PROJECTING INDUSTRIAL POLLUTION
IN THE GREATER MEKONG SUBREGION

▲ The smoke stacks of an oil refinery emit pollutants into the atmosphere.

Rapid economic growth in the Greater Mekong Subregion (GMS) has lifted millions out of poverty, and helped the six member countries make progress on their Sustainable Development Goals. However, the push for industrial development has resulted in significantly increased and diversified pollution and related risks. The subregion's greenhouse gas (GHG) emissions per capita have more than doubled since 2001, and toxic discharges to air and water are increasing. The World Health Organization estimates that more than 12 million people die annually from environmental health risks largely caused by air, land, and water pollution. This is particularly concerning because pollution disproportionally affects developing countries, yet it remains one of the most under-recognized global problems.

Better regulations and standards are needed to tackle rising industrial pollution in the GMS.

To do this, government agencies will need to capture detailed and timely data for both monitoring current pollution and projecting future trends.

This brief overviews the diverse pollutants and their sources that are harming the natural environment and people's well-being in the GMS. It looks at how the World Bank's Industrial Pollution Projection System (IPPS) has been used in the subregion to help the countries identify current and future pollution risks. This includes Core Environment Program (CEP) support to Cambodia, the Lao People's Democratic Republic (Lao PDR), and Myanmar for applying the IPPS as a first step toward managing pollution from their rapidly growing manufacturing sectors. The brief provides recommendations on how the IPPS should be used to complement monitoring systems to enable a sharper view of emerging pollution risks.

KEY MESSAGES

1. Most industrial pollution in Cambodia, the Lao PDR, and Myanmar is generated by a fraction of industrial activities. Top polluters are typically a small number of large enterprises concentrated in a few geographic areas.

2. Substantial gains in reducing pollution could be made by targeting interventions on a relatively small number of enterprises in these locations.

3. The IPPS has been widely used in the GMS to overcome the lack of data on manufacturing pollution, and can be used in several ways to improve the management of industrial pollution (e.g., informing national environmental strategies and plans).

4. GMS countries should continue using the IPPS even when national pollution monitoring systems exist, as it provides unique insights into likely future pollution trends and mitigation options that on-the-ground monitoring cannot provide.

CATEGORIZING POLLUTION

Pollution is categorized into three major groups: air, water, and soil pollution. Various sectors contribute differently to these pollution types.

Manufacturing has the widest spectrum of pollutants, many of which are extremely harmful to people and the environment. In relative terms, some of the largest polluters come from the chemical, pesticide, oil refining, petrochemical, metal smelting, iron and steel, food processing, textile, leather tanning, paint, plastics, pharmaceutical, and paper and pulp industries. The pollution risk also depends on the state and structure of a country's manufacturing sector. Some of these high-risk activities might play only a minor role in some countries, while other relatively lesser, polluting manufacturing activities are problematic due to their large share of the overall manufacturing sector.

▲ Pipes discharging dirty water into a river.

Energy from fossil fuels emits harmful compounds such as sulphur dioxide and nitrous oxide, as well as climate-changing GHGs. Air pollutants such as these contribute to acid rain, ground-level ozone, particulate matter pollution, haze, and eutrophication. Although significantly lower than pollution from fossil fuels, some renewable energy sources also generate air pollution, for example, from the building and operation of hydropower plants.

▲ A coal-fired power plant next to rice fields in Southeast Asia.

Agriculture is a major contributor to water and soil pollution. Fertilizers, pesticides, and sediment are among the main sources of agricultural pollutants that degrade and contaminate soil, groundwater aquifers, and surface water—and can directly impact the food chain. Agriculture is also a major GHG emitter through land use change such as deforestation and the decomposition and combustion of organic residue such as crop waste and manure.

