, it will be possible in some cases to assume that some measures would be equivalent to other measures already identified. For example, replacing diesel vehicles with electric vehicles would have a similar impact on black carbon emissions to retrofitting a diesel vehicles with diesel particle filter (DPF) or introducing EURO VI standards for new diesel vehicles. However, electric vehicles would have zero emissions of other pollutants. Over the overall impact on emissions would then depend on how the electricity is generated in the country. The overall impact of such a shift can be modelled in the integrated assessment capability of LEAP-IBC.

Developing Business-as-Usual emission scenarios as a ‘Reference’ to compare with mitigation scenarios

Planning for SLCP mitigation requires an understanding of what emissions changes from SLCP-relevant sources are likely to be in the future. If emissions from a source are likely to be reduced by current trends in factors driving those emissions (including current and planned legislation) and without further interventions, there may be no need to prioritise measures that reduce emissions from these sources. On the other hand, some sources that are currently unimportant could grow significantly in the future. Therefore, the estimated change in emissions from such sources into the future according to a ‘business as usual’ case or a ‘reference’ scenario needs to be compared with scenarios where additional action is taken to reduce emissions (i.e. mitigation scenarios), in order to understand where there are opportunities for further emissions reductions to address air pollution and climate change.

The word ‘Scenario’ means a plausible alternative state of the future. A scenario involves the understanding of how trends, driven by certain driving forces (e.g. social, demographic and technological) can evolve with high or low degree of certainty. A scenario building process is the
exercise of building, exploring and assessing different visions of the future and is a strategic tool for making and guiding decisions. Each scenario is one alternative image of how the future might unfold. The ‘reference’ scenario, or scenarios if so desired, that can be used to inform the national planning represent likely development in the main emitting sectors. Figure 3 shows the relationship between socio-economic drivers affecting the development of sectors, policy measures that will affect the volume of activity and introduction of technical measures affecting emission factors.

Figure 3. Development of scenarios – the relationship between socio-economic factors affecting emitting sector development, the impact of policies and measures on the volume of activity and the influence of policies or global trends that introduce improved and low emission technological measures. By developing knowledge of the progression of these over time, reasonable emission scenarios can be developed.

The development of scenarios entails different levels of uncertainty, and methods look at trends in those social, economic and technological factors that are important for each emitting source relevant to SLCPs, GHGs and air pollutants. There are some overarching socio-economic trends that are likely to affect all emissions in some way. These include changes in population and changes in purchasing power and wealth. In the pilot phase of SNAP, most countries have used simple relationships between GDP, population and the development of emissions in key sectors, incorporating different elasticities for different sectors.

However, for any particular source there are likely to be driving forces specific to that sector. This would include preferences for the purchase and use of diesel vs. petrol cars in different countries, or whether people prefer brick buildings as opposed to concrete, wood or other materials. For point sources, such as methane from coal mines, any plans to close the mine if reserves become depleted will clearly affect emissions in the country. And of course the trends in technology used in a sector will affect emissions.

For any particular source there will be a relationship with key drivers that could be used to estimate the development of the sector and change in emissions into the future. The difficulty is to understand the extent to which the drivers affect emissions. This will also vary by country and understanding how a sector will change will be of the aspects that the country will need to undertake. Table 3 shows examples of likely drivers that will affect different sectors.
Table 3 Examples of drivers affecting the progression of emission in selected sectors and emission sources

<table>
<thead>
<tr>
<th>Emission source</th>
<th>Factors and driving forces affecting development of emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Economic: GDP – as a country gets richer, people purchase more vehicles and more goods are transported by trucks; energy prices affect activity rates; trends in national and international trade. Population: km travelled and number of cars is affected by population. Technological: Engines are improving and emissions of newer vehicles are lower; fuel quality is also improving. Social change: Rate of urbanisation and industrialisation; lifestyles affecting transport behaviour; awareness of environmental issues affecting policy; fuel preference. Stock turnover rates: Rate of retirement of old trucks / buses and penetration of newer technology. Legislation and policy: Urban planning, transport planning, fuel pricing, inspection and maintenance and vehicle / emission regulation all affect emissions.</td>
</tr>
<tr>
<td>Brick kilns</td>
<td>Economic: As people get richer, household size decreases so more houses will be built. Population: As population increases more buildings are needed. Technological: Brick kiln design and technician capability will affect emissions. Social change: Desire for bricks or other building materials will affect brick production. Stock turnover rates: Lifetime of kilns affect how rapidly new design are adopted. Legislation and policy: Any laws on design and technology will affect emissions.</td>
</tr>
<tr>
<td>Residential cooking</td>
<td>Economic: Wealth influences the fuels that people use – increased wealth usually means moving away from high emitting fuels. Population: To be completed.</td>
</tr>
</tbody>
</table>

Stages in the development of scenarios

To estimate likely changes in emissions from different sectors required developing the reference scenario, the following steps can be used:

1. List key factors that affect decisions about the development of emission from the sectors;
2. List the driving forces (can be primary – increase in brick demand; or secondary – population growth, GDP, equity development over time..... etc.);
3. Rank the key factors and trends (in terms of importance to the emissions development);
4. Develop a story-line concerning the most important factors and their trends;
5. Develop the implications: what do the trends in factors mean for the emissions from a sector;
6. Develop quantitative relationships between the driver and the variable in LEAP-IBC to model the change.

Once the relationships between the most important driving forces and the different source sectors have been established, and the story lines for the likely development of emissions from each source has been developed, the emission scenarios can be developed, using the LEAP-IBC tool if desired. The resulting ‘reference’ scenario describing the overall development in emissions from all sources can then be used as a reference against which further action on SLCPs can be measured.

Developing analyses of different policy scenarios

Having developed baseline or business-as-usual scenario, as a reference against which mitigation scenarios can be assessed, there are then different methods by which different policy scenarios can be developed as part of the analysis. Important considerations when evaluating different policy scenarios are i) that the assessment of SLCP mitigation measures is not done in isolation from existing policies and measures that are considered in current plans in the country, and ii) that the analysis considers a
wide range of mitigation options and the potential that could result from implementing additional actions to reduce SLCPs, and simultaneously improve air quality and mitigate climate change.

One approach that can achieve both of these goals is to first develop scenarios that reflect changes from the reference scenario as a result of the successful implementation of already agreed policies and measures that the government will implement that will affect emissions. For example, the government may have an energy efficiency plan, a plan for the electrification of rural areas, or other development plans and measures that, if implemented as has been committed to, would change the overall emissions from the country. Modelling the implementation of these existing policies and measures allows i) the benefits of already agreed government actions to be quantified and ii) the benefit of additional measures on top of existing policies and measures to be estimated. To do this, for each sector a review of existing government policies and measures is required, and each policy and measure should then be translated into a specific target for each sector, with a time frame for implementation.

In addition to already agreed policies and measures, many countries are also developing, or have developed air quality plans or climate change strategies, in particular their Nationally Determined Contribution (NDC). The actions included in the NDC represent measures that in some cases could affect emissions of SLCPs or air pollutants, in addition to reducing greenhouse gas emissions, due to the common sources of GHGs, SLCPs and air pollutants. Hence, in addition to assessing the effect of already agreed policies and measures, in many cases it is also very useful to model the emission reductions and changes in air quality and climate impacts that would result from the implementation of the actions included in the NDC, air quality strategy and/or sectoral plans. Evaluating this scenario can also identify the gaps and source sectors that are not adequately considered in current plans, and for which additional mitigation measures could be proposed. In addition, this provides the basis for assessing the benefits from implementing additional actions targeting SLCPs, over and above the benefits that could result from implementation of the measures that have already been agreed in the country, and those that have been proposed as part of the country’s climate change mitigation commitments contained within their NDC.

Next, scenarios can be created that look at the effect of implementing additional mitigation measures. A wide range of mitigation measures could be considered across a range of sectors, including increasing the ambition of mitigation in sectors that are considered in current plans, as well as mitigation measures implemented in sectors that are not being considered in current plans. By considering the full implementation of all of these additional SLCP-relevant measures, a ‘maximum feasible reduction’ scenario can be created to evaluate the maximum additional benefit on top of current plans that could be achieved.

**Estimating the benefits of implementation of the identified measures**

In order to estimate benefits, the emissions reduction resulting from the implementation of the different scenarios can be used to estimate the health, crop yield and climate benefits. There are standard methods to do this and these are included in LEAP-IBC developed for the CCAC National Planning activities by SEI and US EPA (see Annex 1).
Assessing the SLCP, GHG and air pollutant benefits from policies and measures in Ghana

As part of the modelling developed for Ghana’s National SLCP Plan, the SLCP, GHG and air pollutant emission reduction, and air quality and climate change benefits were estimated for a number of different scenarios, including: i) a reference scenario without current policies and measures (PAMs), ii) Current policies and measures (PAMs) that have been agreed and will be implemented, and iii) full implementation of NDC actions. After identifying the major sources of SLCPs not covered by current policies and measures or measures included in Ghana’s NDC, a final scenario assessed the benefits from implementation of four additional measures that target major SLCP source sectors. This allowed the increased ambition of the measures included in the national SLCP plan can be quantified in the context of the other actions being proposed in the country related to climate mitigation, air quality management and sustainable development.

An example output from this analysis in Ghana is shown below, which shows the progression of black carbon emissions for the reference, current policies and measures, NDC actions and SLCP priority measure scenarios. By modelling currently agreed policies and measures, and the NDC actions, it shows that implementation of these actions could reduce black carbon emissions by over 50% compared to the reference scenario in 2040. It also shows clearly the increased ambition from implementation of the additional SLCP-focused measures identified, an additional 35% reduction in black carbon emissions above what could be achieved from implementation of the NDC actions and current policies and measures. The analysis also allows showed the reduction in other SLCPs (methane), GHGs (CO₂) and other air pollutants that could result from the implementation of these measures, as well as the overall estimated benefits to air pollution health and crop yield impacts, and the reduction in Ghana’s contribution to climate change.

Black carbon emissions in Ghana between 2010 and 2050 for the reference scenario (Current PAMs (policies and measures) failure), for implementation of current PAMs (Current PAMs success), implementation of NDC actions (Additional PAMs+) and implementation of additional SLCP actions (Additional PAMs++ (SLCP)).
## STEP 5: Developing national priorities and implementation pathways for mitigation measures

<table>
<thead>
<tr>
<th>Step 5</th>
<th>Developing National Priorities for SLCP Abatement</th>
</tr>
</thead>
</table>
| Key Aims | • To identify those mitigation measures that achieve simultaneous air pollution and climate benefits that should be prioritised for implementation based on national circumstances.  
• To identify the implementation pathways for air pollution and climate change mitigation measures accounting for i) barriers to implementation, ii) cost, iii) ease of implementation, and iv) speed of implementation.  
• To identify specific actions that need to be taken to increase implementation of climate change and air pollution mitigation measures  
• To identify linkages to existing planning processes that can facilitate implementation of mitigation measures |
| Key Questions | • What activities under existing plans and processes can facilitate implementation of mitigation measures to achieve air pollution and climate change mitigation?  
• How can mitigation measures be mainstreamed into existing plans and processes?  
• What additional actions need to be taken to increase implementation of mitigation measures?  
• Who needs to be involved in actions to implement mitigation measures?  
• What resources are needed to implement each action? Are these available under current activities or are additional technical, human and/or financial resources needed? |
| Key Challenges | • Quantifying the cost of implementing particular mitigation measures  
• Identifying key barriers to implementation of measures and how they can be overcome  
• Identifying actions being taken under existing activities that will contribute to implementation of measures  
• Identifying additional actions that are needed to increase implementation of mitigation measure |
| Key Outputs | • List of priority mitigation measures to achieve simultaneous air pollution and climate change mitigation  
• Identification of implementation pathways for priority air pollution and climate change mitigation measures  
• List of key actions to be taken forward for implementation of mitigation measures with air pollution and climate change mitigation potential |

In order to develop national planning to reduce SLCPs, priorities for national action on some key measures are required. In order to define these priorities, the major emitting sectors have already been identified in STEP 3, both historically and for scenarios at different points in the future. The measures that are relevant to the country, and the benefit that would be likely to be realised if the relevant measures were fully implemented/partially implemented in the country have been described in STEP 4. These results can help to set priorities for abatement by highlighting those sectors that give rise to the most significant emissions and measures that provide the largest benefits. However, they do not give all of the information required to set priorities. Other more practical factors must then be considered when deciding what can realistically be achieved and over what timescale.
Setting strategic policy priorities is ultimately a judgement for ministers, but this can be supported by relevant information on the opportunities, constraints, costs and timescales associated with each of the emitting sectors and available mitigation options. For any country to set priorities, additional information is required about:

- major barriers to the implementation of the relevant measures;
- an inventory of processes, institutions, planning and policies relevant to the implementation of relevant measures;
- assessment of lag times from identification of a problem, decision to do something about it, and the actual implementation and emission reductions;
- costs of implementing the policy or strategy and costs of the measure itself.

From an analysis of these factors, stories for the implementation of the measures can be developed and implementation pathways for the different measures identified. This can be done as a sector by sector, measure-by-measure assessment of opportunities and constraints, and as a basis for identifying a mitigation strategy for each of the relevant areas. In circumstances where resources and time are inevitably limited, some broad judgements of priority as between sectors and measures have to be made. This can be informed by the stakeholder engagement process.

The aim of this step is to move from analysis of the emission reduction potential of mitigation measures to achieve air pollution and climate change mitigation to practical, concrete actions that can be taken to increase implementation of the most important of these mitigation measures. To identify these actions requires that an assessment is made of the barriers to implementation, the cost and speed of implementation, and identify current activities, regulations, plans and strategies where actions could be taken to support implementation of integrated air pollution and climate change measures. The following section describes the key considerations when formulating a concrete set of actions that can be taken forward to implement the priority mitigation measures.

**Assess barriers to implementation**

There may be barriers to the implementation of key measures for a variety of reasons, either due to financial, technical, institutional or other reasons. Examples of barriers related to the different measures, as well as enabling activities to overcome them are included in Table 4. As countries undertake their national planning, further barriers specific to these countries may be identified, such as:

- lack of equipment to monitor emissions from vehicles as required by policy;
- increased operation and maintenance costs of moving from one fuel to another (e.g. to CNG from diesel);
- awareness of the importance of issues in key ministries;
- lack of data for emissions from new technology (e.g. new cookstove designs);
- upgrading laws on emission standards;
- lack of cost-benefit information (e.g. for coal-bed methane extraction);
- limited data (e.g. on venting of methane from coal mines); and
- lack of capacity in the private sector (e.g. to measure methane leakages etc.).
Table 4 Example of major measures, barriers and enabling reforms available to facilitate implementation of the package of 16 SLCFs mitigation measures (Source: UNEP 2011)

