THE ENERGY AND RESOURCES INSTITUTE
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NATIONAL INVENTORY MANAGEMENT SYSTEM IN INDIA

ISSUES, NEEDS, AND IMPLEMENTATION FRAMEWORK

DISCUSSION PAPER
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ASI	Annual Survey of Industries
BEE	Bureau of Energy Efficiency
BTR	Biennial Transparency Report
BUR	Biennial Update Report
CDA	Central Designated Agency
CPCB	Central Pollution Control Board
CSIR	Council of Scientific and Industrial Research
DARE	Department of Agricultural Research and Education
DHI	Department of Heavy Industry
FSI	Forest Survey of India
GHG	Greenhouse Gas
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ISID	Institute for Studies in Industrial Development
IVA	Impact Vulnerability Assessment
LDCs	Less Developed Countries
LULUCF	Land Use Land Use Change and Forestry
MoAFW	Ministry of Agriculture and Farmers' Welfare
MoC	Ministry of Coal
MoCA	Ministry of Civil Aviation
MoEFCC	Ministry of Environment, Forest and Climate Change
MoP	Ministry of Power
MoPNG	Ministry of Petroleum and Natural Gas
MoR	Ministry of Railways
MoRTH	Ministry of Road Transport and Highways
MoS	Ministry of Shipping
MoSteel	Ministry of Steel
MoSPI	Ministry of Statistics and Programme Implementation
MoU	Memorandum of Understanding
MPGs	Modalities, Procedures, and Guidelines
MRV	Monitoring Reporting and Verification
MSME	Ministry of Micro, Small and Medium Enterprises
NATCOM	National Communication
NIMS	National Inventory Management System
NDCs	Nationally Determined Contributions
NRSC	National Remote Sensing Centre
QA/QC	Quality Assurance/Quality Control
SIDS	Small Island Developing States
TOR	Terms of Reference

Importance of a National Inventory Management System

Inventories of greenhouse gases (GHG) are increasingly being prepared by countries as an effective tool to manage their own domestic environment. Corporate or environmental laws in some countries obligate businesses and industries to disclose the environmental impact of their operations *inter alia* through such inventories. However, in most cases, the inventory of GHGs is prepared at the national level primarily to fulfil the international reporting obligations under Article 4.1 of the UNFCCC as per the guidelines contained in Decision 17/CP.8. Therefore, the requirement for submitting GHG inventory is not new. The Paris Agreement to the UNFCCC signed in 2015 has further made it mandatory for each country to report inventory of their GHGs as per the agreed methodologies of the Intergovernmental Panel on Climate Change (IPCC) under Article 13.7. In addition, it mandates the Parties to provide information necessary to track progress made in implementing and achieving their NDCs under Article 4.

The Paris Agreement has significantly altered the reporting landscape by making the GHG inventory preparation not only obligatory for all countries, with exemptions limited to specific groups of countries, but also stricter in submission timelines and enhanced transparency of action. According to Decision 18/CMA.1, all Parties except Least Developed Countries (LDCs) and Small Island Developing States (SIDS) shall provide a national inventory report of anthropogenic emissions by sources and removals by sinks of GHGs, in accordance with the Modalities, Procedures and Guidelines (MPGs) of the Enhanced Transparency Framework under Article 13. Further, MPGs specify the flexibility that is available to those developing country Parties that need it in the light of their capacities pursuant to Article 13, paragraph 2. Such flexibility includes the scope, frequency, and level of details of reporting, and in the scope of the review, as referred to Decision 1/CP.21, paragraph 89. The MPGs have, however, increased the reporting burden on the developing countries. For instance, developing country Parties will have their latest reporting year as three years (X-3) prior to the submission of their national inventory report as compared to X-4 earlier. So far, India has submitted two national communications to the UNFCCC containing the national inventories that were seven to eight years older than the submission years, with an eighth-year gap (2004 and 2012) in submission. However, India's two Biennial Update Reports (BURs) submitted in January 2016 and December 2018 respectively (about 3-year gap), contained inventories four years older than the submission years. With increased reporting requirements in place, not only the gap between reporting cycles needs to be optimized, but the inventory for more recent years needs to be prepared with greater sustainably. Strengthening and improvement of the national system for inventory preparation and management is, therefore, needed for which additional measures, both technical and financial, are required.

The Paris Agreement links the inventory to measuring a country's progress in relation to its NDCs. This is a new development and an innovation in the process of international disclosure of emissions of countries participating in the Paris Agreement. This development is important in light of Article 13 of the Agreement that talks of transparency of goals/targets and actions (NDCs) of countries and requires each participating country to go through a process of international scrutiny of its emissions and mitigation actions. During COP-24 at Katowice, Poland, it was decided that the Parties shall also submit Biennial Transparency Reports (BTRs). This has further intensified the burden on developing countries who have not yet been able to submit their BURs in regular time periods.

Given the change in the balance of international obligations under the Paris Agreement, it is critical for developing countries like India to build a strong, comprehensive, and modernized national inventory management system (NIMS) capable of capturing relevant information in detail and serving its NDCs. It is felt that the existing structure (discussed in Section 5) needs to be strengthened in order to cater to international obligations. It is also necessary that this system is built sooner rather than later so that the country is able to not only prepare the GHG inventories regularly, timely, and adequately, but also track the progress in achieving economy-wide and sectoral targets for emissions or mitigation actions embedded in the NDCs.

UNFCCC Mandate for NIMS

Transparency in reporting on various aspects of the Paris Agreement including NDCs and mitigation actions is another major requirement of the Paris Agreement relating to national reporting. Article 13 of the Paris Agreement mandates each Party to submit a national inventory report of anthropogenic emissions by sources and removals by sinks of GHGs, prepared using good practice methodologies accepted by the IPCC and agreed upon by the Conference of the Parties serving as the meeting of the Parties; and also provide information necessary to track progress made in implementing and achieving its NDCs.

Modalities, Procedures and Guidelines for Transparency were agreed in COP 24 at Katowice (UNFCCC, 2018). Key points of interest to national inventories are as follows:

(i) Each Party shall use the 2006 IPCC Guidelines, and shall use any subsequent version or refinement of the IPCC guidelines agreed upon by the CMA.

(ii) Each Party should make every effort to use a recommended method (tier level) for key categories in accordance with IPCC guidelines.

(iii) Each Party may use nationally appropriate methodologies if they better reflect its national circumstances and are consistent with the IPCC guidelines.

(iv) A Party may be unable to adopt a higher tier method for a particular key category owing to lack of resources. In such cases, the Party may use a tier-1 approach, and shall clearly document why the methodological choice was not in line with the corresponding decision tree of the IPCC guidelines.

(v) The Party should prioritize future improvement any key categories.

(vi) Each Party is encouraged to use country-specific and regional emission factors and activity data, where available.

(vii) Each Party shall identify key categories for the starting year and the latest reporting year.

(viii) To ensure time-series consistency, each Party should use the same methods and a consistent approach to underlying activity data and emissions factors for each reported year.

(ix) Each Party should use surrogate data, extrapolation, interpolation, and other methods consistent with splicing techniques contained in the IPCC guidelines to estimate missing emission values resulting from lack of activity data, emission factors, or other parameters in order to ensure a consistent time series.

(x) Each Party shall perform recalculations, ensuring that changes in emission trends are not introduced as a result of changes in methods or assumptions across the time series.

(xi) Each Party shall quantitatively estimate and qualitatively discuss the uncertainty of the emissions and removal estimates for all source and sink categories, including inventory totals.

It is clear that the arrangements for transparency under the Paris Agreement will require countries like India to enhance their capacity to prepare and file inventory reports as per the IPCC guidelines. India, along with major developing countries and all developed countries, is now required to produce BTRs at fixed 2-year intervals. The first BTR and national inventory report (if submitted as a stand-alone report) are to be submitted latest by 31 December 2024 (UNFCCC, 2018). While the obligation to file national communications (including the emissions inventory) as required under the Convention subsists, the Paris Agreement has replaced the requirement of filing BURs of inventories with a composite BTR consisting of a structured summary and additional information as per the extant provisions. Moreover, the inventory data will have to be collected and validated in a manner so as not to be less than 3 years older than the year in which the report is furnished to the UNFCCC.

The BTR will also be an instrument for measuring and tracking a country's progress on its NDCs. Countries filing BTR will be required to undergo scrutiny/assessment as per the agreed MPG under the Paris Agreement. The

current process that involves 'international assessment and review (IAR)' of the submissions of developed countries and 'international consultation and analysis (ICA)' of the submissions made by developing countries will be replaced by a process of technical expert review for both developed and developing countries (as a measure of 'transparency of action') and a facilitative, multilateral consideration of progress for the developed countries (as a measure of 'transparency of support'). Accordingly, it is expected that NIMS should create and handle a transparent process for preparation of inventory, NDC reports including structured summary, and technical (international) review under the MPGs. NIMS can also form the basis for developing a domestic MRV system for this purpose. The need for developing a strong MRV system is also expressed in India's BUR-2 (GoI, 2018).

The format of the structured summary in BTRs is still being negotiated. However, it is likely that information on indicators such as emissions; Land Use, Land Use Change, and Forestry (LULUCF); Internationally Transferred Mitigation Outcomes' (ITMOs) traded through agreed market mechanisms; and a self-assessment of whether the target has been achieved will form part of the BTR. Each reporting country will need to describe the methodology and accounting approach applied in the BTRs, in light of the IPCC guidelines and provide details of the results expected and achieved in terms of NDC goals. Besides, there will be a necessity of providing data and participating in the stock-take of global progress towards the climate stabilization goal; this will happen every five years. As the stock-take is designed to inform the next reporting cycle of the next NDCs, it has to be based on sound scientific inputs and data; the NIMS can help in this process if it is suitably equipped to prepare the data of emissions and make the necessary projections.

Another provision of the UNFCCC that makes NIMS relevant to a country is its possible participation in the international carbon trading. Article 6 of the Paris Agreement talks about voluntary cooperation for the implementation of NDCs to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity. This includes the use of ITMOs and mechanism to contribute to the mitigation of GHG emissions and support sustainable development (United Nations, 2015). In order for ITMOs to be usable towards NDCs, the parties involved 'shall' develop accounting systems that will be consistent with accounting guidance developed by the Subsidiary Body for Scientific and Technological Advice (SBSTA). Some of the submissions made to the UNFCCC in this regard propose a solution that rely on the use of tabular reporting formats, similar to what is being used for biennial reports (Marcu, 2017). The proposals are under consideration to apply 'corresponding adjustments' based on the amount of ITMOs traded. It is clear that trading requires a robust accounting of GHG emissions with monitoring and verification systems that could be assured only in the presence of NIMS. The proposals recognizes the need for establishing a NIMS and meta-registry of mitigation actions and associated emission reductions, in order to set up a market-based mechanism, strengthen MRV, and enhance transparency (GoI, 2017). As a part of the project 'Partnership for Market Readiness', India is aiming at establishment of an integrated data management and meta-registry for India's GHG emissions as per need. Specifications of such a meta-registry includes accounting for pre-existing market-based mechanisms and domestic registry architecture; IT infrastructure, hosting, and capacity; security, data management, and data confidentiality; interlinking between registries; communications protocol (MoEFCC, GoI, 2018). This is similar to what needs to be done for NIMS.

India needs to strengthen its national institutions for transparency-related activities. It will need to make a transition from existing temporary processes to a more continuous, sustained, and institutionalized process handled by permanent national institution(s) having adequate expertise in such matters.

Elements of NIMS

The IPCC *Good Practice Guidance* supports the development of inventories that are transparent, documented, consistent over time, complete, comparable, assessed for uncertainties, subject to quality control and assurance, efficient in the use of the resources available to inventory agencies, and in which uncertainties are gradually reduced as better information becomes available (IPCC, 2000). This requires sustainability in data availability and its management.