▲ Farm workers spraying a rice field in the early morning in Southeast Asia.
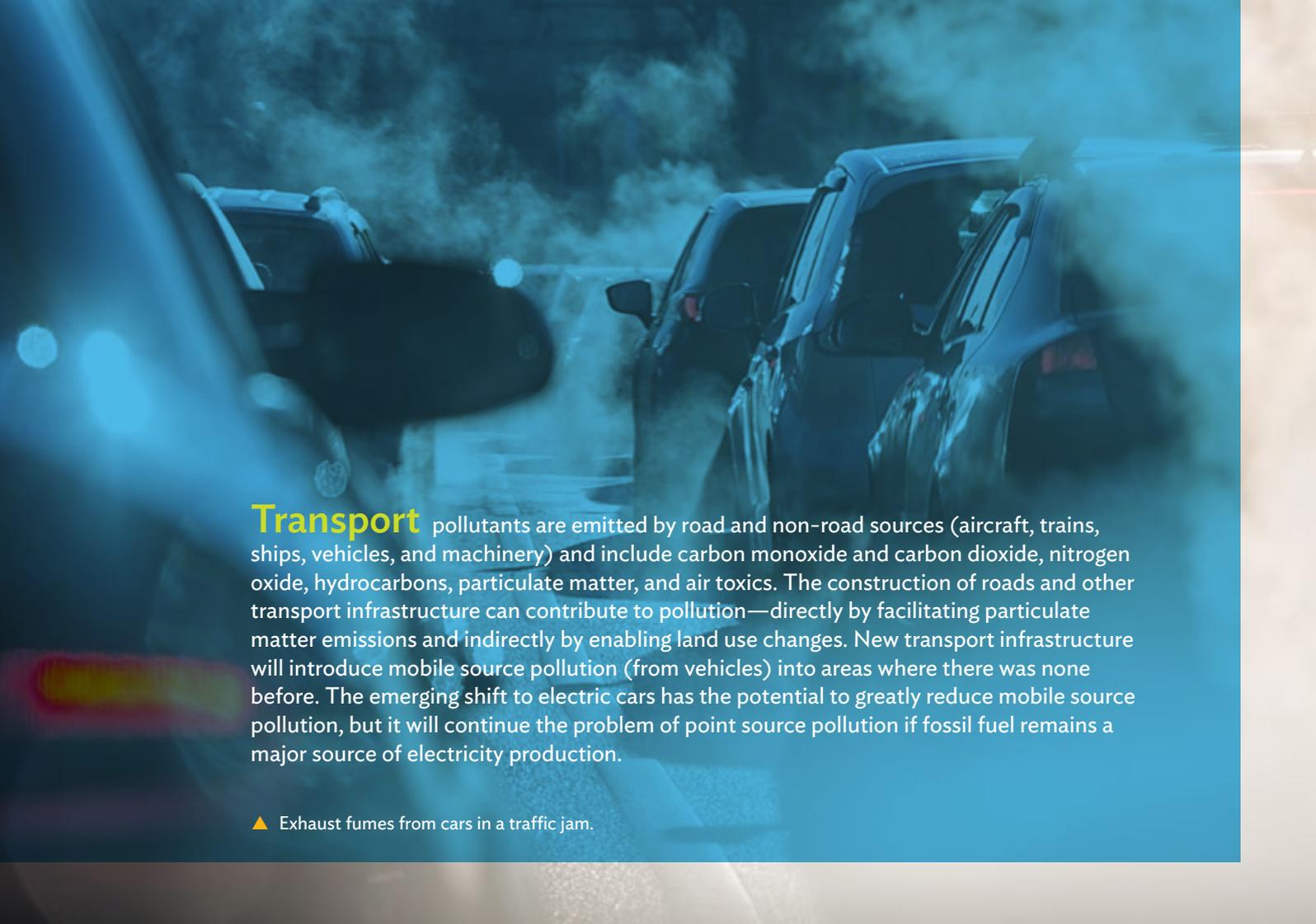
Transport pollutants are emitted by road and non-road sources (aircraft, trains, ships, vehicles, and machinery) and include carbon monoxide and carbon dioxide, nitrogen oxide, hydrocarbons, particulate matter, and air toxics. The construction of roads and other transport infrastructure can contribute to pollution—directly by facilitating particulate matter emissions and indirectly by enabling land use changes. New transport infrastructure will introduce mobile source pollution (from vehicles) into areas where there was none before. The emerging shift to electric cars has the potential to greatly reduce mobile source pollution, but it will continue the problem of point source pollution if fossil fuel remains a major source of electricity production.

▲ Exhaust fumes from cars in a traffic jam.

