Integrating Co-benefits into Nationally Determined Contributions, Climate Policies and Air Pollution Policies in Asia

Flagship Report 2024

ACP ASIAN Co-benefits Partnership

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Contents

Acronyms

ACP	The Asian Co-benefits Partnership
APCAP	Asia Pacific Clean Air Partnership
APeq	Air Pollutant Equivalence Indicator
ASEAN	Association of Southeast Asian Nations
BCG	Bio-Circular Green
CCAC	Climate and Clean Air Coalition
CCUS	Carbon capture, utilization, and storage
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon Dioxide
EANET	East Asia Acid Deposition Monitoring Network
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
JCM	Joint Crediting Mechanism
MONRE	Ministry of Natural Resources and Environment
NAMAs	Nationally Appropriate Mitigation Actions
NCCC	National Committee on Climate Change Policy
NDCs	Nationally Determined Contributions
NEACAP	North-East Asia Clean Air Partnership
ONEP	Office of Natural Resources and Environmental Policy and Planning
SDGs	Sustainable Development Goals
SLCPs	Short-lived climate pollutants
TGO	Thailand Greenhouse Gas Management Organization
T-VER	Thailand Voluntary Emissions Reduction
UNDESA	United Nations Department of Economic and Social Affairs
UNEP ROAP	United Nations Environment Programme's Regional Office for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
VNR	Voluntary National Review
VOCs	Volatile Organic Compounds
WHO	World Health Organization

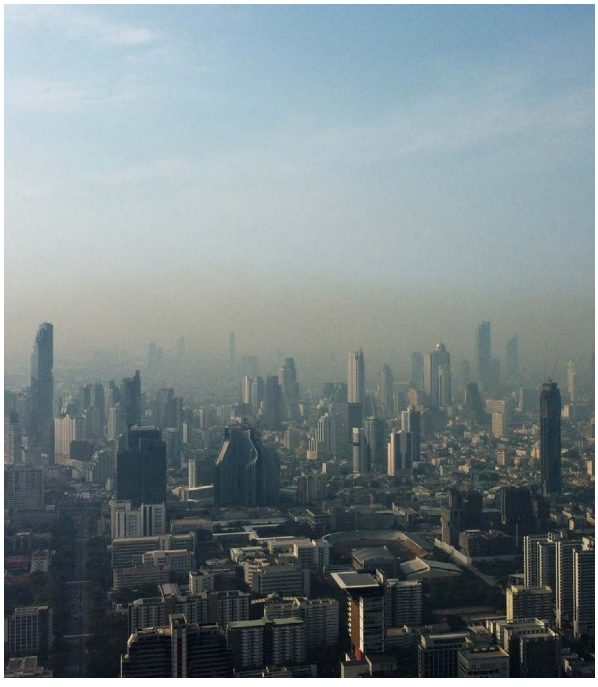
Executive Summary

The Asian Co-benefits Partnership (ACP) was created to support the mainstreaming of co-benefits into projects and policies in Asia and the Pacific in 2010. The increase in the number of policies featuring co-benefits in Asia and the Pacific suggests the ACP has had some success achieving this objective. Recent changes in the international climate policy landscape (the continual strengthening of Nationally Determined Contributions (NDCs) and the creation of an Article 6.4 financing mechanism) as well as developments with air pollution initiatives have nonetheless generated demand for concrete examples of how countries are integrating co-benefits into NDCs and other sectoral interventions. The main purpose of this report is to share with policymakers how countries are working on co-benefits in NDC and related processes. The hope is that that the opening chapter and three case studies—Thailand, Mongolia, and China—will shed light on the progress and gaps encountered in leveraging co-benefits to integrate climate and other development priorities in NDCs and related areas.

Chapter 2 on Thailand offers insights into how one of the leading countries in Southeast Asia are moving co-benefits forward in NDCs and elsewhere. The chapter demonstrates the growing awareness of co-benefits among policymakers in Thailand. Reflecting this growing awareness, Thailand's NDC includes several actions that could deliver co-benefits (not only in the energy sector but also the waste sector) as well as climate institutions that cut across several sectors. There is nonetheless potential for a more explicit recognition and quantification of co-benefits in key policies as well appointing a single organisation within the current institutional setup to lead on co-benefits in Thailand. Greater efforts to strengthen technical capacities to assess co-benefits could help in this regard. Aligning support for co-benefits to promote a bio-circular green (BCG) economy model and carbon markets is another recommendation that would prove helpful.

Chapter 3 on Mongolia shows that many policymakers in the country have recognised the potential for co-benefits to strengthen key policies. In particular, Mongolia is placing a growing emphasis on transitioning from fossil fuels to clean energy as well as featuring the linkages between air pollution, climate change and other development priorities in the Sustainable Development Goals (SDGs). The chapter nonetheless recommends Mongolia places a greater emphasis on strengthening the interface between research, policy and action on co-benefits. In addition, it calls for decision makers in Mongolia to work on the following three areas: 1) using estimates of co-benefits from renewables to secure funding; 2) strengthening coherence between national and local air pollution, climate and sectoral policies; and 3) continuing the emphasis on co-benefits in the SDGs.

The last case focuses on China's experience with co-control. It notes that China has been pioneer in implementing a co-control approach to address air pollution and climate challenges. Research on co-control in China has covered a wide range of regions and sectors. At the same time, there are still some knowledge gaps (i.e. limited attention to some sectors/benefits, lack of precision in defining efficiency, and inattention to governance) as well as emerging trends (interactive effects between policy areas, dynamic changes in modelling assumptions, and interest in sources of Volatile Organic Compounds (VOCs)) that can help strengthen the interface between research and policy on co-control in China.



Chapter 1

Integrating Co-benefits into Nationally Determined Contributions, Climate Policies, Air Pollution Policies and Sectoral Interventions in Asia: An Overview

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Key Messages

1. The Asian Co-benefits Partnership (ACP) has made progress toward reaching its ultimate goal of mainstreaming co-benefits into policies and projects in Asia.
2. There nonetheless remains scope for leveraging co-benefits to strengthen the integration between Nationally Determined Contributions (NDCs), climate/air pollution policies and other sectoral interventions in Asia.
3. To some degree, data-driven modelling studies and emerging areas of co-benefits research (nature-based solutions/biodiversity and social equity) are helping to meet this need.
4. Several regional initiatives that aim to bring research on co-benefits to bear on air pollution policies are also playing a useful role in this regard.
5. However, increasingly ambitious climate goals as well as Paris Agreement funding mechanisms require concrete demonstrations of how countries in Asia and the Pacific are bringing co-benefits into NDCs, climate/air pollution policies and other sectoral interventions.
6. This chapter sets the context for a report that offers those demonstrations with case studies from Thailand, Mongolia, and China.
7. The chapter further suggests creating an interactive platform on co-benefits and NDCs in Asia and the Pacific could offer policymakers the knowledge needed to work on co-benefits to strengthen NDCs, climate/air pollution policies and other sectoral interventions.

1.1 Introduction

Approximately 14 years ago, the Asian Co-benefits Partnership (ACP) was created as an informal network to support the mainstreaming of co-benefits into projects and policies in Asia and the Pacific (ACP, 2015, 2021). With currently over more than 400 members, the ACP has worked with many stakeholders to help achieve this overarching objective. The impacts of the ACP and likeminded organization's efforts to mainstream co-benefits are clear in many places. To illustrate, the term "co-benefits" is mentioned nearly 700 times in the Third Working Group's Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2022). These effects are further apparent in a notable increase in the national and local national and local policymakers with practical knowledge of co-benefits—a group that now cuts across diverse sectors. The effects are also evident in the growing number of publications on co-benefits (see **Table 1.1** later in this chapter for illustrative examples). Last but not least, the push to strengthen synergies between climate change and sustainable development demonstrates—and is driven by—the interest in co-benefits (UN, 2019; UNFCCC et al., 2021).

There are many reasons for the growing appeal of co-benefits—or all of the benefits of actions that mitigate climate change while delivering on other development priorities (Miyatsuka & Zusman, 2008). Some of these reasons involve the economic logic that initially sparked the interest in co-benefits. That logic suggested that the integration co-benefits into decision-making processes would demonstrating additional development benefits (i.e. improved air quality and better health) and thereby offset the costs of climate actions (Karlsson et al., 2023; Nemet et al., 2010; Pearce, 2000; Pearce, 1992). While concerns over these costs have become less important in some countries, they still stand in the way of ambitious climate actions in many others.

Yet another reason that interest in co-benefits has continued to rise involves their potential to align the interests of different agencies and stakeholder groups. To illustrate, the inherently cross-cutting nature of co-benefits may make them attractive to government agencies working on climate and other environmental concerns. It also makes them attractive to agencies with remits beyond the environment—for instance, educational and social welfare agencies. Especially as the notion of co-benefits spreads to other sectors, co-benefits may also attract civil society groups and businesses hoping to forge linkages with the climate change agenda (Amanuma et al., 2018; Cohen et al., 2021).

A third notable reason for the rising interest in co-benefits involves financing allocated for climate change. In this case, there is a growing realization that pools of "climate finance" can help meet other development needs (ADB, 2017). This potential—which continues to be discussed in international policy circles—is also increasingly finding its way into national policy discussions. In fact, those discussions have gained steadily more momentum as climate policies and plans are reflected in NDCs or processes that explicitly aim to support the co-control of multiple pollutants (Akahoshi et al., 2018).

The above suggests that there has been indeed considerable progress in mainstreaming co-benefits into policies and projects. One needs to look no further than the United States Inflation Reduction Act to see evidence that co-benefits has left its imprint on major legislation. Another piece of encouraging news for the ACP is that much of the progress is evident in Asia and the Pacific. In fact, there are several signs of that co-benefits have found their way into important policy documents in the region. Notable examples include the references to co-benefits that run through Cambodia Clean Air Act and ongoing work to bring co-benefits into policies in Pakistan and Lao PDR (Malley et al., 2022; Slater et al., 2022).

While the short summaries above are indeed encouraging, they should be tempered by a sobering reality: namely, the world is not moving fast enough on the climate or sustainability agendas to avert planetary crises (UNESCAP, 2022). Though there has been growing experience working on co-benefits, a pressing need exists for analysing the experiences of countries in Asia and the Pacific with integrating co-benefits in NDCs, climate change/air pollution and other sectoral policies. A related concern is that much of the effort to feature co-benefit in policymaking processes is pursued with limited knowledge of the experience of other countries. These two concerns—the need for analysing different experiences; and the limited sharing of those experience—are critical since there still remains significant scope for leveraging co-benefits to strengthen the integration between

Nationally Determined Contributions (NDCs), climate policies, air pollution and other sectoral interventions in Asia and the Pacific (Akahoshi et al., 2018). The main objectives of this special ACP report on integrating co-benefits into NDCs and other policymaking processes is closely related to the above two needs.

The main goals of the report are as follows:

1) To showcase efforts in Asia to integrate co-benefits into NDCs, climate/air pollution policies and other sectoral policies; and

2) To offer insights into the different experiences across countries with the integration of co-benefits into the above policies.

The report is intended chiefly for policymakers in Asia and the Pacific who seek knowledge of opportunities and challenges to incorporating co-benefits into relevant plans and policies. It is also likely to be of interest to policymakers outside of Asia and the Pacific with similar interests in co-benefits. The report may further prove useful for researchers, civil society representatives, and businesses following developments on co-benefits, synergies, or climate and SDG integration within and beyond the Asia and the Pacific.

The remainder of this chapter is divided into four sections that will help achieve the report's two main goals. The following section (section 2) reviews opportunities emerging from international climate discussions for supporting co-benefits in NDCs and Article 6 financing mechanisms. Section 3 reflects on how existing research and air pollution initiatives on co-benefits can help countries take advantage of those opportunities. A final section connects this context-setting discussion to the country case studies in chapters 2, 3, and 4 as well as the possible creation of platform on NDCs and co-benefits to extend this work.

1.2 Co-benefits in the International Climate Policy Landscape

Since the formation of the ACP, there have been several notable developments in the international climate policy landscape that have created favourable conditions for countries to work on co-benefits. This subsection focuses on two of the more important such developments: NDCs; and Article 6 funding mechanisms.