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Measures</th>
<th>Barriers</th>
<th>Enabling activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential combustion</td>
<td>Fuel switching</td>
<td>● High fuel and technology costs</td>
<td>● Tax incentives, subsidies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Limited fuel supplies</td>
<td>● Facilitated access to alternative fuels</td>
</tr>
<tr>
<td>Improved cookstoves</td>
<td></td>
<td>● Low awareness of health impacts of established cooking practices</td>
<td>● Awareness raising and community outreach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Limited durability of improved stoves</td>
<td>● Improved technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● High cost of technology for the poor</td>
<td>● Subsidies or loans</td>
</tr>
<tr>
<td>Pellet stoves/boilers in</td>
<td></td>
<td>● Lack of awareness</td>
<td>● Public education and outreach</td>
</tr>
<tr>
<td>industrialized countries</td>
<td></td>
<td>● Lack of harmonised standards</td>
<td>● Introduce harmonised black carbon emission standards</td>
</tr>
<tr>
<td>Agriculture and forestry</td>
<td>Banning the burning of agricultural residues</td>
<td>● Weak enforcement of regulations</td>
<td>● Enhanced enforcement capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Awareness raising of alternative uses of crop residues (e.g. composting)</td>
</tr>
<tr>
<td>Intermittent aeration of</td>
<td></td>
<td>● Low stakeholder awareness</td>
<td>● Outreach and demonstration projects</td>
</tr>
<tr>
<td>rice paddies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions from manure</td>
<td></td>
<td>● Farms too small for anaerobic digestion</td>
<td>● Co-operation between farms</td>
</tr>
<tr>
<td>(farm-scale anaerobic</td>
<td></td>
<td>● Adherence to traditional practices</td>
<td>● Outreach and demonstration projects</td>
</tr>
<tr>
<td>digesters)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methane emissions from</td>
<td></td>
<td>● High costs of modified feed</td>
<td>● Economic incentives</td>
</tr>
<tr>
<td>livestock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial processes</td>
<td>Cleaner and more efficient brick kilns</td>
<td>● Limited access to finance and skilled personnel</td>
<td>● Economic incentives</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Capacity building &amp; training</td>
</tr>
<tr>
<td>Modernisation of coke</td>
<td></td>
<td>● Limited community awareness</td>
<td>● Outreach and demonstration projects</td>
</tr>
<tr>
<td>ovens</td>
<td></td>
<td>● Lack of relevant regulation and enforcement</td>
<td>● Issuance of relevant regulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Enhanced enforcement capacity</td>
</tr>
<tr>
<td>Pre-mine gasification</td>
<td></td>
<td>● High upfront investment</td>
<td>● Economic incentives</td>
</tr>
<tr>
<td>Fossil fuel industry</td>
<td>Ventilation air methane oxidation</td>
<td>● Technical constraints</td>
<td>● Improved technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>● Technology transfer</td>
</tr>
<tr>
<td>Recovery of vented methane</td>
<td></td>
<td>● Lack of infrastructure</td>
<td>● Economic incentives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Lack of nearby markets</td>
<td></td>
</tr>
<tr>
<td>Reducing leaks from</td>
<td></td>
<td>● Cost of monitoring and maintenance</td>
<td>● Strengthened regulations and enforcement procedures</td>
</tr>
<tr>
<td>transmission pipelines</td>
<td></td>
<td></td>
<td>● Enhanced enforcement capacity</td>
</tr>
<tr>
<td>Transport</td>
<td>Diesel particle filter</td>
<td>● Unavailability of ultra-low sulphur fuels</td>
<td>● Government regulations to require ultra-low sulphur fuels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removing high-emitting</td>
<td></td>
<td>● Lack of regular inspection/enforcement</td>
<td>● Introduction &amp; enforcement of inspection &amp; maintenance programmes</td>
</tr>
<tr>
<td>vehicles</td>
<td></td>
<td></td>
<td>● Scrappage schemes</td>
</tr>
<tr>
<td>Waste management</td>
<td>Separation of biodegradable solid waste, and generation and recovery of</td>
<td>● High capital costs</td>
<td>● Economic incentives including financial mechanisms</td>
</tr>
<tr>
<td></td>
<td>methane</td>
<td>● Low prices for methane</td>
<td>● Introduction of clear legislation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Complex permitting schemes and liability issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upgrading primary wastewater treatment</td>
<td>● High cost</td>
<td>● Further legislation requiring secondary or tertiary treatment</td>
</tr>
</tbody>
</table>

In each country and for each measure the ways by which barriers may be overcome need to be assessed and described. This assessment of how barriers can be removed to implementation needs to link strongly to ongoing activities that may be working to overcome these barriers. In particular, if implementation of mitigation measures can link to ongoing activities under climate change planning, air pollution mitigation, sectoral strategies and national development plans, then there may be a greater chance that some of the key barriers can be effectively overcome. It is also key to understand the status with regard to the main institutions that have a responsibility or stake in implementing key
measures, as well as understanding the policy environment and on-going programmes which could provide an opportunity for early implementation.

**Identifying regulatory institutions, stakeholders, policies and programmes relevant to implementation of integrated air pollution and climate change measures**

An inventory of processes, institutions, planning and policies pertinent to the implementation of relevant measures needs to be identified. For each relevant measure identified for a country the following questions may be appropriate:

- which decision-making processes in your country are relevant to the implementation of this measure? (e.g., climate policy, air quality management, waste management policy etc...);
- which institutions are involved in the sector, emissions or applying the measure in your country?
- which ministries have responsibility for the sector and its emissions?
- which policies exist for emissions from this sector?
- what are existing relevant government programs?
- which development priorities interface with different SLCP sources and measures?
- what new national initiatives are there?

In addition to policies and legislation, there are regional processes and international initiatives that may be active in the country. These may be directly related to the emissions – such as through the Low Emission Development Strategies initiative and the Global Methane Initiative (GMI) which will address methane and other emissions directly. For some initiatives the linkages are less obvious, yet still affect SLCPs, as well as GHGs and air pollutants. For example, a GEF-funded project to reforest the Sahel requires that on-field agricultural burning of biomass be controlled, to avoid accidental burning of planted forest. Other international initiatives focus on individual sectors – such as the Clean Cooking Alliance. There are also a multitude of projects by bilateral donors, regional banks and the World Bank. Knowing what is going on and learning from these and understanding how the national SLCP planning can best integrate with them is an important part of the national planning process. The following questions can help determine the scope of this potential for help from international initiatives:

- Which regional processes could be used to promote the implementation of different SLCP measures?
- Which international action programmes can support the mainstreaming of SLCP mitigation into the national development process?

**Costs of implementing measures**

The costs of implementing measures is clearly an important step in the decision-making process of any country and important in developing the priorities for action on SLCPs, and GHGs and air pollutants. In many countries the ability to compare costs with benefits is an important part of the decision-making process. However, assessing costs of measures is not an easy task. The measures being discussed are being implemented in many parts of the world already and there is considerable evidence for the derivation of direct costs of a measure – the cost of a cookstove or cost of methane recovery from a coal mine. These costs are relevant in many cases, but for other measures the indirect costs may be more important than, or at least equally as important as, the direct costs. These indirect costs refer, for example, to the cost of implementing a policy or costs of enforcing regulations. Therefore, the success of a cookstove policy may depend more on the cost of awareness raising, capacity building and engagement of the private sector than the cost of the stove itself. Table 6 shows direct costs of different measures from two different perspectives: the social planner perspective with a low assumed discount rate of 4%, where the concentration is on long-term benefit to society, and the private investor perspective, requiring more rapid return on investments where a 10% discount rate is assumed (UNEP, 2011).
Table 6 Overview of costs of methane and black carbon measures. Shown are preliminary cost estimates of methane and black carbon measures in terms of costs per tonne of methane or black carbon. Two cost perspectives are shown, that of the ‘social planner’, and that of the private investor. See text. (Note: these are preliminary cost estimates. The uncertainty is higher for measures related to technologies that are not traded globally) (Source UNEP 2011)

<table>
<thead>
<tr>
<th>Costs per tonne reduced†,§ (social planner’s perspective; global mean value; variation across the regions shown in parentheses)</th>
<th>Equivalent carbon price†,§ (private investor’s perspective; global mean value; variation across the regions shown in parentheses)</th>
<th>Non-climate benefits of measure</th>
</tr>
</thead>
</table>

**GROUP 1: Cost Savings or Low Cost**

<table>
<thead>
<tr>
<th>Cooking and heating with biomass in developing countries:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- clean burning stoves instead of conventional stoves and/or</td>
<td>-10,100 $/t BC (-12,000 to -5,000)</td>
<td>-6 $/t CO₂e (-7 to -3)</td>
</tr>
<tr>
<td>- clean fuel (LPG/biogas) instead of biomass stoves.</td>
<td>-200 $/t BC (-240 to -100)</td>
<td>7 $/t CO₂e (6 to 14)</td>
</tr>
</tbody>
</table>

| Recovery and utilization of vented associated gas during oil production. | -150 $/t CH₄ (-730 to 480) | 70 $/t CO₂e (32 to 92) |

| Separation and treatment of biodegradable municipal waste with no biodegradable waste disposed of to landfill. | -1,650 $/t CH₄ (-1,840 to -1,450) | 29 $/t CO₂e (12 to 53) |

| Replacing coal with coal briquettes in cooking and heating stoves in developing countries. | Approximately zero $/t BC | Approximately zero $/t CO₂e |

| Reduced leakage during gas pipeline transmission. | -190 $/t CH₄ (-259 to 1,120) | 27 $/t CO₂e (21 to 382) |

| Recovery and utilization of vented associated gas during gas production. | -690 $/t CH₄ (-721 to -632) | -7 $/t CO₂e (-8 to -6) |

| Farm-scale anaerobic digestion on large farms with liquid manure management. | -400 $/t CH₄ (-2,320 to -1,250) | 34 $/t CO₂e (17 to 81) |

| Replacing traditional brick kilns with more efficient kilns. | -5,500 $/t BC (-5,600 to -4,400) | -7 $/t CO₂e (-5 to -8) |

**GROUP 2: Moderate Cost**

| Coal mines: oxidation of ventilation air methane including improvements in ventilation air systems. | 280 $/t CH₄ (222 to 2,820) | 13 $/t CO₂e (11 to 137) |

| Coal mines: recovery of pre-mine degasification emissions. | 1,300 $/t CH₄ (500 to 10,500) | 74 $/t CO₂e (37 to 445) |

| Feed changes for dairy and non-dairy cattle. | 1,330 $/t CH₄ (1,090 to 1,880) | 53 $/t CO₂e (44 to 75) |

| Replacing traditional coke ovens with modern recovery ovens. | 190 $/t BC (140 to 500) | 0.4 $/t CO₂e (0.3 to 1.1) |

**GROUP 3: High Cost**

| Euro VI/6 standards (incl. DPF) for heavy duty vehicles | 145,000 $/t BC (120,000 to 200,000) | 300 $/t CO₂e (240 to 410) |

| Euro VI/6 standards for light duty vehicles: | 570,000 $/t BC (225,000-815,000) | 1,400 $/t CO₂e (500 to 2,000) |

| Euro VI/6 standards (incl. DPF) for off-road mobile machinery. | 80,000 $/t BC (36,000 to 150,000) | 180 $/t CO₂e (80 to 350) |

| Intermittent aeration of continuously flooded rice paddies. | 3,160 $/t CH₄ (1,750 to 35,300) | 130 $/t CO₂e (70 to 1,410) |

**Note:** These are preliminary cost estimates. The uncertainty is higher for measures related to technologies that are not traded globally.
The potential speed of implementation of each measure

Once a measure has been identified for a country and considered a priority, the time it takes to develop the appropriate policy or programme for implementation will differ. In some cases, small changes to existing legislation may be possible, or it could be added as an additional concern to existing programmes in a country. In such cases the time from identification of the measure to implementation of the policy may be short. In other cases, the time to implementation may take longer if entirely new legislation needs to be developed, or where the implementation of the SLCP measure is dependent on other major infrastructure decisions and programmes before it can be implemented.

Identify potential implementation pathway for the measure

On the basis of the inventory of policy processes, institutions, stakeholders, barriers, costs and speed of implementation, several possible and plausible implementation pathways can be developed. This process will need to consider which interventions would be most effective and where combinations of different policies will be needed to achieve progress (e.g., emissions regulations implemented together with subsidies to facilitate the implementation of measures).

The process of developing the pathways can be pursued by undertaking forward looking scenarios, but a process of backcasting from a desired end-point could deliver fresh thinking and different and perhaps more ambitious pathways. In considering different scenarios the approach used in framing questions can have a profound influence on the discourse and results of a process to understand the options and potential for mitigation. A forecast can result in a scenario with a high likelihood for success, that is pragmatic and based upon current practices, an incremental modification of current practice. It may however lead to less ambitious outcomes. A backcast would frame the questions very differently and force participants to consider options in a rather different way. This can lead to bolder and more ambitious programmes, but lack the reality of a forecasting approach. Therefore, if both approaches are used, it can lead to a fuller consideration of the different options.

Ease of Implementation

In some cases, emission reductions could be delivered relatively simply and on a large scale. This is generally the case for emission reduction measures in large-scale integrated industries (e.g., control of flaring and methane emissions in the oil and gas sector), because of their tight top-down command
and control structures, and the concentration of activity in a few companies. By contrast implementing change in the domestic sector, for instance cookstove programmes, can necessarily be a slower and more incremental process because of the cultural issues involved and very large number of individual actors involved.

**Potential for early action**

There is variability in the readiness for early action. There are for instance measures where there is the opportunity for early implementation because much preparatory work has already been undertaken. By contrast there are some measures where early implementation on any substantial scale appears difficult because of the need for continuing research and development – for instance methane emissions from enteric fermentation in livestock. In other cases, the chances of early action are clearly much reduced by the structure of the industry: this may for instance be because of the underlying economics (the scarcity and cost of water effectively prohibiting early action on intermittent aeration of continuously flooded rice-paddies); or rigidities in the industry such as the capacity of vested interests to resist change (e.g., the road haulage industry and scrappage of high-emitting vehicles). With regard to introducing measures as part of large infrastructure programmes, in some cases mitigation can be achieved by changes of practice or procedure, but in most cases it is likely that mitigation will have to be achieved incrementally as new infrastructure programmes are agreed. The important issue therefore is to ensure that new investments do not go ahead without appropriate cost-effective emission reduction measures incorporated in them. However, that means that the rate of progress in methane mitigation will then be driven by the priority accorded to investment in the sector, although the co-benefits from methane reduction may allow it to make the case for higher priority in public investment.

**Setting national priorities**

There are many different ways by which priorities may be set regarding actions to implement different mitigation measures in any country. This will be informed by the implementation plans developed in the light of knowledge about the measures and how they might be implemented in a country. There will also be other criteria that can be used to develop priorities for action. Several of the SNAP pilot countries used the following criteria:

- **Impact of measure**: the potential of a measure to reduce emissions and bring about benefits.

- **Benefits**: this could be in terms of achieving progress to goals other than SLCPs, and benefits not easily quantifiable, including creating new jobs and industries, allowing women to work and develop income, rather than gather woodfuel, fewer absences from school due to respiratory causes of ill-health etc.

- **Time to introduction**: this criterion summarises the potential time required to implement the measure, from the point at which there is a policy decision to make the measure a priority, to the point at which the measure is implemented and reducing emissions.

- **Time to significant benefits**: Once a policy has been enacted, it will still take time for the emission reductions to materialise. For example, new vehicle standards may be decided upon, but stock turnover rates will determine how rapidly emissions will reduce. This can of course be affected by further policies, such as scrappage schemes for old vehicles, and financing to encourage purchasing of new vehicles.

- **Technical effectiveness of the measure**: This refers to how effective the measure will be in reducing emissions. Introduction of emission standards for new vehicles will deliver lower emissions; measures to promote different behaviour, might not deliver expected benefits, as transport model shift does not always follow policy development as planned.
Implementation Effectiveness: This refers to the difficulty of ensuring that the measure delivers emission reductions in practice. Better fuel quality will reduce emissions, but if there is fuel adulteration, this will counteract the improvement. And issues such as corruption might mean that policies do not deliver as planned – vehicle testing may not deliver the expected reductions if corruption occurs. This also needs to overcome barriers that could hinder implementation, such as lack of political will. Ease of implementation and identifying potential for early action also need to be considered.

Costs: This reflects roughly the total costs to implement the measure, divided according to costs to the users, to businesses and to the government. If costs are not analysed the qualitative judgment can be undertaken as a first step. A more detailed costs and benefits analysis would be valuable for each of the measures before the implementation of the action plan.

Combining perspectives to develop an overall prioritisation of measures

Clearly the issues discussed above are all important to develop priorities for national action to reduce SLCPs. Combining this can be done in different ways. In Bangladesh, a qualitative assessment of the major issues were made and then combined through expert judgement and consultation with sector experts (see Table 7). In Colombia, a more formal multi-variate analysis was used.

Table 7 Part of table for Bangladesh showing process of qualitative assessment of overall priorities based on assessment of key factors (Source: Phase 1 national planning document for Bangladesh).

Stakeholder feedback concerning measures and climate/air quality benefits

Stakeholder feedback is particularly important at the stage where the data for emissions for historical and future years have been estimated, and the key measures that are relevant for each country have been identified, and the benefits of fully implementing all measures have been calculated. Further stakeholder consultation is required to develop national priorities and to understand the issues that are faced when implementing measures. In the pilot phase, some countries held three stakeholder workshops (initiation, mid-point and review of the planning document) and in others the consultation was developed as a one-to-one discussion about specific parts of the plan where the stakeholders had specific expertise or responsibility for areas where SLCPs could be integrated into their planning.
**Identifying Actions to implement integrated air pollution and climate change mitigation in Nigeria**

In Nigeria, the mitigation measures in major SLCP, GHG, and air pollution source sectors were identified. Through engagement with key stakeholders in bilateral discussions, and peer-review workshops, the current activities, barriers to implementation and future actions required to implement each of the identified mitigation measures were identified. The table below summarises these aspects for a mitigation measure in the transport sector to eliminate high-emitting vehicles. This process was undertaken for all mitigation measures identified as reducing SLCP, GHG and air pollutant emissions.