OVERCOMING DATA CONSTRAINTS: THE INDUSTRIAL POLLUTION PROJECTION SYSTEM

Having good data is essential for the GMS countries to be able to design and enforce effective national pollution control regulations and standards. Unfortunately, environmental regulators in the subregion are often working with insufficient data because of staff, budget, and technology constraints. Monitoring of ambient pollution, if done at all, is often too broad-based and it is difficult to trace pollutants back to a distinct source, meaning remedial actions are hard to identify and target. Measuring emissions from specific sources—whether actual factories or larger areas such as industrial complexes—is a much more direct approach for enabling effective pollution control responses. However, it can be prohibitively costly and resource-intensive for countries, particularly the less-developed ones, to monitor source emissions even for a representative selection of sites.

The lack of emissions data is a significant obstacle to the design and enforcement of effective national pollution control regulations and standards. To deal with this problem, the IPPS has been used in the GMS countries, including with CEP support. The IPPS was designed to help developing countries gain insights into the sources of their industrial pollution, particularly in factories. The IPPS builds on industry survey information (also known as an "enterprise database") that many of these countries have, containing each enterprise's type and quantity of manufactured products, number of employees, location, etc. Using this information, the IPPS applies coefficients for 16 key air, water, and land pollutants to estimate emissions. In effect, the IPPS provides "appropriate estimates" in the absence of more direct (emissions monitoring) data on industrial pollution at the enterprise level. This provides, as the World Bank says, "a profile of the associated pollutant output for countries, regions, urban areas, or proposed projects."[1]

The IPPS is currently the only ready-to-use method that includes a comparatively rapid, cheap, and disaggregated screening of emissions from the manufacturing sector for countries lacking comprehensive pollution or emission databases.

[1] H. Hettige et al. 1994. The Industrial Pollution Projection System (IPPS) Policy. *Policy Research Working Paper Series.* No. 1431. Washington, DC: The World Bank.

▲ A water treatment facility in Southeast Asia.

THE INDUSTRIAL POLLUTION PROJECTION SYSTEM IN THE GREATER MEKONG SUBREGION

In Thailand, the IPPS was used in 2001 to estimate water pollution from industrial estates. In 2006, the World Bank, together with Viet Nam's Ministry of Natural Resources and Environment and Ministry of Industry and Trade, conducted an environmental analysis of pollution from the country's manufacturing sector using the system. Since 2014, the CEP has responded to requests from the governments of Cambodia, the Lao PDR, and Myanmar to help build much-needed capacity to evaluate their industrial pollution risks and to support strategic responses. The CEP applied the IPPS in the Lao PDR in 2014 and 2015, and in Cambodia in 2016. In Myanmar, the CEP reviewed the country's manufacturing sector enterprise database in 2017 in preparation for a full IPPS exercise at a later date.[2]

Despite differences in sizes and compositions of the manufacturing sectors in these three GMS countries, the CEP work revealed common trends:

1. Most pollution is generated by a fraction of industrial activities (e.g., the 6 top polluters of 48 types of manufacturing enterprises in Cambodia).

2. The bulk of pollution loads from top polluters come from only a few enterprises, but these tend to be large. For example, 10 cement lime and plaster firms account for more than 30% of industrial air pollution emissions in the Lao PDR.

3. These few enterprises are often concentrated in a small number of locations, such as urban fringes, economic and industrial zones, and major transport and trade areas (e.g., near ports, airports, and national and regional roads).

These commonalities suggest that large overall reductions in industrial pollution discharges could be achieved by focusing attention and resources on certain sectors and on a limited number of manufacturing facilities in a few locations. Figures 1, 2, and 3 as well as the map highlight this point.