1.2.1 NDCs

Arguably the most significant development in international climate policy over the past decade has been the advent of NDCs under the Paris Agreement. NDCs are the national plans countries share with the UNFCCC to achieve the collective targets set out under the Paris Agreement. In so doing, they continue a shift toward a more bottom-up pledge and review architecture that began under the Bali Action Plan and was operationalized with "Nationally Appropriate Mitigation Actions (NAMAs) in the context of sustainable development." (UNFCCC, 2012; Winkler et al., 2008; Zusman, 2012)

Like the NAMAs before them, NDCs have also motivated countries to make linkages between climate and sustainable development or co-benefits (UN, 2023). There are several studies that demonstrate that countries are making these linkages (Cohen et al., 2021). For example, some work has shown that about one-third of the NDCs reflected connections to the SDGs (UNDP, 2021). There are also several good practice examples illustrating that countries are making these connections; notable examples include Colombia, Uganda, and Burkina Faso. These are further indications that the consideration of these co-benefits has advanced due to the use of different assessment tools in countries ranging from Zimbabwe to Viet Nam to Pakistan (Sithole et al., 2023; Slater et al., 2022; Viet Nam, 2020). There are also indications that countries are leveraging NDCs links with air quality to raise climate ambitions and improve public health—a synergistic effect that could arguably be augmented with more robust monitoring and transparent assessments of climate and sustainable development benefits (Malley et al., 2023).

One of the ways that the Paris Agreement has helped to institutionalize a more transparent assessment is through the Global Stocktake. The Global Stocktake takes place every five years to ensure that countries and other actors are steadily raising ambitions on their climate actions. In so doing, it intends to evaluate global progress on reducing GHG emissions while building resilience. The results of First Stocktake at the end of 2023 reviewed over 1,600 documents and consulted diverse stakeholder groups (including scientists, governments, cities, businesses, civil society representatives). Importantly, this consultation and continual evaluation of actions could also help to

spotlight how governments and non-state actors are working with co-benefits to drive transformational action across energy, nature, food and transport systems (UNFCCC, 2023; WRI, 2023).

1.2.2 Article 6

Another area in the Paris Agreement that has helped to advance co-benefits is Article 6. Several of the provisions in Article 6 outline how the Paris Agreement will allocate climate finance, while also underlining that international cooperation is needed for implementing NDCs that promote sustainable development. In so doing, it also continues a tradition that began under the Kyoto Protocol's Clean Development Mechanism (CDM) and its emphasis on delivering sustainable development co-benefits as one of its two main objectives (CDM Executive Board, 2014; Economics, 2010; Zusman, 2012).

The Article 6 mechanisms nonetheless take important steps to learn from and improve upon the CDM. Arguably the area where that has the greatest potential in this regard is a decision to have a mandatory check of sustainable development. This requirement aims to move away from the less systematic country-driven approaches to co-benefits under the CDM; it will also limit the risk that project developers and governments add on weak and ambiguous claims of SDG contributions in funding proposals (GEA, 2021). It may additionally help build awareness that robust assessment and monitoring of the climate and sustainable development co-benefits is in the interest of the host country as it can contribute to NDC and SDG targets.[1]

While discussions are still ongoing over how this assessment will be conducted, there are some experiences that will arguably play a useful role in defining the approach. Some of these experiences come from cooperative approaches under Article 6.2 under the Paris Agreement. Those approaches provide a decentralized framework for bilaterally/multilaterally defined cooperative approaches and call for countries engaging in cooperative approaches to provide 'information on how each cooperative approach promotes sustainable development' (UNFCCC, 2018). These cooperative approaches can arguably learn lessons from Japan's Joint Crediting Mechanism (JCM) and its experience with co-benefits (see **Box 1.1**).

Box 1.1: Co-benefits and the JCM

Consistent with cooperative approaches under the Paris Agreement's Article 6.2, the JCM facilitates investments into emissions reductions which are assessed as contributions to NDCs within both partner countries and Japan. It has also worked with partner countries to deliver sustainable development co-benefits. These include work in the following areas:

- Renewable energy has diversified energy sources, enhanced energy security, and promoted the diffusion of low-carbon technologies.
- New infrastructure (transmission lines, local roads, and street lighting) or strengthen and rehabilitate existing infrastructure (port facilities, water supply and wastewater treatment systems) have brought enhanced energy access, greater connectivity, and improved safety, health and hygiene.
- New job and vocational opportunities have been created in the construction as well as operations and maintenance phases of the projects.

Source: ADB, 2017, 2019

Above and beyond Article 6.2, the Article 6.4 mechanism is likely to offer the greatest opportunities for promoting co-benefits. The Article 6.4 mechanism—which will take the place of the CDM—will be overseen by a 12-person Supervisory Body that is currently discussing how to systematically assess co-benefits under a centralized market mechanism and what types of monitoring and reporting protocols will be needed to concretize the proposed mandatory approach on these matters.

1 In terms of the NDC targets, the host country has a stronger incentive for more robust monitoring since they will have more to lose than under the CDM. Under the CDM, claiming additional crediting could bring more finance. Under the Paris Agreement, the de facto "export of emission reductions" will make it more challenging to reach an NDC target (GEA, 2021).

1.3 Filling Gaps

The developments on the NDC and new financing mechanisms are encouraging: they suggest that there is a growing push to codify the approach to explicitly recognizing and potentially financing co-benefits. As such, they offer a clear signal that the world is moving toward greater integration between climate and other development priorities in policies and projects. At the same time, they also highlight gaps that need to be filled before countries are regularly making links in NDCs or fully accounting for co-benefits in climate finance. The good news is that there have been important developments in both data-driven modelling as well as emerging research on co-benefits that can help these gaps. In addition, there are also several initiatives internationally and in Asia on co-benefits between air quality and climate change that can help fill these gaps. The next subsection reflects on how both trends in research and efforts from key initiatives.

1.3.1 Research

One encouraging sign is the growing amount of research that could help integrate co-benefits into NDCs, climate policies, or other sectoral interventions. As illustrated in **Table 1**, the last three years have seen a steady stream of research on co-benefits. This research has continued to place an important emphasis on quantifying co-benefits in varying contexts and at different scales—often with a focus on the links between climate, air quality, and health. For example, studies have estimated the co-benefits for cases ranging from pilot emissions trading schemes in China to air pollution strategies in Pakistan (Anwar et al., 2022; Zhang et al., 2024).

Another favourable sign from research on co-benefits involves the growing amount of attention devoted to policy applications. Recent work has begun to look more closely at whether and how co-benefits are integrated into different types of policymaking processes. This includes, for example, studies on opportunities and barriers to policy integration in city-level climate plans as well as typologies for classifying the different entry points for co-benefits in Sweden (Boyd et al., 2022; Karlsson et al., 2023).

A final observation from work on co-benefits involves the expanding scope beyond energy-air pollution-climate change as well as the refreshing considerations of equity impacts (Johnson et al., 2022; Lee, 2021). In terms of broadening the sectoral coverage, studies have begun to make important links to biodiversity and natural resource conservation, including work on how tiger conservation can help sequester carbon or protecting oceans can be good the climate and local livelihoods. In terms of equity, studies have begun to note that emission trading can have potentially regressive effects on poorer regions or electric vehicles may not bring health benefits to those most suffering from transport emissions (Garcia et al., 2023; Sileci, 2023).

In sum, research on co-benefits has continued to apply increasingly sophisticated assessment techniques to quantify co-benefits; however, several studies have begun to look more closely at policy applications and implications. This latter stream of policy-relevant work has arguably also led to expanding the scope of studies to look at a wider range of sectors, benefits, and equity concerns. This report offers insights and messages that is broadly aligned with the above trends—and could be augmented further from other projects and initiatives focusing on co-benefits.

1.3.2 Air Pollution Projects and Initiatives Promoting Co-benefits

There are several initiatives that could help fill these gaps in policy. At the global level, the Climate and Clean Air Coalition (CCAC) has continued to promote the mainstreaming of multiple benefits into policymaking processes. In fact, the CCAC's national action planning hub has worked with stakeholders in both Thailand and Mongolia to co-design strategies that could contribute to updating NDCs. At the international level, the United Nations Environment Assembly (UNEA) will offer a third resolution on air pollution that calls for greater integration between air pollution and climate change in an effort to achieve co-benefits (other UNEA resolutions UNEA Resolutions issues such as sustainable nitrogen management also have the potential to enhance integration between food production, biodiversity, air quality and climate while avoiding trade-offs) (Sutton et al., 2018). As noted elsewhere in the chapter, there are also growing momentum behind efforts to strengthen synergies between climate change and the SDG processes with backing from the UNFCCC and United Nations Department of Economic and Social Affairs (UNDESA) (UN, 2023).

Table 1.1: Recent Research on Co-benefits

Authors/Year	Scope	Strengths/Focal Areas			
		Quantify	Policy Integration	Beyond Climate-Air-Health	Equity
Cui et al., 2024	Quantifies health co-benefits from the closure of coal mines in China between 2016 and 2022	X			
Finn & Brockway, 2023	Survey of 50 co-benefits studies in Europe to analysis of energy demand-side reduction	X	X		
Lamba et al., 2023	Estimates carbon sequestration co-benefits of efforts to protect tigers	X		X	
Shi et al., 2022	Climate co-benefits from China's efforts to control air pollution from 2013 to 2020	X			
Dong et al., 2022	Local and spill-over effects of emission trading pilot programmes in China	X			X
Jiang et al., 2023	Estimates co-benefits and integrates in marginal abatement cost and evaluates in China	X			
Garcia et al., 2023	Assesses air quality and health co-benefits from zero emission vehicles in California notes possible concerns about equity	X			X
Salimifard et al., 2023	Demonstrates tool to estimate the future health/climate co-benefits in buildings in the United States through 2050	X			X
Dong et al., 2022	Estimates the effects of pilot SO_2 and CO_2 emissions trading schemes individually and together in China	X			
Boyd et al., 2022	Assesses mitigation co-benefits from eight cities adaptation policies (Durban, Cape Town, London, Manchester, Surat, Indore, Montreal, and Vancouver)		X		
Karlsson et al., 2023	Sets up a typology to categorize three different entry points for co-benefits and applies framework to Sweden		X		
Chatterjee et al., 2022	Underlines the context-specific nature of co-benefits from energy efficiency measures in the European Union and South Asia		X		
Song et al., 2023	Estimates the co-benefits from high organic content industrial wastewater (HOCIW) in several parts of China	X		X	
Nowakowski et al., 2023	Provides a quantitative assessment of the co-benefits (or trade-offs) between marine protected areas (MPAs) (especially highly protected areas (HPAs)) and fish yields and livelihood benefits in Mesoamerican region	X		X	
Khatri-chhetri et al., 2022	Assesses climate co-benefits of development assistance programmes for more than 100 sustainable agricultural projects in 51 countries	X		X	
Tennhardt et al., 2022	Evaluate social and economic co-benefits from cocoa farms in Ecuador and Uganda			X	X
Cai et al., 2023	Traces the evolution of policies and institutions promoting co-benefits/synergies in China		X		
Anwar et al., 2022	Estimates the co-benefits from air pollution strategies in Pakistan	X			
Sileci, 2023	Assesses the air quality co-benefits of the 2008 carbon tax in British Columbia, Canada	X			X
Roggero et al., 2023	Underlines the disconnect between empirical research showing sizable co-benefits and impacts on policy using Paris, Montreal, and Moscow		X		
Zhang et al., 2024	Estimates the air quality and climate co-benefits from the transport sector in China's Henan province	X			
Bragge et al., 2021	Conducts a systematic review of the work on co-benefits in the buildings sector as well as stakeholder interviews in Southeast Asia	X	X		
González-garcía et al., 2023	Quantifies the multiple co-benefits (based on an estimate of 4 types of ecosystem services) of nature-based solutions (NbS) for 85 cases in the Alps	X			X
Vandyck et al., 2020	Assesses the air quality and health co-benefits from 1.5 and 2 Co degree climate change scenarios for 56 regions	X			
Cohen et al., 2021	Illustrates the relationships between climate change mitigation action and co-impacts in NDCs/SDGs		X	X	

Support for integrating co-benefits into NDCs and other sectoral policies is also gaining attention at the regional level. For example, the United Nations Economic and Social Commissions (ESCAP) Regional Action Programme has not only sought to enhance regional cooperation on air pollution, but has also encouraged countries to work on the interlinkages with climate change and other sustainable development concerns at the national level. Meanwhile, the East Asia Acid Deposition Monitoring Network (EANET) has seen its scope expand to include a wider range of air pollutants such as fine particulates—and the potential of black carbon to warm the climate. In South Asia, the Male Declaration has continued to promote cooperation on SLCPs as well reduce transboundary air pollution, while North-East Asia Clean Air Partnership (NEACAP) has offered a voluntary framework for experience sharing on air pollution in Northeast Asia. In addition, the United Nations Environment Programme's Regional Office for Asia and the Pacific (UNEP ROAP) has supported several programmes under the Asia Pacific Clean Air Partnership (APCAP) that cut across the climate and air pollution agendas. Meanwhile, the Association for Southeast Asian Nations (ASEAN) has recently endorsed a Second Roadmap to help implement the region's haze agreement that underlines the need for more the explicit recognition of connections between air quality, climate change and other sustainable development priorities.

