The U.S. environmental protection Agency Integrated Environmental Strategies (IES) Program

Le programme « Stratégies Environnementales Intégrées (IES) » de l'Agence pour la protection de l'environnement des États-Unis

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Another approach that has been used in a number of Asian and Latin American countries to assess greenhouse gases, air pollution and other co-benefits is the Integrated Environmental Strategies (IES) program established in 1998 by the U.S. Environmental Protection Agency. IES is designed to work with country officials to provide a framework and the associated models and tools to address co-benefits at a variety of scales – local, metropolitan region or national. IES has been used to quantify environmental (air quality and greenhouse gas), public health, and economic co-benefits of areas and/or projects of interest to the country in which it is being applied. It is also designed to help the country in question build expertise in integrated energy and environmental analysis, and promote local support for implementation of measures and policies with multiple benefits.

Unlike GAINS, IES is not a model, but rather a framework that can be used to analyze co-benefits by organizing the approach and bringing together the necessary models and tools to address the specific issues of concern to the host country. Under the IES approach, in-country research teams, guided by policymakers and assisted by U.S. counterparts, identify key policy objectives and a range of conventional and innovative policy measures. The teams analyze the potential co-benefits of selected mitigation strategies and make recommendations to inform policy decisions.

To date, IES has been applied by government agencies and/or research institutions in Argentina, Brazil, Chile, China, India, Mexico, the Philippines, and South Korea. In these countries, IES has been used at a variety of scales. For example in China, IES has helped examine co-benefits benefits of clean energy and transport strategies in Shanghai and Beijing, in terms of reductions of greenhouse gases and air pollution, and associated public health benefits. A third study, the IES-China National Assessment, is analyzing multiple benefits of clean energy and transportation policies at a national level.

1. Summary of Steps involved in applying the IES framework

1.1. Scope project and build team

- Acquire commitment from government host organization.
- Identify technical team, project coordinator, technical leaders, and IES partners.
- Organize formal scoping meeting.
- Develop project work plan outlining the coordination of all project activities.

1.2. Develop Energy/Emissions scenario

- Determine energy sector categories for inclusion.
- Compile base-year emissions inventory.
- Develop baseline and integrated mitigation energy/emissions scenarios.
- Select energy/emissions model.

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- Perform fuel consumption and emissions sector survey(s).
- Collect fuel-use data.
- Develop/adopt emissions factors.
- Run model to project future emissions for each scenario.
- Summarize results for air quality analysis.

1.3. Calculate Atmospheric Concentrations

- Assess existing ambient air quality.
- Identify targeted emissions.
- Select air quality model.
- Refine emissions data (from energy/emissions model), if necessary.
- Collect local, historical ambient air quality monitoring data.
- Collect local, historical meteorological data.
- Run model to project future ambient concentrations for each scenario.
- Summarize results for health effects analysis.

1.4. Quantify Public Health Effects

- Determine health endpoints and analytical methodologies.
- Develop/identify appropriate C-R functions.
- Collect local public health data.
- Perform local epidemiological studies or adapt results.
- Estimate avoided health effects for each scenario.
- Perform uncertainty analysis.
- Summarize results for economic valuation analysis.

1.5. Perform Economic Valuation of Health Benefits

- Collect economic valuation data.
- Determine appropriate valuation methods.
- Apply selected valuation approaches.
- Perform benefits transfer, if necessary.
- Perform comprehensive valuation analysis.
- Summarize results through a range of valuation scenarios.

1.6. Rank measures and share results

- Quantify cumulative costs and benefits for each recommendation.
- Develop benefit-cost ratios for each recommendation.
- Prioritize recommended measures based on benefit-cost ratios or other criteria.
- Share project results.
- Identify additional steps to advance implementation.

1.7. Implement measures

- Incorporate results into policymaking processes.
- Build support for implementation.
- Institutionalize IES process and results.
- Develop funding proposals.

Analyses of co-benefits under IES have primarily focused on estimating the human health benefits resulting from air quality improvements associated with increased use of clean energy technologies and measures. IES analysis can be extended to quantify additional benefits, such as economic development impacts (e.g., job creation, trade balance) and reduced traffic congestion.

2. Examples of IES application in Brazil, India and Mexico

IES has been applied in a variety of different ways and at different scales – local, regional and national in various countries. Following are examples of different applications of IES in three different countries.

In Brazil, for example, a team applied the IES approach in the São Paulo metropolitan region, with particular focus on the transport sector. IES was used to evaluate a series of alternative scenarios, estimating the emission reductions and health benefits associated with each. The final report for Brazil, released in August 2004, indicates that the National Program for Motor Vehicle Pollution Control in São Paulo (PROCONVE) will prevent an estimated 10,000 hospital admissions and more than 8,800 deaths attributed to air pollution cumulatively between 2000 and 2020. This number, valued at U.S. $4.8 billion to U.S. $6.7 billion ($1999), is in addition to the benefits already felt since PROCONVE's inception in the 1990s. Other scenarios that the Brazil team assessed had significant additional benefits, but the team must further investigate the costs of each measure. Cumulative CO_2 emission reductions between 2010 and 2020 are expected to be between 2.6 million to 57.2 million metric tons. The study also found that the ongoing Integrated Transport Plan of the State of São Paulo considered as an alternative scenario, will avoid an additional 2,277 hospital admissions and 1,800 deaths from air pollution-related effects from 2000 to 2020, valued at U.S. $1.7 billion to U.S. $2.3 billion ($1999). *(Integrated Environmental Strategies in São Paulo, Brazil,* 2004)

In India, IES has been used to analyze various scenarios for the transportation and industrial sectors in Hyderabad. The IES-India ambient air quality analysis focused on measures in the transportation and industrial sectors. RITES, the transportation analysis partner, developed four scenarios for analysis:

- A more effective public bus transit service (bus lanes, better bus stops, and better trunk lines).
- More effective traffic management and strategies to improve traffic flows (flyovers, traffic signals, and foot paths).

