Governance for Integrated Solutions to Sustainable Development and Climate Change

From Linking Issues to Aligning Interests

Institute for Global Environmental Strategies (IGES)

Governance for Integrated Solutions to Sustainable Development and Climate Change: From Linking Issues to Aligning Interests

Eric Zusman and Nobue Amanuma, Editors

Institute for Global Environmental Strategies (IGES)
2108-11, Kamiyamaguchi, Hayama, Kanagawa, 240-0115, Japan
Tel: +81-46-855-3700 Fax: +81-46-855-3709
E-mail: iges@iges.or.jp
URL: http://www.iges.or.jp/

IGES is an international research institute conducting practical and innovative research for realising sustainable development in the Asia-Pacific region.

ISBN 978-4-88788-209-6

Printed in Japan

Chapter 2

The Co-benefits of Integrated Solutions in Asia:
An Analysis of Governance Challenges and Enablers

Authors: Bingyu Chiu, Eric Zusman and So-Young Lee
Contributor: Huang Jian

Chapter 2

The Co-benefits of Integrated Solutions in Asia: An Analysis of Governance Challenges and Enablers[1]

Authors: **Bingyu Chiu, Eric Zusman and So-Young Lee**
Contributor: **Huang Jian**

Main Messages

- Co-benefits are all the benefits of actions that mitigate climate change while meeting other development priorities;
- They provide a compelling near-term, local, and relatively certain rationale for mitigating climate change compared to the often long-term, global, and relatively uncertain climate benefits that would come from focusing only on climate change;
- Governance findings from 28 co-benefits case studies show that more inclusive institutions and processes are needed to reach out to affected communities; results also suggest technical solutions need to be tailored to local conditions;
- Perhaps surprisingly, the challenges involving inter-agency coordination were fewer than anticipated, while often it is important for government to reach out to external parties such as the private sector;
- Governance was not the only factor that prevented/mattered for the success of the cases: finance, technology, capacity building, or other means of implementation (MOI) are also needed; and
- The concept of social co-benefits and greater efforts to include assessments of jobs created, equity effects, and gender impacts arguably deserve more attention.

1 This chapter draws upon some material from Chiu and Zusman 2018.

1. Introduction

In 2015, the international community welcomed the Sustainable Development Goals (SDGs) with much enthusiasm and fanfare. Some of this optimism grew from a sense that the 2030 Agenda for Sustainable Development would encourage governments, businesses and other stakeholders to take an integrated approach to development. Such an approach involves adopting actions that can capitalise on synergies and avoid trade-offs across multiple policy areas. It also entails aligning different interests behind solutions that cut across these areas. Past attempts at multi-sector integration have nonetheless often performed below expectations (Olsen and Zusman 2013; Runhaar, Driessen, and Uittenbroek 2014; Casado-Asensio and Steurer 2014). This was frequently due to the lack of capacity and limited mandate of responsible (usually environmental) agencies to align a wide range of varying interests behind integrated approaches. Chapter 1 argued that a possible way to overcome this challenge is to focus on more narrowly drawn solutions that integrate climate change and one or two additional sectoral concerns. A set of solutions that have exhibited modest success making connections between climate change and some development priorities (particularly controlling air pollution) involve co-benefits.

Co-benefits are all of the benefits of actions that mitigate climate change while meeting other development priorities; they can also be viewed as the additional climate benefits of actions focused chiefly on development needs (ACP 2014; ACP 2018). Co-benefits are important because they offer decision-makers a compelling near-term, local, and relatively certain rationale for mitigating climate change. That motivation stands in stark contrast to the often long-term, global, and relatively uncertain climate benefits that would come from focusing only on climate change (Krupnick, Burtraw, and Markandya 2000). Co-benefits have also been associated with helping to bring climate finance to interventions that reduce greenhouse gases (GHGs) while meeting other development priorities (Zusman, 2008). These two reasons—one focusing on mitigation costs and the other climate finance—have generated a fast-growing literature on co-benefits. Many of these studies concentrate on the quantification of reductions in GHGs and other benefits (chiefly local air quality and public health effects) (Pearce 2000; Markandya and Rübbelke 2004; Nemet, Holloway, and Meier 2010). Similar to the SDG linkages literature in Chapter 1, a possible limitation of focusing on quantification is the lack of attention to governance arrangements needed to align interests which support actions with co-benefits.

This chapter aims to complement the quantitative co-benefits work with insights into which kinds of governance arrangements affected attempts to align interests behind solutions with co-benefits. It also sheds some revealing light on this report's main questions involving the relative importance of vertical coordination; horizontal coordination; and engagement with multiple stakeholders. The chapter draws upon a collection of 28 co-benefits case studies in five sectors in Asia to identify whether, and to what extent, the three dimensions of governance were important to the achievement of co-benefits across multiple sectors and countries.