Table 1.2: Initiatives with Potential to Promote Co-benefits

Name	Summary of Goals/Vision/Key Provisions	Membership/Countries Covered
Climate and Clean Air Coalition	Address short-lived climate pollutants (SLCPs) driving both climate change and air pollution	86 state partners/83 non-state partners
UNEA Resolution 1/7	Formulate plans/implement nationally-determined ambient air quality standards/emissions standards, accounting WHO guidelines	160 countries
UNEA Resolution 4/14 and 5/2: Sustainable Nitrogen Management	Calls on the Executive Director to consider options for facilitating coordination of policies across the global nitrogen cycle at the national, regional and global levels	193 countries
UNEA Resolution 3/8	UNEP Executive Director designated to strengthen regional cooperation on air pollution	193 countries
UNEA 6 Resolution 2024	Set ambitious ambient/ indoor air quality standards; integrate air pollution into NDCs; and engage international funding agencies for support	-
ESCAP Regional Action Programme on Air Pollution	Share knowledge to enhance air pollution policies in Asia and help countries achieve WHO guidelines	53 states/9 associate members
Asia Pacific Clean Air Partnership	Enhance coordination and collaboration of clean air programs; knowledge sharing platform on air quality management	16 countries across Asia and the Pacific
East Asia Acid Deposition Monitoring Network	Provide inputs for decision-making and support coordination for addressing adverse impacts of acid deposition	13 countries from East and Southeast Asia
ASEAN Haze Agreement/ Second Haze Free Roadmap	Elimination of regional transboundary haze pollution through collective actions to prevent and control open burning from agriculture, land and/or forest fires	10 ASEAN countries
Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia	Aid the process of providing a clean environment through clean air and promote regional cooperation to address the threat of transboundary air pollution and its possible impacts	8 countries in South Asia
North-East Asia Clean Air Partnership	Offer a voluntary framework to address air pollution in Asia and the Pacific through, *inter alia*, promoting science-based policies and experience sharing	6 countries in Northeast Asia

1.4 Chapter Summaries and the Way Forward

The remainder of the report is organized into three chapters that reflect on the experiences of three countries with integrating co-benefits into NDCs, climate/air pollution policies and other sectoral interventions.

Chapter 2 highlights that there is growing awareness of co-benefits among policymakers in Thailand. Reflecting this growing awareness, Thailand's NDC includes many actions that could deliver co-benefits (going beyond the energy sector to include the waste sector). At the same time, there are also several gaps in coverage, including a lack explicit recognition and quantification of co-benefits in key policies as well as the lack of a single organization leading on co-benefits. Greater efforts to strengthen technical capacities to assess co-benefits (potentially under the National Committee on Climate Change Policy (NCCC)) could help in this regard. Aligning support for co-benefits with effort to promote a BCG model and carbon markets could also prove helpful. Continuing to strengthen Thailand's relationship with the CCAC also has the potential to help advance co-benefits in Southeast Asia.

Chapter 3 suggests that policymakers in Mongolia have also recognized the potential for co-benefits to strengthen climate and other sectoral policies. In particular, Mongolia is placing a growing emphasis on transitioning to clean energy while recent efforts have sought to remove raw coal from households. At the same time, greater effort to enhance coherence between climate change and air pollution policies by underlining the co-benefits potential in the transport and residential energy sectors in the NDC would be useful. Improving the enabling environment for renewable energy by bringing co-benefits assessments into investment decisions as well as using the SDG process to strengthen interagency coordination needed to advance co-benefits would also be useful.

Chapter 4 focuses on China's experience with co-control strategies. In recent years, China has adopted several policy reforms that helped advance co-control and synergies. Researchers have generated a considerable amount of work on the potential for co-control in key regions and major sectors in China. At the same time, there are a few challenges (i.e. limited attention to some sectors/benefits, lack of precision in defining efficiency, and inattention to governance) as well as emerging trends (interactive effects between policy areas, dynamic changes in modelling assumptions, and interest in sources of Volatile Organic Compounds (VOCs)) that can be considered to strengthen the interface between research and policy on co-control in China.

Collectively the report's four chapters underline that there is already notable progress in featuring co-benefits in NDCs and other relevant policies in Asia and the Pacific. At the same time, the diversity of entry points for and related challenges with integration suggest a need for sharing experiences on NDCs and co-benefits in Asia and the Pacific. An interactive NDC and co-benefits platform that enabled policymakers to understand the tools that facilitate integration and experiences using them could help to extend the results of this report. This platform could be complemented by additional case studies from South Asia—a region not featured in this report but that has also generated a wealth of knowledge in this area. At the same time, there is also scope to look at the experiences of local and subnational governments. Implementing many of the provisions in NDCs and national policies often happens locally and filling implementation gaps at the subnational level requires more attention. How national governments are working with subnational governments to provide the funding and technical support to work on co-benefits is another area that could be featured on an interactive platform. Last but not least, the interactive platform could include guidance on acquiring support for policies and projects with co-benefits under, for instance, the financing mechanism or regional air pollution initiatives.

Chapter 2

Integrating Co-benefits into Thailand's National Determined Contribution and Climate Policies: Progress, Challenges and the Way Forward

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Key Messages

1. Thailand has recognized that air pollution and climate change often come from similar sources and can be addressed with shared solutions.
2. There is growing awareness of the potential to make the link to co-benefits to strengthen relevant policies, including Thailand's NDC.
3. This potential could be realized with the explicit recognition and quantification of co-benefits in Thailand's NDC.
4. It may also help to have single unit or single agency or organization leading on co-benefits (under the National Climate Change Commission).
5. Additional efforts could focus on the following:
   - making the links between climate policies and the bio-circular green economy model (BCG Model)
   - considering co-benefits in carbon markets; and
   - playing a more prominent role in the CCAC to help advance co-benefits at the regional level.

2.1 Introduction

Few issues pose a greater threat to sustainable development in Thailand than air pollution and climate change. In recent years, Thailand has recognized that air pollution and climate change often come from similar sources and can be addressed with shared solutions. Increasing support for co-benefits has emerged out of this growing realization. Co-benefits are the result of solutions that explicitly aim to not only mitigate climate change but improve air quality and health while delivering other socioeconomic benefits (Miyatsuka & Zusman, 2008).

The potential for co-benefits is particularly great in Thailand. This is partially because Thailand confronts worsening air quality from health-damaging pollutants such as fine particulates ($PM_{2.5}$)—with seasonal air pollution episodes that could become more acute as a warming climate leads to the intensification of agriculture and open burning of crop residues (Mueller et al., 2021). At the same time, Thailand's economic structure continues to rely heavily on coal-fired power plants and fossil-fuel energy while employing traditional technologies in a large number of small and medium-sized industries. Increases in emissions from the transport and residential sectors also suggest that there is significant scope for Thailand to achieve co-benefits (CCAC, 2023; IIASA, 2023; Rungsiyanon et al., 2023).

The promise and challenges for co-benefits is also implied in several important trends shaping socioeconomic development in Thailand such as pressures to grow more food and modernize technologies in key industries. But, even as Thailand's struggles with some of the above challenges, other parts of Thailand's economy have begun to transition towards becoming more environmentally-friendly technologies and advanced production practices. Some international pressures have also begun to generate pressures for resource-savings and pollution-friendly technologies. The potential and challenges are also implied in Thailand's $PM_{2.5}$ National Action Plan—an ambitious policy that includes several measures that intend to clear the air. Finally, this potential is reflected in Thailand pledge to achieve carbon neutrality by 2050 and net-zero emissions by 2065 as well as its Nationally Determined Contribution (NDC).

However, whether Thailand will be able to leverage this potential to achieve co-benefits remains an open question. In fact, answering that question requires analysing the opportunities for and constraints on co-benefits in Thailand's policies and institutions. The main purpose of this chapter is to assess areas where this potential can be realized as well as offer concrete recommendations for making good on the promise of co-benefits in Thailand.

The remainder of this chapter is divided into three sections. The next two sections reflect on policies with potential for co-benefits as well as gaps in coverage. The section that follows that overview reflects on how existing projects and activities could fill relevant gaps.

2.2 Policies and Institutions

2.2.1 Policy Overview

To some extent, Thailand has recognized that co-benefits are a foundational building block of a cost-effective air pollution and climate change strategy. This recognition is reflected in some of the aforementioned policy documents such as Thailand's NDC as well as many other cross-cutting and sector specific policies and plans.

Arguably the policy document the greatest potential to bring co-benefits to Thailand is its NDC. In line with the Paris Agreement, Thailand shared its NDC in 2015 and announced its intent to reduce its greenhouse gas (GHG) emissions by 20—25% by 2030 compared to the business-as-usual scenario. Importantly, the NDC not only features an overarching target but also outlines a series of sector-specific measures with the potential to improve air quality, health, and spur progress on other dimensions of sustainable development (Thailand, 2022).

Many of the notable examples of the measures with the greatest co-benefits potential in the NDC are in the energy sector. For instance, some of the provisions in the NDC emphasize energy conservation as well as increasing the share of renewable energy in the energy mix. Yet the NDC does not only focus on the energy sector. Policies and measures intended to improve waste management practices could help limit open dumping and lower emissions of methane. Methane has recently been labelled a so-called super pollutant that contributes to near- and long-term climate change as well as tropospheric ozone (Thailand, 2022).

The NDC is aligned with several national policies that also offer for potential for co-benefits. For instance, Thailand's Climate Change Master Plan (2015—2050) is a multi-sectoral framework that outlines integrated policies and action plans to achieve low carbon development and climate resilience. Similar to the NDC, it also offers a set of narrower sectoral actions with a sharper focus. This include measures targeting reduction of emissions from the agricultural sector—an area that could, once again, help lower methane emissions.

Thailand has also promulgated several policies and measures that work only on one sector but with the potential for multiple benefits. This includes the $PM_{2.5}$ National Action Plan—a plan that was crafted by

various government agencies, private, academic and public sector stakeholders. The plan consists of a series of measures that are intended to control $PM_{2.5}$ emissions - including continually implementing continually implementing effective mitigation measures to manage and control emissions from urbanization, industry, construction, road traffic, home cooking, open burning of agricultural residues, and municipal waste in line with short-, medium- and long-term timelines embedded in the plan.

Many other policies with co-benefits potential focus on particular sector such as Thailand's Integrated Energy Blueprint. This plan has elements that concentrates on guiding energy transition by boosting energy efficiency and renewable energy development that augur well for co-benefits (though also including provisions for oil and gas development that may entail trade-offs). In addition, Thailand's has adopted an Alternative Energy Development Plan (2015—2036) that includes a target of achieving 20,000 MW of renewable energy and supplying 20% of net national electricity demand with renewable sources by 2036. Solutions to reach this target involve biofuel, such as compressed bio-methane, which is set to reach 4,800 tonnes/day by 2036. Yet another policy in this area is Thailand Oil Plan (2015—2036)—a plan aims to bring coherence to help smooth the transition to renewables by phasing in renewables and energy efficiency measures.