- Training for operators of two-stroke vehicles on the proper maintenance and operation of their vehicles.
- A multi-modal transport system.

After developing an emissions inventory, the IES-India team estimated the effects of the alternative transportation scenarios on air quality and associated GHG emissions. In addition to transportation sector scenarios, the team developed scenarios to consider how Hyderabad's growing industrial sector could most effectively limit the growth of its air pollutant and GHG emissions, including:

- Use of additives in boiler fuel oil.
- Use of particulate controls on all uncontrolled solid waste fired boilers.
- Use of natural gas in coal fired boilers.
- Use of renewable sources of energy (biomass gasification) in fuel oil boilers.

The team focused its analysis on PM_{10} as the air pollutant of most concern and CO_2 as the major greenhouse gas. As part of this work, the team developed estimates of exposure to PM_{10} using existing data on total suspended particulates, established conversion factors used in other cities, and monitored data for PM_{10} in Hyderabad. It then conducted ambient air quality analysis using the Industrial Source Complex (ISC-3) model.

Once the team estimated pollutant emissions and human exposure to various concentrations, the team analyzed the health effects of measures to address ambient air quality, adapting concentration-response relationships from comparable developing country cities for use in Hyderabad. IES researchers also conducted an economic valuation of the health effects of air pollution using methodologies such as the Cost of Illness (COI) approach and willingness to pay assessments based on local information, where available, and on studies conducted internationally and adapted as appropriate, using a benefits transfer approach.

In 2004 the IES-India team presented its final report on its key findings, including cost-benefit analysis and recommendations, to government officials at the central, state, and municipal level and then revised the report per their feedback and suggestions. Highlights from the report include the following:

- The maximum PM_{10} concentrations are found in the Municipal Corporation of Hyderabad (MCH) area, due to high vehicular population. The projected average concentrations for the "business as usual"-2021 scenario are very high due to the projected growth.
- The effective bus transit mitigation scenario shows greatest reductions in PM_{10} and GHG emissions. For this scenario, ambient pollutant concentrations are reduced to one-third of "business as usual" levels.

For the "business as usual"-2021 scenario, Patancheru and Rajendranagar are the most polluted areas (after MCH), due to their vicinity to the air polluting industries.

Industrial mitigation scenarios do not show significant PM_{10}/GHG reduction in MCH area, but they are significant in reduction of ground level concentrations in industrial areas. *(Integrated Environmental Strategies (IES) for the City of Hyderabad, India Final Report,* 2005).

The IES-India project activities also include outreach to key constituencies to build support for the implementation of the most promising alternative measures. The local India team developed outreach activities to engage public sector officials, local businesses and trade association and Hyderabad civil society (civic groups, neighborhood associations, etc.) in a discussion on the benefits of an integrated strategies approach and to develop an action plan for implementing alternative scenarios to better meet Hyderabad's public health, economic, and environmental objectives.

In Mexico, IES has been applied in four phases – from local to national in scale. The first phase was designed to build capacity in Mexico for addressing the problems of urban air pollution and associated GHG emissions in an integrated manner. During Phase 2 the team focused on the Mexico City Metropolitan Area and considered effects of the measures analyzed on primary and secondary particulate matter (for both $PM_{2.5}$ and PM_{10}) and ozone while examining impacts on emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), using 2010 and 2020 as the time horizons. The final Phase 2 final report describes how the five measures considered in this study could reduce annualized exposure to particulate air pollution by 1% and to maximum daily ozone by 3%, and also reduce greenhouse gas emissions by 2% (more than 300,000 tons C equivalent per year) for both the time periods. The IES team estimated that for both time horizons, over 4400 quality-adjusted life years per year could be saved, with monetized public health benefits on the order of $200 million US per year. In contrast, total costs are under $70 million US per year. The mean cost per quality-adjusted life year is estimated to be under $40,000 US for the five measures. Of the measures considered, transportation measures are most promising for simultaneous reductions of both local and global pollution in Mexico City. *(Co-control of Urban Air Pollutants and Greenhouse Gases in Mexico City,* 2003)

Phase 3 of the application of IES in Mexico focused on quantifying the costs and benefits of a new bus rapid transit system over the period 2005-2015. The study found that between 2005 and 2015, 280 thousand tons of CO_2-equivalent emissions will be eliminated due to the new Metrobús corridor on Insurgentes Avenue. Avoided health outcomes from reductions in $PM_{2.5}$ concentrations are 6100 work loss days, 600 restricted activity days, 12 new cases of chronic bronchitis, and 3 deaths annually, with an estimated annual value of $3 million US. The Insurgentes Avenue Metrobús corridor saves over 2 million hours of travel time each year, which is valued at $1.3 million US. Between 2006 and 2015 over $3 million US will be saved in operating costs annually. Accounting for health benefits, travel time benefits, and costs of the Metrobús between 2005 and 2015 and applying a discount rate of 7% yields a net present value of $12.3 million US. *(The Benefits and Costs of a Bus Rapid Transit System in Mexico City,* 2008)

Phase 4 of IES-Mexico is using national-level emission inventories for local (CO, NO_x, SO_2, VOCs, and $PM_{2.5}$) and GHG (CO_2, N_2O, and CH_4) emissions to conduct a national-level co-benefits analysis. A selection of measures with potential for substantial reductions in local and GHG emissions will be investigated for their impact at a national scale. Modeling tools will be used to estimate local and global emission reductions from the investigated measures. Using a gridded air quality model with Mexico-specific parameters, the impact of those reductions on ambient air quality will be quantified and used to determine health and monetary benefits of the measures.

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