The methodology for preparation of GHG inventory, as recommended by the IPCC, prescribes certain basic

elements for its preparation. These elements consist of planning for inventory preparation, devising mechanism for collection, submission and reporting of data, ensuring quality assessment and certification of data, and assessment of uncertainty in preparation of the inventory. The NIMS must plan for the preparation of the GHG inventory through a work plan in accordance with the guidelines of the IPCC; identify and monitor individual sources and sink categories, and be responsible for the data collection network across various sectors of the economy. This includes the following steps:

- **Planning**: This involves identifying and selecting the institutions that would provide the inventory and emission factors, deciding the manner of contracting them, and delineating the tasks they would be expected to perform in the long run.
- **Preparation**: It requires a country to set up an agency that will take care of the above planned needs and also be responsible for providing the inventory numbers in time.
- **Reporting**: It involves collecting and accessing data from the identified sources and/or the institutions selected in the planning stage. Correct planning and preparation will make this step more sustainable, accurate, and consistent.
- **Documentation and archiving**: It is most relevant to document and archive the annual or periodical inventories to monitor, analyse, and also recalculate past emissions, if required, based on new data and discoveries.
- **Inventory improvement strategy**: Improvement requires an inventory improvement plan which must take into account: upgradation of country-specific emission factors, ensuring smooth flow of data, availability of disaggregated data for key category sectors, and advanced reference check methods (quality analysis/quality check).

In the course of developing a NIMS, it is important that a country starts by setting up proper institutional arrangements, as suited to its national circumstances, in order to allow for smooth and regular development of GHG inventories (CGE, n.d.). The inventory compiler should be responsible for coordinating the institutional and procedural arrangements for inventory activities. As per 2006 IPCC Guidelines (IPCC, 2006), it is a good practice for the inventory compiler to define specific responsibilities and procedures for the planning, preparation, and management of inventory activities described above, including the collection of data; selection of methods, emission factors, and activity data; estimation of emissions and removals; uncertainty assessment; and QA/QC.

The objective of institutional arrangements to be established for NIMS is to ensure smooth and regular development of GHG inventories. This involves fixing responsibilities and procedures for planning, preparation, and management of inventory activities described above. During the development phase of GHG inventories, it is equally important to document fully and systematically all the activity data and the methods used. Quality assurance and quality control will be critical, even as an archiving system (both for electronic and for paper versions of the information stored) will need to be created and maintained. Where possible, data quality objectives should be measurable. It is a good practice that countries improve the quality of national GHG inventory keeping in mind (IPCC, 2019):

- **Transparency**: The assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information.
- **Accuracy**: A relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals.
- **Completeness**: An inventory should cover all sources and sinks and gases included in the IPCC Guidelines for the full geographic coverage in addition to other existing relevant source/sink categories, which are specific to individual countries.
- **Comparability**: Estimates of emissions and removals reported by countries in inventories are comparable among countries. For this purpose, countries should use agreed methodologies and formats.
- **Consistency**: Means that an inventory is internally consistent in all its elements over a period of years. This happens if the same methodologies are used for the base year and all subsequent years and if consistent data sets are used to estimate emissions or removals.

International Examples of NIMS

In outlining the contours and elements of a possible national system of inventory management, it is useful to take into account the inventory reporting and management systems functioning in some of the emerging economies and developed countries. A few of these are described in the following sub-sections.

NIMS in Developed Countries

NIMS in Finland

In Finland, Statistics Finland is the national entity responsible for preparing the national inventory in collaboration with sectoral institutions. The system is managed through its law of statistics, protocols, agreements, and contracts (Figure 1). An advisory board, consisting of relevant ministries, Energy Market Authority, Finnish Environment Institute, Finnish Forest Research Institute, and Agrifood Research Finland, further looks into the preparation of the inventory. The Climate Law enforces Statistics Finland's role as the national entity, which has agreements with responsible ministries defining the responsibilities and collaboration in relation to the reporting requirements under the UNFCCC and Kyoto Protocol. By law, Statistics Finland has access to data collected under the EU ETS, regulation on fluorinated gases, the European Pollutant Release and Transfer Register (EPRTR) registry, and energy statistics regulation (Statistics Finland, 2018). The VAHTI system (compliance monitoring data system) of Finland's environmental administration is one of the main data sources used in the inventory. The VAHTI system functions as a tool for the 15 Centres for Economic Development, Transport and the Environment in their work on processing and monitoring environmental permits. The authorities check the quality of these data before accepting them to the VAHTI system (Statistics Finland, 2018). This ensures quality control at the source of data collection.

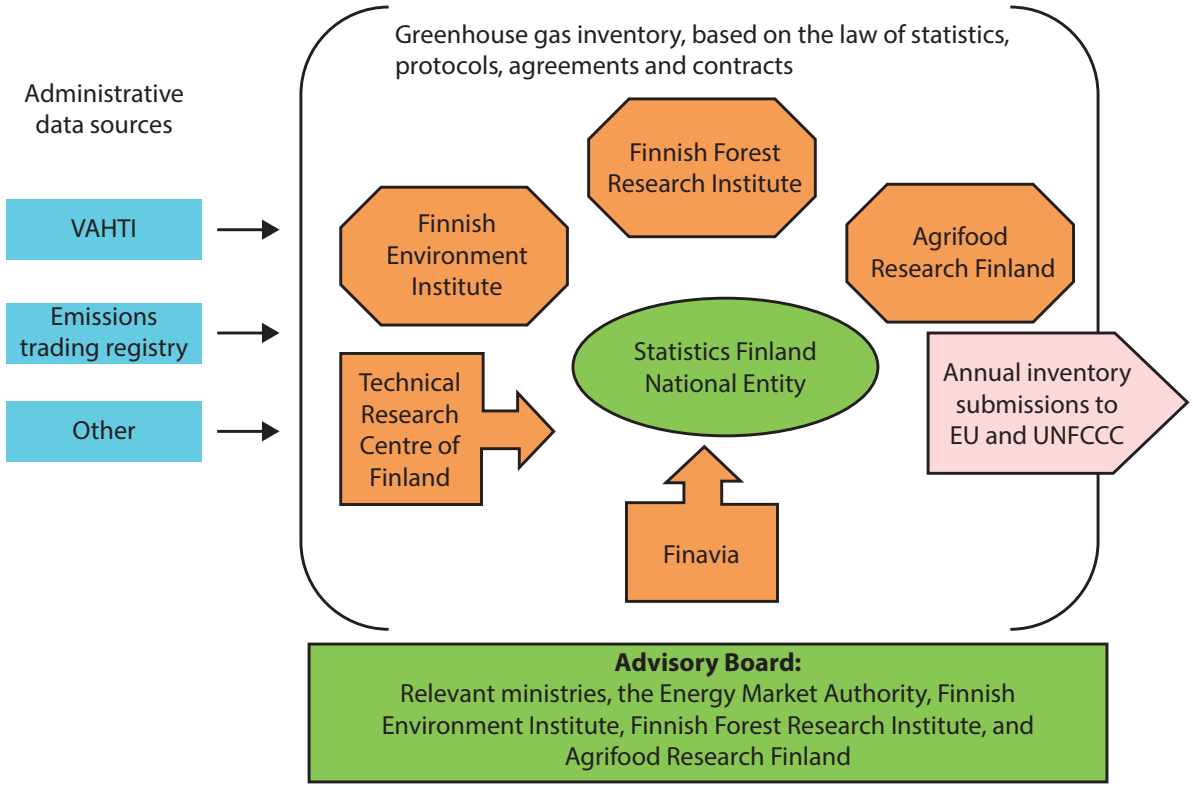

Figure 1: Finland's national inventory management system

Source: Statistics Finland (2018)

NIMS in the United Kingdom

Figure 2 shows the main elements in the UK national inventory system. Department of Energy and Climate Change (BEIS) is the single national entity responsible for submitting the UK's greenhouse gas inventory

(GHGI) to the UNFCCC. Ricardo Energy & Environment, a professional and independent entity, compiles the GHGI on behalf of BEIS, and produces disaggregated estimates for the devolved administrations within the UK. This arrangement ensures independence of data as well as continuity of expertise and stability of the management system. Data is derived from both official and unofficial datasets. Unofficial datasets include those from industries, NGOs, trade associations, and individual companies.

Legally, Section 85 of the UK Climate Change Act 2008 mandates the Secretary of State to make regulations under Section 416(4) of the Companies Act 2006 (c. 46) requiring the directors' report of a company to contain such information as may be specified in the regulations about emissions of GHGs from activities for which the company is responsible, or lay before Parliament a report explaining why no such regulations have been made (Climate Change Act 2008, 2008).

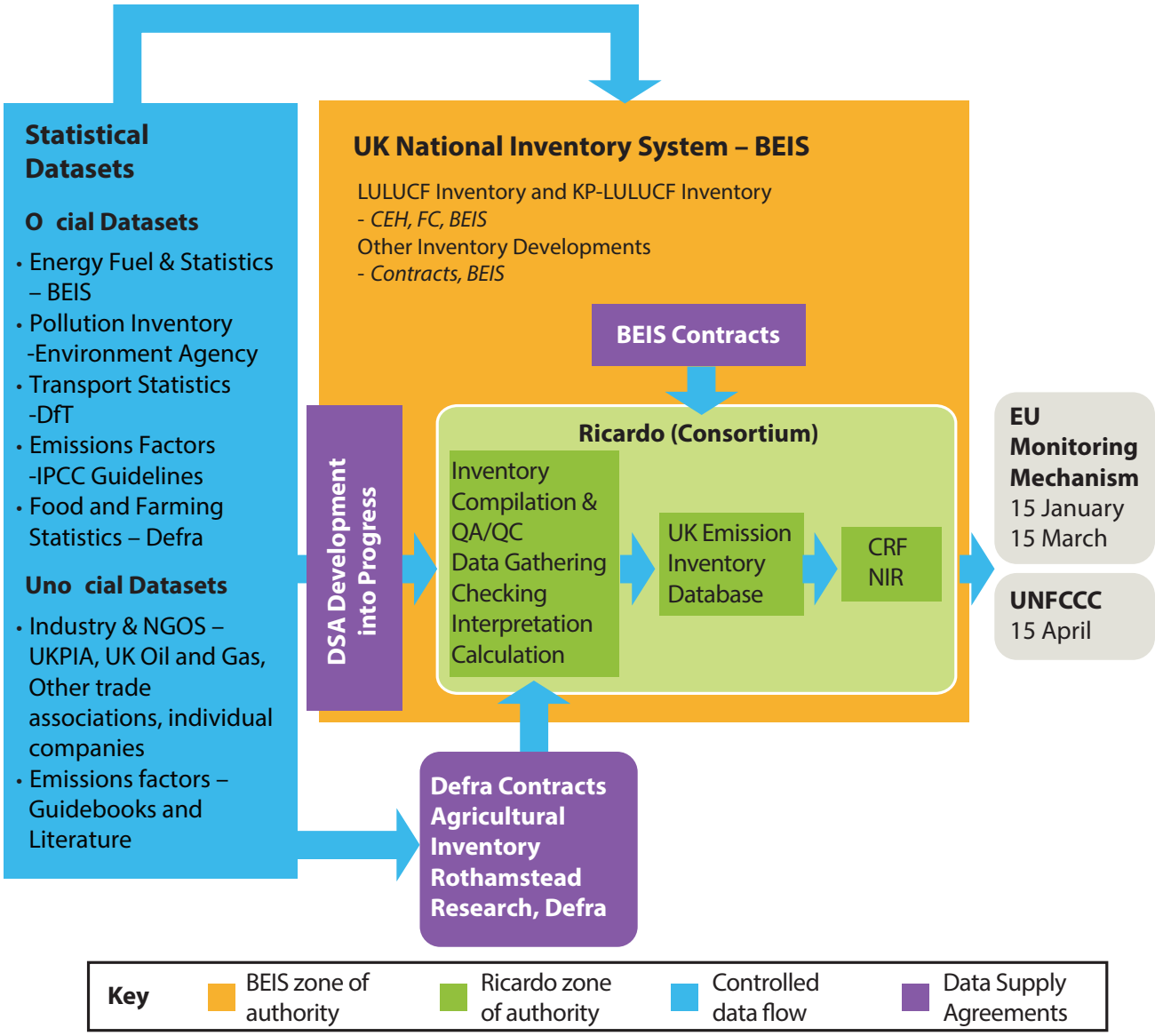

Figure 2: UK's inventory management system

Source: Details available at http://naei.beis.gov.uk/about/national-inventory-system

NIMS in Germany

The main agencies and levels involved in the national reporting system of Germany are

- the federal departments,
- the Federal Environment Agency, and
- organizations/institutions outside of the federal government/administration.

