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FROM THE GHG MEASUREMENT FRONTLINE: A SYNTHESIS OF NON-ANNEX I COUNTRY NATIONAL INVENTORY SYSTEM PRACTICES AND EXPERIENCES

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SUMMARY

National greenhouse gas (GHG) inventories provide fundamental data to inform domestic and global action on climate change. However, many non-Annex I countries do not yet have the necessary capacity to produce regular inventories of their GHG emissions. With new reporting requirements under the United Nations Framework Convention on Climate Change (UNFCCC) set to take effect in 2014[1] and a variety of planned domestic GHG mitigation goals, non-Annex I countries are looking to build capacity to support more sustainable and robust systems for national GHG inventory reporting. Drawing upon case studies authored by inventory experts from Brazil, Colombia, India, Mexico, and South Africa, this paper highlights seven emerging good practices that these countries have used to develop capacity and improve and sustain their national GHG inventory systems, specifically:

- sustained institutional arrangements
- identification and enabling of a lead agency to manage the national GHG inventory process
- sectoral coordinating institutions with well-defined roles, responsibilities, and processes
- detailed institutional mandates and data-sharing agreements that include work schedules
- processes to archive inventory information and retain institutional memory
- sufficient, well managed, and sustained financial resources
- an iterative approach to improving the national GHG inventory system

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This paper and the national inventory case study series upon which it is based are part of the World Resources Institute's Measurement and Performance Tracking Project.

INTRODUCTION AND CONTEXT

A national GHG inventory provides a comprehensive estimation of a country's GHG emissions and removals due to human activity. Establishing a system for regularly reporting a national inventory enables countries to meet international reporting requirements under the UNFCCC. It also helps countries identify and prioritize mitigation actions and track and report progress toward domestic emissions reduction goals.[2]

Under the UNFCCC, national GHG inventories are prepared using methods and guidelines produced by the Intergovernmental Panel on Climate Change (IPCC).[3] The IPCC guidelines assist countries in the estimation and reporting of anthropogenic GHG emissions and removals in a transparent, complete, consistent, comparable, and accurate manner.[4] Countries may also use non-IPCC methods if these are consistent with the IPCC guidelines and improve the accuracy of emissions estimates.[5]

Signatory parties to the convention are required to periodically submit a national GHG inventory report to the UNFCCC Secretariat. The 43 industrialized countries considered to be Annex I parties[6] are required to report a national GHG inventory on an annual basis.[7] The group of 154 nations considered to be non-Annex I parties[8] are not subject to the same reporting requirements as Annex I parties[9] but have submitted national GHG inventories as part of their national communications.[10] Although nearly 100 non-Annex I parties have completed two or more national GHG inventories as part of their submitted national communications, these were often produced with a time lag of several years to a decade or more between reports,[11] creating challenges in building the long-term institutional capabilities, systems, procedures, and processes required for more frequent reporting of a national GHG inventory. The Durban Agreements of 2011 call for non-Annex I countries, "consistent with their capabilities and the level of support provided for reporting," to submit national communications every four years and national GHG inventories every two years beginning in 2014.[12] These new reporting requirements present both opportunities and challenges for countries that do not have well-established or systematic approaches to producing a national GHG inventory.

Motivated by the international reporting landscape, as well as a variety of domestic low-carbon development objectives and goals, a number of non-Annex I countries are seeking to develop a more robust and sustainable national GHG inventory management system. However, significant challenges exist, including: [13]

- a lack of permanent government institutions, resulting in high staff turnover and loss of institutional memory;
- a lack of formal data-sharing agreements between institutions, resulting in delays in obtaining the necessary data;
- a lack of clear mandates and institutional frameworks detailing responsibilities, timelines, and products, resulting in excessive time spent on clarifying inventory procedures;
- insufficient data management and/or quality assurance processes to ensure accurate and archived information; and
- inadequate training of domestic inventory experts to ensure that future inventory compilation efforts can be effectively carried out and to lighten the burden on current inventory practitioners who are over-stretched.

Through the Measurement and Performance Tracking (MAPT) project, the World Resources Institute (WRI) seeks to provide insights on the capacities required for effective national inventory development.[14] To that end, in 2012—2013 the MAPT project developed a series of case studies that provide analyses of country national inventory system capacities and remaining capacity challenges. WRI worked closely with in-country inventory experts in order to ensure that those with a deep knowledge of the national inventory system were able to reflect on their domestic capacity challenges and successes.

This paper draws on the MAPT national GHG inventory case study series to provide a high-level synthesis of common attributes that contribute to the development

of a sustainable and robust national GHG inventory system. Through this working paper, we hope to share the experiences and lessons learned that are described in the MAPT case studies with other countries grappling with similar inventory management concerns and capacity constraints. For more detailed examples and country-specific information, we encourage readers to review individual case studies within the series, all of which are available for free at https://sites.google.com/site/maptpartnerresearch/national-ghg-inventory-case-study-series.

RESEARCH APPROACH AND CAVEATS

Fifteen case studies from five non-Annex I countries were reviewed for this synthesis report (Table 1). The case studies address four thematic topics[15] and were written by a national inventory expert using a common template to assess the capacities associated with and necessary for national GHG inventory systems.[16] The countries represented in this synthesis all have experience completing at least two national GHG inventories.