Another set of sector-specific policies and measures have concentrated on the waste sector. Thailand's Solid Waste Management Master Plan (2016—2021) was adopted a little more than five years ago to encourage citizens to follow the 3Rs (reduce, reuse, recycle). As such, it aims to minimize waste production, introduce centralized facilities for waste utilization, and convene relevant sectors to participate in managing solid and hazardous waste. This integrated program emphasizes the waste-to-energy path and co-benefits for health, the local economy, and climate. Under the plan, there are several measures that are meant to trigger action on the ground and make these benefits even more visible. Notable examples include reducing open dumping sites, increasing proper waste disposal systems, and implementing waste separation policies.

An additional illustration of a policy area where Thailand has the potential for co-benefits is agriculture. In this case, the Agriculture Strategic Plan on Climate Change (2017—2021) has concentrated on enhancing climate resilience and adaptation while also mitigating GHGs in an effort to achieve the Sustainable Development Goals (SDGs). This plan is unique in that it makes direct connection between agriculture and climate change. It is similarly noteworthy in that it has several provisions that can work across climate and other SDGs, including those increase crop yields, livestock productivity, and biogas capture while improving food and economic security for farmers.

A final illustration of a set of sector-specific policies and measures comes from the transport sector. To demonstrate, Thailand has adopted its The Sustainable Transport Master Plan that consists of both a short-term program from 2013—2017 and a long-term program from 2018—2030. The Master Plan seeks to increase the development of an environmentally sustainable transport system; build monitoring and evaluative frameworks for supporting projects; manage transportation systems for sustainability and GHG reduction; and promote research and public awareness. Measures include improving non-motorized transport, introducing new vehicle emission standards, and improving railway systems.

2.2.2 Institutional Overview

Part of the reasons that Thailand has made links between climate, air pollution and other areas of sustainable development are its policymaking institutions. This subsection provides a brief overview of the institutional arrangements that can help explain some of the progress in section 2.1.

In Thailand, the Ministry of Natural Resources and Environment (MONRE) is the lead agency charged with conserving the environment at the national level; other line agencies with remits involving the industrial, transport, agriculture, waste, and energy sectors work with the MONRE on many of the reviewed policy documents.

At the same time, because climate change cuts across many sectors and is matter for international diplomacy, Thailand has also established a National Committee on Climate Change Policy (NCCC). The NCCC is chaired by the Prime Minister and has members from both the public and private sectors, including sectoral and subject matter experts. The NCCC is mandated to define national climate policies

and establish guidelines and mechanisms for international collaboration regarding conventions and protocols on climate change and air pollution. The NCCC is further empowered to support and evaluate relevant domestic organizations so that announced plans complement and do not conflict with existing policies and plans.

To help carry out its assigned role, the NCCC is composed of seven subcommittees and working groups (see **Figure 2.1**). As one might surmise, some of these subcommittees and working groups are more inclined to focus on co-benefits or cross-sectoral linkages than others.

2.3 Policy and Institutional Gaps

While many of the policies and institutions have demonstrated awareness of co-benefits, there are still gaps in coverage. These gaps become even more evident when looking at whether there is was an explicit effort to mainstream co-benefits into relevant policies and institutions.

Some of these gaps are evident in policy documents that are not featured in this chapter. For example, the 20-Year National Strategy 2018–2037 and the 12th National Economic and Social Development Plan 2017—2021 do not feature co-benefits—though they do

Figure 2.1: Structure of the National Committee on Climate Change Policy in Thailand

National Committee on Climate Change Policy (NCCC)	
Chairperson	Prime Minister
1st Vice-Chairperson	Minister of National Rosources and Environment (MONRE)
2nd Vice-Chairperson	Minister of Foreign Affairs

Committee members:
Permanent Secretary of;

1. Prime Minister's Office
2. Ministry of Finance
3. Ministry of Foreign Affairs
4. Ministry of Tourism and Sports
5. Ministry of Transport
6. Ministry of Digital Economy and Society
7. Ministry of Energy
8. Ministry of Commerce
9. Ministry of Interior
10. Ministry of Labor
11. Ministry of Education
12. Ministry of Public Health
13. Ministry of Industry
14. Ministry of Agriculture and Cooperatives
15. Ministry of Higher Education, Science, Research and Innovation
16. Bangkok Metropolitan Administration
17. Office of the National Economic and Social Development Council
18. Office of the National Water Resources
19. Bureau of Budget
20. 5-9 Experts on law, economics, environment, science and technology, energy or climate change
21. One expert from the private sector

Secretariat: Permanent Secretary, MONRE

Assistant secretary: Secretary-General of ONEP

Assistant secretary: Director of Thailand Greenhouse Gas Management Organization (TGO)

Subcommittee on Climate Change Policy and Planning Integration	Subcommittee on Climate Change Knowledge and Database	Subcommittee on Climate Change Negotiation and International Cooperation	Subcommittee on Action for Climate Empowerments and Public Relations	Subcommittee on Climate Law	Subcommittee on the Mobilization of GHG Mitigation with Carbon Sequestration in LULUCF Sector	Subcommittee on the Mobilization of GHG Mitigation with CCUS Technology Implication
Working Group on GHG Mitigation Policy and Planning	Working Group on GHG Inventory and Mitigation Measures	Working Group on Climate Change Convention Conference and Negotiation				
Working Group on National Climate Change Adaptation Implementation integration	Working Goup on Climate Change Date and Modeling					
Ad-Hoc Working Group on REDD-Plus						

Source: Office of Natural Resources and Environmental Policy and Planning (ONEP), Thailand

make references to climate change and other development priorities. A similar set of critiques applies to the Policy and Plan for Enhancement and Conservation of National Environmental Quality 2017–2036 that covers and works across different dimensions of environmental concerns but does not underline co-benefits.

The policies with possibly the greatest potential to spotlight co-benefits but that still shows some areas for greater attention are Thailand's NDC and the underlying Climate Change Master Plan (2015—2050). In both cases, more explicit references to co-benefits could help strengthen connections between climate, air quality, health and many of the sectoral priorities covered in the waste, transport and agricultural plans. References to these co-benefits could also underline possible connections to ongoing efforts to reduce $PM_{2.5}$ under the aforementioned $PM_{2.5}$ control plan (Rungsiyanon et al., 2023).

A related gap—as well as possible reason—that co-benefits are not highlighted involve assessment methods. The methods that are typically used to develop climate strategies are frequently intended to analyse the potential to achieve one goal: namely, mitigating GHGs. To the extent that other variables are considered, the focus is on the costs of the technologies needed to achieve reductions in the GHGs. In other words, co-benefits are often not taken into account in the energy and economic models and cost-benefit calculations that inform climate strategies.

Another underlying factor is the are the limited technical capacities and standards related to co-benefits assessment methods. Simply stated, quantifying co-benefits is complicated. Some of the complications trace to features of air pollution, health and other priorities that go beyond economic use functions of environmental assets—though there have been strides in this area with the development of contingent valuation methods and values of statistical life (VSL). These limitations present a challenge for experts in gathering data for quantifying benefits and costs. They also may prove problematic for decisionmakers for understanding options and opportunities (Rungsiyanon et al., 2023).

Another gap and challenge involve the institutional arrangements in Thailand. Almost by definition, co-benefits span multiple institutional remits. It can therefore be difficult for agencies like MONRE to include co-benefits within relevant policies with extensive consultation with other relevant agencies. At the same time, there is unlikely to be a single entity that is charged with explicitly recognizing (and quantifying) different benefits in key policies and measures. The natural division of labour across agencies weakens incentives to lead on co-benefits. At the same time, there may be scope for cross-sectoral coordination mechanisms such as the NCCC to provide that support—for instance, under one of its subcommittees or in consultation with experts who have knowledge of diverse assessment methods.

2.4 Filling Gaps

Some of the ways that the gaps highlighted in the previous section can be filled are relatively straightforward and follow logically from the previous analysis. For example, there are many opportunities to use co-benefits as concept to strengthen the linkages between the NDCs and relevant sectoral policies. In similar fashion, there may also be greater efforts to build the technical capacities to standardize methods to assess co-benefits in climate planning. Yet another plausible way that could fill gaps involves strengthening interagency coordination by including a technical subcommittee within the NCCC that focuses on co-benefits assessment specifically and/or linkages with the SDGs generally (this follows with a growing body of work on co-benefits and institutions (Cai et al., 2023; Zusman et al., 2021)).

At the same time, there may also be potential to bring co-benefits into new initiatives that could help make them become more visible in existing policies and institutions. For instance, one ongoing effort to accelerate decarbonization is the bio-circular green economy model (BCG Model). Thailand's Government introduced the BCG model as a comprehensive strategy to create sustainability and inclusiveness across the economy, society, and the environment. The BCG Model emphasizes applying science, technology, and innovation to turn Thailand's domestic comparative advantage in biological and cultural diversity into an international competitive advantage. To realize this transformation, it focuses on the production of renewable biological resources and the conversion of these resources into value-added products in four sectors: 1) agriculture and food; 2) wellness and medicine; 3) energy, materials and biochemicals; and 4) tourism and creative economy. Importantly, it holds at its core the need to integrate the bio-economy, circular economy, and green

economy as actions are developed in each of these four areas (the BCG model aligns well with recent interest in co-benefits from nature-based solutions see (González-garcía et al., 2023)).

Another ongoing initiative that could help advance co-benefits in Thailand involves carbon markets. The Thailand Greenhous Gas Organization (TGO) and Thailand Greenhouse Gas Management Organization (public organization) has been working on carbon markets since the creation of the Thailand Voluntary Emissions Reduction (T-VER) program in 2014. That programme aimed to support all relevant sectors but with an emphasis on particular small project developers so as to facilitate their participation in the domestic voluntary GHG emissions. The further development of the carbon market could pay dividends for co-benefits because they offer a cost-effective way to encourage the private sector to invest in decarbonization. In addition, since they place an emphasis on accounting for and independently verifying reductions in GHG emissions, they could relatively easily incorporate assessments of reductions in air pollution and health benefits (Dong et al., 2022). If combined with advances in assessment methods from the above BCG model, they might also generate multi-dimensional development evaluations.

Yet a final area that Thailand may consider to help fill gaps involves strengthening its ongoing collaboration with the Climate and Clean Air Coalition (CCAC). Thailand became a CCAC partner in 2019 and stated its commitment to reducing short-lived climate pollutants (SLCPs). Thailand has since worked with the CCAC on various SLCP projects such as quantifying the emissions from inland heavy-duty water transport vehicles. Thailand's Pollution Control Department has also participated in co-designing a report that estimated the co-benefit of measures that integrate air pollution and climate change actions. In recent years, there has been some discussion of Thailand playing a more active leadership role in the CCAC, especially at the subregional level. Part of the effort could focus on filling some of the policy and institutional gaps highlighted in this chapter. It might also involve spearheading efforts to encourage other countries in Southeast Asia to feature co-benefits more prominently in their policies and institutions.

2.5 The Way Forward

This chapter began with the contention that Thailand has considerable potential to achieve co-benefits. It then underlined that there is growing awareness of this potential in relevant policies and institutions—for example, Thailand's NDC includes many and policies and measures that could deliver co-benefits. It nonetheless argued that there are still several gaps that have arguably left some of this potential untapped. These include the lack of explicit recognition and quantification of co-benefits in key policies as well as related limits on a single agency or organization leading on co-benefits. It then offered a few recommendations that can help fill these gaps moving forward. The suggested reforms included a greater effort to build coherence between the NDC and sectoral policies and the strengthening of technical capacities to assess co-benefits (perhaps under the NCCC). In addition, the chapter argued that initiatives aimed at creating a BCG model, strengthening carbon markets, and efforts to play a more prominent role in the CCAC can help advance co-benefits.