A national coordinating committee includes representatives of all federal departments involved in the inventory supports emissions reporting process (Figure 3). It also clarifies open issues pertaining to the national system. The Federal Environmental Agency serves as the single national entity for emission reporting. It has the tasks of 'planning, preparing and archiving of inventories, describing inventories in the inventory reports and carrying out quality control and assurance for all important process steps'. For the execution of these tasks, the working group on emission inventories was set up within the Federal Environmental Agency. In the framework of the national system, the ministries are obliged to provide reliable data in accordance with their scope. The Central System on Emissions (CSE) database of the FEA is the national database for emissions calculation and reporting (FEA, 2011).

NIMS in Norway

The Norwegian CO_2 emission inventory has been produced for more than three decades. It started as a collaboration between Statistics Norway and the Norwegian Environment Agency, and the reporting to the UNFCCC has evolved based on this GHG emissions inventory. The Norwegian Environment Agency, Statistics Norway, and the Norwegian Institute of Bioeconomy Research (NIBIO) are the institutions in the national GHG inventory system in Norway (Figure 4). Statistics Norway is responsible for the calculation of emissions from the energy, IPPU, agriculture, and waste source categories. The Norwegian Institute of Bioeconomy Research is responsible for the calculations of emissions and removals from LULUCF. The Norwegian Environment Agency is the national entity. The institutions are committed to implementing the QA/QC and archiving procedures, providing documentation, making information available for review, and delivering data and information in a timely manner to meet the deadline for reporting to the UNFCCC (Norwegian Environment Agency, Statistics Norway, and Norwegian Institute of Bioeconomy Research 2018).

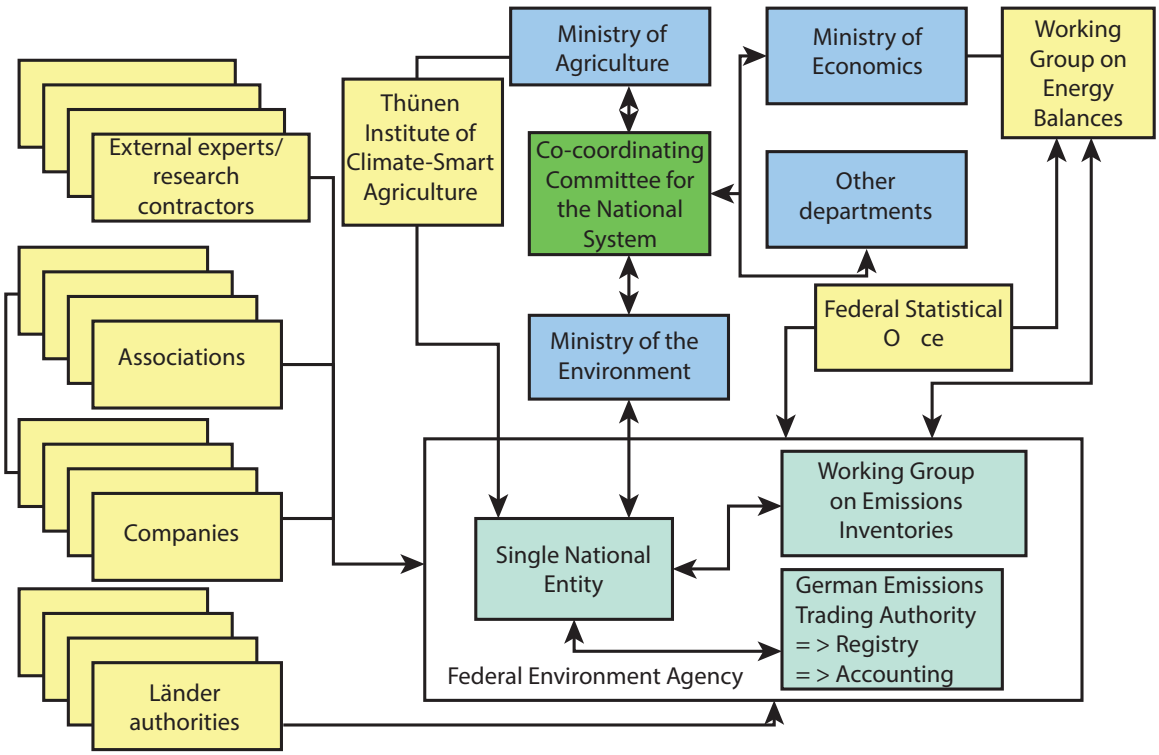

Figure 3: Germany's inventory management system

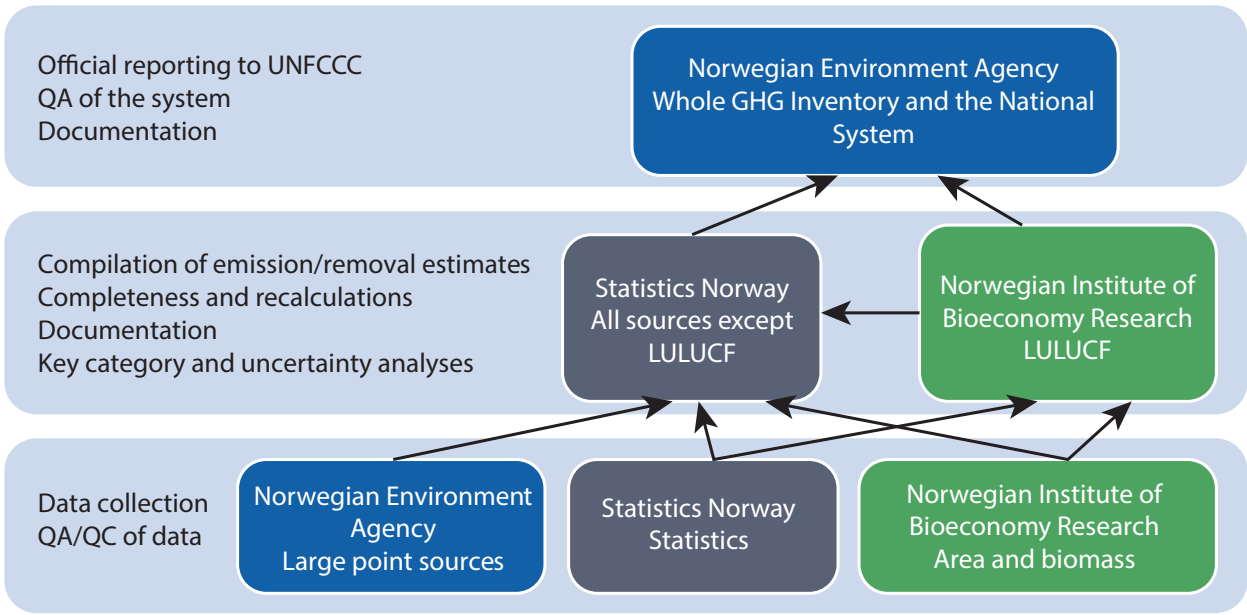

Figure 4: Norway's inventory management system

Source: Norwegian Environment agency et al. (2018)

NIMS in the United States

The Environment Protection Agency (EPA) is the national entity for inventory preparation in the United States and works with source leads in different sectors to collect activity data. The US EPA is responsible for finalization of the inventory (Figure 5) including key source category analysis (KCA), QA/QC, etc. The management team is placed in the EPA and the data is collected from energy departments, universities, national departments (USDA, USGS, USFS, etc.), trade associations, and consultants (Hanle, 2004). Peer and public reviews are conducted before data archival. To ensure flow of data from industries and other businesses, confidential business information (CBI) used for development of inventory calculations is kept private in line with the EPA internal guidelines, as well as regulations (Code of Federal Regulations part 2,

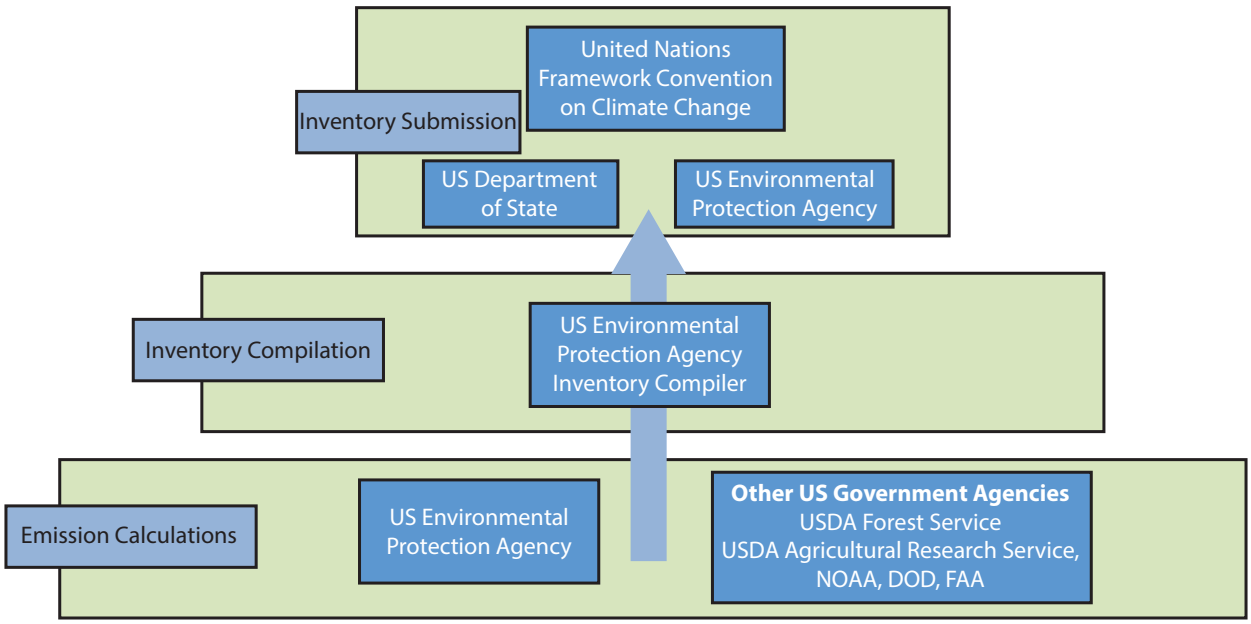

Figure 5: National inventory management system of the US

Source: EPA (2018)

Subpart titled 'Confidentiality of Business Information') applicable to the data used. EPA procedures ensure that these confidential data are sufficiently aggregated to protect confidentiality while still providing useful information for analysis (EPA, 2019).

NIMS in Canada

Environment and Climate Change Canada (ECCC) is the federal agency responsible for preparing and submitting the national inventory. ECCC has defined the roles and responsibilities for the preparation of the inventory. As such, ECCC is involved in many agreements, formal and informal, with data providers and expert contributors. They include: partnerships with other government departments, namely Statistics Canada, Natural Resources Canada (NRCan), Agriculture and Agri-Food Canada (AAFC); arrangements with industry associations, consultants, and universities; and collaborative bilateral agreements with provincial and territorial governments (Figure 6). Canada's national statistical agency, Statistics Canada, provides ECCC with a large portion of the underlying activity data to estimate GHG emissions for the Energy and the Industrial Processes and Product Use sectors. ECCC has officially designated responsibilities to Agriculture and Agri-Food Canada and the Canadian Forest Service of Natural Resources Canada (NRCan/CFS) for the development of key components of the LULUCF sector. This has been formalized through memoranda of understanding (MOUs). The Greenhouse Gas Reporting Program (GHGRP) was established in 2004 to collect GHG emissions information annually from facilities across the country. Under this mandatory reporting program, reporting requirements are described in the legal notice issued under Section 46(1) of the Canadian Environmental Protection Act, 1999 (ECCC, 2020).

