EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) initiated the International Co-Control Benefits Analysis Program (ICAP) in 1998 to support and promote the analysis of public health and environmental benefits of integrated strategies for greenhouse gas mitigation and local environmental improvement in developing countries. This program, managed for EPA by the National Renewable Energy Laboratory (NREL), is assisting Argentina, Brazil, Chile, China, Korea, and Mexico in evaluating the environmental and economic benefits of integrated climate change and local environmental protection strategies. This work has focused initially on the potential health benefits and greenhouse gas reductions that could result from implementation of integrated climate change and air pollution strategies. Initial results from country assessments in Chile, China, and Korea indicate that relatively modest energy sector mitigation measures under consideration in these countries have the potential to significantly reduce greenhouse gas emissions, improve local air quality, and produce considerable public health and economic benefits. The economic value of these air pollution health benefits in Chile and Korea range between $10 and $104 per ton of carbon emissions reduced.

Climate change and air pollution officials in the participating countries have been actively engaged in the design and implementation of work. These officials recognize the value of integrated policy analysis and have expressed strong interest in using the results of country assessments to improve understanding of the ancillary benefits of greenhouse gas mitigation and to develop integrated climate change and local air pollution control strategies. Future work under this program will extend this analysis to other countries such as South Africa, additional pollutants and health and environmental impacts, economic impacts including employment generation and to more in-depth evaluation of integrated climate change and local air pollution control strategies.

Goals

The objectives of the ICAP are to:

- Support and promote analysis and quantification of the environmental, public health, and GHG mitigation benefits of integrated air pollution and greenhouse gas reduction strategies and measures for the energy sector in developing countries,
- Develop, test and refine effective analytical methodologies to guide further collaboration on co-benefits analysis,
- Assist developing country policy makers with the development of integrated strategies for addressing local air pollution and greenhouse gas reduction,
- Build lasting institutional and human capacity for analysis of health, environmental and greenhouse gas mitigation impacts of alternative strategies and development of integrated air pollution and climate change policies.

Methodology

ICAP assists government agencies and research institutions in Argentina, Brazil, China, Chile, Korea, and Mexico in conducting analysis of the local air pollution health benefits and greenhouse gas reductions that could be realized through implementation of integrated environmental strategies. Analytical work focuses on the use of clean energy technologies and includes extensive interaction with domestic and international policy makers. Efforts build

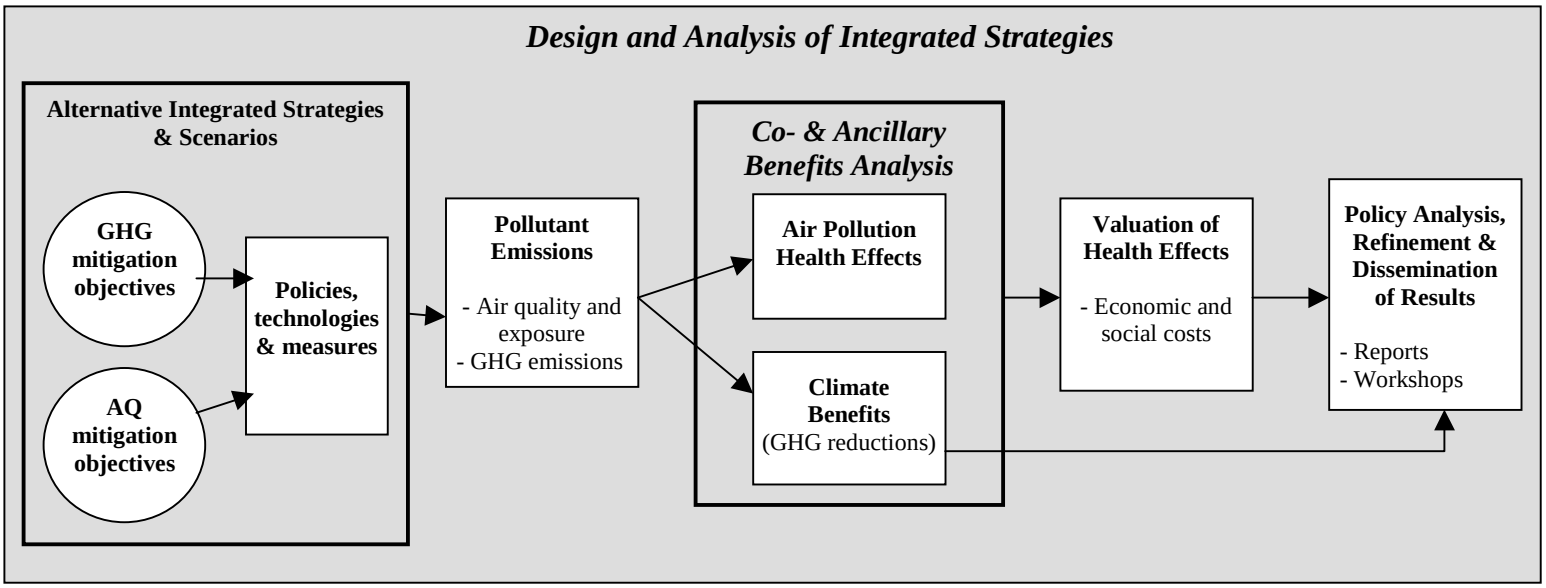
recognition and understanding of the potential for environmental "co-benefits" of integrated air pollution and climate change strategies and are enhancing support for their implementation.