These cases reveal that the most common enablers involved governance arrangements that encourage participation from sets of stakeholders that are affected by and/or could contribute to a project or policy.[2] More inclusive institutions and processes are needed to reach out to affected communities that would benefit from co-benefits solutions. A second, related need was for greater interaction with the users of specific technologies; this would help ensure that technical solutions were in line with local conditions. The chapter also underlines the importance of governments engaging with the private sector to fill financing shortfalls. As these shortages frequently involve covering initial infrastructure costs, public and private partnerships (PPP) are likely to become increasingly important to yield co-benefits. A final notable finding was that horizontal and vertical coordination were less commonly cited as challenges or enablers. This finding may be because many of the cases were projects and not wider policies; it could also suggest that, because air pollution and climate mitigation are relatively closely related issues, they may require less coordination across agencies.

The remainder of this chapter is divided into three sections. The next section reviews literature on co-benefits, underlining the need to look more closely at the three dimensions of governance featured in this report. The third section presents the background and methods for analysing the case studies as well as the results of that analysis. The final section concludes with areas for further study.

2. Literature review on co-benefits

The term "co-benefits" originated in the early 1990s when environmental economists were researching the affordability of climate mitigation technologies and strategies (Ayres and Walter 1991; Nemet, Holloway, and Meier 2010). It was at this juncture that some observers recognised that, even with uncertainty surrounding the benefits of mitigating climate change, there were "no regrets" in investing in climate actions if they brought additional development benefits (Morgenstern 1991). From this realisation emerged an extensive literature that drew upon cost-benefit analyses and integrated assessment models to estimate the favourable impacts from hypothetical climate policies; the policies chosen for analysis often involving a carbon tax (Pearce 2000). This work has some parallels to the more recent issue of SDG linkages studies reviewed in Chapter 1. This early research frequently concluded that it was cost-effective to control GHGs even without the consideration of climate benefits in many contexts. This conclusion was laid out in Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2001—the first IPCC report to include a section on co-benefits (IPCC 2001).

Over the past decade, research on co-benefits has moved in a few parallel directions that have aimed to convert increasingly robust science into equally strong action. Some of that work has taken an air pollution perspective on co-benefits; studies adopting this view feature types of air pollution that can warm the climate while degrading local air quality.[3]

2 The absence of participatory institutions could be a challenge.

3 There is an ongoing debate on the degree and certainty of the warming impacts of black carbon. This debate involves issues such as the ratio of the black to organic (white) carbon from a given emission source as well as the effects of different aerosols on cloud formation. Readers are invited to review the cited Bond et al. 2013 article for more information on this debate and some of the key variables influencing the warming and cooling of black carbon emissions.

These pollutants, collectively known as short-lived climate pollutants (SLCPs), have given rise to an expansive scientific literature on the different impacts of black carbon (Bond et al. 2013). They have also led to the creation of a partnership of more than 100 countries and non-state actors known as the Climate and Clean Air Coalition (CCAC) that is working to introduce technical measures that can curb SLCPs (UNEP/ WMO 2011). In many ways, the SLCP work has helped not only to better understand the impacts of different pollutants but also to drive action on the ground.

Studies on co-benefits from mitigating GHGs have also increasingly sought to spur action. This action-oriented perspective has involved, for example, studies that look at co-impact pathways, showing there may be an interrelationship between streams of different kinds of benefits that should be considered in policy and project decisions. Accompanying the suggestion to look at pathways has been a call for making data analysis tools and quantification methods more user friendly (streamlined) to facilitate the entry of estimates of co-benefits into policy decisions (Ürge-Vorsatz et al. 2014). This desire to make work on co-benefits more relevant to policy decisions can also be found in the Fifth IPCC Assessment Report that underlines a "growing political and analytical attention to co-benefits…that has resulted in an increased focus on policies designed to integrate multiple objectives" (IPCC 2014: 96). A similar sentiment is expressed in work that underlines the challenges to implementing recommendations for co-benefits based on modelling of those benefits (Aunan et al. 2004; Mayrhofer and Gupta 2016).

Finally, and perhaps most importantly, there has been some evidence that the work on co-benefits has left an imprint on policies and projects. China's approach to climate change is closely linked to the development objectives of energy security and energy efficiency—with air pollution control and public health receiving more attention lately (Qi, Zhang, and Li 2008; Kostka and Hobbs 2012; Tsang and Kolk, 2010). A similar set of impacts is evident in India where decision-makers underlined climate co-benefits that could come from plans mitigating climate change, as well as reaching other development goals, in its national climate plan (Atteridge et al. 2012). Further, the Government of Japan has worked closely with partners in Indonesia, Mongolia, and China (see Box 2.1) to demonstrate the feasibility of pursuing multiple benefits in a few key projects (ACP 2016). There are also several less publicised cases across the region where other development objectives are pursued at the same time as mitigating climate change.