Table 1 | **MAPT NATIONAL GHG INVENTORY CASE STUDIES EXAMINED FOR THIS STUDY**

COUNTRY CASE STUDIES	TOPIC	TOPIC SUMMARY
1. Brazil 2. Colombia 3. India 4. Mexico 5. South Africa	Initiating a national GHG inventory system and making it sustainable	Describes the core capacities required to initiate a formal, comprehensive national inventory system (or undergo a significant overhaul of a previous system) and, where applicable, identifies where the introduction of new capacities or changes in certain capacities facilitated the progression to a more sustainable national inventory system.
6. Brazil 7. Colombia 8. India 9. Mexico 10. South Africa	Management and coordination of the inventory process by the lead institution	Describes the core capacities required for the lead institution to effectively manage and coordinate the national inventory process with other relevant agencies, ministries, and organizations. These studies explore how institutional relationships are organized, implemented, maintained, and revised, as necessary, as well as how institutional responsibilities are delegated and enforced.
11. Brazil 12. Colombia 13. India	Producing an inventory for the land use, land-use change, and forestry (LULUCF) sector	Describes the core capacities that can assist countries in their preparation of LULUCF inventories as part of a national GHG inventory initiative.
14. Brazil 15. Colombia	Producing an inventory for the industry sector	Describes the core capacities that countries have developed to effectively coordinate, manage, and produce an industry-sector GHG inventory as part of the overall national inventory process.

This paper provides a synthesis of country examples from these published case studies that highlight emerging good practices for national inventory systems. Given the available case study topics at the time of publication, our summary focuses on practices required to initiate, manage, and coordinate the national inventory process. Other critical capacity-building practices, including those related to specific sectors, data management and quality assurance systems, training tools, and the development of more accurate data inputs and methods, are not directly discussed in this synthesis. However, to explore some of these topics and expand the initial evidence base, additional case studies have been commissioned by WRI and will be made available at https://sites.google.com/site/maptpartnerresearch/national-ghg-inventory-case-study-series. This synthesis paper may, therefore, be updated in the future as new examples of effective practices become available.

Finally, it is important to note that neither this paper nor the case study series upon which it is based provide a comprehensive assessment. The practices presented here may not be directly applicable in all country contexts. In addition, it is difficult to definitively isolate the identified good practices as factors that led to national inventory development success as they are drawn from the experiences of only five countries, which may lead to biases or partial information. It is also challenging to isolate which practices led to certain outcomes. Readers are encouraged to be cautious in interpreting the findings discussed below and to consider reviewing the original case study associated with each highlighted country practice for additional context and insights.

FINDINGS: GOOD PRACTICES CONTRIBUTING TO AN EFFECTIVE INVENTORY SYSTEM

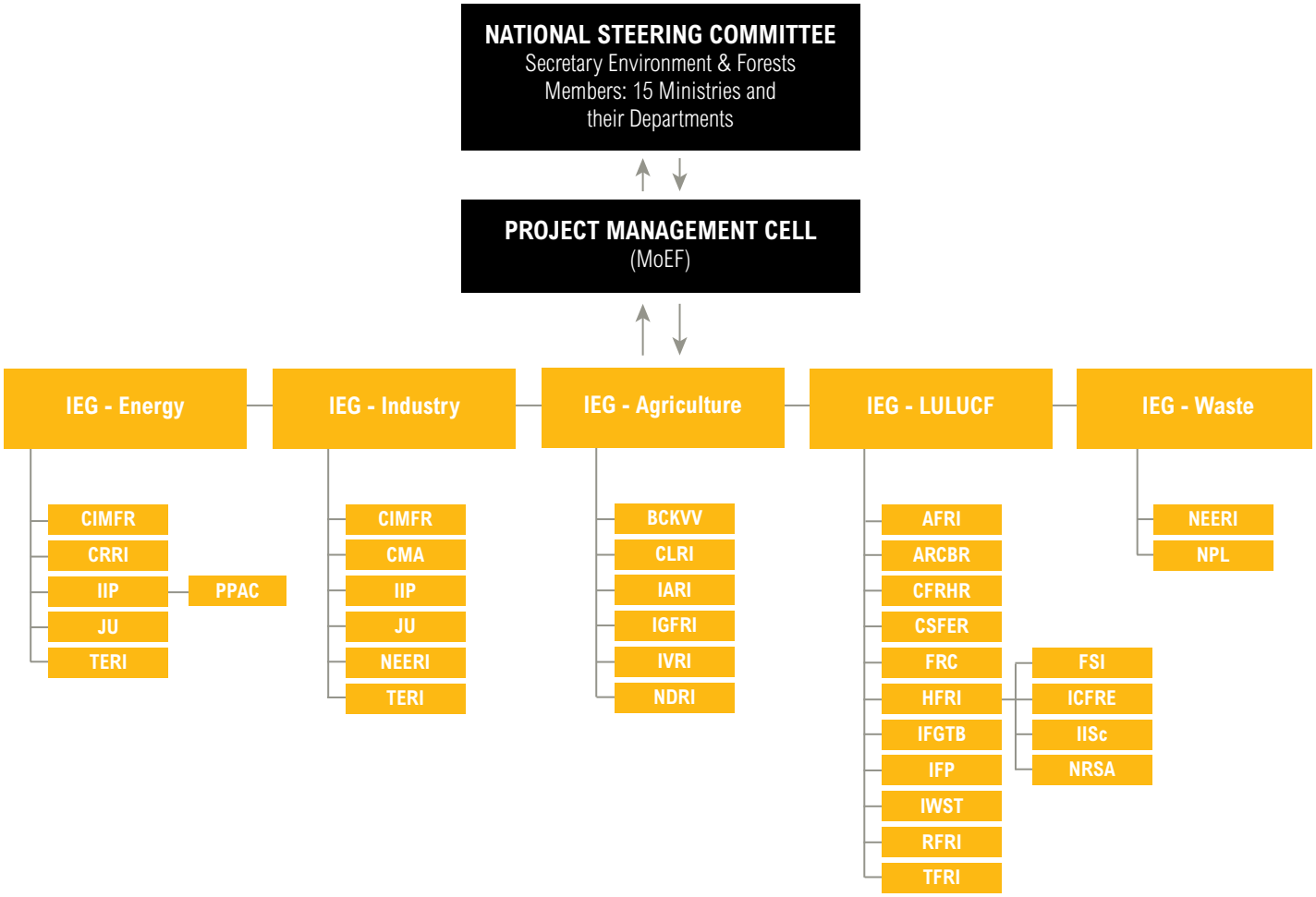
This section presents strategies and practices that countries have executed to address various capacity challenges. Although the context is different in each of the five countries—Brazil, Colombia, India, Mexico, and South Africa—we have highlighted the practice attributes that are similar and that could have played a role in strengthening these countries' inventory systems.