IPPS results have been used—and can be used—to improve the management of industrial pollution in the GMS in the following ways:
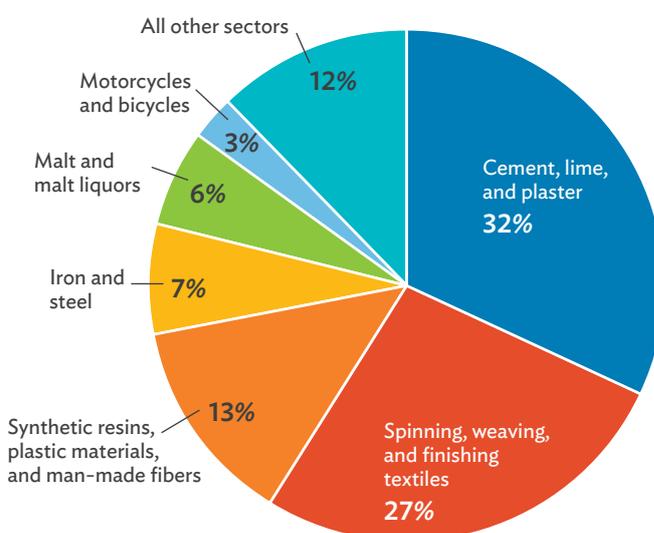
1. Review resource allocations for industrial pollution controls at the national and provincial levels and shift pollution management resources to better align with areas and sectors where industrial emissions are concentrated.

2. Support the design and implementation of industrial pollution audits for enterprises that are big polluters. These audits should not only identify the quantity of pollution emissions and discharges, but also the production technologies, pollution controls, and abatement processes of plants. And they can then be used to show where pollution can be cut cost-efficiently, as well as where opportunities exist to reduce overall production costs, thereby increasing profits and competitiveness.

▲ Dump trucks and other vehicles at a large opencast gold mine in Southeast Asia.

3. Inform environmental strategies and plans, as occurred recently with the Lao PDR's Pollution Control Strategy and Cambodia's National Environmental Strategy and Action Plan.

4. Help influence the development of environmental guidelines, strategic environmental assessments, and environmental and social safeguards.

5. Provide a basis for the development of environment taxes, penalties (polluter pays), and incentives.

6. Use the IPPS results to enable stakeholders to advocate for stronger and more empowered pollution control authorities.
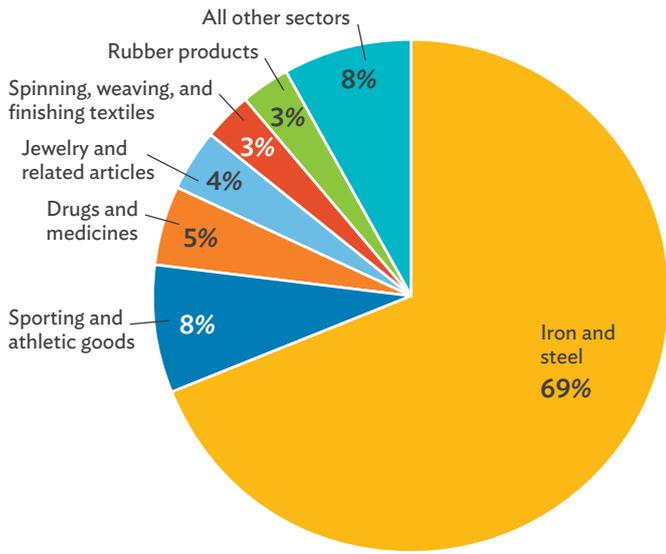
FIGURE 1: CAMBODIA—SHARE OF AIR POLLUTION EMISSIONS BY SECTOR

- All other sectors 12%
- Motorcycles and bicycles 3%
- Malt and malt liquors 6%
- Iron and steel 7%
- Synthetic resins, plastic materials, and man-made fibers 13%
- Cement, lime, and plaster 32%
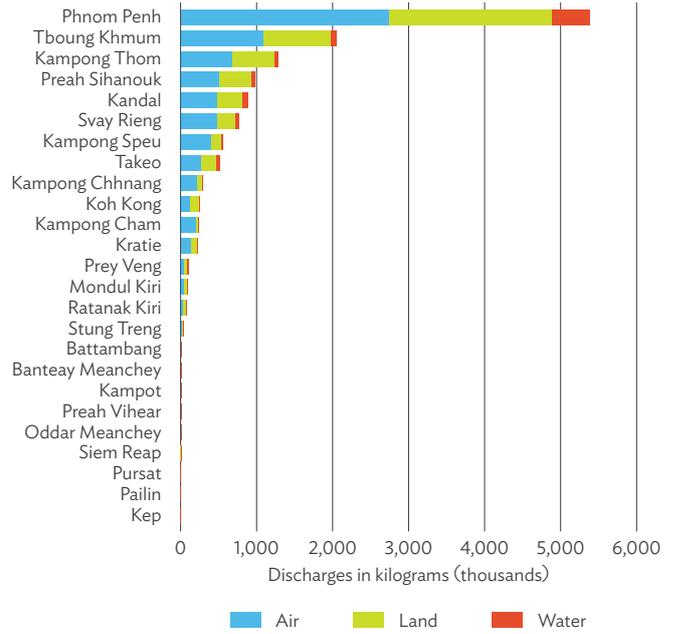- Spinning, weaving, and finishing textiles 27%

Source: Author.