Above and beyond these recommendations, there are other areas Thailand could target to make co-benefits a more central feature of its decision-making calculus. In this connection, Thailand may want to explore the co-benefits and trade-offs with emerging climate change technologies such as carbon capture and storage (CCS) or carbon capture, utilization and storage (CCUS) in power plant and industries. It may also to use lifecycle assessment methods to look at a wider range of co-benefits and costs from the promotion of electric vehicle, batteries and supporting infrastructure (Xue et al., 2015). These issues are likely to gain more attention as Thailand moves from short-term to mid- and long-term net zero targets.

Last but not least, Thailand may also want to invest into the assessment of the interactive effects between different policies and projects. Such an assessment might help to limit some of the trade-offs that come from more advanced technologies; it might also lead to a greater understanding of how the positive impacts can be achieved or even amplified. These efforts to understand the additive or multiplicative effects could be combined with broader attempts to connect arguments for co-benefits to a push for key performance indicators (KPI) for a wide range of development policies that go above and beyond climate change.

Chapter 3

The Co-benefits of Mongolia's NDCs and Clean Air Policies: Progress, Challenges and the Way Forward

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Key Messages

1. The co-benefits from integrating climate change and air pollution planning are drawing attention in Mongolia.
2. The chapter surveys how co-benefits have been reflected in Mongolia's Nationally Determined Contribution (NDCs) and other relevant policies as well as relevant gaps in coverage.
3. The chapter shows that many of the areas covered in Mongolia's NDC (renewable energy) and recent air pollution policies (restrictions on loose coal) are bringing co-benefits to Mongolia.
4. Mongolia's approach to the Sustainable Development Goals (SDGs) also features the linkages between air pollution, climate change and other development priorities.
5. The chapter further recommends a greater emphasis on the following areas to strengthen the interface between research, policy and action on co-benefits in Mongolia:
   - co-benefits from renewables (to secure funding for scaling pilot projects);
   - strengthening the coherence between national/local air pollution, climate and sectoral policies (especially bringing co-benefits into interventions from non-energy sectors); and
   - continuing the emphasis on co-benefits in the SDGs.

3.1 Introduction

Climate change is among the most significant challenges confronting policymakers in Mongolia today. Several data points hint at the size of this challenge. The Global Climate Risk Index, for instance, ranks Mongolia as one of the most climate vulnerable countries in the world (Germanwatch, 2021). Further, though Mongolia's greenhouse gas (GHG) emissions are still relatively low, both per capita and emission intensity levels (emissions per unit of GDP) are much higher than global averages (Global Green Growth Institute, 2020; Government of Mongolia, 2019). With more than two-thirds of total consumed energy generated from coal-fired power plants, reducing per capita and emissions intensity will not be an easy undertaking in Mongolia (ADB, 2021).

At the same time, air pollution presents a sizeable threat to the health and well-being of many of Mongolia's residents (Soyol-Erdene et al., 2021). This threat is particularly evident in Mongolia capital of Ulaanbataar. Ulaanbataar consistently ranks among the cities with world's most polluted air—concentrations of fine particulate matter ($PM_{2.5}$) are almost six times higher than World Health Organization (WHO) recommended guidelines (Allen et al., 2011; Hill et al., 2017; WHO, 2021). The impacts of poor air quality can also have adverse impacts on other development priorities. For instance, children in Ulaanbataar breathe air in their classrooms that is three to ten times higher than national air quality standards (ADB, n.d.).

Fortunately, there is a growing a realization of the close relationship between the causes and solutions to these problems. This realization grows from the fact that often GHGs and air pollutants are emitted from the same sources. It is also reflected in the recognition that a subset of air pollutants known as short-lived climate pollutants (SLCPs) (such as black carbon, methane and tropospheric ozone) can warm the climate in comparatively short atmospheric lifetimes. The heightened awareness of the linkages between climate change and air pollution provides an opportunity for policies and measures that address both issues at the same time. The benefits that are generated from these integrated solutions are known as co-benefits (Miyatsuka & Zusman, 2008).

The awareness of co-benefits in Mongolia is growing. Part of the reason for that increased awareness relates to studies that involve integrated assessment of emissions of multiple pollutants funded by the Climate and Clean Air Coalition (CCAC) (Dagvadorj et al., 2020). These studies can estimate the different benefits of mitigation options that simultaneously improve air quality and mitigate climate change. Another explanation for—and result of—the expanded interest in co-benefits are policy changes that demonstrate the potential to align climate and air pollution responses. One of the clearest examples of such as policy is Mongolia's Nationally Determined Contribution (NDC) (Government of Mongolia, 2019).

The remainder of this chapter outlines how co-benefits have been reflected in Mongolia's NDC and other relevant policy documents while also reflecting on possible gaps in coverage. The chapter further recommends how relevant gaps can be filled and ways forward for future research and action on co-benefits in Mongolia.

3.2 Policy Overview

Like many other countries, Mongolia officially announced its commitment to the Paris Agreement by submitting an NDC to the United Nations Framework Convention on Climate Change (UNFCCC) in October 2020 (Government of Mongolia, 2019). In a related move, Mongolia approved an NDC Implementation Plan for 2021—2025. The NDC contains a series of national and local targets to address climate change. To illustrate, the GHG mitigation target is 22.7% compared to the business-as-usual scenario by 2030; the mitigation target could increase to 27.2% with international support. Mongolia is also planning to enhance its NDC in the near future, a move that will raise ambitions and expand sectoral coverage while setting the table for post-2030 targets.

Many of the provisions in the NDC offer the potential to deliver co-benefits to Mongolia. This is apparent, for instance, in the deliberate effort to ensure that targets are consistent with national development policies and priorities. Another indication of the promise for co-benefits are efforts to boost renewable and reduce the reliance on coal for energy in industries and households. Recent policy statements suggest that Mongolia is willing and able to depend more heavily on solar power. To demonstrate, Mongolia has pledged to increase the share of energy

generated from renewables to 20 percent by 2020 and 30 percent by 2030. To achieve this goal, the government has approved construction licenses for 247 MW of solar energy. In addition, it has successfully secured finance for renewable projects with co-benefits (See **Box 3.1**).

The interest in co-benefits is not only clear in the NDC's emphasis on renewables. It is also evident in the aforementioned national implementation plan for the NDC. Mongolia's Ministry of Environment and Tourism (MOET) envisions that plan as a more detailed roadmap that will guide relevant actors across ministries, institutions, and territories towards the achievement of not only climate goals but short-term development needs.

Outside of the NDC and the underlying implementation plan, Mongolia has also promulgated policies and measures that aim to improve air quality while delivering co-benefits for the climate. Notable examples of action in this area include the 2012 Law on Air Quality—a key piece of legislation that outlines measures to protect ambient air quality as well as generating emissions inventories (Government of Mongolia, 2012). In more recent years, Mongolia also approved a National Program for Reducing Air and Environment Pollution for the period 2017– 2025 as well as issued a ban on raw coal in 2019 (ADB, n.d.).

This latter effort to ban raw coal was particularly consequential for air quality and climate change (Ganbat et al., 2020). The reform allocated subsidies for refined coal briquettes to reduce $PM_{2.5}$ levels across Ulaanbaatar. The reason that the ban and related subsides were so important is research shows that 80% of Ulaanbaatar's air pollution in the winter months is caused by households and low-pressure boilers burning raw coal in ger districts. These pollution-intensive sources are often responsible for spikes in pollution and concentrations of $PM_{2.5}$ that can reach 1000 $\mu g/m^3$ (or more than 200 times the WHO recommended guideline levels).

Last but not least, Mongolia's first Voluntary National Review (VNR), a document that outlines progress on the Sustainable Development Goals (SDGs), highlights the awareness of co-benefits (Mongolia Voluntary National Review, 2019). In particular, the VNR goes to considerable lengths to spotlight the importance of air pollution and its linkages with many other development priorities, including climate change. In addition, the VNR also outlines a series of solutions and options that can help improve air quality and mitigate climate change (Mongolia Voluntary National Review, 2019) (See **Figure 3.1**). The recognition of these linkages is particularly remarkable given that air pollution is not covered under a single standalone SDG and is rarely given so much attention in other country's VNRs.

Box 3.1: Financing Renewable Energy Projects in Mongolia

Mongolia has worked with partners to attract finance for renewables that can help mitigate climate change while improving air quality and health. This includes a high-profile project approved by the Green Climate Fund that is designed to develop a 10MW solar photovoltaic (PV) farm in the Sumber Soum district. The PV solar farm is expected to create 15,395 megawatt-hours (MWh) of power per yea and reduce 12,270 tonnes of tCO_2eq in annual greenhouse gas (GHG) emissions, while delivering environmental and social co-benefits. Importantly, the solar farm has not relied solely on public funds. Rather, it has turned to private sector involvement.

A similar characterisation applies to another solar project located in Tuv aimag (province) Sergelen soum in the Khushig valley (county). In this case, the Sermsang Power Corporation Public Company Limited (SSP) and Tenuun Gerel Construction LLC (TGC) signed a $18.7 million loan with the Asian Development Bank (ADB) and the Leading Asia's Private Infrastructure Fund (LEAP) to build, operate, and maintain a 15-megawatt solar power plant. The plant is planned to provide 22.3 gigawatt-hours annually, lower CO_2 emissions by 26,400 tons per year, and also lower pollution levels.

Source: ADB, n.d.

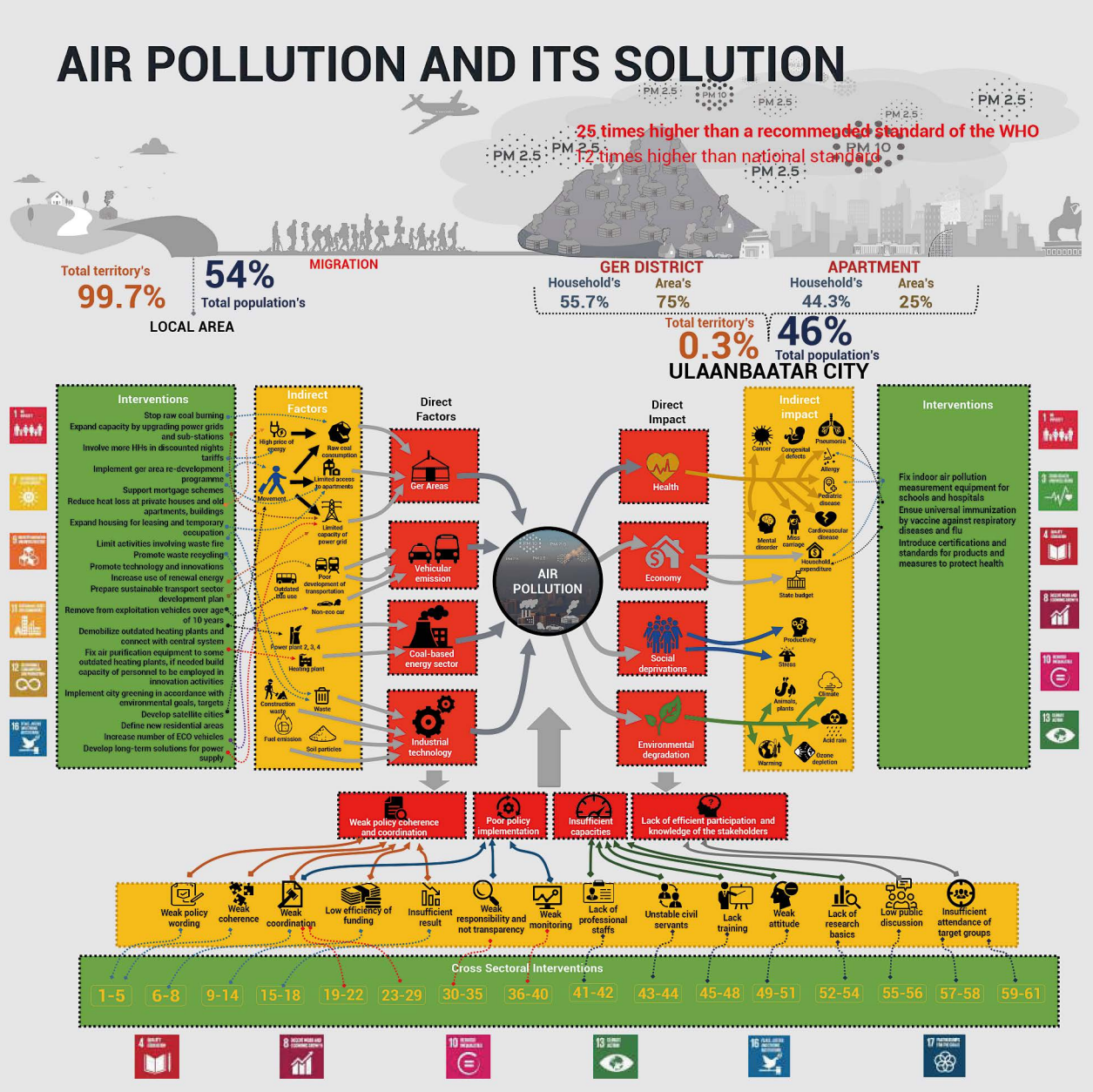

Figure 3.1: Illustration from Mongolia's VNR Demonstrating Links between Air Pollution and Other Development Priorities in Mongolia

Source: Mongolia Voluntary National Review, 2019

3.3 Gaps

While the NDC, air pollution policies and the VNR suggest a growing awareness of the potential for co-benefits in Mongolia, they are not free of limitations. This subsection highlights some of the gaps in the policy landscape.