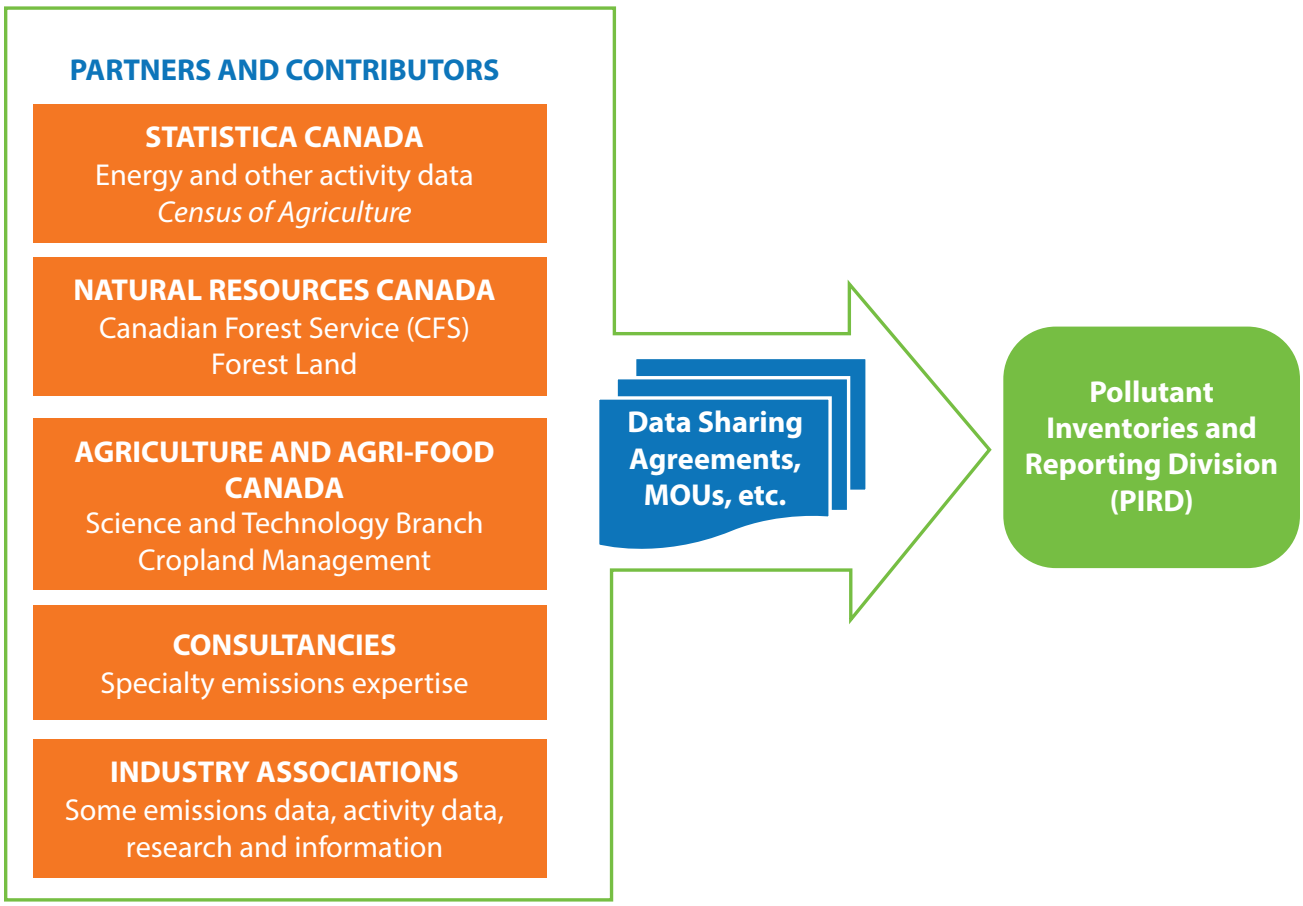

Figure 6: Canada's national inventory management system

Source: ECCC (2020)

NIMS in Developing Countries

NIMS in Republic of Korea

The Korean NIMS consists of multiple institutions. The Korea Energy Economics Institute manages the energy sector inventory and there are other ministries and academic institutions that manage the remaining sectors. The compilation and QA/QC are completed by the Greenhouse Gas Inventory and Research Centre (GIR) in Seoul, South Korea (Figure 7). To facilitate the functioning of the system, the GIR, which was earlier part of South Korea's Ministry of Environment, is now placed under the Prime Minister's Office, hence making it an umbrella institution for inventory preparation and data archival. A system known as the Clean Air Policy Support System, an annual national emissions data system, aids in inventory preparation since 1999 (TERI, 2018). Both the top-down (national inventory) and bottom-up approaches (including inventories at the local government prepared in line with the green growth plans of the central government) are followed simultaneously and alternatively.

NIMS in China

China has established a national system for GHG inventory development. China's National Development and Reform Commission is responsible for inventory preparation, including selected domestic research institutions and universities, working with the National Bureau of Statistics (NBS) to provide data for inventory and establish national GHG inventory database. The materials supporting the inventory are archived. NBS has established a sector statistical reporting system which has increased the types of energy statistics in a detailed way to gradually incorporate the activity data required for inventory preparation into the government statistical system (P.R. China, 2016). Such a system also provides a legal backing and helps in collecting data from industries and other key category sectors.

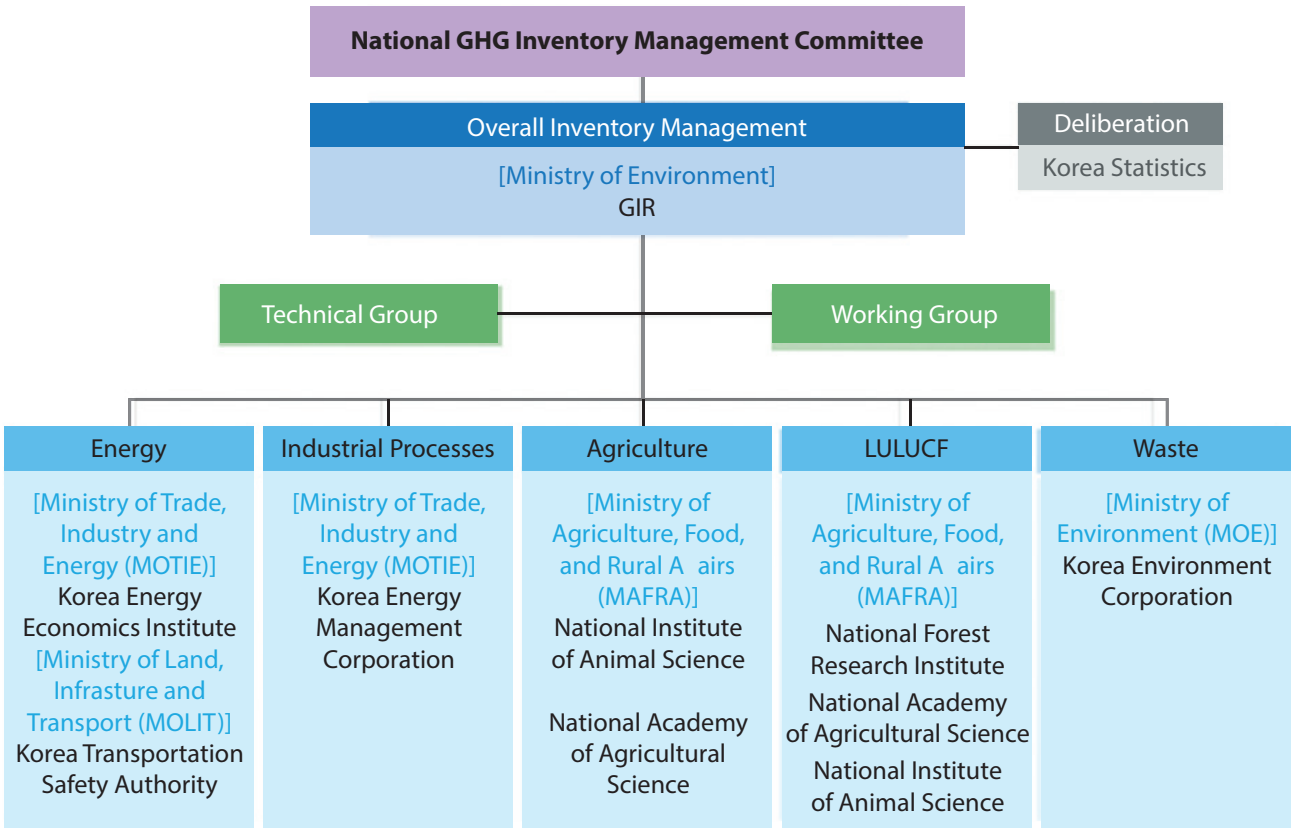

Figure 7: South Korea's national inventory management system

Source: The Republic of Korea (2014)

NIMS in Brazil

The Ministry of Science, Technology, Innovation and Communications (MCTIC) coordinates the preparation of the national emissions inventory, including by convening different working groups that survey sectoral information and conduct studies to obtain country-specific emission factors. The respective sectoral reference reports, which transparently describe methodological details with indication of data sources and the assumptions adopted for the preparation of the inventory, are also filed in the MCTIC. These reports, initially available on the MCTIC's webpage, are publicly available at the National Emissions Registry System (SIRENE) website. In 2017, the MCTIC was officially charged with implementing and maintaining SIRENE to provide security and transparency to the preparation of national GHG emissions inventories. Since 2016, the national emissions estimate database has been hosted on the MCTIC's servers and is also publicly available on the SIRENE website (Federal Republic of Brazil, 2019). Brazil's inventory management system is described in Figure 8.