<table>
<thead>
<tr>
<th>SLCP Abatement Measures</th>
<th>Description</th>
<th>Current Activities</th>
<th>Current Gaps/Barriers</th>
<th>Future Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elimination of high emitting vehicles that do not meet vehicle emission standards</td>
<td>This measure would promote the renewal of the vehicle fleet to meet increasingly stringent emission standards by enforcing the 15 year limit on new vehicle imports, and through inspection and maintenance programmes ensure vehicles met Euro III standards by 2013 and Euro IV standards by 2030</td>
<td>NESREA is enforcing National Environmental Regulations on Diesel and Petrol engines by Ban on importation of two stroke engines Four Stroke Engines enforcement already in place as recommended substitute New vehicle imports from 2013 need to meet Euro III standards (Enforcement by NEDCC) National Vehicle Emissions Control Programme (NVECP) has been initiated but has not yet been implemented. Flag off planned for end of 2018.</td>
<td>Demonstration of feasibility of emission testing methods through pilot project Identification and procurement of standardized equipment for emission testing Capacity building on vehicle emission testing and identification of private sector organizations to run testing sites Development of database of vehicle data to determine plan for increasing how stringent the emission standard become Modalities for cooperation with MDAs Internet Accessibility for system operations Adequate Funding</td>
<td>Implementation of National Vehicular Emissions Control Programme (NVECP) NESREA to develop and publish operational guidelines for Testing Centres Private sector to apply for Testing Centre accreditation and government approval through NESREA Identification of pilot sites and run pilot project in Abuja to showcase feasibility for programme (planned for 2018) NESREA to identify standardized testing equipment for adoption for Programme in collaboration with other relevant Agencies. Government to issue emission compliance in form of stickers and maintain database of vehicles within country Intensive sensitization and awareness creation for programme Capacity building of staff, regulatory agencies, and operators Internal &amp; External Technical Support and Fund Mobilization</td>
</tr>
</tbody>
</table>
### Step 6: Opportunities to Mainstream SLCPs into National Planning and Monitor Progress in Reducing Emissions.

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Opportunities to Mainstream SLCPs into National Planning and Monitor Progress in Reducing Emissions.</th>
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</thead>
</table>
| **Key Aims** | • Identify and implement mechanisms to mainstream integrated air pollution and climate change mitigation into existing climate change and air pollution planning processes  
  • Identify and implement monitoring and evaluation framework implementation of actions to achieve integrated air pollution and climate change mitigation  
  • Identify resource mobilisation required and source for financing implementation of integrated air pollution and climate change actions  
  • Identify and put in place coordination structure for implementation of integrated air pollution and climate change mitigation actions  
  • Ensure momentum is maintained and national SLCP planning process moves successfully to implementation and real-world emission reductions |
| **Key Questions** | • Can implementation of priority actions to achieve integrated air pollution and climate change mitigation be achieved through existing planning processes (e.g. climate change and/or air pollution)?  
  • How will the sustainability of the National SLCP Planning process be ensured? Who will coordinate implementation of priority actions?  
  • How can public funds, private sector investment and international donor funds be used to implement air pollution and climate change mitigation measures? |
| **Key Challenges** | • Identifying most probable source of funding for implementation of key actions  
  • Ensuring that integrated air pollution and climate change mitigation actions are mainstreamed into existing planning processes as much as possible  
  • Ensuring momentum is maintained and clear responsibility is assigned to coordination, monitoring and evaluation of integrated air pollutant and climate change actions |
| **Key Outputs** | • National SLCP Planning process produces output that allows a strategy to achieve integrated air pollution and climate change mitigation to be effectively implemented based on national context  
  • Actions to integrate air pollution and climate change mitigation in the country are taken forward to implementation  
  • Simultaneous SLCP, GHG and air pollutant emission reductions occur and are tracked through effective monitoring, reporting and verification system |

In each country the pathways by which priority actions are implemented will differ. It will be important to outline how the main steps by which the results of the national planning exercise will be acted upon and real emission reductions, which would not have occurred in the absence of further action, are achieved. This means placing the plan at the heart of government and securing high-level buy-in. It also means that the SLCP issue and the measures need to be mainstreamed within the plans of key ministries or departments.
The information gathered in the action planning process can then be used to develop priorities for action, together with details of who will take this forward and with a timeline for implementation. This can include actions that will lead to immediate implementation of some measures and early action to reduce emissions. It can also identify gaps in knowledge, data and capacity, which can be addressed by other actions. It is important to consider how the results of national planning will be disseminated, promoted and implemented.

**Mainstreaming SLCPs in national processes and structures**

- Who will finance action? Using what mechanism? What investment can the country contribute? How much would be required externally?
- How will sustainability of the process be ensured?
- Who will coordinate the national oversight of SLCPs?

**Financing mitigation measures for simultaneous air pollution and climate change mitigation**

Three general options have been identified as potential sources of financing the implementation of integrated air pollution and climate change mitigation actions as part of the National SLCP Planning processes to date.

1. **Public funds for implementation of mitigation measures**: It is important to understand the potential and process for accessing public funds for the implementation of air pollution and climate change mitigation measures. In Nigeria, the Ministry of Budget and National Planning was engaged early in the National SLCP Planning process, and were supportive of assigning public budget to the implementation of SLCP-relevant mitigation measures. To do this, it is necessary that sectoral ministries responsible for implementation of mitigation measures in a particular sector include SLCP mitigation actions in their work programmes and draft budgets submitted to the Ministry of Budget and National Planning. Without the inclusion of measures in sectoral ministry budgets, the Ministry of Budget and National Planning cannot allocate public funding to action to achieve air pollution and climate change mitigation. This process may differ between countries and it is important to understand the mechanism and stakeholders who need to be engaged in each national context.

2. **Private sector investment**: To convince the private sector to invest in the implementation of specific mitigation measures requires that a compelling business case is put forward for the economic opportunity for a particular mitigation measure. Engaging key business institutions (e.g. the chamber of commerce) through the National SLCP Planning process will allow these opportunities to be communicated to business leaders, and actions put in place to increase engagement with the private sector.

3. **Financing from major international donors**: A key advantage of developing a strategy to achieve multiple benefits, and simultaneous mitigation of air pollution and climate change is that the strategy is relevant to multiple international funders of projects related to climate change mitigation, air pollution abatement and sustainable development. For the actions identified in the strategy to be funded by international agencies, it is important that they are reflected in key policy processes within the country, such as the NDC and climate planning processes (e.g. to obtain funding from the Green Climate Fund and other climate change mitigation funding sources).
Monitoring and evaluation of progress

A process for monitoring and evaluating progress towards achievement of the national action planning is required to assess how the strategy is progressing. It is necessary to monitor that actions have taken place, especially if they are outside of the direct control of those who have the mandate to focus on SLCPs. The action planning needs to make sure that the progress and focus on SLCPs continues and allows mid-course corrections to be undertaken. The evaluation will enable assessment of whether countries have achieved what they set out to do. The monitoring and evaluation process needs to be outlined as part of the national action planning. Guidance on a possible method for developing the monitoring and evaluation plan is included in Annex 9 of this national planning guidance. If existing monitoring and evaluation frameworks are in place, e.g. for climate or air quality planning, then it can be advantageous to integrate monitoring or actions identified in the national SLCP planning process into these existing frameworks.

- What monitoring and evaluation system for the SLCPs needs to be developed?
- Can monitoring and evaluation of the actions within the national SLCP plan be embedded within existing M&E frameworks in the country, e.g. M&E framework of the ministry of environment and other sectoral ministries, or within national development M&E processes?

Goals and Strategies for Monitoring and Evaluation in Ghana

The National SLCP Plan in Ghana includes a monitoring and evaluation (M&E) strategy that has a dual purpose. Firstly, the monitoring and evaluation framework will be set up to monitor and evaluate the implementation of the measures and actions that are identified in their National SLCP Plan. Specific indicators are identified to monitor and evaluate the mitigation measures identified in the National SLCP Plan. However, the M&E strategy for the national SLCP Plan follows and is aligned with the existing national monitoring and evaluation system, called the Annual Progress Report (APR).

The advantage of aligning M&E of the National SLCP Plan to the APR is that all relevant government institutions are required by law to prepare their sectoral monitoring and evaluation reports according to the APR framework. This allows monitoring and evaluation of the National SLCP Plan to feed into the overall M&E of the Ghana EPA, and in turn into monitoring and evaluation of national development priorities and progress, providing greater visibility to the national SLCP plan across government.

In addition, progress in implementing the mitigation measures in the National SLCP Plan will be reported publicly as part of Ghana’s Climate Data Hub. The Ghana Climate Data Hub is a one-stop information sharing portal on facts about Ghana’s actions to tackle climate change and the benefits thereof. Incorporating SLCP mitigation into the Ghana Climate Data Hub further integrates SLCP mitigation into Ghana Climate planning processes, and provides a transparent system to report progress on achieving simultaneous air pollution and climate change mitigation to the public.

Producing the output from the ‘national SLCP planning’ process

The assessment of emissions, benefits, implementation and priorities described in this guidance document can be usefully integrated into various different outputs. The form of the output will depend on the most effective method that has been identified to implement the actions identified...
through the processes outlined above. Options for the output from the National SLCP Planning process could include:

- **A standalone ‘National SLCP Action Plan’ or Strategy.** This could be a first step in a process of promoting action on SLCPs, and integrated air pollution and climate change mitigation in any country. This integration of air pollution and climate change mitigation may be a new concept and the document produced needs to outline how this can be taken forward. Even if a separate ‘National SLCP Plan’, or ‘Integrated Air Pollution and Climate Change Strategy’ is produced, it is advisable that its implementation is closely aligned to related plans on climate change (e.g. NDC) and air quality to avoid duplication and maximise efficiency of resources for, e.g. monitoring and evaluation.

- **A National Air Pollution Action Plan:** In some countries, the national SLCP planning process has been used to develop a national plan focussed on improving air quality, where there is not an existing air pollution abatement strategy. The advantage of this is that the development of an air quality strategy can be very closely aligned with climate change planning.

- **Integration in existing planning processes:** The aim of the national SLCP planning process is that it is country-led and the most effective method of implementing integrated air pollution and climate change mitigation measures are identified. There is no requirement that a separate National Plan is produced, if there is an existing framework within which a strategy to achieve integrated air pollution and climate change mitigation can be effectively implemented. In fact, it may be advantageous to aim to integrate air pollution and climate change mitigation measures within an existing planning processes because i) this process may already have high-level political support in the country, ii) existing systems for monitoring and evaluation, reporting, resource mobilisation and communication may already be in place, iii) in the case of the NDCs and climate planning, this planning process has existing international funding mechanisms (e.g. GCF) that inclusion of integrated air pollution and climate change mitigation measures could be accessed for. Examples of the type of planning processes that integrated air pollution and climate change mitigation measures could be integrated in are climate planning process, an air quality strategy, a national development plan etc.

Regardless of the form of the output from the National SLCP Planning process, there are key elements that should be described to make it clear: i) what the concrete actions are that are included in the plan, and ii) how these actions will be taken forward to implementation.

Firstly, it is key to describe the integration of priority actions into existing air pollution, climate change, and development activities. There are different types of integration – integration into overarching policies and plans (e.g. NDC enhancement plan and other climate change strategies and policies; urban development plan; air quality policies and strategies); and integration into sectoral policies, strategies and plans – e.g. transport sector; agricultural and waste policies etc. The analysis should identify those policies that have already been agreed and where gaps exist where additional action is needed to address emissions. For all existing and potential new options, the policy options, constraints, and lead-times need to be identified.

Agreed policy also needs to be implemented, something which is not guaranteed. Opportunities to ensure and facilitate successful implementation of current plans and policies can form part of identified actions. Other parts of the national SLCP plan can also be new measures that need to be implemented. The plan can also include the political judgement on mitigation and selection of measures. The outcome of this chapter is an outline of the implementation pathway for a particular measure within the country, and identification of the priorities for action on SLCPs in the country.

An example of the pathways to implement a clean cooking scenario in Ghana is described in Annex 8. The detailed description of the implementation pathway may be included as an Annex, with a summary provided in the main chapter. The example describes the steps required to: i) obtain a
commitment to implement the measure, ii) setting and enforcing standards and regulations, and iii) required investment and infrastructure development. These are examples categories of actions that may be needed to implement a measure in a particular country. For different measures, depending on the level of support within the country, may require other types of actions, or require a different level of detail on each type of action.

In some cases concrete recommendations can be made – to add arguments as to why certain on-going programmes and policies are important in addition to their planned impact, they are also an important part of the action required to simultaneously address air pollution and climate change. In other cases, small modifications to current policies and programmes can be suggested that would integrate priority mitigation measures into current policies and programmes. It may not be possible with current knowledge to know what the best course of action may be, and, in such cases, the action proposed could be to develop the knowledge required to be able to identify the most important strategies that would reduce emissions from significant sources giving rise to SLCPs in any country. Clearly a planning document is only one step in the process of addressing SLCPs comprehensively in any country but is an important step and enables all of the key information to be assessed in one place. Guidance for producing this document is included in Annex 7. As stated above, the production of a standalone ‘National Plan’ is not a required output from the National SLCP Planning process, and the necessary description of the strategy to achieve integrated air pollution and climate change mitigation could be collated and included as part of an ongoing planning process (e.g. as part of a revision to the NDC, within a National Communication to the UNFCCC, as part of a revision or update to an air quality strategy).
Annex 1: Sources of short-lived climate pollutants

Sources of Methane

Methane emissions result from fugitive emissions from fossil fuels (oil, coal and gas extraction, and from the transport of natural gas), anaerobic digestion of organic matter (in landfills, rice paddy fields, wastewater and animal waste) and from enteric fermentation in livestock. With regard to most of these sources, methane can be regarded as the most important emission from these sources, and co-emitted compounds are of such a low proportion of total emission that they are of little importance in order to assess climate and air quality impacts (this is different from sources of BC – see section below). Exceptions include municipal waste where some toxic compounds may be released and where measures to reduce methane would have an added benefit of reducing toxic emissions; from rice paddies N₂O emissions are important to consider in terms of the overall climate impact, and manure management also has an interaction with ammonia emissions. The following is a list of relevant sources of methane to be considered:

i. Coal mines
ii. Oil and gas extraction
iii. Gas transmission pipelines
iv. Rice paddies
v. Animal husbandry / livestock
vi. Waste water
vii. Municipal waste

Sources of incomplete combustion, including black carbon

Black carbon results from the incomplete combustion of fossil fuels, wood and other biomass. Although complete combustion would turn all the carbon contained in the fuel into carbon dioxide, in practice, combustion is never complete and always releases other gases including carbon monoxide (CO), methane, non-methane volatile organic compounds (NMVOCs), and particulate matter, including black carbon and organic carbon. Black carbon and other particles are emitted from many common sources, such as diesel cars and trucks, residential stoves, forest fires, agricultural open burning and some industrial facilities.