Sustained institutional arrangements

Non-Annex I countries submit a national GHG inventory as part of their national communication reports. As these are often submitted many years apart, the national inventory process is often managed as a time-delimited project. That is, funding is given to produce a specific national communication, including a national inventory; and, as the project cycle ends, there is a period of no funding or activity until the next national communication cycle begins (also see "Sufficient, Well-Managed, and Sustained Financial Resources," later in this paper). As a result, countries are often unable to retain the necessary technical knowledge, including staff experts, data, and methods documentation, and therefore must start over with each new inventory. In addition, countries have reported that this structure can result in high staff turnover as well as less time available for completing the inventory due to the time that is necessary to renegotiate contract terms and restructure working groups or other administrative bodies.[17] With increased reporting frequency under the UNFCCC, countries will need permanent institutional arrangements for the national inventory that are regularly funded and sufficiently staffed.

India provides an example of an institutional arrangement that, while still partially tied to funding cycles, has important components that could be made permanent. India's national communication, including its national GHG inventory, is coordinated by the Ministry of Environment and Forests (MoEF) and reviewed and cleared by a national steering committee (NSC) prior to submission to the UNFCCC. MoEF manages and oversees the development of the national inventory as part of its broader authority for all environment-related policies. To support the development of the first and second national communications and inventories, MoEF set up a project management cell (PMC) to manage the process of inventory preparation. The PMC is led by a senior-level official within MoEF who works with a small team of experts that sits outside the federal government to coordinate inputs from each inventory expert group and its constituent organizations and aggregates inventory content (Figure 1).[18]

Figure 1 | **India's National GHG Inventory Management System**



AFRI	Arid Forest Research Institute
ARCBR	Advanced Research Centre for Bamboo and Rattans
BCKVV	Bidhan Chandra Krishi Vishwa Vidyalaya
CFRHRD	Center for Forestry Research and Human Resource Development
CII	Confederation of Indian Industry
CIMFR	Central Institute of Mining and Fuel Research
CLRI	Central Leather Research Institute
CMA	Cement Manufacturers Association
CRRI	Central Road Research Institute
CSFER	Centre for Social Forestry and Eco-Rehabilitation
FRC	Forest Research Centre
FSI	Forest Survey of India
HFRI	Himalayan Forest Research Institute
IARI	Indian Agricultural Research Institute
ICFRE	Indian Council of Forestry Research and Education
IEG	Inventory Expert Group
IFGTB	Institute of Forest Genetics and Tree Breeding
IFP	Institute of Forest Productivity
IGFRI	Indian Grassland and Fodder Research Institute
IIP	Indian Institute of Petroleum
IISc	Indian Institute of Science
IVRI	Indian Veterinary Research Institute
IWST	Institute of Woods Science and Technology
JU	Jadavpur University
NDRI	National Dairy Research Institute
NEERI	National Environmental Engineering Research Institute
NPL	National Physical Laboratory
NRSA	National Remote Sensing Agency
PPAC	Petroleum Planning and Analysis Cell
RFRI	Rain Forest Research Institute
TERI	The Energy and Resources Institute
TFRI	Tropical Forest Research Institute

Source: Adapted from Bhattacharya, 2013b.

The NSC comprises more than 25 representatives from various ministries and agencies within the Government of India and is chaired by the secretary of Environment and Forests, ensuring broad governmental engagement.

> *"The NSC meets one to two times a year and reviews the inventory development process and its progress vis-à-vis the timelines set out at the beginning of the inventory preparation cycle. Further, the NSC members, representing the line ministries managing activities that are sources of emissions, also review the activity data and estimated GHG emissions for their respective sectors....The incentive for the NSC members to continue in the process from one [national communication] to the other has mainly been due to the government's commitment toward the UNFCCC. Changes in government every five years have never posed a risk to the process."*[19]

Additionally, India has created the Indian Network for Climate Change Assessment (INCCA). Launched in 2009, INCCA includes more than 200 scientists from over 120 institutions around the country. Charged with conducting research and "issuing publications that would enable various stakeholders to make informed decisions on issues related to climate change impacts, adaptation, and mitigation,"[20] INCCA provides a structure that facilitates the exchange and retention of technical knowledge. As a result of its mandate, in 2010 INCCA prepared and published a national GHG inventory with comprehensive estimates through 2007 that was not part of the national communication process.

Although the work on the national inventory in India is ultimately carried out by several inventory expert groups, which may experience changes in their composition, the establishment of several high-level institutional structures has helped ensure accountability and the successful completion of the national inventory process.

Identification and enabling of a lead agency to manage the national GHG inventory process

Practitioner experience documented in the case studies shows that a permanent national GHG inventory system benefits from a lead agency within the national government that has the capacity to oversee the management of the national GHG inventory process. The role of this lead agency is to coordinate the collection of data from across a number of sectoral institutions. The lead agency can also be responsible for compiling and submitting the inventory, developing any data-sharing agreements, convening meetings, holding data providers and sectoral institutions to task, ensuring that quality assurance/quality control (QA/QC) procedures are followed, and ensuring the quality of the inventory as a whole.