Under ICAP, the U.S. EPA provides technical and financial support to the participating countries to enable them to conduct assessments of air pollution and climate change co-control benefits. Each country establishes a team of researchers, including climate change, air pollution, public health, and economic valuation experts which is guided by environmental policymakers. The National Renewable Energy Laboratory, in partnership with Abt Associates, the World Resources Institute and other international cooperators, provides technical support for these in-country teams. The ICAP program is also forging working relationships with the World Bank, the GEF, OECD and other international organizations to promote broader application and refinement of the integrated environmental assessment methodology.

The ICAP methodology (illustrated in the diagram below) includes the following principal activities:

- Design of a country-specific analysis, including identification of objectives and selection and development of integrated air pollution and greenhouse gas mitigation strategies and scenarios,
- Estimation of air pollutant emissions and human exposure to air pollutants for each scenario,
- Estimation, quantification, and analysis of the potential public health benefits which could result from implementation of integrated air pollution and climate change strategies,
- Quantification of the economic value of these potential health benefits, and
- Analysis of the policy implications of the assessments and further refinement and dissemination of results.

As noted above, the ICAP work to date has focused on the health benefits of integrated climate change and local air pollution control strategies. In the future, this analytical framework may be extended to address water and soil pollution, ecological impacts, non-energy technologies and economic development impacts such as employment generation.



Results

The country teams in Chile and Korea have completed initial climate change and air pollution co-control benefits analysis assessments. China has completed partial results, and Argentina, Brazil and Mexico are at the beginning stages of their analysis. Results from Chile and Korea indicate that energy sector greenhouse gas mitigation measures under consideration in these countries will significantly reduce local air pollution and will result in considerable public health and economic benefits. Table E-1 provides a summary of the main results from these three countries.

Key results from the work by Chile and Korea include the following:

- Modest greenhouse gas reduction measures for the energy sector are estimated to avoid around 300 deaths/yr. and 400,000 cases of respiratory diseases for Chile and 40 to 120 deaths/yr. and 2800 to 8400 cases/yr. of respiratory diseases for Korea in 2020.
- The value of these avoided health effects is estimated for Chile at 240 to 1,892 million US$/yr. and for Korea at 59 to 179 million US$/yr. in 2020.
- These avoided health damages have economic benefits equivalent (using an average of the economic valuation estimates) to $US 104 for Chile and $US 21 per ton of carbon emissions reduced in Korea in 2020.