Over the nearly three decades since conceiving of the term co-benefits, research is increasingly aiming to prompt actions that can achieve multiple benefits. It has also become clearer over this period that some of the hurdles to taking actions consistent with co-benefits may have little to do with the models, data or analytical frameworks used to estimate the size of benefits. It may instead imply greater cooperation between government agencies and engagement with other stakeholders that can align interests in support of this work. This is partly because the concept of co-benefits suggests cooperation across actors who may or may not be aware of their shared interests (Pusztai and Suwa 2017). It may also be because as it becomes more common to quantify co-benefits, the governance or institutional challenges to making them relevant in policies become more evident

Box 2.1. Delivering co-benefits to Xiamen, China

The Ministry of the Environment, Japan (MOEJ) has been working on co-benefits projects in China for several years. One of the five largest economic zones in China, Xiamen, Fujian Province, has a generally solid record of managing pollution. However, fine particulate matter ($PM_{2.5}$) remains a significant problem. Resolving that problem has required actions targeting the transport sector as it is responsible for 21.3 percent of the $PM_{2.5}$. To reduce transport-related emissions, Xiamen has been encouraging the introduction of electric vehicles and vehicles that use natural gas for buses and taxis. However, pollution emissions from automobiles remained high.

In 2015, Xiamen installed a device to measure automobile exhaust gases using remote sensing at five points (four bridges and one tunnel). By measuring the exhaust gas concentration of passing vehicles, data from over 30,000 tailpipe samples was obtained daily; Xiamen nonetheless lacked the knowledge to analyse the data. To help support that analysis, the city requested Japanese counterparts to cooperate on a project entitled "Xiamen City automobile pollution prevention technology and policy research." Analysis of the data and other survey results conducted by Japanese experts showed that the significant proportion of nitrogen oxides (NOx) (a precursor to $PM_{2.5}$) came from natural gas buses, while taxis discharged more NOx than diesel buses. Based on this research, Xiamen introduced a new strategy to control pollution by developing a full electric motorisation plan and financial subsidy policy. This would target buses using natural gas (including CNG, LNG, and gas electric hybrid buses) as well as dual-fuel taxis, reducing not only local pollution but also CO_2. Many of these measures will help deliver co-benefits to Xiamen.

Source: Developed by Huang Jian based on her participation in a project on SLCPs funded by the MOEJ

(Mayrhofer and Gupta 2016). Three sets of governance considerations the same factors highlighted in the introductory chapter, may be relevant.

1. The first, horizontal coordination, could be critical because agencies working on climate change, air pollution, and other sectoral interests may have few opportunities to work together in decision-making processes and institutional structures. Supporting more coordination across agencies could lead to greater understanding of cross-issues synergies and conflicts, generate policies and measures consistent with that understanding, and lead to greater efficiencies that lower implementation costs.

2. The second, vertical coordination, involves working across different levels of government. This is particularly important since, while national governments are frequently responsible for shaping national responses to climate change, local governments are increasingly tasked with implementing those actions with links to local development priorities.

3. A third set of possible enablers involves engagement with different stakeholders, ranging from the private sector, businesses, academics to the general public. Mechanisms that can engage with stakeholders beyond the government could elicit varying perspectives as well as financial, technical or capacity building support needed

to align climate with other objectives. They may also help to provide resources and forms of support that could help implement an action with multiple benefits.

Whether, and to what extent, different governance challenges/enablers exist requires an examination of cases. Further, because the literature has focused on quantification, there have been few articles looking across multiple cases to identify broader patterns of challenges/enablers to achieve co-benefits. The studies that have looked at these cases have noted that the political and institutional aspects of co-benefits have been largely overlooked or understudied (Mayrhofer and Gupta 2016). To more systematically examine these challenges/enablers, it helps to examine multiple cases. The next section of this chapter looks at a series of case studies where co-benefits existed and the challenges/enablers to realising them.

3. Overview of the cases

To identify challenges/enablers to achieving co-benefits, 28 cases were selected from a Co-benefits Good Practice Map assembled by the Asian Co-benefits Partnership (ACP) (all of the cases can be downloaded for free from the ACP Good Practice Map at https://www.cobenefit.org/good_practice/). The ACP is an informal and interactive platform established in 2009 to promote information sharing and awareness raising on co-benefits in Asia. The Institute for Global Environmental Strategies (IGES) serves as the secretariat of the ACP; with funding mainly from the MOEJ. The ACP Good Practice Map includes a series of short case studies that follow a relatively standard format. The case studies include essential background such as location, sector and types of co-benefits; the sets of actions that were taken to achieve the co-benefits; and a discussion of barriers to achieving a full range of benefits. In some instances, though not formally part of the structure of the case studies, enabling factors that helped achieve multiple benefits are also mentioned.

The cases come from ten countries in Asia: Bangladesh (1), Cambodia (1), China (5), Indonesia (4), Japan (11), Republic of Korea (2), Lao PDR (1), Nepal (1), Thailand (1) and Viet Nam (1). The high proportion of cases in Japan stems from the fact that many of Japan's approaches to environmental management aim upstream in the production process to both reduce pollution and save energy (often with impacts on carbon dioxide (CO_2)). The cases also come from a variety of sectors: transportation (7), waste management (4), biomass/fuel (5), livelihood (4) and energy/industry (8). The livelihood category refers to projects or policies that focused on both climate and social benefits such as new jobs or more equitable gender relations. Most of the other cases focused on mitigating climate change and other forms of pollution, particularly air pollution.