There is a close relationship between emissions of black carbon, a warming agent, and organic carbon, a cooling agent, as they are always co-emitted. However, the relative proportions will vary depending on the source. Similarly, mitigation measures have varying effects on the black carbon/organic carbon mix, and on concentrations of other particles and ozone precursors emitted alongside black carbon. From the assessment of the relative emission of different substances and their net impact on warming by IIASA during the development of the UNEP/WMO assessment (in 2011) and in Bond et al. (2013), cooking with solid fuels on traditional cookstoves and in-field burning of agricultural waste lead to net warming in the atmosphere. As a result, reducing these activities will provide a climate benefit by reducing warming. Another one of the largest sources of BC is from forest fires. However, here the organic carbon emission far outweighs the BC and so the net impact is cooling and reducing this emission will lead to net warming. While countries may address forest fires (or, similarly, coal-fired power generation) as part of air pollution or GHG mitigation plans, this is not a target for an SLCP strategy. The main sources of BC considered at global scale to be of interest in terms of mitigating near-term climate change are:

i. Industry – brick kilns and coke ovens
ii. Residential cooking and heating using biomass and lump coal
iii. Kerosene wick-lamps
iv. Agricultural residue burning
v. On-road and off-road diesel engines
vi. Gas flaring

**Sources of HFC emissions**

Hydrofluorocarbons (HFCs) are intentionally made to replace stratospheric ozone depleting substances (ODS), in such applications as air conditioning, refrigeration, solvents, foam blowing and aerosols. Although they do not deplete the ozone layer, they are potent greenhouse gases and a substantial fraction of HFCs have a lifetime of 29 years or less (with an average lifetime of 15 years) and can be considered short lived (Velders et al., 2009). Although the abundance of HFCs in the atmosphere is currently small, recent scientific studies project substantial growth in their use in the coming decades as a result of increased demand for refrigeration and air-conditioning, particularly in developing countries. If left unchecked, HFC consumption is projected to double by 2020, and their emissions could contribute substantially to radiative forcing in the atmosphere by the middle of the century. Refrigeration and air conditioning in buildings and industrial operations amount to 55% of HFC usage measured in terms of CO$_2$e using GWP$_{100}$ (percentages for other uses shown in brackets below – from UNEP 2011b). The main uses of HFCs are for the following purposes:

i. Refrigeration
ii. Air conditioning equipment in building
iii. Air conditioning equipment in vehicles (about 24% of HFCs in use)
iv. Foam products (about 11%)
v. Fire protection systems (about 4%)
vi. Solvents (about 1%)

**Other sources of SLCPs**

In the pilot phase, countries identified further source sectors, especially in relation to black carbon emissions. One such example is in Bangladesh, where there are 50,000 rice parboiling units in the country using biomass with poor combustion conditions. In addition, CCAC has identified the potential for kerosene wick lamps to be a large BC source on the basis of Lam *et al.* (2012). Clearly, all diesel engines are sources of substantial BC emissions, and so diesel-powered generators are a target for an SLCP strategy in countries where there are many of these. Therefore the list of source sectors above is incomplete for individual countries, as this classification is based upon the global assessment of black carbon and tropospheric ozone, and the important sources will differ at the national level. Additional methane sources will be easy to identify if these emit largely methane. The same is true for HFC sources. It is more difficult to identify BC sources relevant for an SLCP strategy, as the definition of a relevant SLCP source also depends on the net impact of all co-emitted pollutants on climate as well as on human health and crops.
Annex 2: SLCP national planning Toolkit: LEAP-IBC and BenMAP

An SLCP national planning toolkit has been designed to assess recent and likely future emissions of SLCPs (and co-emitted pollutants) and their impacts on human health, crop yields and radiative forcing (and warming). The tools can also be used to compare the likely benefits of implementing alternative SLCP control strategies and so enable policy makers to identify the most promising measures for action. The first version of the toolkit was developed during the pilot phase of SNAP and was used by the Pilot countries (Bangladesh, Ghana, Colombia and Mexico). This is made up of the following components:

- LEAP-IBC tool: an emissions calculations part (based upon the SEI LEAP tool – see http://www.energycommunity.org/) which can also generate emission scenarios in incorporates an Integrated Benefits Calculator which can show the benefits for health, crop yield and climate (See Figure A1);
- BenMAP – a tool developed and supplied by US EPA which can estimate health benefits in cases where there is either monitored or modelled PM$_{2.5}$ and ozone concentration data (see https://www.epa.gov/benmap).

Figure A1 The outline of the LEAP-IBC – the tool that has been developed for use in the national planning

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**LEAP-IBC Toolkit**

**Estimate Emissions (historical and scenarios) using LEAP**

- **Tree Structure:**
  - Sector
  - Fuel
  - Technology

- **Input data for emissions:**
  - Emission factors (EF)
  - Activity data (Activity)

- **Input data for scenarios:**
  - GDP change
  - Population change
  - Change in technology over time

**Calculations**

- Emission = EF * Activity
- Scenario = EF (New tech and fuel mix) * Sector size ((population; GDP etc.))

**Outputs**

- Emissions (BC, CH$_4$, OC, NMVOC, CO, NO$_x$, SO$_x$, CO$_2$, other PM$_{2.5}$, NH$_3$) for historical year(s)
- Baseline/reference emissions for 2030 & 2050
- Emissions from ‘implement all measures’
- Emissions from 1-3 ‘implementation scenarios’
- Charts comparing emissions of different substances from different sources

**Gridding emissions**

- Using population; roads; urban areas; point source location

**Emissions by chosen grid size**

- Maps of emissions

**Integrated Benefits Calculator**

**GEOS-ChemAdjoint Model Results for Country A**

- PM$_{2.5}$ and O$_3$ population weighted concentrations by country
- O$_3$ crop-distribution weighted daylight concentrations over growing season by country

**Health calculation**

- Premature deaths

**Crop yield loss calculation**

- Yield loss of wheat, rice, maize, soy

**Radiative forcing change**

- Global warming change
LEAP-IBC is an emissions estimation and scenario tool which is a specific application based on SEI’s LEAP (Long-range Energy Alternatives Planning) system that enables a country to compile national inventories of anthropogenic emissions of black carbon, methane, the precursors of ozone (CO, NOx, NMVOC and CH₄) and other co-emitted pollutants involved in the formation of particulate matter or that have radiative forcing properties. As well as estimating the emissions for historical years, the LEAP-IBC tool also enables the construction of future emissions scenarios based on growth in GDP, population, etc., to develop a ‘reference’ scenario (i.e., emissions anticipated under the influence of the main driving forces including existing/ planned legislation and their likely progression). It can also develop scenarios that can explore the impact on future emissions of implementing one or more SLCP control measures.

Emissions from the country (from LEAP) and also from the rest of the world (from GAINS) are provided as totals in 2 x 2.5 degree grids are linked with the results of a global composition and climate model – the GEOS-Chem Adjoint model - to show the changes in the concentrations of key substances over a country required to estimate benefits and also to estimate radiative forcing globally. By multiplying gridded emissions by a series of coefficients which have been derived from the GEOS-Chem Adjoint Model (run by Daven Henze at the University of Colorado), population or crop yield weighted concentrations for different pollutants can be derived for a country and the impacts estimated by linking the concentrations with relevant concentration-response relationships. The Adjoint modelling derives relationships between the results of GEOS-Chem model runs to provide a relationship between the emission and the concentration of the pollutant in a target region, which can be a country or city. It provides an easy and rapid way to link emissions to concentrations and hence to impacts. When multiplied by the gridded emissions the coefficients give population-weighted PM₂.₅ and O₃ concentration for the target country that can be used for human health estimation.

The emissions from LEAP are linked to the Integrated Benefits Calculator (IBC) that can assess the magnitude of different benefits that are likely to result from an implementation of SLCP mitigation strategies in a country. There are also default emissions for every grid in the world that are derived by the IIASA GAINS Model (http://gains.iiasa.ac.at/models/) which have been kindly supplied by IIASA for the years 2005, 2010, 2030 and 2050. The global default emissions from GAINS have been supplied according to two scenarios: the ‘Reference Scenario’ (i.e., ‘business as usual’ with no further mitigation measures beyond those already planned and assuming energy and fuel demand as projected by the International Energy Agency (IEA)) and an ‘SLCP Scenario’ where all 16 SLCP measures are fully implemented globally by 2050. The default emissions dataset is a derivation of the ECLIPSE scenarios further developed for the CCAC Regional Assessment of SLCPs in Latin America and the Caribbean (produced by IIASA in 2015).

The impact on human health of the change in relevant emissions is then estimated from established PM₂.₅/O₃ concentration-response functions. Two functions for health are provided as alternatives in LEAP-IBC. One is according to Krewski et al., (2009) and another is the Integrated Exposure Response functions (Burnett et al 2014) which provides estimates for premature mortality from strokes, ischaemic heart disease, lung cancer and respiratory disease (COPD), as well as due to Acute Lower Respiratory Infections (ALRI) in children (see Annex 3). Thus the Benefits tool estimates the number of premature deaths (burden) in the target country due to PM₂.₅ and O₃ exposure resulting from the global emissions. The benefits assessment tool can thus enable emission scenarios to be compared to determine the health benefit (in terms of premature deaths avoided) that would accrue from implementation of different SLCP control measures.

Other coefficients generated by the Adjoint model enable an assessment of ozone impacts on four crops (rice, wheat, maize and soybean) as well as global climate impacts (temperature change due to changes in radiative forcing) of the emissions scenarios produced from LEAP-IBC tool. This toolkit is designed to assist the experts developing national plans to identify priorities for action to control SLCPs. Training can be provided by SNAP to use this toolkit to help develop the national planning. Anyone interested in BenMAP can contact US EPA (https://www.epa.gov/benmap).
Annex 3: Data requirements from participating countries to develop an emission inventory using LEAP-IBC

In order for the participating pilot countries to be able to use the LEAP-IBC tool, certain data inputs are required for the emissions scenario modelling to be performed. The CCAC SNAP project will concentrate on the effect of implementing the SLCP measures, and so ensuring that the SLCP-related data are as comprehensive and up-to-date as possible is a priority in the current phase of the SNAP project – the data required for this are shown in Part 1 below.

However, in order to look at the full impact of emission scenarios – it is useful to integrate assessment of SLCP methods with assessment of GHGs and other air pollutants for each country. This allows the overall effect of SLCP mitigation measures, and measures designed for GHG mitigation or air pollution abatement on the full suite of pollutants emitted to be assessed. In addition, it is important to consider the data that will be used to develop the analysis. In most cases countries will have already developed emission inventories for GHG emissions, or for air pollutant emissions. Where these exist, it should be considered how closely aligned the development of the analysis for the National SLCP Planning should or needs to be with existing emission inventories or scenario analyses. Integrating National SLCP Planning analysis with existing inventories, modelling and analyses can have substantial advantages in terms of efficiency, as much of the data may be the same as in previous efforts, consistency, so that National SLCP Planning builds upon existing climate and air pollution planning, and acceptability, as using data from existing official inventories or analyses may have a greater degree of validity among stakeholders. Within the default LEAP-IBC datasets that can be provided to countries, initial data from international sources where these are available are included but data from national sources would also be useful to revise and upgrade on these international defaults - the additional data needed to carry this out are explained in Part 2 of this note.

Part 1 - high priority data requirements relevant to the SLCP measures:

1. **Brick kilns**: What was the fuel use by fuel type (e.g., kilotonnes coal burnt per year) and technology (traditional, VSBK, Hoffman kiln, Zig-zag kiln etc.) for 2010? Also, collect production rate of bricks, by technology/fuel type.

2. **Coke production technology split**: What proportion of total production is from ‘traditional’ coke ovens versus ‘modern recovery’ ovens?

3. **Oil production data**: (i) Number of wells drilled per year? (ii) How much crude oil is loaded onto (a) marine vessels or (b) rail tank cars/tank trucks (kt/yr)? (iii) How much is transported in pipelines (kt/yr)? (iv) How much is transported in marine tankers (kt/yr)? (v) How much oil production is onshore and how much is offshore. (vi) Annual volume of gas flared (1000s cubic metres (m³))

4. **Methane from coal mining**: What is the coal production split between surface and deep coal mines? Was any methane recovered in 2010 - if so, how much (t/yr)?

5. **Road transport**: By fuel type and vehicle category, what are (A) the number of vehicles; (B) the annual average distance travelled (km/yr) and (C) the % distance travelled on unpaved roads (see Annex 1 for detailed list of vehicle categories by Euro standard).

6. **Residential (domestic) biomass fuel consumption**: (i) What are the main types of residential biomass stoves used, and (ii) What are the annual amounts (kt) of wood, crop residues, animal dung, charcoal etc. burnt as fuel in each type?
7. **Crop residue open-burning**: For each type of crop grown, what percentage of the crop waste residues is typically burnt in the field? The crop types are: Rice, Wheat, Millet, Soya, Maize, Potatoes, Jute, Cotton (Seed cotton), Groundnut, Sugarcane, Rapeseed and mustard, Others (please specify). (A default of 25% of waste crop residue burned in the field will be assumed if no data are provided. Default crop production data will be taken from FAOSTAT unless local production data are also supplied.)

8. **Rice cultivation (methane emissions)**: (a) For total rice cultivation in 2010, what was the % shares of ‘rain-fed and deepwater’¹, ‘irrigated’² and ‘upland’³ (hill) rice paddy. For the irrigated rice paddy, what proportion was ‘intermittent aeration’⁴ rather than ‘continuously flooded’⁵? (b) Also, what was average rate (tonnes/ha) and type of organic amendment (straw⁶, compost, farmyard manure or green manure) applied to ‘rainfed and deepwater’ and ‘irrigated’ rice cultivation?

9. **Solid waste incineration by ‘open burning’**: In 2010, how much municipal solid waste (MSW) (kt/yr) was disposed of by open-burning (e.g. in back-yards, streets or waste dumps)?

10. **Municipal solid waste (MSW) in landfill (methane emissions)**: What was the amount (kt/yr) of methane (CH₄) recovered from landfill in 2010? (Also, if known, what was the population whose waste was collected, the per capita MSW generation rate and the fraction of MSW sent to solid waste disposal sites? Defaults can be used in the model if this information is lacking.)

11. **Domestic wastewater treatment and discharge (methane emissions)**: (a) What is the population income group split (either as % or proportion) between Rural, Urban high income and Urban low income for 2010)? (b) Also, for each income group, what was the share represented by each treatment system (see Table 2)?

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¹ *Rainfed and deep water*: Fields are flooded for a significant period of time and water regime depends solely on precipitation
² *Irrigated*: Fields are flooded for a significant period of time and water regime is fully controlled.
³ *Upland*: Fields are never flooded for a significant period of time.
⁴ *Intermittently aerated*: Fields have at least one aeration period of more than 3 days during the cropping season
⁵ *Continuously flooded*: Fields have standing water throughout the rice growing season and may only dry out for harvest (end-season drainage).
⁶ *Straw application* means that straw is incorporated into the soil, it does not include straw just placed on the soil surface or straw burnt on the field.
Table 2 The wastewater treatment split by population income group required for methane emissions estimation in the emissions module of the toolkit.

<table>
<thead>
<tr>
<th>Income group</th>
<th>Fraction of population in income group (^a) (fraction 0-1.0; total for all 3 income groups must = 1.0)</th>
<th>Type of treatment system</th>
<th>Utilization of treatment split within income group (^b) (fraction 0-1.0; total within income group must equal 1.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>Latrine</td>
<td>Septic tank</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anaerobic reactor or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>deep lagoon</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aerobic treatment plant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Untreated (Sea, river or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>lake discharge)</td>
<td></td>
</tr>
<tr>
<td>Urban high income</td>
<td>Latrine</td>
<td>Septic tank</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anaerobic reactor or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>deep lagoon</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aerobic treatment plant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Untreated (Sea, river or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>lake discharge)</td>
<td></td>
</tr>
<tr>
<td>Urban low income</td>
<td>Latrine</td>
<td>Septic tank</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anaerobic reactor or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>deep lagoon</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aerobic treatment plant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Untreated (Sea, river or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>lake discharge)</td>
<td></td>
</tr>
</tbody>
</table>

Part 2 (optional – lower priority) Data requirements for compiling a more accurate, complete national emission inventory.

In most cases, the default emission factors\(^7\) contained in the model will be adequate (although they could be replaced by national emission factors if available). However, for some pollutants such as SO\(_2\), the sulphur (S) content of the fuel determines the emission factor and so national information on this aspect of fuel quality is required for more accurate emissions estimates. Often, the default EFs given in the toolkit are ‘uncontrolled’ and so, for certain sectors, information on the types and ‘penetration rates’ of emission control technologies in that country will be needed. For example, power stations may be fitted with flue-gas desulphurization (FGD) devices to control S emissions or low-NOx burners to reduce NOx emissions.

In addition to emission factors, data on the relevant activity rates\(^8\) are needed to be able to calculate more accurate emissions. Where data from international sources are available (e.g. the International Energy Agency (IEA) Statistics, or agricultural data from FAOSTAT), these will already be included in the model (although they could be replaced by local data if preferred).

1. **What are the sulphur contents (\(\%\)S) of fuel used in the country?** (i) Coal by type (e.g., bituminous coal, lignite) and, if it varies, by sector (e.g. electricity power stations, industry

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\(^7\) An emission factor (EF) is the rate of emission of a pollutant per unit of activity e.g. in a power station - kg NO\(_x\) per tonne coal burnt

\(^8\) The activity rate is some measure of the annual level of the relevant activity e.g. in power stations - kilotonnes (kt) coal burnt per year
etc.): typical range 0.5% – 3%. (ii) **Gas/diesel oil**: typical range 0.3% – 1%. (iii) **Heavy fuel oil** (HFO) also known as Residual fuel oil (RFO): typical range 1 – 4%. (iv) **Motor gasoline**: (IPCC default of 0.1% will used if no information provided)

2. **Electricity Power Stations (SO₂ emissions)**: Do any power stations have sulphur dioxide (SO₂) emission controls? If yes, for each type of fuel (hard coal, lignite or heavy fuel oil (HFO), the % fuel use subject to each type of control (e.g., flue-gas desulphurization (FGD), Atmospheric Fluidized Bed Combustion (AFBC), Furnace injection) will be required for 2010. (By default, zero SO₂ emission control will be assumed.)

3. **Solid fuel use in cement production**: What was the consumption of hard coal, lignite or petroleum coke (kt/yr) used for cement production in 2010? (This is needed to account for the ~80% of sulphur in the solid fuel that gets absorbed into the cement.)