One of the notable gaps (and possible opportunity) involves greater alignment between the NDC and air pollution policies. Mongolia's NDC is designed to reduce GHGs by nearly 23% compared to a business-as-usual scenario. Reaching these goals would have sizable air quality benefits—for instance, it would result in an estimated 9% reduction in primary $PM_{2.5}$ emissions and 10% reduction in NO_X emissions (Dagvadorj et al., 2020; Government of Mongolia, 2019). At the same time, there are arguably more that could be achieved for air quality and health with closer alignment between climate and air pollution policies. To illustrate, a greater effort to control emissions from the transport and household sectors (i.e. switching coal for electric heating in Ger areas and switch Ger households to flats) could yield substantial co-benefits. As illustrated in **Table 3.1** and **Figure 3.2**, the direct inclusion of measures targeting transport and households would lead to a 17% reduction in primary $PM_{2.5}$ emissions and NO_X emissions by over 20% by 2030 (Dagvadorj et al., 2020; Farzaneh et al., 2022; Hill et al., 2017).

Table 3.1: Emission reductions from options in the revised NDC and air pollution policies

Scenarios	OC	BC	$PM_{2.5}$	NOx	NMVOCs	CH_4	CO	CO_2
Reference (kilotons)	43	10	83	188	82	914	595	45,902
Mongolia's NDC (kilotons)	40	9	76	170	81	708	578	39,135
Mongolia's NDC (% reduction)	7.1	11.5	8.5	9.5	1.6	22.5	2.8	14.7
Mongolia's NDC and Air Pollution Policies (kilotons)	37	7	68	146	72	706	535	40,220
Mongolia's NDC and Air Pollution Strategy (% reduction)	14.5	26.2	17.4	22.2	13.0	22.7	10.0	12.4

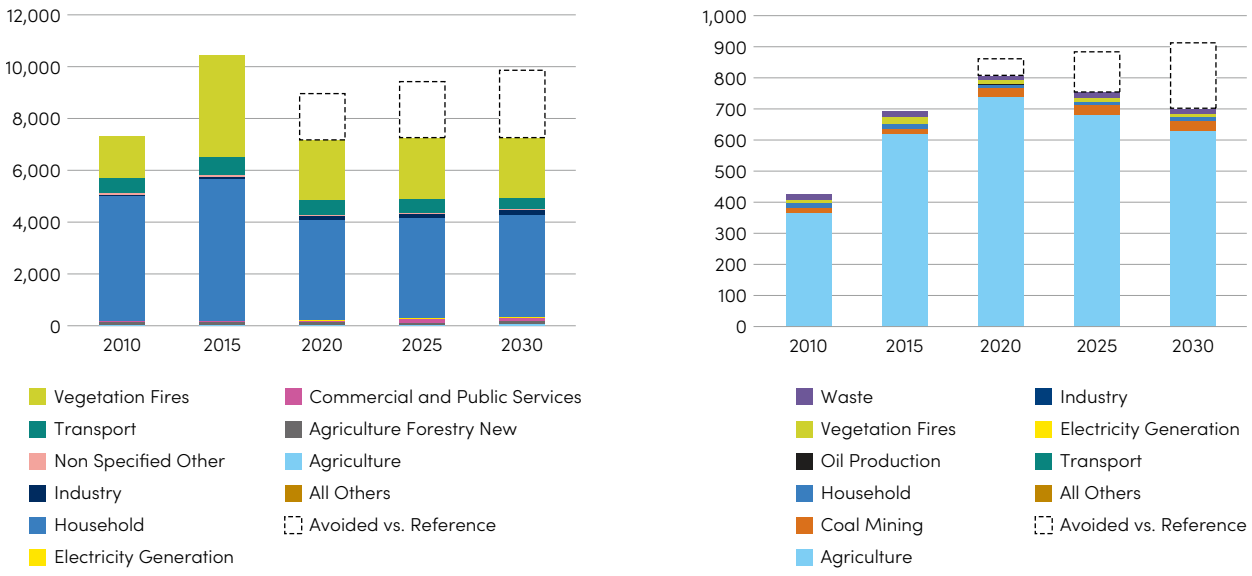

Figure 3.2: Reduction in Black Carbon and Methane emissions from Integrating between Mongolia's NDC and Air Pollution Policies

Source: Dagvadorj et al., 2020

An additional area where there is arguably still untapped potential for co-benefits involves renewable energy. Though Mongolia has sought to promotes renewables in the NDC and other policy documents, several barriers have prevented investments at the scale needed to capitalize on the country's potential to harvest these resources (Xac Bank, n.d.). This unrealized potential is demonstrated in an assessment of the environmental, health, and economic co-benefits of solar electricity and heat generation in the Ger area in UUlaanbaatar. The assessment in question quantifies the avoided emissions from the installation of 100MW solar electricity on rooftop PV and community grids while replacing heating load demand from existing HOBs for 20,000 households. The results of the analysis reveal it is possible to secure an annual reduction of more than 310,000 tons of CO_2 emissions, 76 tons of PM emissions as well as 27.36 ug/m^3 in the population-weighted concentrations of PM in Ulaanbataar. As illustrated in **Figure 3.3**, these reductions would further result in significant improvements in health (more than 6500 avoided disability adjusted life years (DALYs)) and other cost savings.

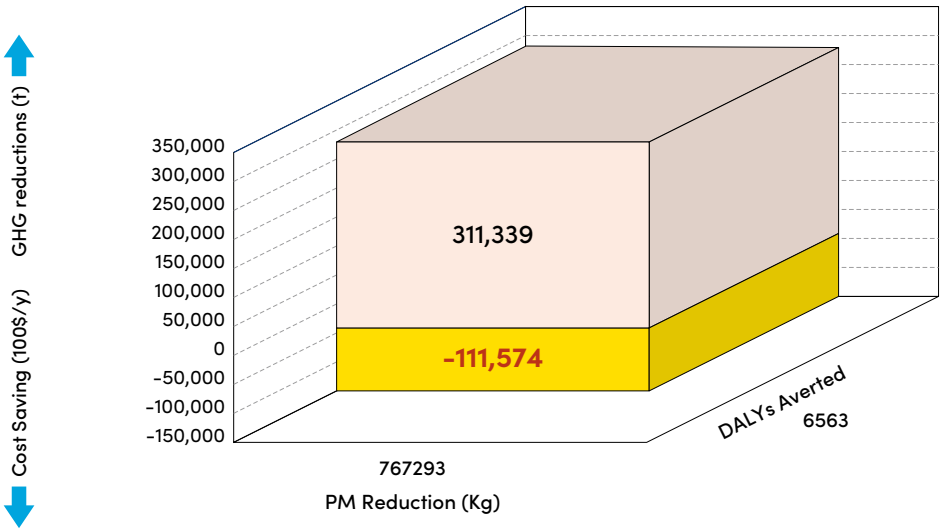

Figure 3.3: **The Co-benefits from an Ambitious Solar Energy Scenario in Ulaanbaatar**
Source: Farzaneh et al., 2022

A final possible gap involves the aforementioned focus on air pollution (and co-benefits) in the VNR. Though that document placed a sharp focus on air quality and its wide-ranging impacts on other SDGs, it does not clearly reference linkages with the NDC. In addition, Mongolia second VNR that was released in 2023 no longer underlined the critical role of air quality in SDG planning. In consequence, the linkages between clean air and healthy climate are not as evident in the second VNR.

3.4 Filling Gaps

This subsection proposes some reforms that could help to bring co-benefits into Mongolia's NDC and other policies.

A first set of reforms would involve increasing efforts to align the NDC with Mongolia's air pollution policies. As noted in the previous section, greater coherence between these policies would help increase emission reductions from the transport and residential energy

sectors. This would, in turn, have sizable effects on health. To help achieve this coherence, an important step forward would be to strengthen integration between emissions inventory and assessment tools used for air quality planning and NDC (as well as other UNFCCC reporting documents such as the national communications and biennial reports). A related reform would involve examining coherence between relevant sectoral policies and the NDC and air pollution policies. This may entail looking not only at transport and residential energy for potential co-benefits, but also waste and agriculture (Farzaneh et al., 2022).

A second set of recommended reforms involves enabling greater investment in renewable energy. As noted elsewhere in the chapter, sustainable flows of finance still present a sizable bottleneck on capturing the considerable potential for co-benefits from renewables in Mongolia. The encouraging news when it comes to realizing this potential is that Mongolia has succeeded in bringing capital to several projects; additional efforts to scale up these investments could be accelerated. At the same time, to improve the investment case for these kinds of projects, policymakers could encourage project developers to look more closely at the air quality and health co-benefits from these investments. The provision of financial incentives for a fuller assessment of co-benefits and technical assistance from the international development community could help in this regard (Soyol-Erdene et al., 2021).

Another area that merits attention—and could help advance some of the previous recommendations—involves the SDGs. To the point, Mongolia's government may want to bring back the emphasis on air pollution and cross-sectoral linkages in future VNRs. The implications of doing could be significant. They include distinguishing Mongolia as a country that sees the value of improved air quality for other SDGs, including climate change. It would further help to elevate the discussions of these interlinkages in agencies with other sectoral remits (Dawes et al., 2022; UN, 2019). By raising the level of discussion, different agencies might be more motivated to find common cause in the efforts to clean the air and protect the climate.

3.5 The Way Forward

The chapter started by underlining that climate change and air pollution present sizable risks to Mongolia's prosperity. It then argued that co-benefits cannot help address both problems but sit at the intersection of key policymaking processes. To some extent, policymakers in Mongolia have recognized that potential. The NDC, for examples, places an emphasis on transitioning to clean energy while recent efforts have sought to remove raw coal from households. At the same time, the chapter underlined areas that could strengthen the integration between air pollution and climate change so as to achieve co-benefits. Recommendations included a more concerted effort to enhance coherence between climate change and air pollution policies—for instance, highlighting the co-benefits potential in the transport and residential energy sectors in the NDC. Other recommended reforms concentrated on improving the enabling environment for renewable energy by bringing co-benefits assessments into investment decisions as well as using the SDG process to strengthen cross-sectoral coordination.

In addition to the main arguments in the chapter, there are also other interventions that Mongolia where co-benefit could play a role moving forward. One such intervention involves the possible introduction of emissions trading schemes. Putting a price on carbon under such schemes may help accelerate decarbonization but could also result in emission hot spots that expose certain concentrations of the population to higher relative levels of pollution (Sileci, 2023).

