The SEI Initiative on Low Emission Development Pathways (LED-P)

There is a growing sense of urgency about the need to sharply reduce greenhouse gas emissions and shift economic systems away from fossil fuels and onto low-carbon pathways. At the same time, many countries are struggling with severe air pollution, particularly in urban areas, which is harming human health and damaging crops and ecosystems. There is also growing interest in addressing short-lived climate pollutants (SLCPs) – such as methane, black carbon, tropospheric ozone and hydrofluorocarbons (HFCs) – to slow near-term climate change.

Synergies between these three issues have long been recognized, but there has been little integration of efforts to address them. A second key challenge is that decision-makers, particularly in developing countries, lack crucial data on air pollution and greenhouse gas emissions, pollutant concentrations, impacts, trends, and the costs and benefits of different policy options. This makes it hard to identify and prioritize measures, or to make the case for coordinated action.

The SEI Initiative on Low Emission Development Pathways (LED-P) aims to help bridge this gap by providing decision-makers with the tools and knowledge they need to consider these issues together. It is creating an integrated research programme, along with easy-to-use planning and analytical tools. These tools will be backed by hands-on training, synthesis of the latest research, and data to support decision-making. We are also conducting new research to fill knowledge gaps and answer pressing questions that arise in policy and planning discussions.

Responding to an immediate need

The LED-P Initiative grew directly out of SEI's engagement in national and international policy processes. In particular, it builds on our work with the Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants (CCAC), a global collaboration among governments, civil society and the private sector.

Through the CCAC SNAP initiative (Supporting National Planning for Action on SLCPs), we are actively engaged with 16 countries, applying our new tools and research. This work has raised the profile of SLCPs and of strategies to address them – leading Mexico, for example, to include black carbon in its pledge under the Paris Agreement.

The LED-P Initiative is also represented on the CCAC Scientific Advisory Panel, which brings together top scientists from around the world to distil and translate the science on SLCPs for policy audiences. In addition, Initiative team members have contributed to integrated assessments of SLCP measures in Asia, Latin America and the Caribbean.

The Initiative also builds on SEI's long-standing engagement in climate change mitigation and low-emission development

Photo © World Bank

Replacing inefficient brick kilns such as these in Bangladesh would reduce both air pollution and greenhouse gas emissions.

planning around the world. SEI's Long-range Energy Alternatives Planning (LEAP) system is used by planners and analysts in more than 190 countries, and the LEAP user community, COMMEND, has more than 30,000 members.[1] At least 32 national pledges under the Paris Agreement were informed by LEAP analyses. SEI is also active in the Low Emission Development Strategies Global Partnership (LEDS-GP), which works to advance climate-resilient, low-emission development around the world.

The LED-P Initiative is designed to directly respond to the needs expressed by governments, our partner organizations, and users of our existing tools. It includes scientific research and tool development, policy analysis and capacity-building, with three core objectives:

- To advance knowledge on short- and long-term climate change, air pollution, and strategies to address them, with a view to providing decision-makers with the knowledge and tools they need to undertake robust, science-based quantitative assessments.

  This includes work to better quantify air pollution (outdoor and indoor) and its impacts, and to understand linkages between the causes and impacts of climate change and air pollution. We have developed a tool to present this research, so that results from analyses can be immediately applied to inform policy-making and planning in developing countries.

- To identify effective policy frameworks for addressing air pollution and short- and long-term climate change at both the national and international levels.

  This requires direct engagement with decision-makers, combined with rigorous policy analysis informed by the latest science. Our goal is to provide useful guidance and examples for countries developing low-emission development, climate change mitigation, SLCP and air pollution abatement plans, and foster dialogue and mutual learning.

- To build technical and institutional capacity for integrated climate mitigation and air quality analysis and planning in developing countries.

  SEI has a long track record of building capacity for energy and mitigation planning around the world. The LED-P Initiative expands on that work by introducing our new tool as part of LEAP trainings for modellers supporting the development of national climate plans. In addition, as part of our CCAC engagement, we are building capacity in 10 countries in 2016 and 2017 to use the tool in support of national action planning on SLCPs.