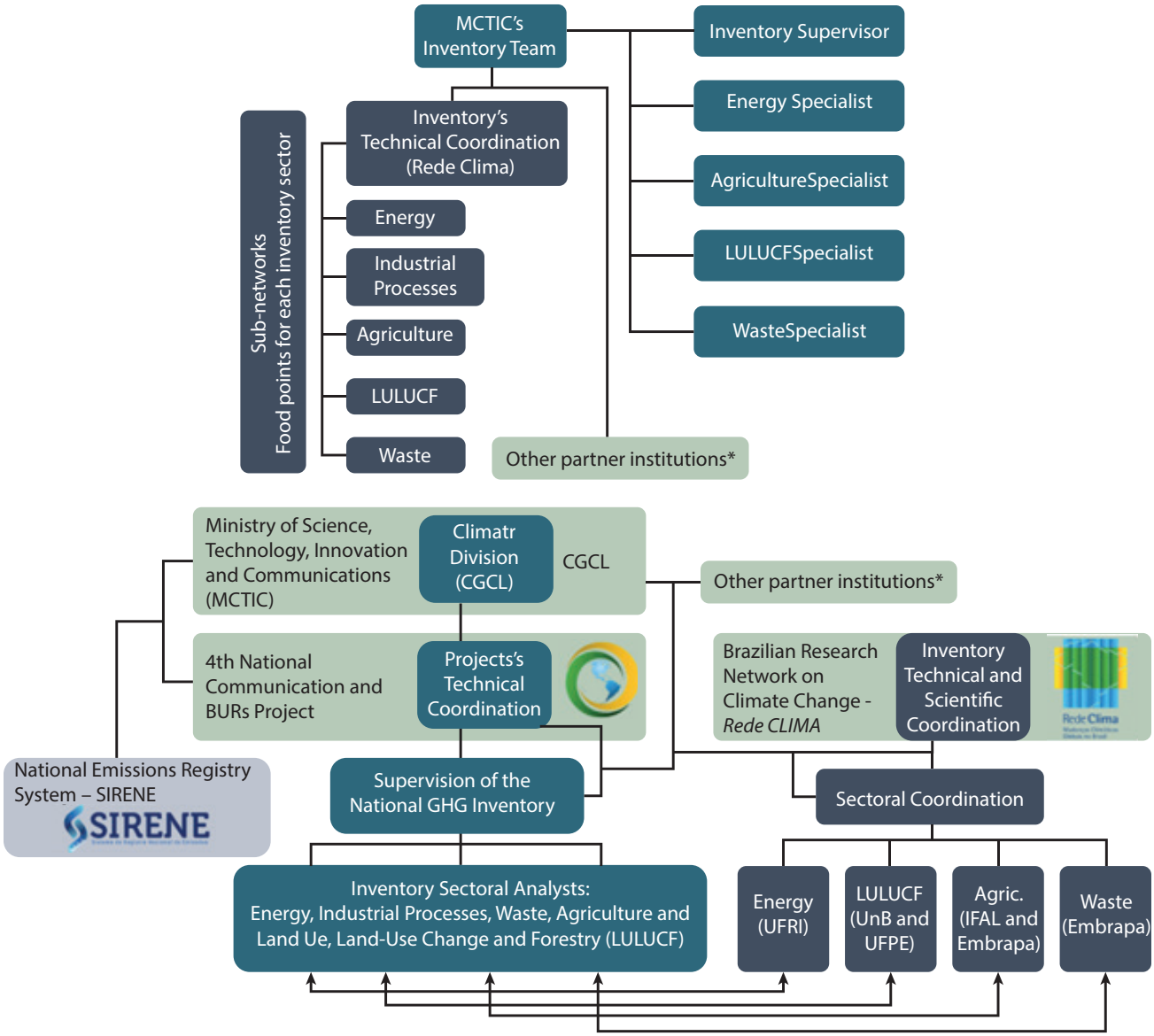

Figure 8: Brazil's national inventory management system

Source: Federal Republic of Brazil (2019)

NIMS In South Africa

Department of Environmental Affairs (DEA), the national entity, is responsible for the preparation of inventory in South Africa (Figure 9). Below DEA, is the Chief Directorate of Monitoring and Evaluation which manages all the IPCC sectors. There is currently no legal mechanism to formalize information flows through this institutional arrangement to ensure consistent and sustainable data input for the GHG inventory. This is currently being addressed though the development of GHG reporting guidelines under the existing National Environmental Management Act: Air Quality (Act No. 39 of 2004, as amended) and the National GHG System. South Africa's National Greenhouse Gas Emissions Reporting Regulations were published in April 2017, thereby officially launching the company-level GHG reporting program in South Africa (Rebublic of South Africa, 2017). South Africa is developing a National Atmospheric Emissions Inventory System (NAEIS) that will manage the mandatory reporting of GHG emissions (TERI, 2018).

Existing Management Structure in India

The national GHG inventory in India is compiled by a central unit called the NATCOM (National Communication) Cell/Project Management Unit (PMU) which currently runs in a project mode under the GEF-UNDP-GOI NATCOM project. It is placed in the Ministry of Environment, Forest and Climate Change (MoEFCC) with a team of individual consultants reporting to a senior officer of the ministry. A schematic representation of the existing structure is given in Figure 10. Although the format and content of the inventory is in line with the internationally agreed methodology for preparation of inventories by developing countries, this work is performed through a periodic process of data collation and coordination amongst the relevant agencies of the Central Government, selected scientific and research institutions, and a few researchers and academicians in their individual capacity. The process is dependent on data inputs and sources, co-opted on *ad-hoc* basis.

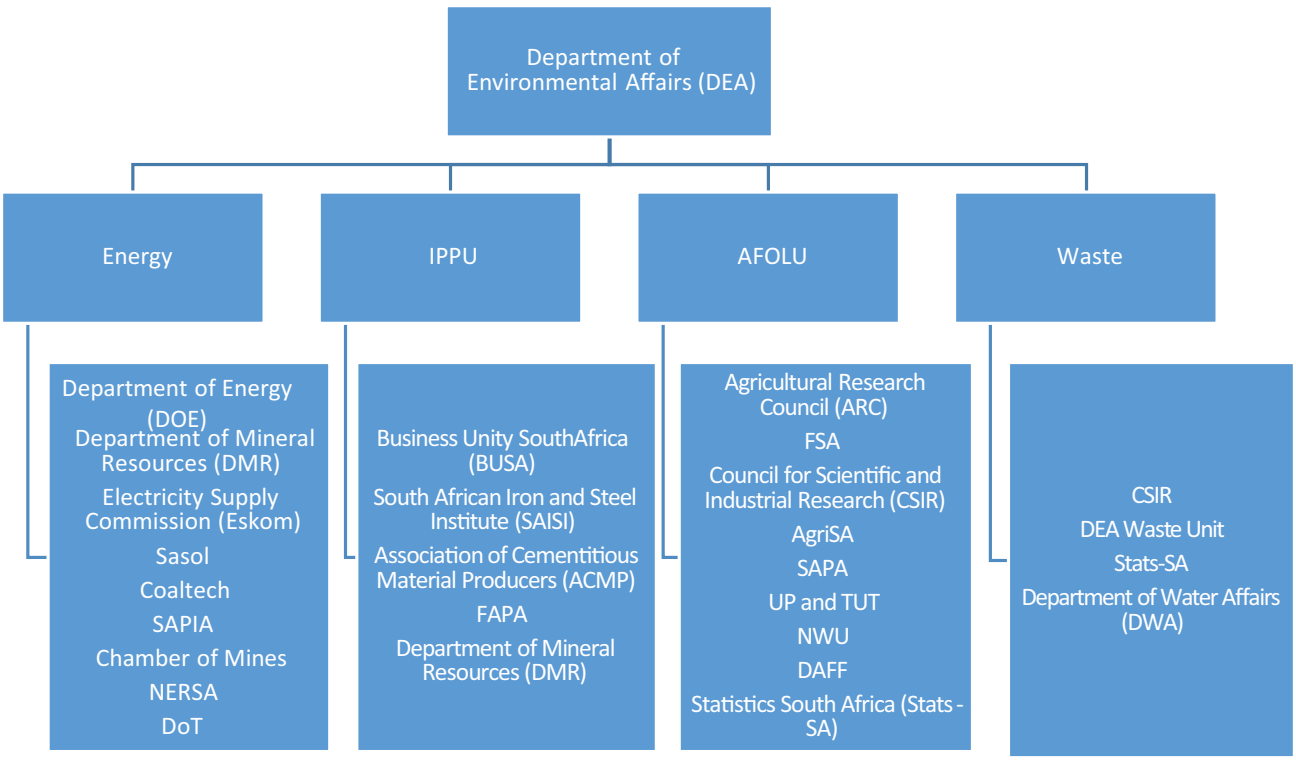

Figure 9: Institutional arrangement for national GHG inventory preparation in South Africa

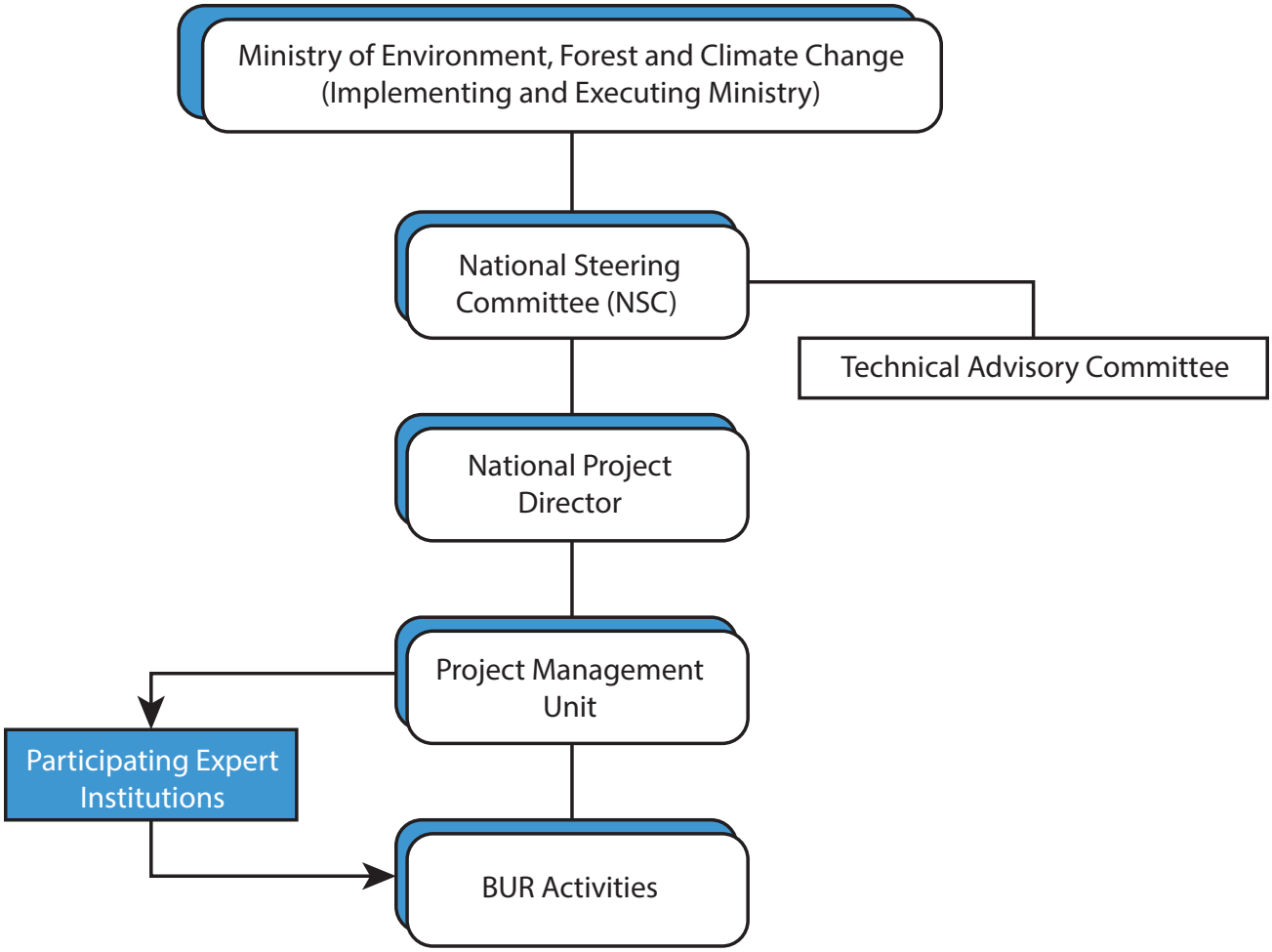

Figure 10: Present structure for inventory preparation and management.

Source: GoI (2018)

The NATCOM cell of the MoEFCC has the responsibility of coordinating with various expert institutions to prepare and submit the national communications. The MoEFCC, being the implementing and executing agency of the GEF-UNDP-GOI NATCOM project, assigns several studies and conducts stakeholder engagement activities including workshops and national consultations for the preparation of BUR. A network of scientific institutions and ministries are engaged for the data collection and compilation covering the IPCC sectors (Annexure 1). A technical advisory committee (TAC) is constituted with experts from academia, research, and other relevant groups while the National Steering Committee, in the form of an inter-ministerial body, chaired by the Secretary (MoEFCC), looks after the preparation and submission of the inventory.