A related set of concerns that might also feature in efforts to include co-benefits in policy discussions involve social equity. Though equity is not always discussed in work on co-benefits, it is increasingly clear that some efforts to mitigate climate change might leave some social segments worse off (Johnson et al., 2022; Lee, 2021). For instance, restrictions on loose coal without subsidies could levy an additional cost on poorer families. In this connection, it will be important to consider packages of policies that limit these trade-offs. This could also include thinking creatively about empowering different social segments to participate in decision making processes that affect their livelihoods.

Chapter 4

Co-Control Policy in China: Progress and Challenges

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Key Messages

1. In recent years, China's has achieved significant reductions in air pollution and carbon intensity.
2. However, many parts of China still struggle with air pollution against the backdrop of ambitious peak carbon and carbon neutrality goals.
3. China's pioneering efforts to implement a co-control approach could help address air pollution and climate challenges.
4. Since the 14th Five Year Plan, China has stepped up efforts to integrate a co-control approach into high-level statements, sectoral policies and subnational plans.
5. There have also been notable advances in research on co-control China in key regions and sectors.
6. Filling some gaps (i.e. limited attention to some sectors/benefits, lack of precision in defining efficiency, and inattention to governance) as well as emerging trends (interactive effects between policy areas, dynamic changes in modelling assumptions, and interest in sources of VOCs) can help strengthen the interface between research and policy on control in China.

4.1 Introduction

China's pursuit of an "ecological civilization" arguably rests of how well it manages two related transitions. The first of these transitions is related to climate change. It involves reaching peak carbon dioxide (CO_2) emissions on the road to carbon neutrality. This transition will require a dramatic transformation of China's socioeconomic system. Such a transformation is difficult because China is rapidly urbanizing—the level of urbanization has nearly doubled from 37% in 2001 to 65% in 2022. It is also complicated by a heavy reliance on coal for energy (56.2% in 2022) and

energy-intensive industries that produce/consume over half of the world's steel, cement, and aluminium. The above data partially explain why China's CO_2 emissions are still increasing. They also underline why realizing carbon neutrality in the envisaged 30 years—a interval that is much shorter than most developed countries—is an inherently complex and ambitious undertaking.

A second transition transition involves controlling pollution to improve the health and vitality of China's natural environment. Though aggressive reforms over the past decade has helped limit air pollution, some of the pressures reviewed above (a reliance on coal and energy-intensive industries) and other unfavourable meteorological factors have resulted in continuing struggles with air pollution. This is reflected in the fact that still more than one-third of cities in China fail to meet national air quality standards. It is also evident in data that suggests that fine particulate ($PM_{2.5}$) annual concentrations are about two to four times averages in Europe and the United States. Above and beyond air pollution, changing consumption patterns have expanded waste streams and heightened pressures on ecosystems.

Fortunately, policymakers in China have recognized that these transitions are related. In fact, China has been a global leader in advocating for the co-control of CO_2 and pollution. Moreover, this advocacy has led to references to co-control in high-level policy statements on China's ecological civilization construction—one of core elements of a "five-pronged approach" that is helping guide China's modernization efforts. The interest in advancing co-control is similarly evident in references to a "battle for pollution prevention and control" as one of the three critical battles. The growing emphasis on promoting the harmonious coexistence between humans and nature and the desire for constructing a "beautiful China" similarly suggest the country's leadership is behind synergistic efforts to lower carbon emissions, reduce pollution and increase resource efficiency.

While China has been a pioneer in the co-control of pollutant and carbon emissions, there is a growing need to understand how that concept is reflected in current policies. There is also a related need to assess gaps in those policies and how they could be filled. The main purpose of this chapter is to fill those needs, beginning with the policy overview in the next section.

4.2 Policy Overview

As noted in section 4.1, China has been a pioneer in mitigating greenhouse gases (GHG) while controlling air, water, and soil pollution as well as curbing waste and preserving ecosystems. The commitment to co-control is reflected in institutional arrangements that promote multi-level, multi-sectoral coordination. It is also apparent is several policies that outline how China can operationalize co-control. These section reviews some of the foundational cross-sectoral and more focused sectoral measures that illustrate its support for co-control.

The contents related to co-control of pollution and carbon emission and increasing efficiency have been clearly defined in China's laws and regulations. The "Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution", which was formally implemented 2016, illustrates the support for co-control. In Article 2 of Chapter 1, it is clearly stated that "To prevent and control atmospheric pollution, we should strengthen the comprehensive prevention and control of coal burning, industry, motor vehicles and ships, dust, agriculture and other air pollutants, promote joint prevention and control of regional atmospheric pollution, and implement coordinated control of particulate matter, sulfur dioxide, nitrogen oxides, volatile organic compounds, ammonia and other air pollutants and greenhouse gases." This principle is still retained in the revised version of the "Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution" in 2018, which is the current version being implemented.

The foundational policy is the "Implementation Plan for Coordinating Pollution Reduction and Carbon Reduction to Enhance Effectiveness." The Implementation Plan is also an important part of China's "1+N" policy framework for carbon emission peaking and carbon neutrality. Consisting of seven major sections (situation faced, overall requirements, strengthening source control, key areas, optimizing environmental governance, promoting innovative models, and strengthening support and guarantee) the Implementation Plan also suggests for co-control.

An additional important policy is the "Guiding Opinions on Coordinating and Strengthening the Response to Climate Change and Ecological Environmental

Protection" (hereinafter the "Guiding Opinions"). Adopted in 2021, the "Guiding Opinions" is China's first specific regulation on coordinating pollution reduction and carbon reduction. The "Guiding Opinions" consist of seven chapters and 24 articles, including sections that cover overall requirements, strategic planning, policies and regulations, institutional systems, pilot demonstrations, international cooperation, and guarantee measures.

A fourth overarching policy designed to coordinate climate and pollution control goals is the "Opinions of the CPC Central Committee and the State Council on Deepening the Tough Battle Against Pollution Prevention and Control (The Opinions of the CPC)." The "Opinions of the CPC" was released in 2021 to not only comprehensively prevent pollution but also reduce GHGs. The document takes achieving coordinated and enhanced effectiveness in pollution reduction and carbon reduction as its guiding principle.

Beyond the four policies mentioned above, China has also adopted other policies and measures that support co-control. Notable examples include the "Action Plan for Deepening the Elimination of Heavy Pollution Weather, Prevention and Control of Ozone Pollution, and Control of Diesel Truck Pollution", "Action Plan for Continuous Improvement of Air Quality", "Opinions of the Central Committee of the Communist Party of China and the State Council on Comprehensively Promoting the Construction of Beautiful China", "Action Plan for Methane Emission Control", "Implementation Opinions on Promoting Synergy and Efficiency Enhancement in Sewage Treatment and Pollution Reduction and Carbon Reduction", and "Comprehensive Treatment Plan for Volatile Organic Compounds in Key Industries".

While the above policies cut across several sectors, China has also promulgated sector specific measures with co-benefits potential. For instance, in industry China has adopted the "14th Five-Year Plan for the Development of the Raw Material Industry" not only explicitly incorporates "carbon emissions into environmental impact assessments" but also proposes "leveraging the synergistic effects of pollution reduction and carbon reduction around the targets of carbon peaking and carbon neutrality." Moreover, the "Implementation Plan for Carbon Peaking in the Industrial Sector" clarifies that one of its main goals is "promoting the coordinated enhancement of pollution reduction and carbon reduction." It also proposes constructing/transforming green and low-carbon production lines by coordinating pollution and carbon reduction in the cement, glass, ceramics and other industries as well as demonstrating carbon capture, utilization, and storage (CCUS) technologies.

The transport sector has also been an area where China has sought to achieve co-benefits. In 2021, for instance, the "14th Five-Year Plan for Green Transportation Development" proposes to "firmly grasp the overall requirements for coordinating pollution reduction and carbon reduction" and introduces "pollution reduction and carbon reduction" as primary indicators for green transportation development under the 14th Five-Year Plan. The same policy includes secondary quantified targets such as a 5% reduction in CO_2 emissions per unit of cargo turnover for operational vehicles and ships by 2025; and a 3.5% reduction in nitrogen oxide (NO_X) emissions for operational ships compared to 2020 levels. Other policies and measures in the transport sector with co-benefits aim to reduce emissions from diesel trucks, ports, and delivery services.

Table 4.1: Co-control Policies and Plans for Key Industries

Iron and steel	• "Guidelines for Energy Conservation and Carbon Reduction Transformation and Upgrading in the Steel Industry" • "Guiding Opinions on Promoting the High-Quality Development of the Steel Industry"
Petrochemical	• "Guiding Opinions on Promoting the High-Quality Development of the Petrochemical Industry in the 14th Five-Year Plan" • "Working Plan for Stabilizing Growth in the Petrochemical Industry"
Metallurgy and building materials:	• "Guidelines for Energy Conservation and Carbon Reduction Transformation and Upgrading in the Nonferrous Metal Smelting Industry" • "Implementation Plan for Carbon Peaking in the Building Materials Industry" • "14th Five-Year Development Implementation Plan for the Building Materials Industry"

The effort to achieve co-benefits have also been extended to waste and wastewater management. In this case, China's "Action Plan for the Tough Battle Against Black and Odorous Water Bodies in Cities" and the "14th Five-Year Plan for Urban Domestic Waste Classification and Treatment Facilities Development" are intended to co-control pollution and CO_2 by promoting the collaborative governance of polluted water bodies and domestic waste classification, and encouraging multi-level, multi-sectoral innovations that curb pollution and CO_2.

Efforts to co-control emissions also extend beyond urban and industrialized areas. Agricultural ecological farms are the basic units for green development, pollution prevention, and emission reduction and carbon sequestration. The "Guiding Opinions on Promoting the Construction of Ecological Farms" calls for coordinating the management of pollution and carbon reduction in promoting the construction of ecological farms and upgrading of agriculture. Subsequently, the Ministry of Agriculture and Rural Affairs and the National Development and Reform Commission, highlighting the need for "implementing major actions to reduce pollution and carbon emissions and enhance carbon sinks", issued the "Implementation Plan for Agricultural and Rural Emission Reduction and Carbon Sequestration."

Importantly, China's efforts to realize co-control have begun to be partially realized due to concrete implementation plans at the provincial level. Most notably, Zhejiang Province has helped spearhead some of these efforts with a so-called "1+4+N" system. In this new system, the "1" refers to a single top-level design document ("Implementation Plan for the Construction of Zhejiang Province Collaborative Innovation Zone for Pollution Reduction and Carbon Emission Reduction"); the "4" refers to a target list, task list, policy list, and evaluation index system; and the "n" refers to multiple co-control actions (i.e. pilot promotion, financial support, carbon assessment access, investment and financing). This new system is also designed to work on multiple scales (cities, industrial parks, enterprises, etc.) and sectors (energy, industry, urban and rural construction, transportation, agriculture and rural areas, ecological construction, green living, etc.).

The new system has had visible impacts elsewhere in Zheijiang province. To help localize and generate incentives for co-control, Zhejiang and its cities have taken several notable steps forward. For example, the province has released a pollution and CO_2 index that is used for quantitative evaluations of implementation of co-control in 11 prefecture-level cities. Meanwhile, cities in Zhejiang have applied similar techniques at the county and district levels (Hangzhou's Yuhang district) or within particular industries (Zhoushan's petrochemical industry). Other similar motivated efforts involve the creation of leadership groups that can help guide the implementation of co-control in cities like Jiaxing and Longyou Economic Development Zone. These efforts have also gained momentum due to carefully-designed financial incentives for co-control that, *inter alia*, offer a suite of differentiated subsidies, a benchmark project library, and calls for financial institutions to underwrite pilots. The financing has also been complemented by online applications that enable decision makers to view co-control scenarios and manage data with comparable multidimensional assessments in mind.