2 For more information, see: Greater Mekong Subregion, Core Environment Program. Capacity Support for Pollution Modeling (2013–2016). http://www.gms-eoc.org/resources/capacity-support-for-pollution-modelling-in-lao-pdr-2013-2014-.

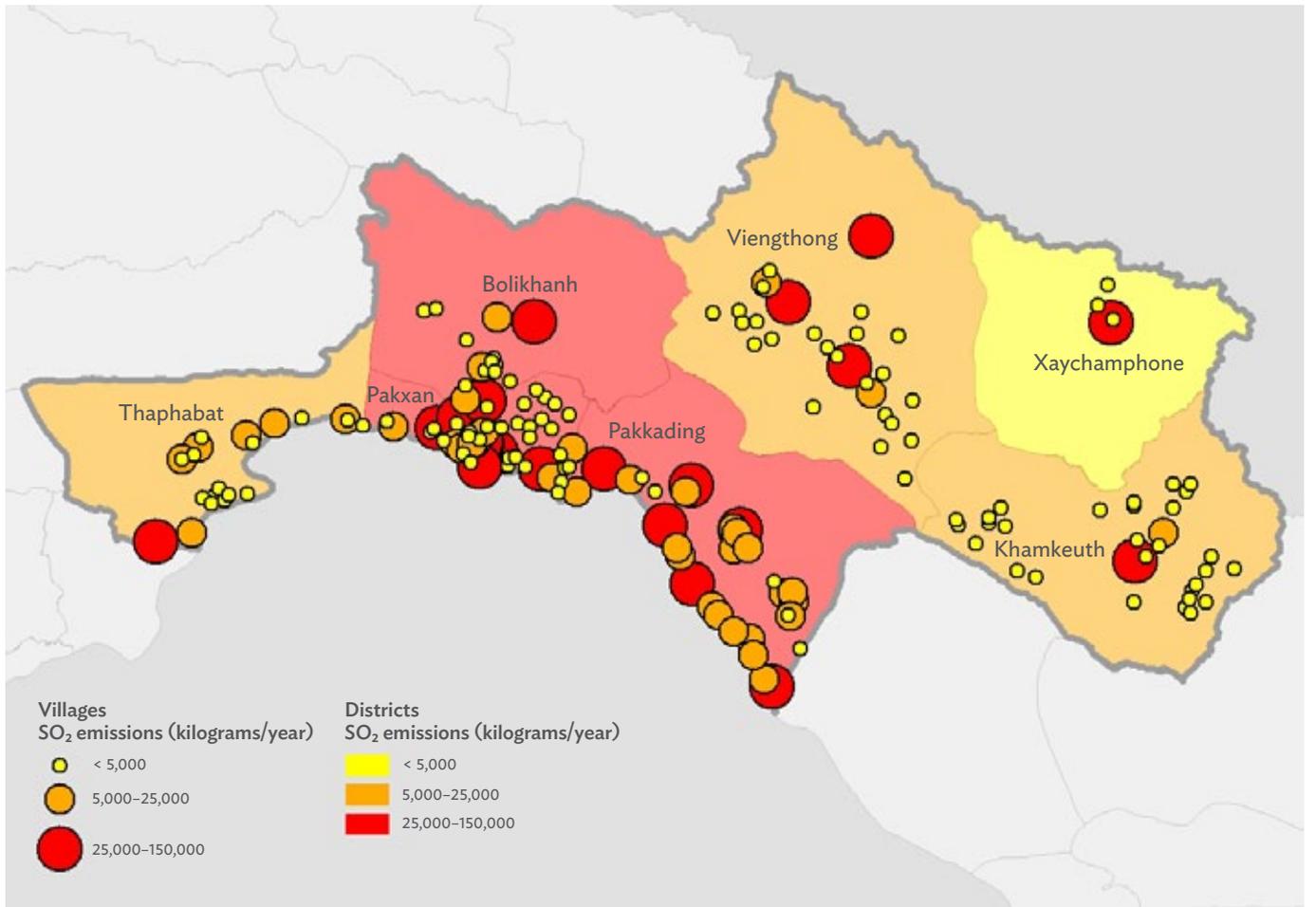## FIGURE 2: CAMBODIA—SHARE OF WATER POLLUTION EMISSIONS BY SECTOR

All other sectors 8%

Rubber products 3%

Spinning, weaving, and finishing textiles 3%

Jewelry and related articles 4%

Drugs and medicines 5%

Sporting and athletic goods 8%

Iron and steel 69%

Source: Author.

FIGURE 3: CAMBODIA—PROVINCIAL SHARE OF TOXIC POLLUTION

Phnom Penh
Tboung Khmum
Kampong Thom
Preah Sihanouk
Kandal
Svay Rieng
Kampong Speu
Takeo
Kampong Chhnang
Koh Kong
Kampong Cham
Kratie
Prey Veng
Mondul Kiri
Ratanak Kiri
Stung Treng
Battambang
Banteay Meanchey
Kampot
Preah Vihear
Oddar Meanchey
Siem Reap
Pursat
Pailin
Kep

Discharges in kilograms (thousands)

■ Air ■ Land ■ Water

Source: Author.

MAP: LAO PEOPLE'S DEMOCRATIC REPUBLIC—SULFUR DIOXIDE EMISSIONS SOURCES IN BOLIKHAMXAY PROVINCE

Villages
SO$_2$ emissions (kilograms/year)
○ < 5,000
● 5,000–25,000
● 25,000–150,000

Districts
SO$_2$ emissions (kilograms/year)
■ < 5,000
■ 5,000–25,000
■ 25,000–150,000

Source: Author.

▼ A large industrial complex in Southeast Asia.

FUTURE APPLICATIONS IN THE GREATER MEKONG SUBREGION

Applying the IPPS is an important first step toward mainstreaming pollution concerns into strategic planning in the GMS. To leverage the full potential of the IPPS, countries should invest in more complete and better-quality information about their manufacturing firms, since existing enterprise databases in some of the countries are outdated and have gaps and inconsistencies. Guided by the IPPS results, countries should then target the most polluting facilities for on-site emission measurements and use this information to gradually build a representative national pollution inventory.