Table E.1 Summary of Results for 2010 and 2020 for Chile and Korea

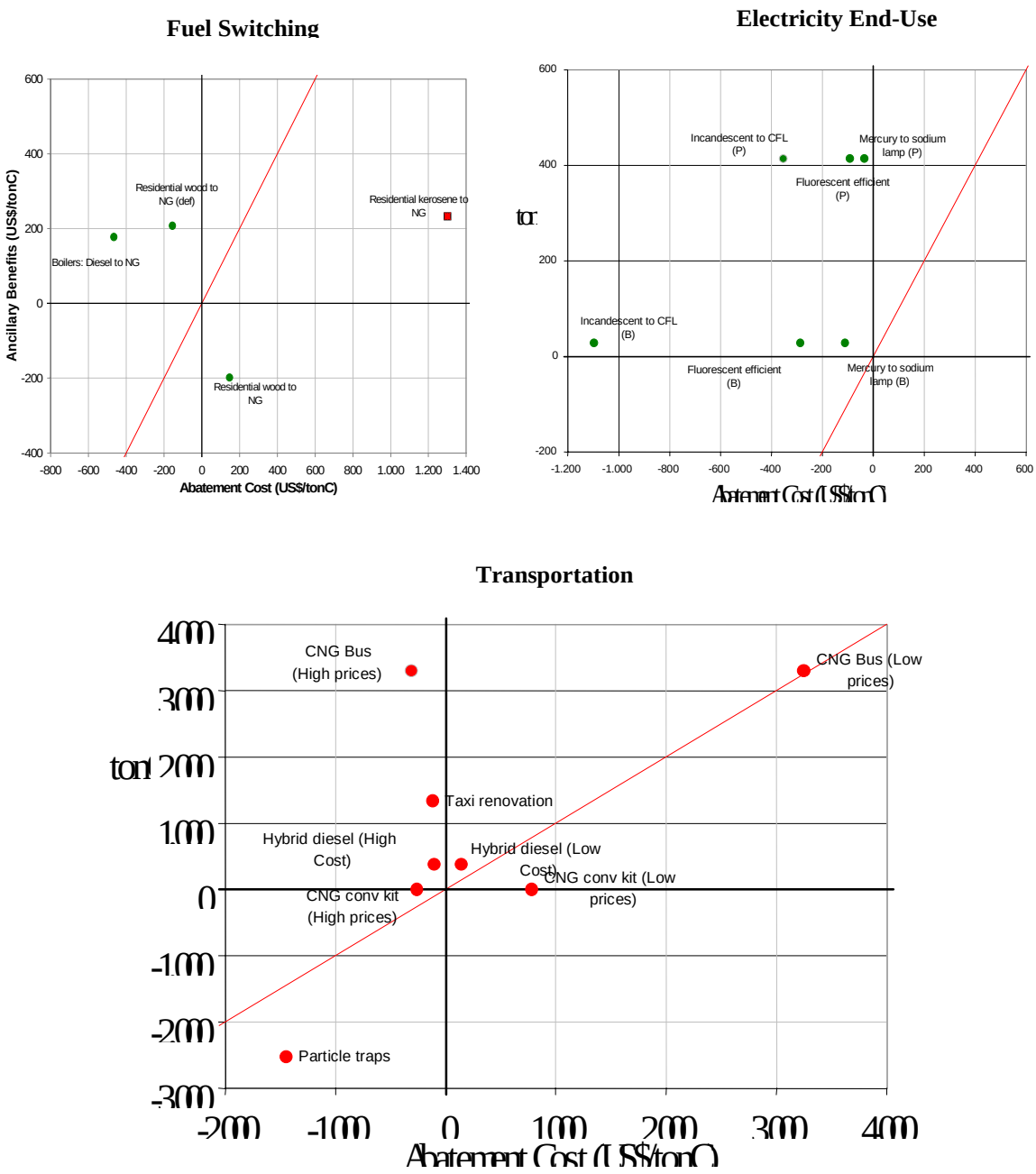
	Chile		**Korea**	
Study Region	Santiago Metro Region: Extended to whole country		Seoul Metro Region	
Energy Measures in Climate Policy Scenario	- Energy efficiency - Fuel switching -Transportation - Incorporation of assumptions from the: Santiago decontamination plan and National strategic plan		- Energy efficiency - CNG buses	
Air Pollutants Evaluated	$PM_{2.5}$		PM_{10}	
	2010	2020	2010	2020
Carbon eq. Reductions in Million tons of Carbon Equivalents	1.4	3.9	2.25-6.75	2.82 –8.46
Annual Avoided Deaths	100	305	33-98	40-120
Annual Avoided Respiratory Diseases	133,000	399,000	2,257-6,772	2,787-8,361
Economic Annual Value of Health Effects	$60-472 Million (1997 $)*	$240-1892 Million (1997 $)*	$48 -145 Million (1999 $)	$59 – 179 Million (1999 $)
Economic Benefits / Ton of Carbon (eq) Reduced	$42-337 (1997 $)	$60-479 (1997 $)	$10-38 Ave. $21 (1999 $)	$10-38 Ave. $21 (1999 $)

* Benefits estimated using only source apportionment air quality model.