The efforts to localize and implement co-control have also extended to other parts of China. Another such illustration can be found in high-tech zone in the city of Hefei, Anhui Province. This zone has been recognized as a national demonstration zone for work on environmental and health management and clean production over the past 30 years. In recent years, the zone has introduced reforms to help operationalize co-control. These reforms include introducing joint pollution reduction and carbon emission planning; a multiple-factor pollution reduction and carbon emission governance roadmap (based on the "one park, one policy"); and an evaluation indicator system that features pollution and carbon reduction as part of its assessment framework. The zone has also piloted an emission trading scheme with carbon credits that list pollution and CO_2 levels. The programme's carbon credits are linked with other programmes that encourage investments that help co-control emissions and is backed backed by banks that are promoting the development similarly motivated loan products. The above programmes and incentives have led industry-leading technology companies to make technological advances that help concretize co-benefits (See **Box 4.1**).

Box 4.1: Supercritical Combined Cooling, Heating, and Power Technologies

One of the technologies that was developed in the high-tech zone in the city of Hefei is the Megawatt-level Supercritical Carbon Dioxide Combined Cooling, Heating, and Power Technologies that use the thermodynamic characteristics of CO_2 to change the traditional mode of separate operation for cooling and heating systems in the industrial field. This technology enables a single device to provide both cooling and heating, achieving the "three zeros" goal of zero energy consumption, zero cost, and zero emissions on the heating side. It has pioneered the industrial application of carbon dioxide for cooling and heating. With a promotion rate of 20% domestically, it can save more than 50 million tons of standard coal and reduce CO_2 emissions by more than 100 million tons, reduce PM, SO_2, NO_X emissions by more than 2800, 13800, and 22100 tons respectively annually for the country.

4.3 Research Overview

Part of the reason that China has made progress with co-control policies is the quantity and quality of research on the theme. This section reviews some of the advances—and gaps—in co-control studies in China. The section moving from work on strategic regions (Beijing-Tianjin-Hebei, Yangtze River Delta) to important sectors (power, transportation, agriculture).

4.3.1 Key Regions

The Beijing-Tianjin-Hebei region faces pressure to improve its air quality while also reaching peak carbon and carbon neutrality goals. To illustrate, work on synergistic effects from carbon reduction in the "2+26" city clusters in the Beijing-Tianjin-Hebei region and surrounding areas has shown that adjusting the industrial structure (phasing out outdated production capacity, upgrading/ transforming industrial boilers, and reorganising diffusely located enterprises) can help meet this challenge, especially by forging links between controls on CO_2 and NO_X (Yang et al., 2022). Other work in the Beijing-Tianjin-Hebei region has demonstrated that Hebei has greater potential than Beijing and Tianjin for controlling multiple emissions (Wan et al., 2022).

Another region that has benefited from research is the Yangtze River Delta. Studies in this region have used satellite data to analyse the distribution of atmospheric NO_2 and CO_2 (Y. He et al., n.d.), while other work has looked at the spatiotemporal characteristics and interactions between air pollution and carbon emissions (Gao, 2022). A related set of studies in the

same region analysed the contributions of different factors behind CO_2 and pollution emissions for key industries in different provinces/cities (Y. Li et al., 2022). Yet another pertinent study found pollution and carbon-intensity are related in urban clusters in the regions as both fell from 2003 to 2017 (Ma et al., 2022).

A third region that has drawn similar attention is the Guangdong-Hong Kong-Macao Greater Bay Area. Research on this region has revealed that strengthening cooperation between cities and promoting coordinated control of CO_2 and air pollutants can be mutually beneficial. In this connection, studies have drawn on integrated index of GHG and air pollution (consists of 20 indicators in four aspects, such as the GDP increasing rate, per capita disposable income of urban residents, SO_2 condensate, SO_2 emission amount per capita) to suggest a need for greater coherence between environmental management systems in the three regions in the Greater Bay Area (Liu et al., n.d.).

4.3.2 Studies on Key Sectors

Given the still heavy reliance on coal, it is not surprising that much of the work on co-control has focused on the energy sector in China. Early studies on this sector have constructed atmospheric pollutant coordinated reduction (APeq) index to compare the cost-effectiveness of technical and structural controls (Mao, Xing, et al., 2012). Others have concluded that technologies such as ammonia desulfurization can help manage SO_2 and CO_2 in coal-fired power plants—though CO_2 may increase from operating desulfurization technologies (Yu, 2016). Another set of studies have drawn upon life cycle analysis to highlight the multiple benefits of grid-connected onshore wind are greater than thermal power in the Shandong Peninsula (Tang & Liu, 2017). Importantly, some studies have cautioned that the regional distribution of these benefits may be a concern since less developed provinces (Inner Mongolia, Shaanxi, Xinjiang, and Jilin) will need to produce more coal-fired power and therefore bear a larger share of the health burden (Hui, 2018).

A sizable body of work has focused on particular industries such as steel. Early studies in this area have examined the potential synergistic effects on SO_2, NO_X and CO_2 from technical measures (Mao, Zeng, et al., 2012). Similarly motivated work has added in cost data to create an APeq that can assess the marginal costs and reduction potential for co-controlling SO_2, NO_X and CO_2 (Liu et al., n.d.). A study with a comparable focus has assessed and compared the emission reduction potential, mitigation costs, and co-benefits of 22 energy-saving and emission measures for steel (Martin & Chen, 2017). Research has also used life cycle assessment methods to examine the impacts of different steelmaking processes on energy, air quality, and water (Ren, 2019).

A parallel set of work has looked at the potential for co-control in another heavy industry: cement. Early studies on cement used an energy-environment-economic input-output model to assess different solutions and argue that substituting raw materials could significantly reduce industrial solid waste and CO_2 (Zhou et al., 2013). Scenario analyses in Henan Province have taken a comparable approach, finding clinker substitution and fuel substitution yield the greatest co-benefits after screening more than 30 energy-saving technologies (Tian et al., 2016). Research has also added costs for a comparable assessment of 24 energy-saving and emission reduction measures in the cement industry (Y. He et al., n.d.).

Fast-growing transport emissions has also led to co-control research in this sector. Some studies have drawn on modelling scenarios and localized activity and emission factor data to assess energy-saving and emission reduction benefits in the transport sector nationally (Wu, 2016). Others have explored the potential emission reduction from transport interventions in the Beijing-Tianjin-Hebei region, finding that maximizing co-benefits depends on technological changes in conventional vehicles and the diffusion of electric vehicles (Xu, 2019)—though the latter depends on complementary changes in energy production (Wang et al., 2019). Studies have also concluded that tightening emission standards could deliver synergies between CO_2 and $PM_{2.5}$. Not all of the work on transport has argued for technological changes, however. Studies have also pointed to considerable co-benefits from public transportation (especially rail) in Beijing (Yu et al., 2013).

Reflecting growing awareness of emissions outside the energy-consuming sectors, studies have also looked at co-control in China's agricultural and wastewater sectors. In terms of agriculture, controlling

emissions of ammonia and GHGs from livestock and poultry farming is important to addressing pollution and climate change. Some of the measures that can help in this regard include encouraging the selection of high-quality and efficient livestock and poultry breeds, controlling stocking density, improving ventilation facilities, and implementing scientifically standardized feeding regulations. An additional set of more technical options that can also support co-control in this area includes the utilization of manure through biogas projects, land restoration, and employing alternative technologies for fertilizer production, energy production, and substrate utilization. To look more closely at some of the measures, studies have examined how the composting of chicken and cow manure can lower ammonia and GHGs in Hubei Province; a comparable line of work has underlined that increasing management scale of pig manure and technical interventions could help co-control emissions (Bu et al., 2020). Research has further underlined the potential for aerobic composting experiments using chicken manure and mushroom residue to bring down ammonia and GHG emissions (Zhan et al., 2023). There is similar promise for joint reductions in ammonia and GHGs from physical, chemical, and biological additives and optimising gas supplies according to other studies in this space (Cao et al., 2020).

As for waste treatment, studies have called for unique data sets to call for co-control in industrial park wastewater treatment (M. Yang et al., 2023). Other studies have nonetheless underlined that there might be trade-offs in the sector. For example, the anaerobic removal of chemical oxygen demand chromium (CODCr) could increase methane (CH_4) (Fu et al., 2021), while sewage treatment technologies may lower COD but increase CO_2 (Li et al., 2014).

4.4 Gaps and Trends

One of the gaps involves the coverage of sectors and types of benefits. Much of the research on co-control in China is centred on large-scale energy-consuming sectors; there are relatively few studies on transportation, construction, and agriculture and their effects on water, soil and solid waste. Further, the work on these less-covered sectors and benefits tends to have more a technical as opposed to a policy focus. More policy-related research on, for instance, the wide range of benefits in the agricultural sector would be helpful.

A second gap relates to the understandable interest in improving efficiency in the work on co-control. While efficiency is clearly an important goal, much of the research lacks precision in defining what the terms means. In a similar vein, there is also a lack of discussion of how different recommended interventions contribute toward improving efficiency. Additional efforts to define and compare how efficiency relates to other desirable policy goals (i.e. efficitiveness and equity) would be useful for policymakers and industry-level decision makers.

Yet a third gap involves discussions of the links between governance and co-control. Research on how environmental governance influences policy design and implementation that can achieve co-benefits has been limited. In a similar manner, there have been few studies of how different policy instruments (regulation, subsidies, taxes, information sharing) influence the effectiveness of recommended co-control interventions. This is particularly important given the growing interest and experience with emissions trading in China. Looking more closely at how institutional arrangements and related implementation challenges influence modelling results could help to strengthen the impacts of work on co-control.

While there are indeed some gaps, there are also emerging trends in the work on co-control that researchers may want to "lean into" to enhance policy impacts. To illustrate, since the adoption of the aforementioned "Implementation Plan for Synergistic Efficiency Improvement of Pollution Reduction and Carbon Reduction" there have been efforts to change the orientation of this work from concentrating on climate or pollution control policies to packages of policies with different underlying goals. For instance, studies may examine the combined effect of tighter air quality standards (pollution control) and a carbon tax (mitigating climate change). Studies that looked at the interactive or additive effects of policies with different entry points offers a more useful and realistic assessment of the policy landscape; they should therefore be continued.

Yet another related trend in work on co-control involves a growing interest in making research less "static" and more "dynamic." In this case, there is a

realization that recent changes in government policy have altered existing baseline assumptions. There is similar a recognition that altering the timing and location of different reforms may lead to varying results. Finally, there may be several factors that are behind major policy changes and that influence the timing and spatial distribution of reforms. As such, it is important to deepen work considering how policy changes are related to other changes in underlining factors (expansions in trade or economic downturns). Incorporating these more dynamic changes into ongoing research is welcomed.

A third trend involves an interest in light industries such as textiles. Part of this interest is motivated by the growing awareness of the effects of smaller industries on difficult-to-control air pollutants such as volatile organic compounds (VOCs) that influence atmospheric chemistry by contributing to ozone and fine particulates. An emerging body of work into how to co-control VOCs and CO_2 from small-scale industries should also draw more attention moving forward.

4.5 The Way Forward

This chapter began by suggesting that China's ability to achieve an ecological civilization rests on how well it manages climate change and air pollution. It then demonstrated that China has taken significant steps in managing both issues together as part of co-control strategy. That strategy has been marked by important policy reforms that have gained momentum over the past few years (since the release of the 14th Five-Year Plan). It has also benefited from a wide range of studies on the types of reforms that can deliver co-benefits for key regions and major sectors. At the same time, there have emerged some gaps (i.e. limited attention to some sectors/benefits, lack of precision in defining efficiency, and inattention to governance) as well as emerging trends (interactive effects between policy areas, dynamic changes in modelling assumptions, and interest in sources of VOCs) that can be reviewed to strengthen the interface between research and policy.

Moving forward there may also be scope to develop more practical guidelines on how to operationalize co-control in varied contexts. For instance, local-level decision makers or factory owners may seek a set of steps that can follow to make co-benefits relevant to their community or enterprise. This may entail creating easy-to-use tools to assess multiple benefits as well as recommendations of how to secure finance to implement actions based on that analysis. A final way to move forward some of the work described in this chapter is to share China's experiences with co-control and synergies with other countries. This chapter has hopefully helped in making those efforts more visible to an international audience.

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Asian Co-benefits Partnership (ACP) is a voluntary information sharing platform. The ACP seeks to collaborate with organisations working to mainstream co-benefits into decision making processes in Asia.