4. **Emission controls for NOx in Electricity Power Generation and in Industry**: For each fuel type (hard coal, lignite, natural gas, crude oil, gas/diesel oil or HFO), what was the % fuel use in that sector (i.e. Power or Industry) that was subject to each type of control (see Table 3 for list of technologies) in 2010? (By default, zero NOx emission control will be assumed.)

5. **Electricity Power Stations (PM emissions)**: What was the ash content (%) of coal or petroleum coke used? (If unknown, a default of 10% will be assumed).

6. **Emission controls for particulate matter (PM) in Electricity Power Generation and in Industry**: For a particular fuel type, what was the % fuel use in that sector (i.e. Power or Industry) subject to each type of PM control technology type (e.g. Multiple Cyclone, Scrubber, Electrostatic Precipitator (ESP) or Baghouse (fabric filtration in "baghouses") systems) in 2010? (If the exact type of PM control technology is unknown, a default control rate will be assumed. If no data provided, zero PM emission control will be assumed.)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Representative NOₓ reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Excess Air (LEA)</td>
<td>15</td>
</tr>
<tr>
<td>Overfire Air (OFA) - Coal</td>
<td>25</td>
</tr>
<tr>
<td>OFA - Gas</td>
<td>40</td>
</tr>
<tr>
<td>OFA - Oil</td>
<td>30</td>
</tr>
<tr>
<td>Low NOₓ Burner (LNB) - Coal</td>
<td>45</td>
</tr>
<tr>
<td>LNB - Tangentially Fired</td>
<td>35</td>
</tr>
<tr>
<td>LNB - Oil</td>
<td>35</td>
</tr>
<tr>
<td>LNB - Gas</td>
<td>50</td>
</tr>
<tr>
<td>LNB with OFA - coal</td>
<td>50</td>
</tr>
<tr>
<td>Cyclone Combustion Modification (in power stations)</td>
<td>40</td>
</tr>
<tr>
<td>Flue Gas Recirculation (in industrial boilers)</td>
<td>40</td>
</tr>
<tr>
<td>Ammonia Injection</td>
<td>60</td>
</tr>
<tr>
<td>Selective Catalytic Reduction (SCR) - Coal</td>
<td>80</td>
</tr>
<tr>
<td>SCR - Oil</td>
<td>80</td>
</tr>
<tr>
<td>SCR - Gas</td>
<td>80</td>
</tr>
<tr>
<td>Water Injection - Gas Turbine Simple Cycle</td>
<td>70</td>
</tr>
<tr>
<td>SCR - Gas Turbine</td>
<td>80</td>
</tr>
</tbody>
</table>

7. **Chemicals production**: What was annual production (tonnes /yr) in 2010 of: Nitric acid, Sulphuric acid, Adipic acid, Carbon black and Titanium dioxide?

56
8. **Cement production and Lime production**: What were the types of particulate matter (dust) controls typically used - if any (e.g. electrostatic precipitator, fabric filter) in 2010?

9. **Metals production – sulphur recovery**: What were the average levels of sulphur removal (% $S$ recovered) during the smelting of (i) copper, (ii) lead (primary), (iii) lead (secondary) and (iv) zinc in 2010?

10. **Solvent and other product use (NMVOC emissions)**. What were the levels of consumption (or chemical products manufacture) in 2010 of the NMVOC emitting substances/processes listed in Table 4. Also what were the average levels of solvent recovery (if any) for metal degreasing and dry cleaning of fabrics?

### Table 4 Activity data requirements for solvent and other product use

<table>
<thead>
<tr>
<th>Process</th>
<th>Units for activity rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint application (solvent based)</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>tonnes paint sold</td>
</tr>
<tr>
<td>Decorative</td>
<td>tonnes paint sold</td>
</tr>
<tr>
<td>Unknown</td>
<td>tonnes paint sold</td>
</tr>
<tr>
<td>Paint application (water based)</td>
<td>tonnes paint sold</td>
</tr>
<tr>
<td>Metal degreasing</td>
<td>tonnes solvent consumed</td>
</tr>
<tr>
<td>Dry cleaning of fabrics</td>
<td>tonnes solvent consumed</td>
</tr>
<tr>
<td>Chemical products manufacture:</td>
<td></td>
</tr>
<tr>
<td>Polyester processing</td>
<td>tonnes of monomer</td>
</tr>
<tr>
<td>Polyvinylchloride</td>
<td>tonnes product</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>tonnes foam processed</td>
</tr>
<tr>
<td>Polystyrene foam</td>
<td>tonnes product</td>
</tr>
<tr>
<td>Rubber processing</td>
<td>tonnes product</td>
</tr>
<tr>
<td>Paints, varnish, inks and glues</td>
<td>tonnes product</td>
</tr>
<tr>
<td>Other use of solvents</td>
<td></td>
</tr>
<tr>
<td>Mineral wool production</td>
<td>tonnes product</td>
</tr>
<tr>
<td>Glass wool production</td>
<td>tonnes product</td>
</tr>
<tr>
<td>Printing industry</td>
<td></td>
</tr>
<tr>
<td>Heat set offset</td>
<td>tonnes ink consumed</td>
</tr>
<tr>
<td>Publication gravure</td>
<td>tonnes ink consumed</td>
</tr>
<tr>
<td>Packaging (small flexography)</td>
<td>tonnes ink consumed</td>
</tr>
<tr>
<td>Fat, edible and non-edible oil (solvent extraction)</td>
<td>tonnes seed</td>
</tr>
<tr>
<td>Application of glue and adhesives</td>
<td>tonnes product used</td>
</tr>
<tr>
<td>Fuel</td>
<td>Vehicle class</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
</tr>
<tr>
<td>Diesel</td>
<td>Passenger car (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Passenger car (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Passenger car (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Passenger car (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Passenger car (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Light commercial vehicles (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Heavy duty vehicles (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Heavy duty vehicles (Euro 6)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Heavy duty vehicles (Euro 6)</td>
</tr>
</tbody>
</table>

Table 5: Mobile emissions from on-road vehicles (Detailed method)
<table>
<thead>
<tr>
<th>Type</th>
<th>3-wheeler (Bharat 1 = Euro 1)</th>
<th>3-wheeler Retrofit (Bharat 1 = Euro 1)</th>
<th>Passenger car retrofit (moderate control)</th>
<th>Passenger car retrofit (Bharat 1 = Euro 1)</th>
<th>Passenger car retrofit (Euro 4 and later)</th>
<th>Urban Bus (HO Euro II)</th>
<th>Urban Bus (HO Euro III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNG</td>
<td>0.66 $^a$ 1.30 $^b$ 0.26 $^a$ 0.014 $^a$ 0.016 $^a$ 0.015 $^a$ 90 14</td>
<td>0.14 $^a$ 0.49 $^b$ 0.26 $^a$ 0.014 $^a$ 0.016 $^a$ 0.015 $^a$ 90 14</td>
<td>0.63 $^a$ 0.85 $^b$ 0.79 $^a$ 0.014 $^a$ 0.001 $^a$ 0.001 $^a$ 125 19</td>
<td>0.06 $^a$ 0.90 $^b$ 0.30 $^a$ 0.014 $^a$ 0.002 $^a$ 0.002 $^a$ 125 19</td>
<td>0.006 0.216 0.116 0.014 0.001 0.001 125 19</td>
<td>16 27 0.12 0.31 n.a. 0.01 0.10 450 69</td>
<td>19 1 0.05 2 n.a. 0.01 0.01 450 69</td>
</tr>
<tr>
<td>LPG</td>
<td>0.06 $^a$ 0.7 $^b$ 0.5 $^a$ 0.005 $^a$ 0.17 $^a$ 0.17 $^a$ 90 14</td>
<td>0.14 $^a$ 0.25 $^b$ 0.13 $^a$ 0.08 $^a$ 0.13 $^a$ 0.13 $^a$ 140 14</td>
<td>2.16 8.86 0.01 0.002 0.012 0.012 125 19</td>
<td>11.34 3.52 0.15 0.002 0.011 0.011 125 19</td>
<td>11.34 3.52 0.15 0.002 0.011 0.011 125 19</td>
<td>16.5 8.4 0.971 n.a. 0.002 0.01 450 69</td>
<td>16.5 8.4 0.971 n.a. 0.002 0.01 450 69</td>
</tr>
</tbody>
</table>

**Total for CNG:**

<table>
<thead>
<tr>
<th>CNG</th>
<th>3-wheeler Retrofit (Moderate control) $^a$</th>
<th>3-wheeler Retrofit (Bharat 1 = Euro 1)</th>
<th>Passenger car (Conventional) $^b$</th>
<th>Passenger car Retrofit (Euro 2)</th>
<th>Passenger car Retrofit (Euro 3)</th>
<th>Passenger car Retrofit (Euro 4)</th>
<th>Passenger car Retrofit (Euro 5)</th>
<th>Passenger car Retrofit (Euro 6)</th>
<th>Light-duty vehicles (Uncontrolled)</th>
<th>Light-duty vehicles (OBD control - Euro4)</th>
<th>Light-duty vehicles (OBD control - Euro3)</th>
<th>Heavy-duty vehicles (Uncontrolled)</th>
<th>Heavy-duty vehicles (OBD control)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.66 $^a$ 1.30 $^b$ 0.26 $^a$ 0.014 $^a$ 0.016 $^a$ 0.015 $^a$ 90 14</td>
<td>0.14 $^a$ 0.49 $^b$ 0.26 $^a$ 0.014 $^a$ 0.016 $^a$ 0.015 $^a$ 90 14</td>
<td>2.16 8.86 0.01 0.002 0.012 0.012 125 19</td>
<td>11.34 3.52 0.15 0.002 0.011 0.011 125 19</td>
<td>11.34 3.52 0.15 0.002 0.011 0.011 125 19</td>
<td>16.5 8.4 0.971 n.a. 0.002 0.01 450 69</td>
<td>16.5 8.4 0.971 n.a. 0.002 0.01 450 69</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Total for LPG:**

- Emission factors are Tier 2 exhaust emission factors from EM-EPREEA (2013), Tables 3-16 to 3-25, unless otherwise indicated.
- Uncontrolled EFs = Tier 1 maximum value from EM-EPREEA (2013) converted assuming 15% economy from Table 3-14, EM-EPREEA, 2013.
- Assume no motorcycle 2-stroke (uncontrolled).
- Heavy-duty vehicle, gasoline, >3.5 L weight.
- Emission factors for Diesel passenger cars (1.4 - 2.0 L engine capacity), Open loop technology (from EM-EPREEA 2013), Tables 3-16 and 3-17.
- Emission factors for Diesel passenger cars (1.4 - 2.0 L engine capacity), Conventional technology (from EM-EPREEA 2013), Tables 3-24 and 3-25.
- Emission factors for 4-stroke motorcycles (250 - 750 cc), Conventional technology (from EM-EPREEA 2013), Tables 3-24 and 3-25.
- Emission factors for Light Commercial Vehicles (<3.5 L weight) from EM-EPREEA (2013) Tier 2 exhaust emission factors, Tables 3-10 and 3-19.
- Emission factors for Heavy Duty Vehicles (7.5 - 16 L weight) from EM-EPREEA (2013) Tier 2 exhaust emission factors, Tables 3-26 and 3-21.
- Urban buses standard - vehicles used for the carriage of passengers and comprising more than 18 L seat in addition to driver's seat.
- Assume PM2.5 + PM10 + CO2 EF.
- Derived from Gilles et al. (2005) for unpaved rural roads in dry weather.
- Assume PM2.5 factor is 15% of PM10 factor (USEPA, 1995).
- EM-EPREEA (2013) Tier 2 fraction BC (%) and Organic matter (OM) to BC ratio (Table 3-14) assuming OM = 1.3xOC.
- AR4R (2008) value for Indian fleet post 2000 (Bharat 1 = Euro 1).
- Assume LDV = passenger car, HDV = 2+ passenger car.
- Assume = LCV (Conventional).
Annex 4: Short-lived climate pollutant mitigation measures from UNEP/WMO Assessment

Measures identified to reduce methane emissions and emissions from incomplete combustion from the UNEP/WMO Assessment

The UNEP/WMO Assessment identified the most important measures that could yield the largest reduction in radiative forcing from SLCPs at the global scale. Measures that have only a small net impact or that would even increase radiative forcing have been excluded from the portfolio. The measures focus on reducing methane emissions – which reduce background ozone formation as well as reducing warming - and reducing the emissions from incomplete combustion. Combustion is rarely complete and burning fuels such as coal, wood, biomass and petroleum products under sub-optimal conditions usually leads to the emission of a number of different pollutants. These include BC, OC, methane, CO and NMVOC. There are also likely to be other co-emitted substances such as CO₂, nitrogen oxides (NOₓ) and sulphur oxides (SOₓ). Some of these warm the atmosphere (BC, methane, CO, CO₂, NMVOCs) and some cool the atmosphere (OC, SOₓ, NOₓ). In order to identify the measures that lead to net climate benefits, the relative magnitude of the emissions of the various substances and their cooling/warming potential needs to be used to evaluate the net impact of a measure on emissions and climate.

In the UNEP/WMO Assessment, this analysis was undertaken using the IIASA GAINS model which estimates mitigation potentials for the full range of air pollutants and GHGs of hundreds of different measures (about 400 broad emission control categories). The analysis found that about 130 measures lead to lower radiative forcing and the top 16 collectively achieve nearly 90 per cent of the overall mitigation potential according to the GWP₁₀₀ metric used in the analysis. These 16 measures (7 ‘methane measures’ and 9 ‘BC measures’ affecting incomplete combustion) are shown in Table 1.
Table 1. Measures Identified in the UNEP/WMO Assessment of Black carbon and tropospheric ozone to reduce radiative forcing from short-lived substances, and improve air quality

<table>
<thead>
<tr>
<th>Measure</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>‘Methane measures’</strong></td>
<td></td>
</tr>
<tr>
<td>Extended pre-mine degasification and recovery and oxidation of CH₄ from ventilation air from coal mines.</td>
<td>Extraction and transport of fossil fuels</td>
</tr>
<tr>
<td>Extended recovery and utilization, rather than venting, of associated gas and improved control of unintended fugitive emissions from the production of oil and natural gas.</td>
<td></td>
</tr>
<tr>
<td>Reduced gas leakage from long-distance transmission pipelines.</td>
<td></td>
</tr>
<tr>
<td>Separation and treatment of biodegradable municipal waste through recycling, composting and anaerobic digestion as well as landfill gas collection with combustion/utilization.</td>
<td>Waste management</td>
</tr>
<tr>
<td>Upgrading primary wastewater treatment to secondary/tertiary treatment with gas recovery and overflow control.</td>
<td></td>
</tr>
<tr>
<td>Control of CH₄ emissions from livestock, mainly through farm-scale anaerobic digestion of manure from cattle and pigs.</td>
<td>Agriculture</td>
</tr>
<tr>
<td>Intermittent aeration of continuously flooded rice paddies.</td>
<td></td>
</tr>
<tr>
<td><strong>‘Black Carbon measures’, reducing incomplete combustion; affecting BC and other co-emitted compounds</strong></td>
<td></td>
</tr>
<tr>
<td>Standards for the reduction of pollutants from vehicles (including diesel particle filters), equivalent to those included in Euro-6/VI standards, for road and off-road vehicles</td>
<td>Transport</td>
</tr>
<tr>
<td>Elimination of high-emitting vehicles for road and off-road transport.</td>
<td></td>
</tr>
<tr>
<td>Replacing lump coal by coal briquettes in cooking and heating stoves.</td>
<td>Residential</td>
</tr>
<tr>
<td>Pellet stoves and boilers, using fuel made from recycled wood waste or sawdust, to replace current wood-burning technologies in the residential sector in industrialized countries.</td>
<td></td>
</tr>
<tr>
<td>Substitution of traditional biomass cookstoves with stoves using clean-burning fuels (liquefied petroleum gas (LPG) or biogas)¹ ².</td>
<td></td>
</tr>
<tr>
<td>Substitution of clean-burning cook stoves using modern fuels for traditional biomass cook stoves in developing countries¹ ².</td>
<td></td>
</tr>
<tr>
<td>Replacing traditional brick kilns with improved kilns – e.g. vertical shaft kilns and Hoffman kilns.</td>
<td>Industry</td>
</tr>
<tr>
<td>Replacing traditional coke ovens with modern recovery ovens, including the improvement of end-of-pipe abatement measures in developing countries.</td>
<td></td>
</tr>
<tr>
<td>Ban of open burning of agricultural waste¹.</td>
<td>Agriculture</td>
</tr>
</tbody>
</table>

¹ Motivated in part by its effect on health and regional climate, including areas of ice and snow.