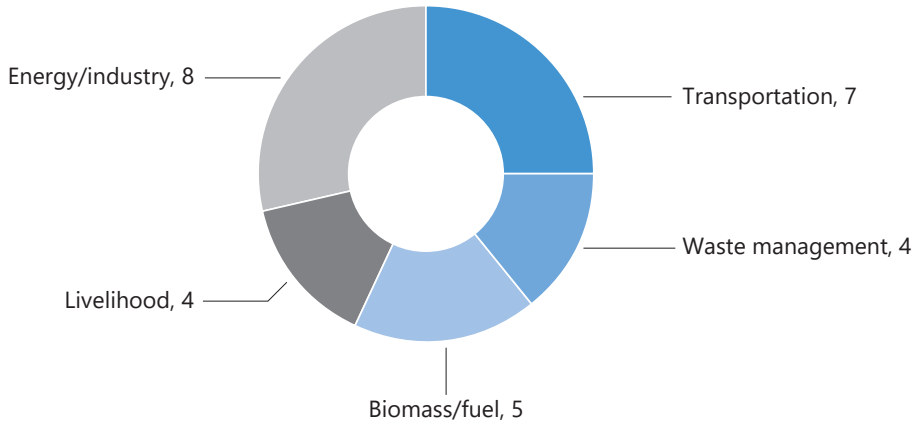

Figure 2.1. Sectoral breakdown of the case studies

Before summarising some of the major challenges and key enablers, a few important observations warrant highlighting. First, as for much of the co-benefits literature, the benefits in terms of reduced GHGs were quantified in many of the cases. In 17 out of the 28 cases, there was a measure of how much CO_2 or methane (CH_4) was reduced: CO_2 was mentioned in twelve cases involving energy or transport and CH_4 was measured in five cases involving waste or wastewater. A smaller number of cases included measures of reductions in air pollution and SLCPs. The arguably lower number of cases where there is quantification of air pollution reduction may be attributable to the large concentration of cases in Japan where air pollution issues are not as serious. They are also likely related to the need to use emission factors for some local pollutants that may not exist or are difficult to calculate in developing countries. Beyond quantification, which is consistent with the mainstream literature on co-benefits, several interesting findings relating to the main questions in the introductory chapter can be seen by looking at the enablers and barriers in the cases below.

3.1 A review of challenges and enablers

The most frequently cited governance barriers involved different forms of stakeholder participation and engagement. For example, in Suwon, Korea, policymakers faced sharp public criticism due to what was perceived as an excessively top-down, insufficiently transparent and tourist-centric approach to a month-long, neighbourhood-wide car-free event; it nonetheless managed to win back support as it demonstrated the benefits of a larger urban renewal effort (in which the car ban was embedded) to the affected citizens. In the waste management sector, Hino, Japan adopted a plan to reduce GHG emissions but several of the measures went unimplemented due to limited engagement with citizens over design and implementation.

On a slightly smaller scale, a related set of challenges involved the government effectively engaging with sets of stakeholders who would use or repair specific technologies or infrastructure. In the transportation sector, three of the seven cases suffered from these kind of barriers. These include, for example, the inconvenience experienced by individuals who lacked information about the schedule and routing of lower carbon transport modes that could have been resolved by greater engagement with affected communities during the planning of the project. They also include the biomass/fuel and livelihood sectors in three of the eight cases—Lao PDR, Bangladesh and Viet Nam—where there was a need to build technical skills or technology users; one of the three (Lao PDR) was affected by a lack of consumer awareness or little appreciation of the long-term benefits of improved cookstoves. Another case, in Cambodia, involved a lack of knowledge of maintenance issues that could have been addressed with more engagement between technology users.

Some of the other challenges involving engagement suggested difficulties of working with the private sector and commercial interests. This was most evident in the transportation and waste management sectors. Four of the seven cases in the transportation sector were affected by a lack of initial finance that could have been managed through greater cooperation with banks and/or businesses. The shortage of these resources undermined the construction of new infrastructure. These cases involved light rail transit and transport sharing stations; new services such as intelligent transport systems; and securing sustained finance operations and maintenance.

As noted at the outset, the challenges involving agency coordination were fewer than anticipated, especially given that there would seem to be a need for cooperation across divisions working on air pollution and climate change. In the case of Tokyo, Japan, the Metropolitan Government needed to consider that most (80 percent) vehicles entering Tokyo came from neighbouring prefectures that were not subject to its authority. This required working with other cities and the national government to make sure the policy would not improve air quality and mitigate climate change in some parts of Japan while worsening the same problems elsewhere. In Indonesia, a lack of coordination and incentives between the local and national governments frustrated attempts to control GHG emissions as well as local pollution on slaughterhouse and waste management projects.