In a second step, GMS pollution control authorities should use the improved enterprise and pollution inventories to create specific national pollution load coefficients to replace the internationally derived IPPS coefficients. With each round of on-site measurements, these national coefficients can be verified and refined in a process that would steadily improve the quality and credibility of the national pollution projection systems.

It is important to emphasize that the IPPS should not be used as a bridging technology that is phased out once on-site pollution and emission monitoring and enforcement procedures are established.

Instead, regular on-site emission projections should become a key part of GMS strategic planning procedures, as they add unique insights into likely future pollution trends that on-the-ground monitoring cannot provide.

For example, countries could use the IPPS or nationally developed pollution coefficients to anticipate which geographic locations (such as a province or perhaps a new special economic zone) are likely to face new or more significant manufacturing pollution in the coming years.

This will enable more proactive and preventive responses, rather than reactive (and often more expensive) "clean-up" actions.

ABOUT THE ASIAN DEVELOPMENT BANK

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to a large share of the world's poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

ABOUT THE CORE ENVIRONMENT PROGRAM

The Core Environment Program (CEP) supports the Greater Mekong Subregion (GMS) in delivering environmentally friendly economic growth. Anchored on the ADB-supported GMS Economic Cooperation Program, the CEP promotes regional cooperation to improve development planning, safeguards, biodiversity conservation, and resilience to climate change—all of which are underpinned by building capacity. The CEP is overseen by the environment ministries of the six GMS countries and implemented by the ADB-administered Environment Operations Center. Cofinancing is provided by ADB, the Global Environment Facility, the Government of Sweden, and the Nordic Development Fund.

▲ An urban wastewater treatment plant in Southeast Asia.

GREATER MEKONG SUBREGION **CORE ENVIRONMENT PROGRAM**

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