² For cookstoves, given their importance for BC emissions, two alternative measures are included.

³ There are other measures than those identified that could be implemented. For example, electric cars would have a similar impact on diesel particulate filters but these are not yet widely available; forest fire controls could also be important but are not included due to the difficulty in establishing the proportion of fires that are anthropogenic.

**Measures to prevent / reduce relevant HFC emissions**

The implementation of HFC measures, as has been agreed through the 2016 Kigali Amendment to the Montreal Protocol, can almost completely eliminate one of the greenhouse gases in the Kyoto basket, avoiding the climate impacts of HFCs before they grow any larger and achieving further benefits by catalysing improvements in appliance energy efficiency. The reduction of HFC emissions could reduce the climate forcing of HFCs in 2050 to below their current forcing today, which would effectively eliminate a climate threat before it develops. Furthermore, transitioning away from HFCs can catalyse additional climate benefits through improvements in the energy efficiency of the refrigerators, air conditioners, and other products and equipment that use HFC refrigerants. Pairing a transition away
from HFC refrigerants with energy efficiency improvement in the room air conditioning sector can significantly reduce peak-load energy demand.

The majority of the HFC emissions come from two sectors: mobile air conditioning and commercial refrigeration. Further important sources include stationary air conditioning, which includes residential window and split unit air conditioners. Measures to reduce HFC emissions include incentives to marketing climate-friendly technology be put in place in countries. This includes, for instance, placing controls on imports of HFC containing products and equipment. At the same time, countries can reduce domestic HFC emissions by converting and retrofitting existing facilities and equipment from high-GWP HFCs or HCFCs to lower-GWP alternatives when technically feasible and safe, reducing unnecessary emissions during equipment servicing and repair, and capturing and destroying HFCs at the end of equipment life.

Countries can skip transitioning to high-GWP HFCs by converting to lower-GWP and not-in-kind technologies (such as district cooling), thus avoiding a secondary conversion in a later stage, and the growth of emissions of these powerful greenhouse gases while eliminating existing sources of HFCs. Different measures and policies are presented in Table 2. The Kigali Amendment to the Montreal Protocol, agreed in 2016, The adds to the Montreal Protocol the phase-down of the production and consumption of HFCs. It is therefore important that the pathway a country has agreed for this phase down as part of the Kigali Amendment is included within the identification, and evaluation of HFC mitigation measures in the country. Evaluating the benefits of increasing the speed of phasing out HFCs could also be considered.

<table>
<thead>
<tr>
<th>Table 2: HFC Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td>o Phase Down HFCs under the Montreal Protocol</td>
</tr>
<tr>
<td><strong>Transport</strong></td>
</tr>
<tr>
<td>o Switch to low GWP HFC-alternatives in mobile air conditioning</td>
</tr>
<tr>
<td><strong>Industry and services</strong></td>
</tr>
<tr>
<td>o Implementation of good practices including leakage control, improved components, and end-of-life recovery;</td>
</tr>
<tr>
<td>o Training of servicing technicians;</td>
</tr>
<tr>
<td>o Technology conversion to lower-GWP or not-in-kind alternatives;</td>
</tr>
<tr>
<td>o Reduce the charge size and improve energy efficiency;</td>
</tr>
<tr>
<td>o Ban imports of products containing high-GWP HFCs, unless essential;</td>
</tr>
<tr>
<td>o Retrofit/replacement of refrigerants with lower GWP alternatives provided the equipment allows this can be done safely and without jeopardizing energy efficiency.</td>
</tr>
</tbody>
</table>

**Health benefit estimation**

In the health field, standard methodologies have been developed to quantify the benefits of health of a wide range of policy measures, in both direct and economic terms, based on the concept of Disability Adjusted Life Years or DALYs and Years of Life Lost (YLL) or number of people subject to premature mortality. Evaluation such as the Global Burden of Disease apply a consistent methodology (e.g. WHO, 2009; IHME/GBD 2016; Brouer et al 2015) to assess the burden of different diseases and causal agents (include factors which maybe be co-benefits, such as reductions in outdoor and indoor emissions of air pollutants) across the globe. This provides a starting point for more detailed analysis of the effects of specific policy interventions and scenarios.

Over the last decades a substantial body of evidence has developed demonstrating that fine particulates (PM$_{2.5}$) in the air are associated with early death (premature mortality). More recently, health impacts due to exposure to ozone have also been demonstrated. BC and ozone will have indirect effects on human health through climate change as numerous studies have demonstrated that both cold and hot weather are associated with increased deaths. However, there is substantial heterogeneity in these health effects. In the UNEP/WMO Assessment the global burden of mortality due to ozone and PM$_{2.5}$ from anthropogenic emissions was estimated. Due to the heterogeneity and uncertainty in the response to climate the Assessment did not try to quantify these effects.

The assessment of PM impacts on health is built upon recent studies that have examined the relationship between changes in PM$_{2.5}$ levels and changes in mortality. These have demonstrated that reducing PM levels prolongs lives and that these benefits occur within a few years of the reductions. The impact of ozone on health has been known for a long time. But the impact of ozone on hastening deaths and longer-term impacts of ozone exposure on mortality is more recent and there are now concentration-response relationships that can be used, which were used in the Assessment.

In the Integrated Benefits Calculator, changes in annual deaths due to changes in outdoor air pollution are estimated following the method of Anenberg et al. (2010) using a health impact concentration-response function, taking into account the exposed population (Pop), baseline mortality rates (Yo), the concentration-response function – CRF (β) defined by the epidemiology literature, and the change in PM$_{2.5}$ and ozone (ΔX) using the following integration method:

\[
\text{Change in Deaths} = \text{Pop} \times \text{Yo} \times (1 - e^{-\beta \cdot \Delta X})
\]

where RR is the relative risk for a. cardiopulmonary mortality from PM$_{2.5}$ (RR=1.128; from Krewski et al., 2009) b. lung cancer mortality from PM$_{2.5}$ (RR=1.142; from Krewski et al., 2009) and, c. mortality

---


from respiratory disease related to ozone (RR=1.04; from Jerrett et al., 2009\textsuperscript{11}). An alternative source for risk assessment is the Integrated Exposure Response relationship (Burnett et al. 2014) used both by the most recent Global Burden of Disease study (Brouwer et al., 2015) and by the WHO (WHO, 2009). The population considered by Krewski is that proportion over the age of 30, as this is the age group for which the concentration-response relationships have been developed.

The Integrated Benefits Calculator derives the average population-weighted PM\textsubscript{2.5} and surface ozone concentrations (\(\Delta X\)) over the target country by multiplying emissions from every 2 x 2.5 degree grid cells covering the entire globe, by population-weighted coefficients derived from the GEOS-Chem Adjoint model. The calculator comes pre-loaded with the country-specific coefficients as well as default global emissions datasets for the base year 2005 and the scenario year 2030, derived from IIASA (The International Institute for Applied Systems Analysis) and subsequently gap-filled and gridded by the EDGAR team of JRC-IES (European Commission’s Joint Research Centre - Institute for Environment and Sustainability). The default emissions for the grid cells covering the target country are then replaced with user-calculated national emissions data taken from LEAP-IBC. This means it is possible to separate out health impacts due to emissions from the country itself as well as those from the rest of the world.

Currently, the user is required to input into the Integrated Benefits Calculator, the emissions for the country taken from LEAP-IBC, for the historical year(s), the reference scenario and the implementation scenarios, as well as data on current and projected population. The calculator will be pre-loaded with default data on baseline mortality rates, the proportion of population aged over 30 (for historical year(s) and scenario year) and Relative Risk (RR) of different health outcomes, However, the user can choose to replace these defaults if there is better or more specific information for a particular country. IBC will then calculate the annual premature death burden for the historical (base) year, the reference scenario emissions and for the various implementation scenarios. The benefit of implementing a particular measure, or set of measures, is derived by subtracting the number of premature deaths in the implementation scenario from the ‘reference’ scenario.

**Crop benefit estimation**

The experimental campaigns conducted in North America (NCLAN) and Europe (EOTC) were instrumental in providing empirical data describing yield and growth responses for a range of crop species that could be used to define O\textsubscript{3} response metrics and associated concentration-response relationships. The resulting concentration-response relationships developed during these pan-regional experimental campaigns have used different metrics to characterise O\textsubscript{3} exposure. These metrics include mean 3-month growing season indices – the ‘M7’ and ‘M12’ indices; where the 7 or 12 refers to the daylight hourly averaging period.

In the Integrated Benefits Calculator, the crop yield loss is estimated from the emissions of the four ozone precursors (NO\textsubscript{X}, NMVOCs, CH\textsubscript{4} and CO) multiplied by crop-weighted coefficients derived from the GEOS-Chem Adjoint model for each of the 2 x 2.5 degree grid cells covering the globe to give the ozone concentration averaged for 7 and 12 hours for each month in the year. As for the health impacts above, the calculator is pre-loaded with the country-specific coefficients and default

emissions. The estimated growing season start for the crop concerned is used to add the M7 or M12 ozone concentrations for the 3-month growing season assumed for each crop. This ozone concentration metric is then used with the concentration response relationship for each crop. The general equation is as follows:

\[
\text{Crop production loss, CPL} = \frac{\text{RYL}}{1 - \text{RYL}} \times \text{CP}
\]

where RYL is the Relative Yield Loss and CP the crop production

\[
\text{RYL} = 1 - \exp\left(-\left(\frac{M7}{a}\right)^{b}\right)/\left(\exp\left(-\left(\frac{25}{a}\right)^{b}\right)\right)
\]

where \(a\) and \(b\) are the exposure-response coefficients for each crop.

The crop yield loss avoided is calculated by subtracting the crop yield loss under the reference scenario from the crop yield loss under the implementation scenarios. As for the health impacts, these calculations are done automatically by the benefits tool, the user only needs to input the national emissions for each ozone precursor taken from LEAP-IBC for the base year and for the reference and implementation scenario(s).

**Estimating the warming response of emission changes**

The radiative forcing change is calculated by multiplying the emission of the radiatively active substances by coefficients for that substance derived from the GEOS-Chem model for each 2x2.5 degree grid. These are all then summed to give the overall global change in radiative forcing. These values are then multiplied by standard values converting radiative forcing to temperature change in four different latitudinal bands and globally.

The impact of implementing all measures compared to the reference scenario is then the difference in temperature or radiative forcing between the two scenarios.
Annex 6: Guidance for stakeholder engagement when drafting the National Plan on short-lived climate pollutants

Introduction

If the planning to reduce short-lived climate pollutants (SLCPs) is to be successful then the SLCP issue needs to be mainstreamed and prioritised across government, the private sector, civil society organisations, and organisations that need to be involved in implementations. Therefore, the planning cannot be isolated in any one ministry or government department but has to be embedded within the planning of the many different sectors contributing to national SLCP emissions. It is good practice to inform all relevant ministries and departments in the government that this process is being undertaken to engage them from the beginning, developing national coordination mechanism for the process and raising awareness of the issues with relevant stakeholders. In many countries such inter-ministerial coordination mechanisms already exist and the SLCP issues can be included within their remit.

The National SLCP Planning process involves identifying which SLCP mitigation measures will be taken forward and for which actions will be taken to implement them by the national government. Assessment of the emission reduction potential of a range of SLCP measures has often been conducted within the Ministry of Environment or Environmental Protection Agency (e.g. using LEAP-IBC). However, it requires the engagement of a wide range of stakeholders to agree and assess which of the potential mitigation measures should be taken forward and committed to implementing in a particular country. It also needs to be decided what level of ambition and target should be set for a particular measure, based on national circumstances. Finally, concrete actions need to be identified that will facilitate the implementation of the priority SLCP measures that are committed to in the National SLCP Plan. The actions may already be outlined in current activities, strategies, plans etc., or the actions may be additional new actions that need to be integrated into overarching policies (e.g. NDCs, air quality plans) or sectoral plans.

Therefore, engaging stakeholders who can advise on the suitability of SLCP mitigation measures for inclusion in the National SLCP Plan, and on the actions needed for implementation is essential. This can be very useful during and following the modelling analysis of mitigation measures, and while the National SLCP Plan is being drafted.

The purpose of this document is to provide guidance on the information that could be presented and obtained from different stakeholders to achieve the following aims.

Aims of stakeholder engagement:

1. To get feedback on measures to reduce SLCPs, including the level of ambition, the target for emission reductions, the commitment of the stakeholder to achieve measure.

2. To identify current activities, plans, strategies that are relevant for implementation of SLCP measures

3. To identify what additional actions to increase implementation of SLCP measures.

The form of the stakeholder engagement can vary based on national circumstances. It could be bilateral meetings with different sectoral ministries, or a workshop involving all
stakeholders together, or probably a combination of the two. Additional stakeholder engagement before and after the national SLCP plan has been drafted is advised. This guidance relates to stakeholder engagement during the initial drafting of the National SLCP Plan document.

The following sections describe the information that could be provided to each stakeholder to describe the mitigation measures being considered in the LEAP-IBC analysis. This information should increase the stakeholder’s understanding of the national planning process, and the options for SLCP mitigation. It also describes the information that could be provided by different stakeholders on the current activities and actions being undertaken that are relevant for implementation of the SLCP measures. Finally, it describes the information that stakeholders could provide on the additional actions that would be required for implementation of the SLCP mitigation actions.

**Feedback on SLCP measures**

The National SLCP Plan should describe clearly the commitment that the national government is making to reduce SLCP-relevant emissions. It therefore needs to be agreed which SLCP mitigation will be included as priority measures in the National Action Plan.

Therefore, during the stakeholder engagement, stakeholders should be presented with the analysis of relevant mitigation measures that has been done. The following information should be included in the presentation to stakeholders:

- Description of the mitigation measure that has been modelled
- The specific target and level of ambition of the mitigation measure considered
- The timeline modelled for implementation of the measure
- The data and assumptions used to model the mitigation measure
- The estimated reduction in emissions (of SLCPs, greenhouse gases, and air pollutants) calculated for implementation of the measure
- The estimated human health, crop yield loss and climate benefits from implementation of the measure.

Having presented the mitigation measures relevant to the stakeholders, they can provide guidance and suggestions on:

- The feasibility of a particular mitigation measure in the national context
- The level of ambition and target for emission reductions from a mitigation measure
- The timeline for implementation of the measure and achievement of the target

Discussions with stakeholders should therefore provide answers to the following questions:

- Should the mitigation measure be a priority measure that is committed to in the National SLCP Plan?
- Is the level of ambition and target for emission reductions, and the timeline for implementation suitable for this measure?
○ If not, what changes would you recommend for this measure to be included in the National Action Plan as a priority measure?

● If appropriate, is additional data available to improve assessment of the mitigation measure in the modelling?

**Current activities relevant for implementation of SLCP measures**

Having identified the priority measures that will be included in the National SLCP Plan, it is necessary to then understand what actions are needed for the measure to be effectively implemented. This requires that the **implementation pathway** for each of the priority measures is outlined.

The first step in discussions with stakeholders should therefore identify all of the specific steps that are required to implement each of the priority measures that will be included in the National SLCP Plan. An example implementation pathway for a clean cookstove intervention in Ghana is included in Annex 1. The specific steps in the implementation pathway could be categorised into three broad categories, i) Obtaining a vision and commitment to implement the measure, ii) Regulation, Standards and Enforcement, and iii) Infrastructure and Investment. Other types of steps may be needed in the implementation pathway for a particular measure.

Having outlined what an implementation pathway is, discussions with stakeholder should then focus on identifying:

- What current activities, policies, strategies etc. are already being undertaken that are relevant for a particular priority SLCP measure?
- How do these current activities contribute to the implementation of the particular SLCP measure?
- What parts of the implementation pathway are already covered by existing plans?
- What barriers remain for implementation of the priority measure that are covered by existing activities, plans etc.?

The aim of these discussions with stakeholders is to identifying how far existing plans go in helping to implement the priority measures. The results from these discussions could be summarised in a table such as that described below.
Example table describing current plans, strategies and activities that are relevant for implementation of SLCP-relevant measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Current plan, strategy, activities or targets relevant for implementation</th>
<th>Contribution of activities to implementation of measure</th>
<th>Remaining barriers and gaps for implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase use of improved cookstoves</td>
<td>● Rural cookstoves policy</td>
<td>● Provides roadmap for increasing access to improved biomass stoves in rural areas</td>
<td>● No cookstove emission standards established or enforced</td>
</tr>
</tbody>
</table>

Additional actions for implementation of SLCP measures

The additional actions needed for implementation of each priority SLCP measure then need to be identified. These are the concrete actions needed to implement the priority SLCP measures that are not covered by current activities, strategies and plans. These additional actions are those that will be taken forward by the national government as part of the implementation of the National Action Plan.