Table 2.1. Governance as a challenge

CASE	Governance Dimensions		
	Horizontal	Vertical	Non-state
Energy conservation, China			√
Compact city, Japan		√	√
Multi-modal transport sharing, Japan		√	√
Diesel emission control, Japan	√		
EcoMobility World Festival, ROK			√
Waste reduction, Indonesia	√		
Slaughterhouse waste management, Indonesia	√		
Increased biomass utilisation, Indonesia		√	√
Utilisation of improved cookstoves, Bangladesh			√
Conserving forest resources, Japan			√

While the enabling factors were not discussed as systematically across the case studies, some of the same findings as the section on challenges can be seen from looking at these factors. Here again, the most consistently cited sets of enabling factors were greater engagement with non-state actors. Three of these cases involved working with women on climate change projects. In each of these cases, efforts to bring women into the production, marketing, and sales of cookstoves and biodigesters could have helped to reduce GHGs and air pollution, while transmitting skills and promoting social equity. Engagement with local communities also helped to ensure that a series of energy initiatives were well aligned with needs of residents in Japan and Korea. In the Japanese case, this was achieved at a relatively small scale for a town that relied on decentralised energy. In Korea, an initiative known as One Less Nuclear Plant had more sizable impacts as it entailed reaching out to residents across Seoul to encourage support for energy saving technologies and behavioural changes that also mitigated climate change.

Table 2.2. Governance as an enabler

CASE	Governance Dimensions		
	Horizontal	Vertical	Non-state
Energy self-supporting communities, Japan			√
Compact city, Japan			√
Empowering women in biogas supply chain, Vietnam	√		√
Women in advanced cookstove supply chain, Cambodia	√	√	√
Disabled women in improved cookstove supply chain, Laos	√		√
Energy reduction through participatory governance, ROK			√

3.2 Overall Assessment

This chapter examines several cases to determine whether and to what extent governance challenges and enablers were needed for actions with co-benefits. Through comparing 28 case studies across various sectors in Asia, a few general observations emerge.

First, many of the most significant challenges involve greater engagement with multiple stakeholders. In some cases, the level of engagement is relatively limited in scope—where a company or even individuals could have helped to make a specific technology more useful. Many of the proposed responses to these user-level constraints are the easiest to implement because more engagement could lead to modest change in behaviour or a technology that would be good for the users, local environment, and global climate. At the same time, there are other instances where there is a need for greater levels of participation from not only affected residents but businesses and civil society. Creating institutional channels that support this engagement while simultaneously strengthening the capacities of government agencies could be a topic for future research on co-benefits.

Second, for several of the cases, it was important to enable participation with a more diverse mix of actors and interests. At one end of the spectrum were cases that involved working closely with women to provide them with the skills and knowledge need to mitigate climate change while achieving other socioeconomic benefits. In other instances, there were efforts to bring sizable populations of entire cities into solutions that delivered multiple benefits. Arguably the most successful case in this regard was Seoul, Korea's One Less Nuclear Power Plant. Importantly, this case worked with multiple not just single groups of stakeholders, including businesses and civil society. This also necessitated other intangibles such as having sufficient support from the political leadership.

Third, for some of the cases that involved infrastructure, it also makes sense for governments to become more adept at reaching out to commercial interests. Several of the solutions either involved or would have benefitted from the formation of PPP. In other cases, additional financial support from higher-level governments in form of subsidies and low-interest loans that support compliance with regulations helped to overcome challenges. This suggests that there are cases where more engagement beyond government and coordination within government would be helpful. In the previously mentioned cases, there was a need for engaging with multiple different kinds of stakeholders—though this was the exception.

Fourth, as demonstrated in the appendix that provides a more complete listing of all the cases, governance was not the only factor that prevented/mattered for the success of the cases. There was frequently a need for finance, technology, or capacity building—referred to elsewhere as means of implementation (MOI)—that played a contributing role. However, as also noted in this chapter, often engagement with actors beyond government could also help to fill some of the gaps related to MOI. In other words, the MOI interacted with some of the highlighted dimensions of governance.

4. Conclusion

This chapter began with an overview of the importance of co-benefits for mitigating climate change and pursuing other development needs. It noted that much of the co-benefits literature to date has concentrated on quantifying possible benefits as opposed to analysing the governance arrangements needed to align interests in support of actions based on that analysis. In many ways, the limited attention to governance parallels a similar gap in studies on linkages in the SDGs. The chapter aimed to fill this gap by assessing the governance challenges and enablers to the actions with co-benefits in five sectors in several countries in Asia.

The chapter found that the most frequently recurring challenges involved insufficient engagement with affected communities and technology users. At the same time, these challenges could be overcome with dedicated efforts to reach out to potential beneficiaries of co-benefits. A related finding is that some of the financial difficulties could also be overcome with greater engagement with the private sector in the form of PPP. Institutional coordination issues were less common in these mostly project-level cases. This suggests a possible correlation between the challenges and scale that is also relevant to Chapters 3 and 4. Those chapters underline that intergovernmental coordination becomes more important as efforts are made to scale up smaller integrated solutions.