The science of climate change and air pollution

Greenhouse gas emissions from human activities are already causing significant warming, leading to extreme weather events and major impacts in vulnerable systems. With no policies to reduce emissions, by 2081–2100, the average global surface temperature is expected to be 2.6–4.8°C higher than the 1986–2005 average.[2]

In the Paris Agreement, world leaders agreed to work to keep global warming "well below 2°C" and preferably below 1.5°C above pre-industrial levels.[3] In their national pledges under the agreement, several countries included not only carbon dioxide (CO_2) and other gases with long-term climate impacts, but also SLCPs. Prompt reductions in CO_2 emissions are crucial to stabilizing the climate in the long term, but because of inertia in the climate system, the benefits may not be felt for decades. The only real way to reduce near-term warming is to address SLCPs, many of which are also harmful air pollutants.[4]

SLCP mitigation strategies not only benefit the climate, but can also avoid harm to human health, crops and natural vegetation. For example, about 2.9 million premature deaths in 2013 have been attributed to outdoor exposure to particulate matter.[5] Crop exposure to ozone reduces yields for soybean (8.5–14%) wheat (3.9–15%), and maize (2.2–5.5%), resulting in losses of US$11–18 billion in 2000.[6]

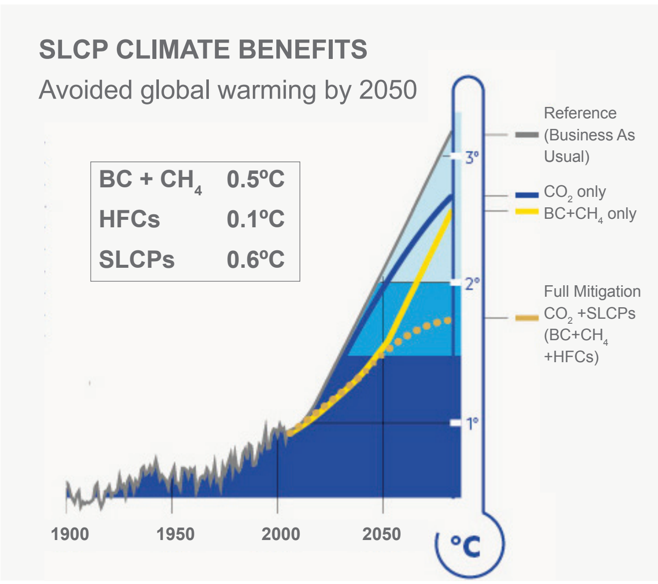

Figure 1: Potential reduction in near-term warming from full implementation of SLCP measures. This includes 16 methane (CH_4) and black carbon (BC) measures, plus the added benefits of hydrofluorocarbon (HFC) measures and the influence of simultaneous CO_2 emission reduction.
Adapted from CCAC graphic: http://www.ccacoalition.org/en/science-resources.

Addressing country needs

As the science on SLCPs and the links between air pollution and climate change mitigation have become better known, many governments have recognized substantial opportunities to implement measures with multiple benefits. For example, the CCAC, established in 2012, now has 50 country partners, along with dozens of non-state partners.[7]

As noted above, the LED-P Initiative is working with 16 countries to develop national SLCP action plans. A guidance document developed by SEI and others for CCAC provides a framework for developing these plans, including steps for raising awareness, identifying opportunities, and developing national priorities for SLCP abatement.

However, many developing countries with severe air pollution lack the capacity to address these issues. Problems include a lack of expertise and inadequate data on air pollution emissions, exposure, and the impact of each pollutant on human health and vegetation. Policy development is also hampered by limited knowledge about policy options available at the national and municipal levels, and about how these issues can be integrated into international policy frameworks.

There are, therefore, substantial opportunities to advance climate and air pollution mitigation efforts by increasing the capacity of countries to undertake robust quantitative analyses and by developing and implementing SLCP strategies. Addressing these shortcomings requires integrating knowledge from diverse disciplines in order to evaluate the co-benefits and trade-offs that may result from implementing mitigation measures.

Developing policy-relevant research

In this context, a major focus of LED-P is to develop and deliver relevant knowledge to users in partner countries. Specifically, the goal is to advance understanding of i) current health, vegetation and climate impacts in each country, ii) how those impacts could be reduced by implementing different SLCP, GHG or air pollution measures, iii) how different sources of pollutants contribute to impacts, so measures can target those sources, and iv) the economic costs and benefits of policy action.

Applied scientific research on this topic, conducted through the LED-P initiative, includes an assessment of the transferability of concentration-response functions for health, agriculture and ecosystems between different countries and regions. For example, do similar ozone concentrations affect soybean crops the same way in India and the United States?[8] Insights from this work can help distinguish between measures for which the benefits are highly context-specific, and measures that are easily replicable across countries.