The activity data is collected from the ministries by the expert institutions engaged by the MoEFCC for the preparation of sectoral inventories. Research and experiments required to develop country-specific emission factors are conducted by these institutions which are assigned the task through mandate (with or without a legal contract) valid for the relevant cycle of national communication. To facilitate and fast-track the process, the MoEFCC sends out requests to other ministries to provide data to the expert institutions, if so needed. A lead institution compiles the inventory for a specific sector and submits it to the NATCOM cell, which is responsible for the finalization of the inventory after a multi-tier review process. Inventory quality check is the responsibility of the expert institutions while inventory quality assurance is the responsibility of the ministry.

Notably, in the present system, data is collected on need basis and at infrequent intervals. The expert institutions are selected by the ministry and are contracted for each inventory cycle separately. These institutions prepare and submit their sectoral inventories as per their mandate in the TORs of the respective studies. This is not the case in many other countries with more systematization, where one organization leads the preparation of inventory for all sectors, while fixed selected institutions for different sectors conduct experiments to upgrade the emission factors and provide updated inventory numbers. A central agency, usually a statistical organization (akin to MoSPI in India), or the nodal environmental agency collects and archives inventory-related data.

Comparison between Existing Inventory System in India and Other Countries

From the description of some of the important examples of established inventory management systems in 'International Examples of NIMS' it is evident that the data management systems can vary considerably in terms of their functions, forms, operational resources, and system access arrangements, depending on a country's specific context (Damassa *et al*. 2015). While there are many significant differences, there are also some similarities in the institutional arrangements. A comparison of the key features of the NIMS in developed/developing countries and the existing arrangements in India is given in Table 1.

Table 1: Comparison of important institutional arrangements between developing and developed countries

Components	NIMS in Developed Countries	NIMS in Developing Countries	India
National entity	• One umbrella institution (national entity) to handle inventory related issues • Sustainable • Acts as the national inventory compiler	• A national entity handles inventory work • Project base	• One ad-hoc entity (NATCOM Cell within the MoEFCC) to handle inventory-related issues but runs on a project basis • Non-sustainable • NATCOM Cell/ PMU compiles the inventory
Data collection system	• Centralized	• Centralized/non-centralized	• Non-centralized
Inventory preparation	• Done by a set of institutions each year • Long-term MoUs/legal regulations	• Done by a set of institutions each year	• May be done by the same or a different institution depending upon the availability of capacity and financial resource • Contract-based studies • No MoUs
Frequency	• Prepared each year by Annex-I countries with an established NIMS	• Prepared biennially but depends on the availability of GEF funds	• Prepared biennially but depends on the availability of GEF funds
Online platform/ Archival	• Available	• Some countries have developed an online archival system. E.g.: SIRENE (Brazil)	• No online/offline archival system

Data Management	• Statistics department of the countries play a major role in maintaining and sharing the data	• Statistics agency is mostly involved	• MoSPI is part of the national steering committee and is also a data source. However, MoSPI is not directly involved in preparation of inventories
Legal regulations	• Laws in place to remove hurdles of data collection for inventory preparation	• Lacks strong legal regulations to assure continuous flow of activity data	• No specific law mandating data collection specifically for the preparation of GHG inventory • Monitoring of other gases (non-GHG) done by CPCB

Both administrative and legal gaps exist in the functioning of NIMS between developed and developing countries. In the case of India, institutional structures do exist but there is a lack of proper legal regulation to streamline flow of data. A central designated authority to manage and prepare the inventory is also absent. For instance, in Finland, the VAHTI system is the main source of data which is a compliance data system and contains information on how installations comply with environmental regulations. The CPCB could play a similar role in India but currently it has no role in inventory preparation. Moreover, CPCB does not maintain GHG-related data considering that most of them are not criteria pollutants. But it does collect and can provide non-energy data. Similarly, statistics departments play a major role in preparation of the inventory and thus, inventories are prepared in collaboration with statistics departments (for example in Norway, UK, and Germany). For Finland, it is the central designated authority. These departments in most countries have legal authority to collect and use inventory-specific data:

a. Finland: Law of Statistics and other protocols and agreements
b. UK: UK Climate Change Act 2008 mandates regulations under their Companies Act 2006
c. United States: Environment Protection Agency guidelines and regulations; Confidentiality of Business Information
d. Canada: The Greenhouse Gas Reporting Program (GHGRP), 2004 under Section 46(1) of the Canadian Environmental Protection Act, 1999
e. South Korea: Clean Air Policy Support System
f. South Africa: National Greenhouse Gas Emissions Reporting Regulations

In India there is no specific regulation that mandates the collection of inventory specific data (discussed in 'Legal/Administrative Framework for NIMS' Also, there is no established web-based system to store and process relevant data. In many other countries, however, systems have been put in place to ensure sustainable flow of data and preparation of inventories:

a. Finland: Compliance data system (VAHTI)
b. Germany: Central System on Emissions (CSE) database
c. China: National Bureau of Statistics established the Sector Statistical Reporting System
d. Brazil: National Emissions Registry System

Initiatives by Civil Society and Corporate Sector

In the context of development of a national inventory management system in India, it is interesting to note that some non-government agencies in private and corporate sector have taken initiatives to collect activity data and prepare inventory on a voluntary basis, which is often reported to institutions and civil society within and without the country for public use.

Some of them have launched their own web-based platforms, which make the inventory data available in downloadable excel sheets in the IPCC format. The following are examples of some of such initiatives:

GHG Platform India – GHG Platform India, a civil society initiative launched by Shakti Sustainable Energy Foundation and Vasudha Foundation, aims at estimating and analysing India's GHG emissions across key sectors such as energy, waste, industry, agriculture, livestock, forestry, and land-use and land use change sectors. The platform includes institutions such as Council on Energy, Environment and Water (CEEW), Centre for Study of Science Technology and Policy (C-STEP), Local Governments for Sustainability (ICLEI), and WRI India (GHG Platform India, n.d.). The platform currently hosts national estimates for GHG emissions from 2005 to 2015 by accounting CO_2, CH_4, and N_2O gases. The activity data is collected from publicly available information/published reports of relevant ministries and other government departments.

India GHG Programme: The India GHG Programme, led by WRI India, Confederation of India Industry (CII), and The Energy and Resources Institute (TERI), is an industry-led voluntary framework to measure and manage GHG emissions. The programme aims at building strategies to measure and manage emissions and drive more profitable, competitive, and sustainable businesses and organizations in India. The CII is currently developing a new web-based platform for the IPPU sector that may provide data and enrich inventory reporting from the sector.

Carbon Disclosure Project (CDP): CDP is a not-for-profit organization that runs the global disclosure system for investors, companies, cities, states, and regions to manage their environmental impact (CDP, n.d.). Although an open data is available with CDP, it is not necessarily India specific and covers only a few industries. For a national-level assessment, a lot more data would be required from all the sectors.

These efforts, however, face challenges and constraints due to the unavailability of complete activity data from all the sectors. Most of them are limited to a particular sector/sectors and lack completeness. Similarly, India's system also faces challenges which are discussed in the next section.

Constraints and Gaps in Existing Inventory Management System

Although India is far ahead of many developing countries in inventory preparation, the system of preparing, documenting, and managing the national GHG inventory suffers from several inadequacies and difficulties. These arise, not in a small measure, from non-availability of regular, complete, and accurate data. India needs to develop a comprehensive, effective, and accurate system for inventory preparation and management that meets national and international expectations. The issues in implementation of the existing inventory management system in India are discussed in this section.

Methodological Issues and Data Availability

The quality of activity data is crucial for an accurate and complete GHG inventory. Methodological tiers need to be chosen for each category. At present, many countries are facing problems in data availability and accessibility, especially the that is considered to be confidential, including data from the industries. Mostly, such data relates to the key source categories (energy and industry sectors). In India, official statistics are available for most key sources but there is no legal backing for the continuous and timely flow of the data. Existing challenges in the key sectors of inventory preparation are described below:

Energy sector

The energy sector inventory is predominantly based on the Tier-2 and Tier-3 approach for CO_2 emissions and the Tier-1 approach for CH_4 and N_2O emissions. This implies employing activity-wise total fuel consumption for activity data and country-specific or IPCC default fuel emission factors. Thus, going forward, the first key challenge is to increase the sectoral coverage and data collection in all the fuel-consuming industries.

Secondly, there is uncertainty in GHG emissions even in the organized sectors, which are major GHG emitters. The uncertainty is particularly high in sectors such as non-specified industries, residential, commercial/ institutional, natural gas production, and transport. The key challenge here is to improve the accuracy of activity data generation in these industries. For example, a large share of emissions is allocated to nonspecific industries category, which may be due to unallocated fuel to the respective sectors. Out

of the total emission of 351,909.54 Gg CO_2e (GoI, 2018) from the manufacturing industries and construction, 36% was attributed to non-specific industries. Allocating this emission to their respective industry will help in recognizing the key source categories effectively and improve the robustness of the system.

Thirdly, to jump the tier ladder and eventually develop Tier-3-based inventories for CO_2, CH_4, and N_2O gases, it is imperative to inventorize the types of combustion technologies that are being used in each plant. As the CH_4 and N_2O emission factors depend on not only the fuel being used but also the boiler technology as well as the operating conditions, it is worthwhile to undertake studies on the fuel–boiler configuration combination being employed in each plant. In addition, while the Annual Survey of Industries categorizes plant-wise fuel consumption for each fuel type, it is necessary to obtain fuel consumption in each of the combustion equipment to get a more disaggregated picture of the total GHG emissions. Also mine-specific fuel quality data, i.e. net calorific value (NCV) and emission factor (EF), and its traceability to the place of consumption, is required.

The BUR preparation process in the last six years has seen some significant improvements in the GHG inventory process with respect to the previous submissions of national communications. This is evident from the fact that ICAs are now being conducted. In the energy sector, these included, amongst other aspects, developing sector-specific emission factors for some of the fuels and improving the quality of activity data through better accounting of fuels consumed in different sectors. New country-specific emission factors are under development.

IPPU sector

In the IPPU sector, a majority of industries are small, unorganized, and scattered and, therefore, the biggest challenge is to obtain a reliable dataset. Except for cement, iron and steel, and aluminium, inventorization of other sub-sectors often requires collection from individual plants and listed companies. Tier-2 methodologies and country-specific emission factors were used for cement and iron and steel, and Tier-1 methodology and IPCC default emission factors were used for all the other sub-sectors. However, Tier-1 methodology was used predominantly for CH_4 and N_2O emissions in all the sub-sectors. Therefore, one of the challenges is creating mechanisms for inventorization of industries within each sub-sector for fast and efficient data collection.

Specifically, while reporting on iron and steel industry, one of the top emitting sectors, the national inventory still does not distinguish between coal consumed for energy use in iron and steel plants and the coking coal used as a reducing agent in the blast furnace for iron, which is a chemical process covered under the IPPU category. In the past submissions, iron and steel emissions have been reported within the energy sector. This issue needs to be resolved. One of the ways to solve this problem can come from increasing activity data resolution wherein a detailed technological study of processes within the plant will also be beneficial in determining the amount of coal used for different processes. This could very well be extended in the case of cement and aluminium.

LULUCF sector

Currently, based on Tier-2 methodology, it does not face many data challenges which are available with the National Remote Sensing Centre (NRSC). It has the capacity to generate and provide three-year-old data as per the new MPGs. Inventory improvements were also done in this sector in the last BUR submission by employing country-specific biomass conversion and expansion factor. Other improvements, including soil carbon accounting, have been planned. However, process-based modelling is needed for upscaling and with that inventory can be generated on an annual basis. Capacity building is needed due to the variety of spatial data and different climate variables that the sector deals with. For example, GHG inventory for wetlands is not produced yet even though the wetlands have been inventorized and assessed by the Space Application Centre (SAC, 2009).