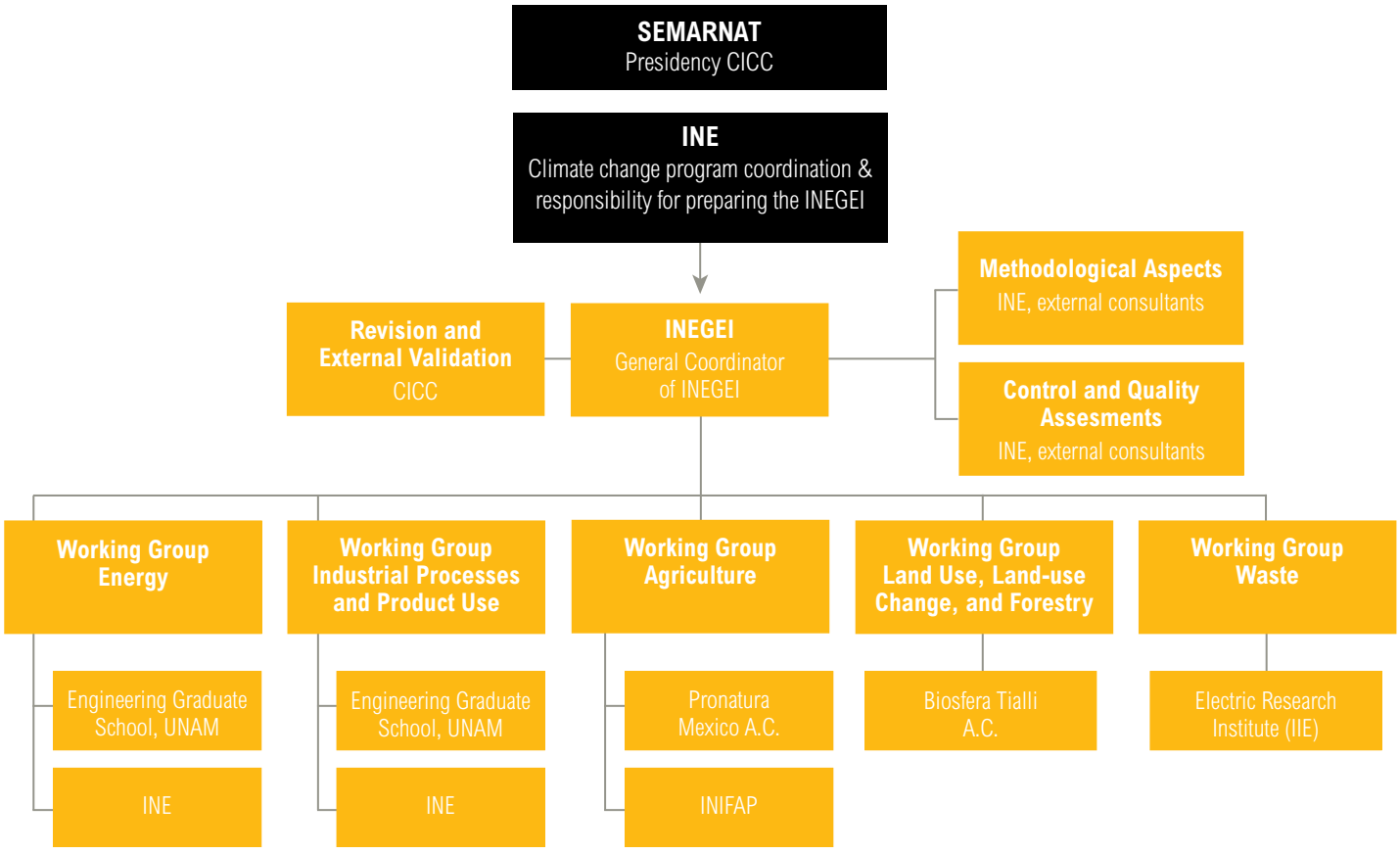
Some countries assessed in the MAPT national inventory case-study series have transitioned over time to an arrangement where the inventory is managed exclusively by a single government agency. These countries emphasize the importance of national governments providing the lead agency with sufficient authority (e.g., through mandates), enabling capacities, and resources.

For example, in order to support the sustainability of South Africa's national GHG inventory process, the country shifted to a new institutional arrangement that expanded the role of the Department of Environmental Affairs (DEA) as the lead agency. The 1990 and 1994 inventories were largely produced by consultants due to a lack of capacity and skills within the lead institution. This arrangement initially led to limited involvement from DEA and other line departments. However, for the 2000 inventory, which was published in 2009, DEA had in place a dedicated unit leading the compilation of the inventory. A project management team comprising DEA staff and consultants was created to lead the process. For its third national inventory (forthcoming), South Africa is working

toward building the capacity of DEA as the lead institution by having it lead the inventories for the energy, industrial processes and product use, and waste sectors. [21]

Mexico has also increased the responsibilities and capacities of the lead institution for its national inventories. For the first and second inventories, the National Institute of Ecology and Climate Change (INECC)[22] commissioned the Center of Atmospheric Sciences of the National Autonomous University of Mexico to coordinate the national inventory. INECC's role as the designated national entity for preparing Mexico's national inventory was not established until 2001 when an amendment to internal regulations codified INECC's ability to "conduct studies for the continuous update and permanent systematization of a national inventory of GHG emissions." For the third, fourth, and fifth national inventories, INECC had definitive authority to manage the inventory process (Figure 2). This transfer of responsibility has served to significantly build the internal capacity of INECC, consolidating expertise and formalizing institutional arrangements and review processes.[23]

Figure 2 | **Structure of Collaboration Established in Mexico to Update the Third, Fourth, and Fifth National Inventory of Emissions of Greenhouse Gases**



SEMARNAT	Ministry of the Environment and Natural Resources	**CICC**	Interministerial Commission on Climate Change
INE	National Institute of Ecology (now INECC)	**UNAM**	National Autonomous University of Mexico
INEGEI	Mexico's National GHG Inventory	**INIFAP**	National Institute of Forestry, Agriculture, and Livestock Research

Source: Adapted from Salas Cisneros, 2013.

By assigning the national inventory to a single lead institution and/or sourcing national inventory work back to the lead institution over time and then providing that institution with sufficient financial and personnel resources, as well as clear authorities, governments can develop GHG measurement and management expertise within the government, enable better integration with policy setting, and produce technical or process efficiencies in support of other objectives, among other benefits.