In the public health realm, we are undertaking novel analysis to understand the global impact of air pollution on adverse pregnancy outcomes, and developing new methodologies for quantifying the health impacts of indoor air pollution.

In agriculture, we are extending research on ozone impacts on crops beyond the four standard crops studied – wheat, soy, maize and rice – to other crops of interest to policy-makers. We are also estimating timber yield losses due to ozone, and will subsequently examine how climate change impacts and

CO_2 fertilization affect timber yields. This will enable us to better model actual conditions that the forestry sector may face from the changing atmospheric concentrations.

Other work considers impacts on grasslands and subsequent impacts on livestock yields. We are also exploring how new approaches, such as earth observation data, can improve vegetation impact assessment, specifically using satellite data to evaluate impacts from open crop residue burning in China. In addition, we are promoting the development of new research programmes on the combined influence of climate change and air pollution on vegetation, terrestrial ecosystem carbon sequestration, and water availability and hydrology.

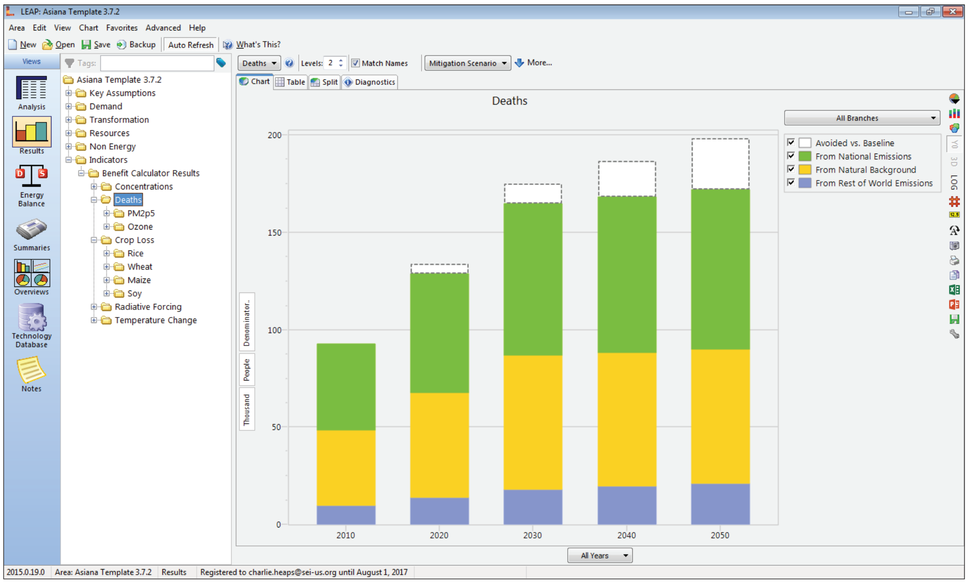

Figure 2: A screenshot of the LEAP-IBC tool. The figure shows the premature deaths that could be avoided by implementing specific measures that would improve air quality.

Improving our understanding of policies, measures and implementation

Scenarios for low-emission development are often technical and purely aspirational: What would be the GHG mitigation benefits if we could somehow cause 50% of cars to be electric in 2050? Or what would be the benefit of switching all households that now cook with traditional biomass to a modern fuel such liquefied petroleum gas? To create more credible, policy-relevant transition pathways, we need to better reflect the key barriers to change – from technical to socio-cognitive and financial. We also need to understand what policy choices are needed to enable key technical developments.

Aiming to fill these gaps, the LED-P Initiative is working to develop new approaches to better link outcomes with the necessary enabling policies. This requires looking more closely at the sectors involved in each strategy to understand what issues are likely to arise that could hinder the implementation of a given strategy, and how they might be overcome.

Photo courtesy of Jim Neumann / Industrial Economics.

LEAP-IBC training exercise at the SLCP National Planning Workshop held in Accra, Ghana, in April 2016.

This exploratory research aims to develop a generic framework to describe policies, the barriers to their implementation, and how those barriers might be modelled in technical scenarios. Case studies will be used initially to demonstrate how this framework provides a systematic way of assessing how policy translates into impact, and how it could raise the capacity of partner countries to undertake analysis on the barriers to transitions.