Waste sector

As per 2006 IPCC guidelines, GHG emissions from the municipal solid waste sector can be estimated accurately by using five half-cycle period data on solid waste generation, collection, and disposal as well as characteristic of waste. In India, time series data for five half-cycle period (equivalent to 50 years) in the waste sector is not available. As the half-life of waste can be calculated based on India's average's temperature and precipitation value, and it will vary from region to region based on precipitation and average temperatures. In

addition, methane correction factors used are the default IPCC values and obtaining India-specific values is a key challenge.

Cities, generally, do not quantify and characterize the domestic wastewater generated. There is a need to establish these values on a city level owing to the impact of environmental, social, and economic factors. Data on actual waste water quantity treated in the existing treatment plants and treatment efficiency over the years are not available in the public domain. Further, data on methane generation, recovery, and flaring from the existing treatment plants is not documented. Regional data on the per capita BOD discharge and correction factor for additional industrial BOD discharged into sewers according to the Indian conditions is a challenge.

Data on the emissions factor of methane generation as per unit of the COD is as per the IPCC 2006 Guidelines, which in turn needs to be validated for Indian conditions. The methane correction factor for each industrial sector based on the treatment technology is a challenge. Data on protein consumption is not available which determines N_2O emission estimates, as per the 2006 IPCC Guidelines.

New methodologies need to be devised to fill these gaps as also to ensure that the data does not compromise the transparency requirements under the Paris Agreement and allow for information safeguards. In the case of unavailability of data for a particular set of years/few years, data gaps are filled up through the data splicing techniques such as surrogate method, overlap method, interpolation method, and extrapolation method. This process is carried out by sectoral experts. However, if actual activity data becomes available at a later date, recalculations with that data are needed to improve and refine the inventory.

Capacity Building

Building additional capacity is a necessity for implementing the MPGs of enhanced transparency framework (ETF), especially in a huge country like India with multiple data sources and users. India needs to strengthen national institutions for transparency-related activities. The transparency of India's climate-related actions can be enhanced over time if adequate capacity to implement such systems is created.

While a central designated authority (CDA) could be entrusted with the task of preparing the sectoral/thematic GHG inventories in coordination with external or internal experts and handling the above tasks, the staff of the designated agency will still need to update their knowledge and skills in managing and preparing inventories. At the same time, capacity building will be needed in other organs/ministries/agencies of the government and corporate sector from where the data is to be sourced: their ability and skills in providing requisite data for preparing the inventory needs to be enhanced, especially if they are key data providers. Capacity is also needed for better inter- and intra-team communication to facilitate mutual and reciprocal requirements during the preparation of the inventory. Identification of various capacities and gaps to match the higher tiers of inventory is a pre-requisite. A sector-wise gap assessment would be more helpful in preparing the national inventory improvement plan.

In future, sector- and stakeholder-specific inventory training courses may be organized by the CDA, either directly or through designated institutions. This will help in training the staff designated for providing inventory relevant data in different ministries/institutions/industries. This will also build capacities of the CDA staff and ensure accuracy in national inventory estimates. The current capacities of the staff and expert institutions (part of existing institutional structure of NATCOM) may be retained to eliminate the need to start from scratch. So far, there is no staff retention policy that may be seen as an institutional capacity challenge (Prasad and Gupta, 2019).

Para 85 of Decision 1/CP.21 establishes a capacity-building initiative for transparency in order to build institutional and technical capacity, both pre- and post-2020, in countries that need it. This initiative will support developing country Parties, upon request, in meeting enhanced transparency requirements as defined in Article 13 of the Agreement in a timely manner. India can also benefit from this facility if it considers it necessary and expedient to do so.

Finance and Technology Needs

The Convention requires that the Parties listed in its Annex II support the Parties not listed in its Annex I for the national reporting on agreed full cost basis.

Most developing countries are being funded through the global environment facility (GEF) to prepare their inventories. To establish a sustainable NIMS, a stable and sustained budget needs to be allocated from the national funds. This purely depends on the developmental priorities of a country and how much budget is actually available. Many a times, a short delay in the funding can delay the inventory process by a year or more. Likewise, advanced technology to monitor real-time emissions and upgrade emission factors is lacking in most developing countries. There needs to be a strong focus on both, technology and knowledge transfer, including sharing of best practices that can help improve the accuracy and reduce uncertainty of the inventory.

Setting up a Centralized NIMS for India

Keeping in view India's long experience with its NATCOMs and BUR, as also the models of inventory management systems in some other countries where the requirements are more stringent, it is felt that the existing GHG inventory management system is reformed and strengthened. For more frequent and accurate reporting of national GHG inventory data as per Decision 1/CP.16 and Decision 2/CP.17, and Decision 18/CMA.1, it is appropriate that the GHG preparation process shifts from a project-based approach to a more internalized and institutionalized approach (CGE, n.d.) in which information is handled dynamically and delivered according to the most recent international guidelines.

This section discusses the essential elements and prerequisites to set up a GHG inventory management system in India based on the UNFCCC Resource Guide for Preparing the National Communications of Non-Annex I Parties (UNFCCC, 2009).

STEP 1: Planning the overall preparation of the GHG inventory and the preparation of individual source and sink categories requires an inventory work plan and inventory preparation instructions. To serve this purpose, one single entity (CDA) needs to be formed that

1. Defines inventory products and plans dissemination of results.
2. Establishes rules, procedures, and guidelines for the overall inventory preparation.
3. Is responsible for the preparation of appropriate guidelines to manage the inventory system.
4. Prepares and implements the national inventory improvement plan considering the experiences and outcomes of inventory preparation, time series analysis, key source analysis, and uncertainty analysis.
5. Decides methodology for each sector based on the assessment that whether a sector falls in the key category or not. Emissions from key source categories are estimated by using higher tiers (Tier-2 or Tier-3 IPCC methodology). This should be decided by the CDA in consultation with sectoral experts.[1]
6. Decides on activity data required from agencies
   - The collection of activity data from various ministries and experts should be spearheaded by CDA.
7. Maintains the data repository on a protected web-based platform or on other archival forms as appropriate (by the central designated agency as well as expert institutions).
8. Develops and implements a QA/QC procedure/protocol based on the good practices available.
9. Decides on expert institutions and continuity of their trained manpower, for continuous sector-specific and country-specific emission factors.
   - To rise in the tier ladder, there is a constant need to develop country-specific emission factors which may change from time to time, based on fast changing national circumstances.
   - The CDA must coordinate and sign MoUs with expert institutions for constant updating of the emission factors.
   - Internally, the CDA needs to have a required number of sectoral experts with a minimum of one data handler per sector.
10. Should prepare budget.
11. Complete and distribute an inventory management work plan as the first step and the inventory improvement plan as the second step.

STEP 2: The CDA designates external sectoral experts and ministries for collecting the data relevant for the inventory. These sectoral experts and ministries would work in coordination with the internal sector experts within the CDA.

1 Expert institutions who are responsible for preparing the sector-specific inventories

The following are the sectors/areas for which designated experts are required:

1. Energy
2. Industry
3. Waste
4. LULUCF
5. Agriculture/Livestock
6. QA/QC experts (multiple experts for each of the above sectors)

The experts should have past experience in inventory preparation/climate change data preparation and handling.

STEP 3: Quality check is an integral part of the inventory preparation process, which needs to be carried out from activity data collection to estimation of EFs, and, thus, must be taken care of by the sectoral agency. The CDA should contract a third party expert for QA or it can be conducted by the CDA itself. The expert should review the data (check the theoretical assumptions) and audit (estimation of GHG emissions for which the expert needs to prepare certain guidelines). QA/QC helps to assess the quality of the inventory. The QA expert should be independent of the inventory compiler/data provider. A third party is necessary to avoid bias in the preparation of the final inventory. Results of QA/QC processes must be documented according to an established protocol adopted by CDA.

STEP 4: Uncertainty analysis (UA) is a difficult task and most countries that have submitted their GHG inventories to the UNFCCC are at present not doing it appropriately. A detailed UA was not part of the BUR of most countries, which have submitted their first BUR. India has done a simple UA of its most recent inventory and results have been documented in its second BUR. An external expert may be designated for this purpose or it can be carried out by the CDA itself. In both situations, capacity building would be needed. There are three ways in which the uncertainty assessment can be done:

1. Through IPCC default values
2. Through expert judgement
3. Through calculation-based research

Prerequisites

For implementing sustainable NIMS, the following are the prerequisites:

1. Appointing a permanent/long-term national/central agency: The CDA, referred to earlier, could be set up as the national agency for management of GHG inventory. The CDA could either be situated within a ministry (e.g. MoEFCC, NITI Aayog) or within an active think tank or academic institution (e.g. TERI) who already possess the infrastructure and knowledge base required to sustain such a system.
2. The strengths and weaknesses of the present institutional structure need to be analysed, based on which the roles of CDA must be assigned and capacities must be enhanced.
3. In the transition phase of NIMS, a committee of selected experts from top institutions (think tanks and research institutions) in India and the MoEFCC could be formed which may:
    a. Frame guidelines regarding inventory products and dissemination of results compiled by CDA
    b. Suggest improvements
    c. Establish rules of procedure for overall inventory preparation
    d. Establish major legal and collaboration arrangements
    e. Define the roles and responsibilities of all the stakeholders involved in inventory preparation
    f. Allocate annual budget for maintaining the inventory management system
7. The committee must have members from think tanks, industry associations, and institutions that are already engaged with the process of inventory preparation or are hosting functional web-based platforms.
8. After the establishment of a fully functional NIMS, a QA/QC arrangement could be set up under NIMS, followed by well-thought national inventory improvement plans informed by the key source analysis and uncertainty analysis.

NIMS Framework for India

NIMS is expected to have key data providers for all the IPCC sectors, while the inventory compilers could either

be the same agencies or other agencies depending on their present capability. The role of involved institutions is presented in the following sections.

Structure and Role of the Central Designated Agency

Based on the steps required for a sustainable NIMS discussed in the previous section, the CDA will not only plan inventory preparation, but also choose expert institutions that can effectively calculate emission factors and give an account of GHG emissions on a yearly basis. The agency shall also recalculate emissions from 1994, based on the data currently available. The expert institutions can directly transfer the emissions data on the web-based platform of the CDA. To retain confidentiality, the web-based platform should have necessary security features such as password protection and two-tier access system, i.e. authority to change an entry must be carefully designated. The CDA will then be responsible for QA/QC. A strong team of experts in the CDA can effectively manage the compilation and submission process.

Functioning of the CDA will be dependent on sectoral experts. Inventory itself requires five experts in each of the five IPCC categories, and a coordinator who will compile the final inventory numbers received from the sectoral CDA experts and conduct a KCA. The KCA has to be done by the CDA in consultation with the external sectoral experts. A data handler will manage the inventory system. The person must be a statistician and aware of inventory know-how in order to conduct QA/QC and uncertainty analysis. On the whole, the inventory coordinator and sectoral experts will be responsible for QA/QC and archiving. In case capacities to conduct QA/QC are not developed, it may be outsourced. The QA/QC and uncertainty assessment of the key sectors will be most relevant as they impact the inventory more than other sectors.

The coordinator and sectoral experts shall also prepare a national inventory improvement plan. It is notable that a national communication contains information not only on GHG inventory and mitigation actions, but also on Impacts, Vulnerability and Adaptation (IVA); Measuring, Reporting and Verification (MRV); Technology Needs Assessment (TNA); finance and capacity needs; education, training and awareness activities; and research and systematic observations. Therefore, the experts in CDA will also be required to manage mitigation, MRV, TNA, and other aspects related to the preparation of NATCOM.

CDA may also be assigned the responsibility of conducting or undertaking IVA assessment , a vast area of additional work, but an essential component of the national communication. It would also require separate experts to manage and review aspects related to water, health, food security, agriculture, forests, and other related issues such as infrastructure and socio-economic cost projections. This calls for a team of dedicated experts in the CDA for the inventory and all other components of the reporting in addition to data handlers and QA/QC experts. Outsourcing of studies may also be required based on the initial capacities of the CDA. Besides this basic manpower, the CDA may appoint research fellows to carry out research, based on the needs of a particular sector including the key source categories. Apart from the NIMS, CDA may work on other R&D activities that would deal with environmental-scientific assessments, and economic and legal analysis.