An additional point involves the role of co-benefits as an integrated approach in helping to achieve the SDGs. A co-benefits approach offers useful experience that could inform other kinds of integrated approaches. These include the possible synergies between concretely measuring and monitoring multiple outcomes as well as promoting the kinds of participation needed to achieve the results of quantitative analysis. It may not be possible to achieve integrated outcomes without an inclusive decision-making process. Although the two are related, they are not the same. A key difference is that decision-making processes will need to be made more inclusive but there may be limits on how far these processes can be expanded to accommodate a wide range of interests. Research on the relationship between levels of institutional capacity and the effective inclusion of diverse interests could be useful for further work on the SDGs.

A related area for future research involves placing greater emphasis on the interrelationship between environmental and social goals. Too frequently, social-environmental interactions are not examined with the same rigour as those between different environmental issues, or those between environmental and economic issues. The concept of social co-benefits and greater efforts to include assessments of jobs created, equity effects, and gender impacts arguably deserve more attention. Similarly, improved methods for accounting for different approaches to public participation and stakeholder engagement are likely to be useful for both researchers and policymakers to consider. Decision-making tools and analytical frameworks that can help better understand how the achievement of multiple benefits rests on improved participation and engagement could also prove illuminating.

Annex 2.1. Overview of case studies

Location/ time	Policy/project goals	Co-benefits achieved	Co-benefits quantified?	Policy actions	Additional Challenges
Toyama, Japan, 2002 onwards	Compact city	Reduced GHGs, reduced dependence on automobiles, economic activities in the city centre, active elderly population	Yes, CO_2	- Revitalizing public transport: light rail transit - Encouraging relocation of residents and business to zones along public transport corridors - Re-energizing the city centre	**Economic:** insufficient financing of construction and operations
Kashiwa, Japan, 2009-2016	Multi-modal transport sharing	Reduced congestion, reduced traffic accidents, reduced air pollution, reduced GHGs	No	- Multi-modal sharing spots (bicycles, electric power-assisted bicycles, electric motorcycles, electric cars, gasoline cars) - Intelligent transport service spots	**Economic:** securing sustainable finance to maintain operations, cost for securing and maintaining the sharing stations
Tokyo, Japan, 1999 onwards	Diesel emission control	Improved air quality	Yes, PM	- Initiating the debate on vehicle pollution control policies - Call for behavioural change on vehicle use - Ban across Tokyo on the use of diesel vehicles non-compliant with PM emissions standards	**Technological:** low-sulfur diesel fuels were not yet available in Japan **Economic:** expensive installation of diesel particulate filters
Toyota, Japan, 2004 onwards	Intelligent transport systems for transport demand management	Reduced CO_2 emissions	Yes, CO_2	- Provision of information through a comprehensive website and smartphone application - Information boards for park-and-ride and public transport services - Ultra-compact electric vehicle sharing system	**Economic:** securing initial finance

Location/ time	Policy/project goals	Co-benefits achieved	Co-benefits quantified?	Policy actions	Additional Challenges
Thailand, 2007 onwards	Making domestic automobile companies globally competitive	Fuel saving, energy security, reduced CO_2 emissions	Yes, CO_2, HC, CO, NOx	- Eco-car program: corporate tax exemption, import duties exemption or reduction	None
Kawasaki, Japan, 1995 onwards	Waste reduction	Extended life of landfill facilities, accrued experience in environmental policy and technology, creation of the Low CO_2 Kawasaki Brand	Yes, GHG	- Rail transport of regular waste, incineration ash and recyclables - Eco-Town plan to promote recycling - 3Rs: Reduce, Reuse and Recycle	**Economic:** national government subsidy was removed half-way in the Eco-Town project; added financial burden of waste collection due to illegal dumping **Legal:** illegal dumping
Hino, Japan, 2000 onwards	Waste reduction	Additional government revenue to fund cleaning service and low-income household subsidies; lower risks of fire; emergence of local networks; increased environmental public concern	No	- Required use of city's trash bags - Removal of garbage cans - Reduced frequency of waste collection - Volunteers to raise awareness	
Banjarmasin, Indonesia, 1991 onwards	Waste reduction	Conservation of space for landfills; decreased production of methane; prevention of odors; improved quality of surface and groundwater; lower risks of fire; recovered methane used as a power source; improvement of workplace health and atmosphere; community improvements	No	- Promotion of recycling and reuse at households - Mandate for local governments to shut down final disposal sites - National environmental standards on water and wastewater	**Economic:** high installation cost of new devices