Additional policy research is focusing on the development of Nationally Determined Contributions (NDCs) under the Paris Agreement and the role of CCAC, the United Nations Framework Convention on Climate Change (UNFCCC) and other relevant forums. Specifically, we are examining how the potential for achieving multiple benefits from a policy can be used to motivate and facilitate agreement at the international scale.

We are also contributing to the debate on climate policy assessment – for example, how to quantify benefits from climate, air pollution and SLCP strategies

Integrating scientific research in policy development

The results of our research will be published in peer-reviewed journals as well as in SEI and CCAC briefing notes and online materials. Most immediately, however, it will be shared with partners in the 16 countries in the CCAC national SLCPs planning initiative. They need quantitative information to understand benefits and methods for SLCP abatement.

We are delivering this material through a new tool, the LEAP-Integrated Benefits Calculator (LEAP-IBC). This tool extends the LEAP platform by expanding the range of emission sources that can be analysed, so that the magnitude of emissions of all major pollutants from all major sources (both within and outside the energy sector) can be calculated.

The new tool also includes a benefits calculator to convert LEAP-derived emissions for a target country to i) concentrations of particulate matter and ozone, and ii) health, vegetation and climate impacts. Concentrations are derived using "adjoint coefficients" produced by the GEOS-Chem global chemical transport model,[9] which quantifies the contribution of emissions in grid squares globally to pollutant concentrations in a particular country. Concentration-response functions calculate premature deaths; crop yield loss for maize, wheat, rice and soybean; and temperature change in four latitudinal bands.

LEAP-IBC is already being used to develop national SLCP strategies – for example, in Bangladesh, Ghana, and Mexico – and it continues to be improved through LED-P research. For example, evaluation of the transferability of health and vegetation concentration-response functions will allow quantification of a wide range of appropriate health and vegetation impacts within LEAP-IBC. The tool is also being used by five PhD students at the SEI York Centre to support their research into SLCP mitigation in West Africa, Kenya, Thailand, Indonesia and Oman.

Building capacity and learning from users

From policy-makers' perspective, a key measure of the utility of our research and tools is whether it helps answer two questions: What is the impact of unabated air pollution and greenhouse gas emissions? And, what would be the benefits of implementing specific measures to reduce pollution and/or GHG emissions?

But policy-makers don't build the models that answer these questions, and we, the researchers and tool developers, don't always fully understand the local context in which these issues are considered. To help bridge this gap, LED-P researchers regularly attend meetings of the CCAC and the LEDS Global Partnership. We also engage directly with decision-makers in different countries and work with partners to host regional workshops.

At the Paris Climate Change Conference, we co-hosted a side-event with CCAC and other partners that brought together climate negotiators, policy analysts and scientists from around the world. The discussion highlighted the huge potential for coordinated action on climate and air pollution to raise overall ambition, and linked these actions to development priorities. In a recent blogpost,[10] we explained how policy choices now being discussed under the UNFCCC could encourage or hinder such coordinated efforts.

Our most important engagement, however, is arguably with our LEAP (and LEAP-IBC) users. By supporting their work and observing how they use these tools and what new capabilities they need, we are able to continually improve the tools and support materials.

As part of the Initiative, we are developing new training materials to help users understand and apply the tool. We plan to publish articles about LEAP-IBC and its application in the peer-reviewed literature. We will also develop guidebooks, presentations, recorded webinars, videos and on-site training curricula to ensure that the materials are widely accessible.

All of this work will be developed in close consultation with our research and policy networks. For example, we have a fruitful collaboration with the U.S. Environmental Protection Agency and researchers at the University of Colorado helping to develop the benefits calculator.

This brief was written by Johan C.I. Kuylenstierna, Charlie Heaps, Chris Malley and Marion Davis.

Endnotes

1 See: http://www.energycommunity.org.

2 IPCC (2014). *Climate Change 2014: Synthesis Report*. Intergovernmental Panel on Climate Change, Geneva. http://www.ipcc.ch/report/ar5/syr/.

3 See: http://unfccc.int/paris_agreement/items/9485.php.

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7 See http://www.ccacoalition.org/en/partners.

8 Our research suggests they do not. See: Osborne, S. A., Mills, G., Hayes, F., A, A. E., Büker, P. and Emberson, L. (2016). Has the sensitivity of soybean cultivars to ozone pollution increased with time? An analysis of published dose-response data. Global Change Biology, online 30 May. DOI:10.1111/gcb.13318.

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10 See: http://www.carbonbrief.org/guest-post-how-to-better-align-climate-goals-with-sustainable-development.

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