Discussions with stakeholders should then focus on identifying the concrete actions that should be included in the action plan in addition to the actions that are covered by existing plans. These additional actions would be those that the government commits to taking forward to increase implementation of the priority SLCP measures committed to in the National SLCP Plan. For each measure, the following questions should be discussed so that the additional actions can be identified with sufficient detail.

- What additional actions are needed for implementation of the priority SLCP measures that are not currently considered in existing activities, plans, strategies etc.?
- How will this additional action increase implementation of the priority SLCP measure?
- What steps would be required to achieve the action?
- Which organisations need to be involved in the action?
- What is the timeline for achieving the action?
- Who will have overall responsibility for achieving the action?
- What is the indicator that the action has been achieved?
- What funding is required to achieve this action?

The results from these discussions could be summarised in a table such as that described below.
Example table summarising the additional actions that will be undertaken to implement the priority SLCP actions committed to in the National Action Plan.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Action</th>
<th>Objectives / Targets</th>
<th>Description</th>
<th>Sub-actions / Milestones</th>
<th>Organisations involved</th>
<th>Timeline</th>
<th>Indicator</th>
<th>Organisation responsible for Action</th>
<th>Funding required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which measure does the action relate to (e.g. SLCP coordination, embedding SLCPs in NDCs or a specific sectoral measure)</td>
<td>Describe the action</td>
<td>What is the objective of the action, if it is implemented what will it achieve?</td>
<td>Describe in more detail the action, and how it will help to effectively implement the measure it relates to</td>
<td>What are the key steps needed to achieve each action or milestones in successfully achieving each action?</td>
<td>What organisation are involved in achieving this action?</td>
<td>When should the action be achieved?</td>
<td>What specific indicator will be used to monitor and evaluate whether the action over time?</td>
<td>Who has overall responsibility for achieving this action?</td>
<td>What funding is needed to implement this action? Where could this funding be obtained (within country or from external sources)?</td>
</tr>
</tbody>
</table>
Annex 7: National Planning Document Template

Format and content

The format and content of the national planning reports will differ from country to country depending on local needs and traditions, and knowledge of the key audiences.

The planning document would develop the logic that would outline the steps that each country could take according to the following steps:

i. Introduce the issue and relevance to the country;
ii. Explain the emissions and their likely progression and highlight the relative contribution of different sources to the SLCP issue, with an understanding of the extent of current knowledge
iii. Identify relevant measures and strategies for each source that would reduce emissions, with an assessment of the certainty regarding the impact of those different measures on emissions and impacts
iv. Assess the potential of full implementation to reduce impacts on health, crop yield and climate
v. Describe the different relevant policy frameworks for SLCPs, relevant programmes and projects (internationally and nationally initiated) in each country
vi. Discuss for each measure the relevant policy frameworks, programmes, strategies that are relevant to the particular measure
vii. Describe possible pathways by which measures could be best integrated into the policy making context of each country. This pathway analysis would identify the major actors, technologies, policy systems according to a common approach
viii. Describe the pathways for the different measures according to the degree to which these are understood:
   a. Well understood pathway
   b. Possible pathway
   c. Poorly understood pathway
ix. Identify main actions for the different measures to move them forward towards action
x. Identify the priority actions that will give results in a short space of time

Process of developing the document

The national planning document will most likely be developed by the consultants / academics undertaking the work for the development of national planning, aided by the relevant ministry commissioning the work and the international team advising on the development of the national plans. Key questions in developing the document include:

- Who will be included in the drafting teams?
- How will stakeholders be represented in the drafting process?
- What peer-review process will be used to review the plans?

Structure of the document

The ‘opportunities’ document does not have to fit any particular format but the following proposes a generic approach which can be used or modified. Most of the national planning reports from the Pilot Phase include these structural elements, but not necessarily in the order shown.
Title:
This needs to fit the purpose of the document in the country concerned.

Summary for Decision Makers
This can briefly introduce the SLCP issue, the national planning process, and explain the identification of relevant measures that could be introduced or augmented in the country, with the estimated benefits that could result from the implementation of these measures. It should then describe the concrete actions that are to be undertaken to promote implementation of each measure, and outline plans for monitoring and evaluation of progress.

Chapter 1: Introduction

This can describe the nature of the SLCP problem; desire of the country to engage in promoting SLCP mitigation and its engagement in the CCAC; the role of the national planning process in the country; institutional setup of the national planning process; goals of the national planning and expected outcomes.

- Nature of the SLCP problem: diversity of sources, diversity of impacts. Not seen as distinctive category, policy spread through a wide range of programmes. In particular ambient air quality and climate have grown apart in policy and institutional terms in recent decades. Given the urgent need to mitigate emissions on climate, health and food security grounds, finding effective implementation mechanisms should be an urgent priority

- National scale as the critical scale for action

- the UNEP assessment: how far it takes us; now need to refine assessments to the national scale and identify relevant and effective delivery processes.

Chapter 2: National overview: the Contribution of different sources to SLCPs now and likely progression to 2030/2050

Here, countries can explain:

- The emissions of key pollutants important to reducing impacts associated with SLCPs by sector and source according to national circumstances (the methods used to estimate emissions and the reference scenario, as a basis for later policy scenarios (LEAP-IBC if using it, or other approach).

- The likely progression or emissions into the future should also be outlined, and the relative contribution of different sources to the SLCP issue in future years according to a reference scenario highlighted.

- A brief description of the context in general and for each sector (legal and regulatory mapping, current initiatives relevant to SLCPs, trends, challenges, etc.)

- The current and expected future impacts of these emissions on health, crop yield loss and climate can also be detailed, with discussion of their progression over time under the reference scenario.

- Key uncertainties and the extent of current knowledge to estimate emissions and projections can also be highlighted.
Chapter 3: National measures to reduce SLCPs

The purpose of this chapter is to present an overview of the measures that have been prioritised to be part of the national strategy on SLCPs. Building on the quantitative assessment and review of all the possible measures, the priority measures could be prioritised based on national circumstances such as the potential to reduce emissions, ease of implementation, cost of implementation, alignment with national priorities, existing targets in current plans, etc. It is important to explain the process and criteria used for this selection.

National priorities for each measure can then be identified that quantify the target associated with implementing each measure in the country. An example summary table for national priority measures is outlined below.

Example Table summarising measures that will reduce SLCPs

<table>
<thead>
<tr>
<th>Source Sector</th>
<th>Measure</th>
<th>Description</th>
<th>Proposed level of ambition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>LPG for cooking</td>
<td>The measure will replace biomass cookstoves with LPG in Country X</td>
<td>50% of households cooking with LPG by 2030</td>
</tr>
<tr>
<td>Transport</td>
<td>Euro IV emission standards on new vehicles</td>
<td>This measure will legislate that all newly registered vehicles in Country X are Euro IV</td>
<td>All new vehicles are Euro IV beginning in 2020</td>
</tr>
<tr>
<td>Industry</td>
<td>Efficient brick kilns</td>
<td>Brick kilns will be converted from traditional kilns to improved vertical shaft brick kilns</td>
<td>80% brick kilns converted to improved kilns by 2030</td>
</tr>
</tbody>
</table>

The estimated impact of these national priority measures on emissions and the potential of the measures to reduce impacts on health, crop yield loss and the country’s contribution to climate change can then be quantified.

The purpose of this step it to quantify the impact of measures that could be applied to key sources of emissions and identify which have the greatest potential to deliver benefits. This can then be followed up by an analysis of how these measures could be implemented in Chapters 4 and 5.

Chapter 4: Implementation strategies of the priority measures

The purpose of this chapter would be to present measure by measure (or sector by sector):

- the existing policy frameworks, programmes, strategies within the country (nationally and/or internationally initiated) that are relevant to that particular measure. A ‘Mapping’ of current strategies, policies, policy frameworks, programmes and projects can be described here that identifies possible implementation options, pathways and delivery mechanisms for each measure.
- Consider barriers to implementation of the measures and examine ways by which these could be overcome.
- Describe possible pathways by which measures could be best integrated into the policy making context of each country. This pathway analysis would identify the major actors, technologies, policy systems.

There are different types of integration – integration into overarching policies and plans (e.g. NDC enhancement plan and other climate change strategies and policies; urban development plan; air quality policies and strategies); and integration into sectoral policies, strategies and plans – e.g. transport sector; agricultural and waste policies etc. The analysis should identify those policies that have already been agreed and where gaps exist where additional action is needed to address emissions. For all existing and potential new options, the policy options, constraints, and lead-times need to be identified.

Agreed policy also needs to be implemented, something which is not guaranteed. Opportunities to ensure and facilitate successful implementation of current plans and policies can form part of identified actions. Other parts of the national SLCP plan can also be new measures that need to be implemented. The plan can also include the political judgement on mitigation and selection of measures. The outcome of this chapter is an outline of the implementation pathway for a particular measure within the country, and identification of the priorities for action on SLCPs in the country.

An example of the pathways to implement a clean cooking scenario in Ghana is described in Annex 5. The detailed description of the implementation pathway may be included as an Annex, with a summary provided in the main chapter. The example describes the steps required to i) obtain a commitment to implement the measure, ii) setting and enforcing standards and regulations, and iii) required investment and infrastructure development. These are examples categories of actions that may be needed to implement a measure in a particular country. For different measures, depending on the level of support within the country, may require other types of actions, or require a different level of detail on each type of action.

The table below can be used to summarise this information for each sector, for each measure that is included in the National SLCP Plan. The actions that are included in this table for a particular measure are those key actions that are required for the barriers identified to be overcome and that will increase the implementation of a particular measure. It would be very useful to indicate whether the actions identified for each measure are covered under existing plans and strategies, and which actions are not included in existing plans.

Example: Table presenting possible implementation pathway & actions per sector/measure

<table>
<thead>
<tr>
<th>Sector Measures</th>
<th>[Sector] [Identified measure]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>[enter target, e.g. penetration rate by date]</td>
</tr>
<tr>
<td>Context, current relevant policies, plans and projects</td>
<td>[list and describe current policies, projects, as well as what is planned under any national climate change, development or sectorial plan, and the status of implementations. Identifies possible implementation options, pathways and delivery mechanisms for this measure.]</td>
</tr>
<tr>
<td>Major Barriers</td>
<td>[indicate whether there are any challenges for the adoption of new policies or their implementation]</td>
</tr>
<tr>
<td>Primary Responsibility</td>
<td>[indicate main Institutions in charge]</td>
</tr>
<tr>
<td>Actions</td>
<td>[identify the actions that will be implemented to achieve the measures]</td>
</tr>
</tbody>
</table>
In order for the actions to be taken forward and implemented, additional detail is needed to understand the organisations involved, the steps needed for the action to be implemented, a timeline for achieving them and how it can be monitored and evaluated. The chapter could therefore also present an overview of the workplan for the implementation of the measure, which could be summarised in a table such as that below. For actions that are already included, and will be implemented under other planning processes, it may not be necessary to describe in detail the workplan for its implementation.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Action</th>
<th>Objectives / Targets</th>
<th>Description</th>
<th>Sub-actions / Milestones</th>
<th>Priority</th>
<th>Organisations involved</th>
<th>Timeline for achieving action</th>
<th>Indicator</th>
<th>Organisation responsible for Action</th>
<th>Funding required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which measure does the action relate to (e.g. SLCP coordination, embedding SLCPs in NDCs or a specific sectoral measure)</td>
<td>Describe the action</td>
<td>What is the objective of the action, if it is implemented what will it achieve?</td>
<td>Describe in more detail the action, and how it will help to effectively implement the measure it relates to</td>
<td>What are the key steps needed to achieve each action or milestones in successfully achieving each action?</td>
<td>What priority does this action have within the national plan (e.g. high, medium or low)</td>
<td>What organisation are involved in achieving this action?</td>
<td>When should the action be achieved?</td>
<td>What specific indicator will be used to monitor and evaluate whether the action over time?</td>
<td>Who has overall responsibility for achieving this action?</td>
<td>What funding is needed to implement this action? Where could this funding be obtained (within country or from external sources)?</td>
</tr>
</tbody>
</table>

**Example table that could be used to summarise all the actions that make up the National SLCP Action Plan and how they will be implemented.** The specific actions included in the table may relate only to a specific part of the implementation pathway. Therefore, the table could be accompanied by a paragraph that describes the context for these actions, summarising the overall goal of implementing the measure and how the actions included for each measure in the national plan will help to achieve the implementation of the measure.
Chapter 5: Implementation of the plan

This chapter could outline how the plan will be implemented, including:

- **Who will coordinate SLCP planning, modelling, monitoring and evaluation of progress**
  - Identify who (institutions and people) will keep an overview of all matters relating to the SLCP plan in the country
  - Outline the concrete actions for revising national priorities for action on SLCPs and engaging with key stakeholders, as appropriate to refine these;
  - Outline the plans to maintain the linkages to international initiatives related to SLCPs including the CCAC;
  - Include details of government commitments to continue the coordination function for managing SLCPs in the country – and identify a national budget that will allow this to happen.

- **The roadmap for integrating SLCPs into overarching policies and plans including existing measures in air quality policy, climate policy (e.g. NDCs), development plans and other overarching policy processes in the country**
  - Outline those plans that already affect SLCP-related emissions and who is responsible for their implementation, and break down the implementation into detailed steps which can be monitored;
  - Outline the concrete steps that will be taken to mainstream SLCPs in relation to these overarching plans and the organisations that implement them;
  - Be clear about the linkage to the plans, and who bears responsibility to promote the SLCP issues;
  - How the development of the plans will be monitored in relation to SLCPs;
  - The further actions that can be mainstreamed in these plans;
  - The concrete steps to be taken (and by whom) to ensure that these further actions are included in the overarching plans and implemented.

Chapter 6: Monitoring and evaluation

This chapter (which could also be a sub-section of Chapter 5) could outline the monitoring process that will be put in place for the monitoring of the implementation of the plan.

Guidance on a possible method for developing the monitoring and evaluation plan is included in Annex 6 of this national planning guidance.
Annex 8: Example implementation pathway for clean cooking measure in Ghana (relevant for Chapter 4 and Chapter 5 in Annex 7)

As an example, the following are ideas on the implementation of an existing policy in Ghana to increase the number of people cooking with LPG.

This Annex outlines the different measures, processes and structures all of the main steps that would need to be taken by different stakeholders for successful implementation of the measures. These following steps are accompanied by specific actions that each stakeholder would need to take and progress in achieving all of these individual actions can then be monitored and evaluated. In terms of the structure of the national SLCP plan described above, this framework for implementation of the clean cooking measure could be initially described in Chapter 4, followed by identifying which of these steps have already been achieved described in Chapter 5. Chapter 6 would then outline which of these actions are yet to be achieved, and what will be done to help them to be achieved. This would provide the set of actions that form the National SLCP Plan.

To outline the implementation pathway for the clean cooking scenario in Ghana (that would be included in Chapter 4 or as an Annex to Chapter), the following process was followed. The aim was to identify the specific steps required to implement the measure, the organisations involved and the funding required to implement them.

**Step 1. Obtaining a commitment to implement the measure:**

**Key Questions:**

- Is a commitment from government required to successfully implement this measure?
- What steps are required to obtain a commitment to implement a measure by the government in your country?
- Who needs to be involved in each step?
- Have the steps needed to obtain a commitment been achieved?

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Organisation</th>
<th>Outcome</th>
<th>Status</th>
<th>Additional Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Set out political vision</td>
<td>Office of the President</td>
<td>Political vision outlined: Sustainable energy for all</td>
<td>Achieved</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Establish clean cooking as development priority</td>
<td>Ministry of Energy National Planning Commission</td>
<td>Clean cooking set as a development priority in national planning documents (Sustainable energy for all, LPG master plan, Ghana Gas masterplan, bioenergy strategy, renewable energy act)</td>
<td>Achieved</td>
<td></td>
</tr>
</tbody>
</table>
| 3    | Establish measure as commitment in Ministry of Energy plans | Ministry of Energy | Commitments made with specific targets:  
  - 50% of households using LPG by 2030  
  - 2 million households using efficient stoves | Achieved |  |
Step 2. Putting in place regulations and setting and enforcing standards

Key Questions:

- What new regulation/standards are required to be able to implement the measure? What steps are needed to produce these regulations/standards?
- How will these standards/ regulations be enforced?
- Who needs to be involved in each step?
- Have the steps needed to obtain a commitment been achieved?
- What funding is required to implement each of these steps? Is this funding available from within the country, or is external funding required?