Location/ time	Policy/project goals	Co-benefits achieved	Co-benefits quantified?	Policy actions	Additional Challenges
Palembang, Indonesia, 2006 onwards	Slaughterhouse waste management	Prevented wastewater leakage, reduced odors; reduced methane emissions; captured methane used as a power source	No	- National environmental standards on slaughterhouse wastewater	**Economic:** Market for compost is not strong enough for economically composting the waste; high initial costs of installation of methane-capturing devices; facility improvements are too costly for local governments to afford
Indonesia, 1997 onwards	Increased biomass utilization	Reduced GHGs attributable to energy production; strengthened domestic energy security and decreased reliance on fossil fuel imports; reduced organic waste, creation of job opportunities for low-income households and affiliated industries	No	none	None
Bangladesh, 1970s onwards	Increased utilization of improved cookstoves	Less time spent collecting biomass and cooking; reduced smoke in the kitchen; improved public health especially for women and children, fuel saving, time saving	No	- Research and development for efficient energy usage - Disseminating improved cookstoves - Promoting improved cookstoves	**Technical:** Limited durability of stoves
Vietnam	Empowering women in biogas supply chain	Reduced GHG emissions; reduced reliance on fossil fuels and chemical fertilizers; increased income of women changing from assistant to leadership roles; increased self-esteem of women, generation of economic benefits for households	Yes, CO_2eq	- Training of female biogas masons - Provision of loans for domestic biogas installations and relevant business capacity building for women	**Social:** Few role models for women masons, gender stereotypes in construction work **Technical:** Women have limited masonry skills, women masons take longer to master the technical issues

Location/ time	Policy/project goals	Co-benefits achieved	Co-benefits quantified?	Policy actions	Additional Challenges
Cambodia	Empowering women to participate in advance cookstoves supply chain	Reduced GHG emissions; fuel saving; time saving; improved health	Yes, CO_2eq	- Integrating women as sales agents into the sales networks of advanced cookstoves; capacity building activities, agreements with the women's families, facilitating good relationships between women sales agents and local governments, organizing meetings among women sales agents	**Economic:** expensive advance cookstoves compared with typical ones **Technical:** potential hardship for users with even slight delay of maintenance
Lao PDR, 2013 onwards	Empowering disabled women in improved cookstoves supply chain	Lowered GHG emissions, fuel saving, time saving, reduced indoor air pollution and improved health, promotion of understanding of gender equality	No	- Testing of the financial viability of improved cookstoves productions - Achieving certification for an local NGO supporting disabled women as an accredited improved cookstoves production facility - Integrating women as sales agents into the sales networks of advance cookstoves: capacity building activities, agreements with the women's families, facilitating good relationships between women sales agents and local governments, organizing meetings among women sales agents	**Techical:** lack of improved cookstoves production background, first batches of improved cookstoves did not pass inspection for quality of construction
Nepal, 2015 onwards	Rebuilding earthquake-affected brick kilns	Decreased PM emission, reduced coal consumption, improved worker health, bricks'	Yes, PM	- Design manual for new bricks manufactured in environmentally-friendly ways - Engineering support	None

Location/ time	Policy/project goals	Co-benefits achieved	Co-benefits quantified?	Policy actions	Additional Challenges
Indonesia, 1995 onwards	Improving the palm oil production process	Capturing the methane generated and reusing it as an energy source; reduced GHG emissions; reduced air pollution; reduced water pollution; creation of jobs; improved work environment	Yes, N_2O, CO_2, CH_4, SO_2, NOx	- Regulations including environmental limits relating to chemicals	None
Panzhihua, China, 2006-2010	Energy conservation and emission reduction	Reduced air pollution	Yes, CO_2, SO_2	- Implementation program for total emission reduction of major pollutants - Optimization and adjustment of industrial structure and the monitoring system	None
Chongqing, China, 2006-2015	Controlling air pollution and GHG emissions	Improved stability of power supply	Yes	- Waste heat recovery system in the cement industry for power generation used for cement production	**Economic:** Chances of not meeting standard internal return on revenue benchmark
Xiangtan, China, 2006-2010	Energy conservation and emission reduction	Increased percentage of days of good urban air quality	Yes, CO_2, SO_2	- Promoting the application of advanced technologies and energy saving and emission reduction devices - Monitoring system to control pollution and smoke from a wide range of industries	None
Ningguo, China, 1998 onwards	Controlling emissions from cement industry	Power generation	Yes, CO_2, SO_2, NOx, $PM_{2.5}$	- Waste heat recycling system as a result of Sino-Japan technology cooperation	**Technical:** information needed for estimating co-benefits
Anhui province, China, 2010 onwards	Energy conservation, reduction of impact on air pollution and GHG emissions	Prevented need for hazardous material treatment equipment	Yes, CO_2	- Integrating a waste incinerator into existing cement operations as a result of Sino-Japan technology cooperation	**Economic:** unwillingness of local government to provide sufficient economic compensation for waste treatment

Bibliography

ACP. 2014. "Asian Co-Benefits Partnership White Paper 2014 Bringing Development and Climate Together in Asia." Hayama, Japan. http://www.cobenefit.org/publications/images/ACPwhitepaper_FY2013.pdf.

———. 2016. "Asian Co-Benefits White Paper 2016 Putting Co-Benefits into Practice: Case Studies from Asia." Hayama.

———. 2018. "Asian Co-Benefits Partnership White Paper 2018." Hayama.

Atteridge, A., M.K. Shrivastava, N. Pahuja, and H. Upadhyay. 2012. "Climate Policy in India: What Shapes International, National and State Policy?" *AMBIO* 41 (S1): 68–77.