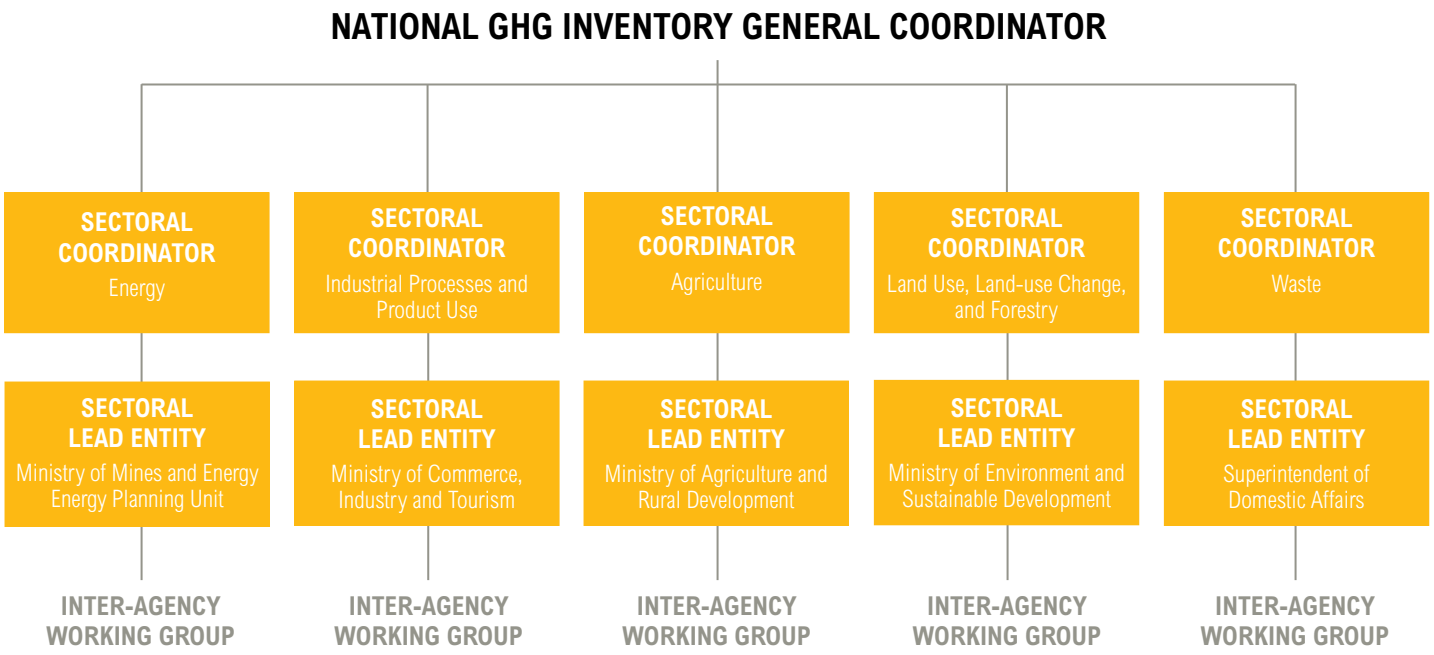
Sectoral coordinating institutions with well-defined roles, responsibilities, and processes

Although the lead institution is often responsible for managing the entirety of the GHG inventory process and compiling the final inventory, the necessary data often reside within a range of ministries, research institutions, and private-sector entities. As a result, some countries have found it valuable to set up sectoral coordinators and/or sectoral working groups that are responsible for compiling activity data and completing an inventory for a specific sector. This devolution of certain responsibilities from the lead agency also requires a clearly defined set of roles, tasks, and time lines. Often this is done through the adoption of coordination or data sharing agreements, terms of reference, and/or memoranda of understanding.

In Brazil, for example, the General Coordination on Global Climate Change (CGMC) unit was created within the Ministry of Science, Technology and Innovation for the implementation of the UNFCCC. As such, the CGMC is the lead institution for the management and coordination of the GHG inventory.[24] While the CGMC in Brazil had overall responsibility for the coordination of the first two national GHG inventories, an institutional coordinator for the energy, agriculture, land-use change and forestry, and waste sectors was also assigned. These institutions, which include ministries, research institutions, and private-sector partners, each had the necessary scientific and technical knowledge to collect data and make calculations for their assigned sector. The CGMC served as the institutional coordinator for the industrial processes and product use sector, due its specific complexities and the number of entities involved.[25]

In Colombia, the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM)—the lead inventory coordinating agency—promoted interagency collaboration through the formation of working groups (Figure 3). These groups bring together representatives from the public, private, and academic sectors to meet periodically throughout the inventory development process. They are charged with facilitating data collection, ensuring quality and flow of information, and identifying data gaps across all IPCC sectors. Each group is composed of a sectoral coordinator and a mix of part-time staff from associated institutions. Within each working group, information is reviewed, and country-specific activity data and emission factors are selected.[26] For certain sectors, such as industrial processes and product use, Colombia has further subdivided working groups to account for different process types and the size of particular industries (i.e., the number of facilities).[27]

Figure 3 | **Schematic Diagram of the Distribution of Inventory Sectoral Working Groups for Colombia's National Inventory System**



Source: Adapted from Gutiérrez Arias, et al., 2013a.

Similarly, for South Africa's third national inventory (forthcoming), working groups have been created to bring together knowledge and experience from across a number of fields and experts. This approach may be particularly effective for sectors where the necessary expertise is outside of the lead agency. For example, although DEA will manage the energy, industrial processes and product use, and waste sectors for the inventory, a working group for the agriculture, land-use, and forestry sector will bring together a broader set of expertise, including the Department of Agriculture, Forestry and Fisheries, the Agricultural Research Council, and other research institutions.[28]

The adoption of sectoral coordinating institutions and/or working groups leverages a country's cross-agency expertise and could additionally help spread the workload. By identifying in-country or existing staff and assigning them coordination responsibilities (even part time), there is an increased likelihood that technical and process knowledge will be retained, and a broader set of stakeholders will have ownership of the final product.