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Organisation</th>
<th>Outcome</th>
<th>Status</th>
<th>Additional Steps</th>
<th>Funding Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Create stove testing programme to inform standard setting</td>
<td>Council for Scientific and Industrial Research</td>
<td>Evidence based setting of stove emission standards</td>
<td>Not Achieved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KNUST University – Technology research centre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Establish emission standards for stoves</td>
<td>Energy Commission Sustainable Energy for all secretariat Renewable Energy Directorate</td>
<td>Emission standards for stoves legislated for</td>
<td>Not Achieved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Enforce emission standards for stoves</td>
<td>Energy Commission Sustainable Energy for all secretariat Renewable Energy Directorate</td>
<td>Stoves used in Ghana adhere to emission standards</td>
<td>Not Achieved</td>
<td>Need for coordination of standard setters and regulators (enforcers): better coordination of permits and inspections</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Regulate cookstove market</td>
<td>Energy Commission Sustainable Energy for all secretariat Renewable Energy Directorate</td>
<td>Stoves for sale in Ghana adhere to emission standards</td>
<td>Not Achieved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Promote and licence clean cookstoves</td>
<td>Energy Commission Sustainable Energy for all secretariat</td>
<td>Licences issued to sellers who sell cookstoves used in Ghana</td>
<td>Not Achieved</td>
<td>Increase Awareness of buyers – advantages</td>
<td></td>
</tr>
</tbody>
</table>
### Step 3. Investment and infrastructure development required

**Key Questions:**

- What infrastructure is required for the successful implementation of a measure?
- Of this infrastructure, what is already in place and what needs to be developed?
- What organisations need to be involved in developing the infrastructure?
- What organisations need to be involved to regulate the infrastructure development?
- What public/private sector investment is required to successfully implement the measure?
- What level of funding is required to implement each of these steps? Is this funding available from within the country, or is external funding required?

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Organisation</th>
<th>Outcome</th>
<th>Status</th>
<th>Additional Steps</th>
<th>Funding Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ensure supply of LPG fuel from domestic sources</td>
<td>Ghana Gas Company; Tema Oil Refinery</td>
<td>Domestic supply of LPG for cookstoves</td>
<td>Not Achieved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Secure supply of LPG fuel from imports</td>
<td>Private Sector LPG importers</td>
<td>Imported supply of LPG for cookstoves</td>
<td>Not Achieved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Enforce effective distribution mechanism for LPG</td>
<td>Private sector distributors (Bulk distributing companies; oil marketing companies, Ghana cylinder manufacturing company; transport operators distributing LPG)</td>
<td>Distribution of LPG to market</td>
<td>Not Achieved</td>
<td>Need to implement distribution method so that users can buy filled cylinders (recirculation model)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Check degree of ambition for Rural LPG programme— for distribution of stoves and LPG</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Coordination of permits/licenses and inspection of LPG filling stations</td>
<td>Ghana EPA (permit for filling station location); Ghana Standards Board (permit for fuel quality)</td>
<td>Id set of filling stations across Ghana</td>
<td>Not Achieved: Enable more stations to be developed quickly— relate to circulation model Enable mobile stations as well</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Having identified the implementation pathway for the measure, it was then identified which measures would be included as part of the national plan (as part of Chapter 5). The following is an example of the specific actions that would be included in Chapter 5 of the National SLCP plan. These actions are related to those identified above as ‘additional steps’ needed to implement a particular measure for which there is currently a commitment, but also an additional action designed to assess how ambition could be increased.

**Step 4. Identifying actions to increase ambition for implementing measure**

**Key Questions:**

- What are the key actions in the implementation pathway that have not been achieved that are required for the successful implementation of the measure?
- What is the priority for each of these measures?
- Who needs to be involved to achieve them?
- What indicator will be used to assess whether it has been successfully achieved?
- Who has overall responsibility for each action?
- What additional actions could be taken to increase the ambition of current plans further?

**Example summary paragraph providing context for actions included as part of national SLCP plan:**

**Measure: 50% of households using LPG for cooking by 2030:** Switching households to cook using LPG already has a commitment to be implemented within Ghana from the Ministry of Energy, as part of the sustainability for all strategy. Successful implementation of this measure requires a consistent supply of LPG, and an effective method of distributing and refilling cylinders for users. This requires a large number of filling stations across the country, and a recirculation model in which users can trade in empty cylinders for filled ones. The recirculation model is not yet implemented in Ghana, but there is a plan to do so in the next years. There is also an existing strategy to extend LPG distribution to rural areas. It is also necessary to create a market for LPG cooking in Ghana, and to demonstrate the benefits of switching from biomass to LPG for cooking. The actions outlined in the table below include monitoring the adoption of the recirculation method for LPG and the rural LPG development plan, as well as developing a tool to communicate to Ghanaians the benefits of switching to cleaner fuels. These actions relate to a subset of the implementation pathway for this measure, described in detail in the tables above. The final measure is to identify a roadmap to achieve larger penetration of LPG cookstoves above current commitments, which could take the form of the table on the following page.
<table>
<thead>
<tr>
<th>Measure</th>
<th>Action</th>
<th>Objectives/ Targets</th>
<th>Description</th>
<th>Sub-actions /Milestones</th>
<th>Priority</th>
<th>Organisations involved</th>
<th>Timeline for achieving action</th>
<th>Indicator</th>
<th>Organisation responsible for Action</th>
<th>Funding Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% LPG in households</td>
<td>Assess degree of Implementation of recirculation model and how it could/ should be enhanced</td>
<td>Objective: To ensure that recirculation model is effectively implemented and that access to LPG is expanded</td>
<td>A recirculation model will decrease the time required to wait to change LPG canisters. It requires that LPG sellers have sufficient filled LPG cylinders to provide to the population using the station</td>
<td>High</td>
<td>Ghana EPA Energy Commission</td>
<td>December 2019</td>
<td>Number of filling stations in Ghana using recirculation model</td>
<td>Ghana EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% LPG in households</td>
<td>Check degree of ambition for Rural LPG programme– for distribution of stoves and LPG</td>
<td>Objective: To ensure that LPG is effectively distributed to the rural population of Ghana</td>
<td>The rural LPG programme aims to increase the penetration of LPG for cooking in rural areas. The implementation of this plan could make a substantial effect on achieving the current policy</td>
<td>High</td>
<td>Ghana EPA Energy Commission</td>
<td>2019</td>
<td>Number of rural households cooking using LPG</td>
<td>Ghana EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% LPG in households</td>
<td>Awareness raising - fill gap in information flow – quantifying benefits and other gains – safety health costs</td>
<td>Objective: To develop a tool that can be used to show people the benefits that could be gained from switching to cooking using LPG</td>
<td>Many people are unaware of the multiple health, economic and time saving benefits of switching to cleaner fuels. This tool would aim to summarise and communicate this information to users in Ghana</td>
<td>Moderate</td>
<td>Ghana EPA Energy Commission</td>
<td>2019</td>
<td>Number of people with exposure to information on benefits of cookstove interventions</td>
<td>Ghana EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional ambition for LPG distribution</td>
<td>Create roadmap for increasing ambition e.g. 60% households using LPG by 2030</td>
<td>Objective: To develop a road map to show how additional emission reductions could be achieved through switching more households to cooking using LPG</td>
<td>Additional benefits could result from even larger scale adoption of LPG. This actions would define the steps required to achieve even greater LPG adoption in Ghana</td>
<td>Moderate</td>
<td>Ghana EPA Ministry of Energy</td>
<td>2019</td>
<td>Roadmap produced</td>
<td>Ghana EPA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annex 9: Guidance on Developing a Monitoring & Evaluation Plan for the National SLCP Mitigation Action Plan

Introduction

Within the Climate and Clean Air Coalition (CCAC) Supporting National Action & Planning Initiative (SNAP), the production of a National Action Plan to reduce short-lived climate pollutants (SLCPs), aims to prioritise measures and sectors for the reduction of SLCPs to benefit air quality and climate change mitigation. These sectors may be subject to different planning processes, under the control of different ministries and implementing agencies, and also subject to different international planning processes. It is therefore important following the publication of the National Plan that there is a performance monitoring process in place to assess the extent to which the recommended actions with the Plan are being implemented, and what additional actions may need to be taken to enhance this implementation.

The Activity Monitoring & Evaluation (M&E) Plan should therefore present the details of the Implementing Partner (IP) M&E systems. It can be used to identify the monitoring and evaluation procedures required to assess the extent to which changes within each organization, group, or population needed to, for example, embed SLCP mitigation within national policies, plans and strategies, or implement a particular mitigation action have been achieved. This includes detailing how results from individual activities contribute to the overall goal of the project (e.g. successful implementation of emission reduction strategies). To this end, the M&E plan should include performance indicators that can be used to measure the success of implementation of the National Plan recommendations.

This document is designed to give teams in each CCAC SNAP country guidance and a M&E report template to follow to develop a plan for monitoring and evaluating progress in implementing the plans, and in reducing SLCP (and co-emitted pollutant) emissions. The following section includes an outline and instructions for producing a M&E plan.

Sections of the Monitoring & Evaluation Plan

Section 1: Purpose of the SNAP project and national planning process

Instruction: Provide a brief description of the purpose of the national SLCP action plan

Guidance: This description could include the status of the document within government, and the aim of the actions that have been identified within the plan, for example, these may be actions related to implementing measures to reduce SLCP-related emissions in particular sectors, or process-based measures aimed at embedding SLCPs within current national strategies, policies and plans (e.g. air quality legislations, NDCs, development plans etc.).

Section 2: Purpose of the M&E plan

Instruction: Provide clear and precise descriptions of the guiding principle for this M&E plan, e.g. intent/purpose, economy of effort, participation, transparency, etc.
**Guidance:** This description should describe the monitoring and evaluation process within the country, and why these M&E processes will be useful in tracking the implementation of the actions described in the national SLCP plan. For example, the structure of the M&E plan outlined below identifies for each action in the national SLCP plan the organisations that are relevant to the implementation of that actions, and what change in their behavior is required for the action to be achieved. Indicators are then defined for each of these organizational outcomes, with monitoring activities specified to evaluate each of these indicators. This structure allows the desired changes that can facilitate the implementation of a measure, or embedding SLCPs within existing laws to be evaluated. A commitment to regularly reviewing progress on each indicator, and identifying new actions as conditions change, ensures that the M&E plan is a dynamic and flexible document that can be updated throughout the National Plan’s implementation.

**Section 3: Results Framework**

**Instruction:** For each overall goal of the national plan separately, develop a results framework describing the overall outcome (e.g. successful implementation of a mitigation action), the actions that are desired from different organisations needed to achieve the outcome, how each action for each organization will contribute to achieving the overall outcome, and the indicators and monitoring actions that will be used to assess whether each action has been successfully implemented.

**Guidance:** A results framework should be developed for each outcome outlined in the National Plan, i.e. for each measure or activity recommended for implementation in the National Plan. For each measure, the results framework should be designed according to Figure 1, and aim to answer the following questions:

1. **What is the overall outcome desired from the project?**
   - In general, this higher outcome could be the successful implementation of the measure specified in the national SLCP plan relating to a specific sector, or it could be a process outcome, such as embedding SLCP measures within a particular policy, regulation or development strategy of the government, like the air quality strategy or NDC process.

2. **Who are the types of organizations or people that need to be influenced by the project in order for the overall outcome to be achieved?**
   - An organization is identified in the results framework because it is a group of people where a behavior change could result in the successful implementation of the measure/action in the national SLCP plan. These organizations can be governments, ministries, industries, unions, civil society groups, the general public, specific populations etc., but in all cases the types of organizations or people should be those groups where a behavior change is necessary for the overall outcome to be achieved. If the behavior change is the same between two groups, you can merge the types of organisations or groups of people into one type.
3. What are the desired ‘organizational outcomes’ for each organization in the framework?

- What will have happened to the awareness, attitudes, capacities and skills, network, and/or behavior of these types of organisations or groups of people at the end of the implementation of the national plan? This step identifies what the desired change of the organisations or people is that contributes to the achievement of the overall outcome.

Figure 1: Results framework for monitoring and evaluating outcomes related to the implementation of measure X.
4. For the desired organizational outcomes, what are the indicators that can show if this organizational outcome has been achieved?

- The indicators should be designed to highlight the context within which an organization is operating (e.g. a government/ministry is working within a set of laws, a population with a collective knowledge of a subject/issue, an industry with an established set of methods). The indicators should be able to reflect whether the context for a particular organization has changed, and whether that change in context is beneficial to achieving the organizational outcome or not. The indicators should also be able to identify whether the project is still relevant, or whether the context has changed such that some activities are no longer relevant (e.g. a scrappage scheme for old cars may no longer be relevant once the fleet has been renewed).

5. What activities are necessary to monitor the indicators?

- Here it should be identified how the indicators will be monitored. Will this be through data collection, questionnaires, meetings? How often will indicators be monitored, and who is responsible for this?

6. Having collected the data what will happen in project processes?

- Here it should be explained how the data on each indicator, when collected, will be used within the project. This can include the production of status reports, and to feed into a review of the plan to assess whether additional actions for organisations are required to successfully achieve the overall outcome. It may also be used to update analysis of SLCP emissions and impacts to assess whether implementation of actions in the national SLCP plan are reducing SLCP-relevant emissions.

The number of levels in the results framework may change, e.g. different ministries may be treated separately due to the different desired outcomes for each. The number of indicators for each organization can also vary depending on the desired outcome, and the ability to analyse the effect of changes in context on achieving the desired organizational outcome.

When developing the results framework, each of the organisations that are targeted with action should be described, alongside the desired outcome for that organization (i.e. what change in behaviour for this organization is desired?). It should be explained how achieving the desired outcome for the organization will contribute to achieving the overall outcome of the project.

Then, for each indicator, associated with an organization, list the monitoring activities that will be undertaken to evaluate that indicator. How will these activities be undertaken, and who is the responsible person for overseeing them? These could be summarized in a table such as Table 1. Describe for each indicator how it will demonstrate whether the desired change in behaviour for that organization has occurred, and that the desired outcome has been achieved? It can help to establish a base value for the indicator in the current year, and targets for subsequent years, so that the monitoring activities can be used to assess the indicator against these targets. These could be summarized for example in Table 2.
### Table 1. Indicator Activities

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Indicators</th>
<th>Activities</th>
<th>Definition and Unit of measure</th>
<th>Data Source</th>
<th>Method or Tool</th>
<th>Frequency of Collection/Reporting</th>
<th>Use of Information</th>
<th>Person Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization 1</td>
<td>Indicator 1 for Organization 1</td>
<td>Monitoring Activity to evaluate Indicator 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Table 2. Indicator Targets table

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Baseline</th>
<th>Target Year 5</th>
<th>Target Year 1</th>
<th>Target Year 2</th>
<th>Target Year 3</th>
<th>Target Year 4</th>
<th>Target Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator 1 for Organization 1</td>
<td></td>
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</tbody>
</table>
Section 4: Management of the Monitoring & Evaluation System

**Instruction:** Provide clear and precise descriptions on the Activity’s M&E structures, functions, and capabilities

**Guidance:** This section can detail the type and level of responsibility that different staff members, and positions have for M&E at different stages of the implementation of the monitoring activities. Ways to address issues identified should be provided, e.g. is there a need to strengthen the capacity of staff within a Ministry to undertake M&E activities, or is there a need to partner with M&E organization(s) to strengthen the M&E system, etc.?

Section 5: Performance Reporting Schedule

**Instruction:** Provide a Gantt chart indicating the planned tasks, frequency, timeline, responsible persons, etc., for performance monitoring.

**Guidance:** If the monitoring schedule is already included in the workplan, relevant information may be copied and pasted here from it.) Describe the various reports (with timing) that will be produced and what relevant M&E type content will be included in each, e.g. what indicator data will be included in each update. State that the project will cooperate with non-scheduled requests for specific M&E data updates, e.g. from CCAC or other international partners.

Section 6: Evaluation Plan

**Instruction:** Indicate planned evaluations and proposed schedule.

**Guidance:** As the national SLCP plan is indicated, the actions required of different organisations may change to successfully achieve the overall outcome of a project. Therefore, evaluation of whether the indicators and monitoring activities included in the M&E are still appropriate is required to understand which indicators work well, which ones are not working well, and whether there are there additional groups that should be looked at or indicators added.

This section can describe the timeline for undertaking these evaluations, and the purpose of proposed evaluations, as well as the relationship of required data to the proposed performance monitoring indicators.

A. Planned Evaluations and Schedule.
B. Purpose of Proposed Evaluations.
C. Link between Evaluations and Performance Monitoring Indicators/Data Collection.
References