Aunan, K., J. Fang, H. Vennemo, K. Oye, and H. M. Seip. 2004. "Co-Benefits of Climate Policy—lessons Learned from a Study in Shanxi, China." *Energy Policy* 32 (4): 567–81.

Ayres, R, and J. Walter. 1991. "The Greenhouse Effect: Damages, Costs and Abatement." *Environmental and Resource Economics* 1 (3): 237–70.

Bond, T.C., S.J. Doherty, D.W. Fahey, P.M. Forster, T. Berntsen, B.J. DeAngelo, M.G. Flanner, et al. 2013. "Bounding the Role of Black Carbon in the Climate System: A Scientific Assessment." *Journal of Geophysical Research: Atmospheres* 118 (11): 5380–5552.

Casado-Asensio, J., and R. Steurer. 2014. "Integrated Strategies on Sustainable Development, Climate Change Mitigation and Adaptation in Western Europe: Communication Rather than Coordination." *Journal of Public Policy,* 34 (3): 437–473.

Chiu, Bingyu and Eric Zusman. 2018. "Taking a Co-benefits approach in Asia: A Comparative Analysis of Barriers with Recommendations." In *Devising a Clean Energy Strategy for Asian Cities* edited by Hooman Farzaneh. Tokyo: Springer.

IPCC. 2001. *Third Assessment Report: Climate Change, 2001: Mitigation.* Edited by B. Metz, O. Davidson, R. Swart, and Pan. J. Cambridge: Cambridge University Press.

———. 2014. *Climate Change 2014"Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Edited by O. et al. Deenhofer. Cambridge: Cambridge University Press.

Kostka, G., and W. Hobbs. 2012. "Local Energy Efficiency Policy Implementation in China: Bridging the Gap between National Priorities and Local Interests." *China Quaterly* 211: 765–85.

Krupnick, Alan, Dallas Burtraw, and Anil Markandya. 2000. "The Ancillary Benefits and Costs of Climate Change Mitigation: A Conceptual Framework." Paper Presented at the IPCC Gas, Expert Workshop on Assessing the Ancillary Benefits and Costs of Greenhouse Mitigation Policies. Washington DC.

Markandya, Anil, and Dirk T G Rübbelke. 2004. "Ancillary Benefits of Climate Policy." *Journal of Economics and Statistics* 224 (4): 488–503.

Mayrhofer, Jan P., and Joyeeta Gupta. 2016. "The Science and Politics of Co-Benefits in Climate Policy." *Environmental Science and Policy* 57 (January): 22–30. doi:10.1016/j.envsci.2015.11.005.

Morgenstern, R. 1991. "Toward a Comprehensive Approach to Global Climate Change Mitigation." *The American Economic Review* 81 (2): 140–145.

Nemet, G. F., T. Holloway, and P. Meier. 2010. "Implications of Incorporating Air-Quality Co-Benefits into Climate Change Policymaking." *Environmental Research Letters* 5 (1): 014007.

Olsen, Simon Hoiberg, and Eric Zusman. 2013. "Governance and National Sustainable Development Strategies: Implications for the Sustainable Development Goals." Hayama, Japan.

Pearce, David. 2000. "Policy Frameworks for the Ancillary Benefits of Climate Policies." CSERGE Working Paper GEC 2000-11.

Pusztai, C., and Suwa, A 2017. "Decision-Support Tools for Climate Co-Benefits Governance." In *Urbanization and Climate Co-Benefits: Implementation of Win-Win Interventions in Cities*, edited by Christopher Doll and Jose A. Puppim de Oliveira, 278–301. London: Routledge.

Qi, Ye, Huanbo Zhang, and Huimin Li. 2008. "Translating a Global Issue Into Local Priority: China's Local Government Response to Climate Change." *The Journal of Environment & Development* 17 (4): 379–400. doi:10.1177/1070496508326123.

Runhaar, H, P Driessen, and C Uittenbroek. 2014. "Towards a Systematic Framework for the Analysis of Environmental Policy Integration." *Environmental Policy and Governance* 24 (4): 233–246.

Tsang, S., and A. Kolk. 2010. "The Evolution of Chinese Policies and Governance Structures on Environment, Energy and Climate." *Environmental Policy and Governance* 20 (3): 180–96.

UNEP/ WMO. 2011. "Integrated Assessment of Black Carbon and Tropospheric Ozone." http://www.unep.org/dewa/Portals/67/pdf/BlackCarbon_report.pdf.

Ürge-Vorsatz, D., S. Tirado-Herrero, N. Dubash, and F. Lecocq. 2014. "Measuring the Co-Benefits of Climate Change Mitigation." *Annual Review of Environment and Resources, 39, Pp.* 39: 549–82.

Zusman, Eric. 2008. "Recognising and Rewarding Co-Benefits in the Post-2012 Climate Regime : Implications for Developing Asia." In *The Climate Regime Beyond 2012*. Hayama, Japan. http://pub.iges.or.jp/modules/envirolib/upload/1030/attach/split06_chapter5.pdf.