Detailed institutional mandates and data-sharing agreements that include work schedules

The Brazilian inventory experience shows that detailed terms of reference that prescribe intermediate products as well as a clear time line are important to help ensure efficient inventory processes. The first national inventory had a less rigid and detailed set of terms, which resulted in delays and a need to adjust deadlines. The CGMC's effort to overcome this hurdle for the second national inventory resulted in more efficient supervision, improved quality control procedures, and better adherence to time lines.[29] This was exemplified by the relationship between CGMC and the Foundation of Space Science, Applications and Technology (FUNCATE)—the sectoral lead for compiling emissions estimates for the land use, land-use change, and forestry sector, Brazil's largest emissions source: "FUNCATE had a clear mandate established through a contract or cooperation agreement that set individual terms of reference, the timetable, the costs, and the responsibilities."[30] In addition, the Brazil experience

highlights the importance of a consultative structure between the lead agency and the institutional coordinating organizations in order to ensure that information is available as needed.[31] For example, periodic meetings were convened between FUNCATE and CGMC with discussions carried out by the coordinators at each step of the process where decision making was required.[32]

Processes to archive inventory information and retain institutional memory

Continuity and sustainability of the national GHG inventory process is very much dependent on a country's ability to retain access to the data and methods used in previous inventories, as well as institutional memory regarding processes, participants, and lessons learned. Retaining this important knowledge is of particular concern in non-Annex I countries due to high turnover of staff and/or insufficient documentation processes and systems.[33]

For its first and second national inventories, South Africa had limited systems in place to retain the background data and information on methods used. As a result, many documents used in the preparation of these inventories have been lost, contributing to implementation delays and the unsustainability of the process. However, efforts are now under way to develop a national system to better manage GHG emissions and related data, as well as institutionalize information management and data collection.[34] More specifically, DEA is in the process of developing a national GHG information management platform/database as part of the South African Air Quality Information System (SAAQIS).

> *"[SAAQIS] will include greenhouse gas emissions reporting by all significant emitters and emission information holders. The system will allow key data collection of all the significant sources of GHG emissions in South Africa, with proper data archiving and processing, as well as provision of the most current revised emissions factors for the calculation of GHG emissions.*
>
> *SAAQIS is visualised as a Web-based emissions monitoring, database, and reporting system. However, DEA realizes that the SAAQIS system will not be able to computationally handle all IPCC sectors within the system. For example, sectors like [agriculture, forestry, and other land use] and waste are likely to be computed outside the SAAQIS system; and the emissions results are to be fed into the system in a way that will allow the system to generate summary reports that meet [domestic] and international reporting requirements…."*[35]

Although advanced technical platforms such as SAAQIS can facilitate collection, storage, and sharing of data and documentation, archiving solutions do not require customized software. Indeed, countries may use more readily available tools to support archiving and documentation,[36] complemented by strong policies and procedures.

India's PMC leads the documentation and archiving of all processes related to the preparation of the national inventory, including the terms of reference and contracts of the various individuals and institutions involved in the compilation of the inventory, the roles and responsibilities assigned to the NSC and sectoral inventory expert groups, and details of meetings and decisions taken. In addition to the documentation of processes, the archiving procedures also include technical documentation. Each institution contributing to the inventory process is responsible for documenting activity data and emissions factors used, applicable methods, the resulting GHG estimates, and QA/QC measures undertaken. This information is sent by each inventory institution to the PMC, where it is consolidated and archived on a regular basis. This process has proved to be extremely beneficial, as it—

- *"Facilitates system continuity. Even if a new set of people were to assume project management, they could refer back to the archived documents…. Expert judgments on methodological approaches, activity data, and emissions factors within the present or earlier process and any decisions regarding any aspect taken during the process are documented.*
- *Facilitates collation at the end of the process for producing the final GHG emissions inventory report ….*
- *Supports the review processes….*

- *...Provides the basis for undertaking additional actions for improvement..., such as*
  - *[the] need for introducing or deleting certain actions taken during planning*
  - *methodological improvements required (if any)*
  - *improvements to emissions factors or to assess if there is a genuine need for developing new emission factors."*[37]

Sufficient, well managed, and sustained financial resources

The attributes of national inventory systems discussed so far encapsulate a variety of institutional, human resource, and technical capacities. Underpinning the development and maintenance of these capacities, however, is the need for sufficient and, ideally, sustained financial resources to support a national inventory system. Countries that are a part of this study report budget figures ranging from approximately US$700,000 to US$3 million to compile their national inventory reports. These figures include direct funding received from the Global Environment Facility (GEF), which makes available financial resources to support the development of national inventory reports (as part of the national communication) in non-Annex I countries.[38] However, countries in this study have generally found it necessary to supplement GEF funds with monetary resources allocated through national budgets or other funding channels.

In Brazil, for example, the National Institute for Space Research supplemented the country's GEF funding to cover the costs of the satellite imagery the country required to make accurate calculations of its emissions from the land use, land-use change, and forestry sector.[39] Similarly, India's "co-financing in-kind by the government is much higher than the amount received from the GEF." Although national monetary resources for inventories can be difficult to procure, these investments, in addition to supporting the completion of a comprehensive national inventory, have also provided co-benefits to the country, such as funding of country-specific research activities and training of GHG management personnel.[40]

As non-Annex I countries may require multiple revenue sources to support their national inventory system, it will likely be essential to prioritize activities (based on capacity needs or a key category analysis, for example) and efficiently manage and allocate financial resources. For its second through fifth national inventories, Mexico used a combination of GEF funding and allocations from the Ministry of Environment and Natural Resources. However, for its first national inventory, Mexico received funding from several, non-national sources, including the United Nations Environment Programme (UNEP).