These results indicate that the air pollution health benefits of fairly modest greenhouse gas reduction measures for the energy sector for these countries are highly significant. When the economic benefits per ton of carbon emissions reduced are calculated for Chile and Korea the assessment indicate that the benefits range from $10 to $479/ton of carbon with a range in the average values of $21 to $104/ton of carbon. Thus on the basis of the air pollution health benefits for particulates alone, the analysis would indicate that these countries can capture highly significant air pollution and greenhouse gas reduction co-benefits through implementation of these measures.

These co-benefits assessments can be especially useful in evaluating the relative magnitude of ancillary air pollution health benefits and greenhouse gas reductions from integrated alternative energy sector measures. Chile is the only country that so far has completed such an analysis for specific measures. Figure E-2 presents the results of this analysis for Chile. This figure presents results comparing ancillary benefits with abatement costs for specific measures for three categories: fuel switching, electricity end-use, and transportation. Notable measures that have ancillary public health benefit greater than their abatement cost include: all of the electricity end-use measures, conversion of diesel boilers and residential wood use (assuming deforestation) to natural gas, conversion of buses to compressed natural gas, taxi renovation, and the use of diesel electric buses. Furthermore the electricity end-use measures, conversion of diesel boilers to natural gas and some of the CNG bus measures have negative abatement costs in addition to significant ancillary benefits and should be given high priority for immediate implementation.

Figure E-2: Analysis for Specific Measures for Chile



Policy Implications

Climate change and air pollution officials from the participating countries have been actively engaged in all phases of this work. Their participation has ensured that the results will be valuable to these officials in the development of their climate change and air pollution policies and consideration of opportunities to pursue integrated climate change and air pollution policies. The preliminary results for Chile, China, and Korea were discussed and evaluated by climate and

air pollution officials through policy-makers review workshops. Key outcomes of these workshops include:

- Climate change officials in these countries noted that analysis of the ancillary air pollution and public health benefits of greenhouse gas mitigation is of great value to them in improving understanding and awareness of the local development and economic benefits of energy sector greenhouse gas mitigation measures. These climate officials also noted that the preliminary findings indicating highly significant public health, air pollution benefits could be valuable in building support for action to reduce greenhouse gas emissions.
- Both the climate and air pollution officials also indicated a strong interest in using these results and future analyses to help them evaluate and develop harmonized policies at the national and local levels for addressing local air pollution and climate change.
- Officials further noted that this kind of study can show where resources and policies should be directed to capture co-benefits and how to avoid adopting measures that will not capture significant co-benefits.
- The participants in these workshops also pointed out the potential use of the results of these studies to assist with directing international resources to support cost-effective climate change mitigation. These assessment results could help guide the design of multilateral and bilateral donor assistance projects and help target funds for climate change to support development of integrated climate change and air pollution strategies. Participants also noted that such assessments can also be helpful in informing the design of potential Clean Development Mechanism projects.
- The estimates of the ancillary health benefits were viewed as conservative due to several limitations of the current studies analytical approach and methodology that tended to underestimate the total benefits which could be realized. Limitations which could be addressed in future work include: development of more specific "harmonized" air pollution and climate change mitigation strategies, inclusion of other significant pollutants, estimation of a range of health endpoints, and inclusion of other economic benefits such as employment generation.
- Significant interest was expressed for extending the analyses to evaluate the benefits of integrated climate change and air pollution strategies, to include a broader range of energy sector measures and additional air pollutants and health effects, and to improve the economic valuation of these health effects. Some interest was also expressed in evaluating non-energy measures and other environmental and economic impacts beyond air pollution health effects such as employment generation.