> *"Because each fund's...schedule differed, various timetables and objectives were established. UNEP sources, for instance, were used to produce an inventory using the Tier 1 approach....Other... funding supported the development of the Country Study on Climate Change....*[41] *[and] helped strengthen technical capacities, particularly the application of more disaggregated estimates."*[42]

Developing a sustainable national inventory system, including ensuring adequate staff, technologies, and capacity building, can also require that financial resources be provided in a regular and dependable way. Although GEF funds have helped many countries compile national inventory reports (including those discussed here), because this funding is provided in a payment-for-project manner and cannot be used to fund internal government staff time, there can be a disincentive for countries to invest in the development of a formalized inventory system. Without some minimum level of sustained funding, it is difficult to extend country engagement and improve the national inventory system beyond the length of the donor funding cycle. In 2006, Mexico addressed this challenge by expanding funding for the national GHG inventory through the Environmental Sectoral Program, which mandated the compilation of two GHG inventories between 2007 and 2012.[43]

Taking an iterative approach to improving the national GHG inventory system

Finally, and perhaps most significantly, all countries in this study highlighted the importance of an iterative approach to improving the national GHG inventory system. Most Annex I country inventory systems have developed over a decade or more, and these countries are still refining and making improvements to their data, methods, and management processes. For non-Annex I countries, the practices previously discussed in this paper are likely to be important for long-term sustainability of an inventory system, but it is unlikely that they will be fully realized in a single year. Therefore, work must start with and build upon available data, documentation, expertise, and institutional arrangements. Indeed, the IPCC guidelines accommodate data and system improvements over time by offering a set of calculation methods with tiered complexity and rigor. In addition, if an inventory system is going to ultimately be beneficial and efficient, countries should commit to a regular review of the system by identifying and prioritizing improvements to be implemented over time.

India provides a clear example of this iterative approach. Estimates of GHG emissions for India were initially made in 1991 by three research institutions. However, these estimates included only carbon dioxide emissions from fossil fuel combustion in energy industries and methane emissions from rice and enteric fermentation. Over the years, subsequent research efforts and calculations of national emissions have included additional sources and involved more organizations and government entities. Most recently, the second national communication—released in 2012—involved more than 30 institutions, used country-specific emissions factors for several sources, and included estimates for all "Kyoto" gases.[44]

Similarly, Brazil submitted its first national communication and inventory in 2004. At that point, knowledge related to GHG inventories was limited in the country and as a result, the coordinating institution for each sector was selected based on criteria such as the institution's general expertise of technical processes within the sector, planning and operations experience, and the perceived ability to build the capacity for compiling a GHG emissions inventory. Much training was on-the-job, supervised by the lead institution. However, for the second national communication and inventory in 2010, sufficient capacity had been built as a result of this work. In addition, collaborating institutions were able to adopt more complex methods and engage subnational institutions in getting improved measurements and data.[45] Iterative improvements were particularly important for the land use, land-use change, and forestry sector where investments were made to achieve greater data resolution and employ digital processing.[46]

Colombia has also undertaken recalculations of its land use, land-use change, and forestry sector emissions as new deforestation and forest carbon content data became available through improved monitoring. These data improvements were the result of collaborations between IDEAM and academia and also benefited from activities supporting the development of Reducing Emissions from Deforestation and Degradation projects. As this is a priority sector for Colombia, the inventory team at IDEAM plans to do another recalculation for Colombia's third national communication.[47]

DISCUSSION AND CONCLUSION

Effective national GHG inventory systems can regularly produce critical data for meeting international reporting requirements under the UNFCCC and informing domestic low-carbon strategies and goals. However, national inventory systems are complex, relying on the work of many individuals (not just inventory practitioners) and typically requiring numerous inputs and processes, as well as regular upkeep, if they are to be truly sustainable. Consequently, there is a need for national governments to adopt more comprehensive and systematic approaches to the development of national inventory systems. Capacity-building organizations can help facilitate this through improved coordination and more on-the-ground support for national inventory system design, implementation, and maintenance. Ultimately, achieving sustainable

national inventory systems in non-Annex I countries may also require that the UNFCCC and the broader international community collectively define international reporting success as more than the completion of a delivered report, by providing direction to parties regarding national inventory systems and better aligning results-based goals of non-Annex I parties and funding institutions/donors.

Through formal (e.g., UNFCCC) or informal processes, countries that seek to learn from the experiences—successes and challenges—of other, more established, national inventory systems can likely expedite the formalization of their own systems. Although capacities and capacity-building challenges can vary widely and are country-specific, it is important to have a detailed understanding of both the range of capacities needed to complete a national GHG inventory as well as the specific challenges facing a particular country. The MAPT national GHG inventory case study series and this synthesis paper are efforts to share some of the good practices and lessons learned of non-Annex I countries with significant national inventory experience.

Although there is no one-size-fits-all solution, this synthesis paper highlights practices that have proved to be effective within a limited number of varied contexts. These practices include the establishment of sustained institutional arrangements, including a lead agency that has sufficient capacity for inventory management; adoption of agreements that define roles, responsibilities, and time lines; archiving data, methods, and other inventory information; access to sufficient financial resources that are deployed in a targeted way; and iterating on the inventory process to identify and make improvements. Regular sharing of these and other practices through capacity-building forums, along with an improved enabling environment, will, it is hoped, promote actions that support countries in building the institutional, human resource, and technical capacity for ensuring a sustainable national GHG inventory system.

ABBREVIATIONS AND ACRONYMS

CGMC	General Coordination on Global Climate Change (Brazil)
DEA	Department of Environmental Affairs (South Africa)
FUNCATE	Foundation of Space Science, Applications and Technology (Brazil)
GEF	Global Environment Facility
GHG	greenhouse gas
IDEAM	Institute of Hydrology, Meteorology and Environmental Studies (Colombia)
INCCA	Indian Network for Climate Change Assessment
INECC	National Institute of Ecology and Climate Change (Mexico)
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land use, land-use change, and forestry
MAPT	Measurement and Performance Tracking
MoEF	Ministry of Environment and Forests (India)
NSC	National Steering Committee (India)
PMC	Project Management Cell (India)
QA/QC	quality assurance/quality control
SAAQIS	South African Air Quality Information System
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WRI	World Resources Institute

ENDNOTES

1. Decision 2/CP.17: http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf.
2. Additional discussion can be found at http://insights.wri.org/news/2012/05/national-greenhouse-gas-inventories-can-help-countries-curb-climate-change.
3. See, for example, IPCC, 2006: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.
4. IPCC, 2006. http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_1_Ch1_Introduction.pdf.
5. IPCC, 1997. http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/introri.pdf.
6. For a list of Annex I parties, see: http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php.
7. For more information on reporting requirements under the UNFCCC for Annex I parties, see: http://unfccc.int/national_reports/reporting_and_review_for_annex_i_parties/items/5689.php.
8. Non-Annex I parties are "countries that have ratified or acceded to the UNFCCC but are not listed under Annex I of the Convention" (http://unfccc.int/essential_background/glossary/items/3666.php). For a list of non-Annex I parties, see: http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php.
9. "In accordance with the principle of 'common but differentiated responsibilities' enshrined in the Convention, the required contents of these national communications and the timetable for their submission are different for Annex I and non-Annex I Parties. Each non-Annex I Party shall submit its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources (except for the least developed countries, who may do so at their discretion)." (http://unfccc.int/national_reports/non-annex_i_natcom/items/2716.php)
10. A national communication is a government document submitted periodically by a country to inform other parties of the convention of their national activities to address climate change. National communications guidelines state that the report should include a summary of the national GHG inventory.
11. See: http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php for examples.
12. Non-Annex I parties will submit national GHG inventories as part of their biennial update reports. For more information, see Decision 2/CP.17: http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=10 & http://unfccc.int/documentation/documents/advanced_search/items/3594.php?rec=j&priref=600006772#beg.
13. These challenges were largely drawn from a six-country study of capacity needs for GHG measurement and evaluation systems, carried out under the auspices of the Measurement and Performance Tracking (MAPT) project. For more information, see the MAPT scoping reports: https://sites.google.com/site/maptpartnerresearch/home.
14. As used in this paper, a country's "capacity" to develop a national GHG inventory is dependent on having in place the necessary enabling environment, resources, and capabilities. This can include adequate institutional capacity such as the arrangements, processes, and mandates required to coordinate the completion of a national GHG inventory. Resource concerns can encompass human resource needs (for example, the hiring and retention of an adequate number of skilled staff), as well as sufficient financial resources to complete the tasks at hand. Technical capacity is also central and can include data availability, appropriate methodologies, and technological infrastructure.
15. Initial topics for the MAPT national inventory case study series were selected through a consultative process involving domestic inventory practitioners from Annex I and non-Annex I countries, as well as representatives from international organizations. A longer discussion of the case study series is available in the "Case Study Series Overview" paper, available online at: https://sites.google.com/site/maptpartnerresearch/national-ghg-inventory-case-study-series.
16. Templates for each topic were designed by WRI with inputs from inventory experts and can be found in the MAPT national inventory "Case Study Series Overview" paper, available online at: https://sites.google.com/site/maptpartnerresearch/national-ghg-inventory-case-study-series.
17. Gutiérrez Arias, et al., 2013a, p. 7.
18. Bhattacharya, 2013a, pp. 2–3, 9.
19. Bhattacharya, 2013b, pp. 9, 11.
20. Bhattacharya, 2013b, p. 3.
21. Witi, 2013, p. 4.
22. INECC was previously the National Institute for Ecology.
23. Salas Cisneros, 2013, p. 8; Conde Álvarez, 2013, p. 2.
24. The CGMC's responsibilities also include supporting climate-change research, education, and awareness raising, as well serving as the designated national authority for the Clean Development Mechanism.
25. Paciornik, 2012, p. 2.
26. Gutiérrez Arias, et al., 2013b, pp.3–5.
27. Gutiérrez Arias, et al., 2013c, p. 5.
28. Witi, 2013, p. 4.
29. Paciornik, 2012, p. 3, 7.
30. Krug, 2012, p. 5.
31. Paciornik, 2012, p. 2, 9.
32. Krug, 2012, p. 4.
33. See, for example, the results of the MAPT scoping reports at https://sites.google.com/site/maptpartnerresearch/home.
34. Witi, 2013, p. 3.
35. Witi and Manzini, 2013, p. 6. For more information on SAAQIS, please see Appendix I of Witi and Manzini, 2013.
36. For example, the IPCC inventory software (http://www.ipcc-nggip.iges.or.jp/software/index.html) or the National System Templates provided by the U.S. Environmental Protection Agency (http://www.epa.gov/climatechange/EPAactivities/internationalpartnerships/capacity-building.html).
37. Bhattacharya, 2013b, pp. 12–13.
38. The GEF is an operational entity of the financial mechanism of the UNFCCC. Non-Annex I countries can apply for GEF funding in support of developing their national communications and, now, biennial update reports. However, there are limits in terms of the total dollar amount available per country and provisions regarding the use of funds. For example, GEF funds cannot be used to pay government staff directly but can be used to fund nongovernment staff or consultants who work closely with the government. For more information see: http://unfccc.int/national_reports/non-annex_i_natcom/guidelines_and_user_manual/items/2607.php & http://www.thegef.org/gef/CC_direct_access.
39. Miguez, 2012, p. 5.
40. Bhattacharya, 2013b, pp. 13–14.
41. The Country Study on Climate Change consisted of two workshops where methods and tools for estimating emissions in each IPCC category were presented.
42. Salas Cisneros, 2013, p. 7.
43. Ibid.
44. Bhattacharya, 2013b, Table 1, pp. 5–7.
45. Paciornik, 2012, pp. 3, 7.
46. Miguez, (2012, p. 8.
47. Gutiérrez Arias, et al., 2013a, pp. 5, 9; Gutiérrez Arias, et al., 2013d, p. 6.

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ABOUT WRI

WRI is a global research organization that works closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.

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Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

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We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.