Role of Different Ministries and Expert Institutions

Preparation of the national GHG inventory is a national endeavour and all relevant ministries should effectively participate in the process in terms of data sharing or climate policy analysis. Some of the ministries that are custodians of requisite data and can directly aid in inventory preparation are:

1. Energy sector: Ministry of Coal, Ministry of Power (Central Electricity Authority and Bureau of Energy Efficiency), Ministry of Petroleum and Natural Gas, Ministry of Road Transport and Highways, Ministry of Railways, Ministry of Steel, Ministry of Shipping, Ministry of Civil Aviation
2. Industrial Processes and Product Use (IPPU): Annual Survey of Industries, Ministry of Micro, Small and Medium Enterprises, Department of Heavy Industry, Cement Manufacturers' Association, Ozone Cell (MoEFCC)
3. Agriculture: Ministry of Agriculture and Famers' Welfare
4. Forestry: Forest Survey of India, National Remote Sensing Centre, NBSS-LUP
5. Waste: Central Pollution Control Board

It may be noted that the Ministry of Programme and Statistics Implementation (MoSPI) collects data for almost

all the sectors and, thus, it may be engaged as a major data provider. Ministries/departments/agencies need to constantly supply and update inventory-relevant data on a web-based platform. The data received will be accessible to the staff of NATCOM/CDA, MoEFCC, and other expert institutions to prepare the GHG inventory which will be shared with the CDA for further processing, checking, and its final submission. The key issues in this exercise will be harmonization of data in the required format, preparation of standardized templates (though dynamic) and tools, and synchronization of the time cycles or periodicity at which the data is collected by the key ministries or their agencies in the relevant sectors for use by the CDA.

Energy and industry, being large sectors, with both organized and unorganized sectors, may require special efforts on the part of the related ministries. One possibility is that the Ministry of Power, Ministry of Petroleum and Natural Gas and the Ministry of Coal, may set up a cell each to monitor GHG emissions from the energy sector. The transport sector may be catered to by the same cells or a key ministry, such as the Ministry of Surface Transport or the Ministry of Railways, is given the nodal responsibility of collecting and collating data from the relevant sources for reporting to the CDA. Also, MoSPI can cater to the needs of the activity data for these sectors like in the case of Canada (Section 4.1). The capacities of MoSPI in inventory data requirements can be enhanced and it could be assigned the responsibility of handling and sharing the activity data with the CDA.

Figure 11 shows the proposed structure of NIMS and gives

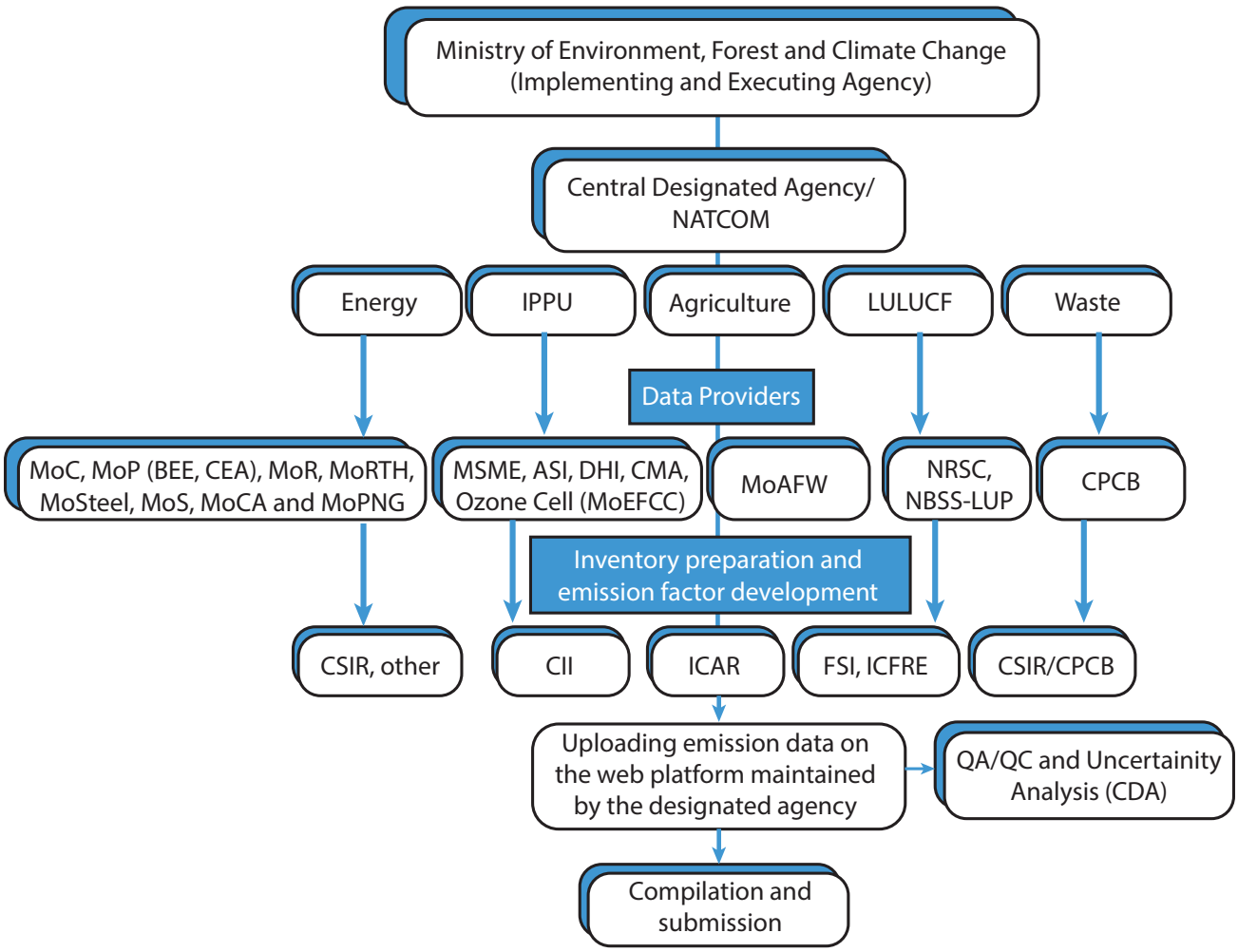

Figure 11: Proposed structure of the national inventory management system

a layout of the functioning of CDA. The data providers and inventory compilers will be pre-determined, and MoUs will be signed with them for smooth functioning. As of now, the inventory is prepared and validated by one of the external experts, being part of the network and the emission factors are similarly determined or developed by external experts/research institutions such as CSIR labs, ICAR, FSI, and CPCB. After CDA develops its own capacity for inventory preparation and maintaining the consistency of data, the inventory may be prepared by CDA itself. However, for emission factor development, the external experts/research institutions including CSIR labs, ICAR, FSI, and CPCB may continue to be relied on. There is already an existing network of institutions for inventory, mitigation, and IVA that are working for the preparation of the inventories. BUR-2 network is shown in Annexure 1. Such a network could be a prerequisite for the future NIMS as envisioned by MoEFCC (GoI, 2018).

Sources and Collection of Data

As mentioned earlier, the present inventory preparation takes place in a project mode and at infrequent intervals. The data collection takes place through a network of selected institutions and the help of relevant ministries is sought to obtain data that is then shared with and analysed by selected expert institutions. This process not only is cumbersome but also lacks the necessary legal tooth for securing compliance and monitoring.

To streamline and facilitate this process, it is felt that a long-term MoU with the concerned ministries and identified key agencies should be put in place to formalize the arrangement and establish the necessary protocol for collection and validation of information. **To make this possible, the CDA may be empowered either through appropriate legal measures or executive instructions to ensure the timely preparation and constant flow of data.**

CDA shall be the umbrella organization for climate-related data. An agency of the MoEFCC or any of the designated agencies of the government such as MoSPI or BEE may be tasked to perform the role of the CDA. During the transitional period, till the time CDA is fully operational, the expert institutions selected to compile the inventory may be provided a fixed annual financial support to prepare continuous inventory for a particular number of years after which the CDA can take over.

Legal/administrative framework for NIMS

Like in most other countries 'NIMS in Developed Countries' there is a need to put a regulatory regime in place for disclosure of information. To ride the Tier ladder, more disaggregated data would be required, especially, for the key source categories. For example, to facilitate the reporting of energy consumption data, the Energy Conservation (Amendment) Act, 2010 has obliged the industry to provide data verified by energy auditors. The Bureau of Energy Efficiency (BEE) has given a format in which designated consumers (DCs) under the Perform, Achieve and Trade (PAT) Scheme in the 11 energy intensive sectors must provide reports containing energy consumption data (Box 1).

Box 1: Regulations under the Energy Conservation (The Form and Manner for Submission of Report on the Status of Energy Consumption by the Designated Consumers) Rules, 2007

Submission of report on the status of energy consumption by designed consumer

1. Every designated consumer shall
   a) Submit in electronic from as well as hard copy to the designated agency, within three months,the first report on the status of energy consumption at the end if the previous financial year in form 1 of the Annexure; and
   b) Submit to the designated agency subsequent report for each financial year in the same manner in the status of energy conservation in Form 1 of the Annexure within three months of the close of that financial year.
2. The Bureau may prescribe different forms for different sections from time to time.

Authentication fo data

Every designated consumer shall ensure taht all the data furnished under rule 3 are duly authenticated by the energy manager appointed or designated by the designated consumer, the Chief Executive

or his nominee authorized for the purpose before it is sent to the designated agency under rule 3 of these rules.

Supply of data to the Bureau

1) Every designated consumer shall also furnish the data in electronic from as well as hard copy, referred to in clause (a) and (b) of sub-rule (1) of rule 3 of these rules, duly authenticated, in the manner prescribed in rule 4 of these rules, to the Bureau of Energy Efficiency.

Similarly, provisions in other existing laws/regulations administered by the relevant ministries may be used to mandate the generation and collection of data. Some of such legal or statutory provisions that can be used to facilitate mandatory and specific information in respect of emissions from specified sources may be as follows:

I. Pollution-related acts: Central Pollution Control Board (CPCB) is the custodian of pollution-related data and holds powers under the Air Act 1981, Water Act 1974, Environment Protection Act 1986, Motor Vehicles Act 1988, and Municipal Solid Waste (Management & Handling) Rules 2000. While none of these acts have notified greenhouse gases as pollutants, the provisions of the EP Act are wide enough to classify them as environmentally significant for the purpose of collection and reporting of data. Considering the position of the CPCB as the environmental pollution watchdog, it may also be possible to mandate them to keep the database of the information related to GHGs and provide it to the CDA as and when required.

II. Companies Act 2013: Provisions may be made to mandate the corporate bodies for disclosure of information relating to emissions or environmental parameters as notified by MoEFCC to specified institutions.

III. The Environment Protection Act 1986: EPA may help in organizing data from various sources in one umbrella institution. Under the provisions of Article 4 of the Environment Protection Act, 1986, which deals with the appointment of officers and their powers and functions, the possibility of empowering the CDA **as an umbrella institution, with powers to access information relevant to climate change action and inventory may be explored.**

IV. Collection of Statistics Act 2008: The Ministry of Statistics and Programme Implementation (MoSPI) has played a key role in bringing together the data that is relevant to inventory. It publishes a yearly report called Energy Statistics. Increasing its powers to facilitate gathering relevant data for inventory will help in building a system that will not only benefit the inventory management system but also in setting up a central data platform.

V. National Data Sharing and Accessibility Policy (2012), Department of Science and Technology: The policy says that there is a need to facilitate sharing and utilization of the large amount of data generated and residing among entities of the Government of India. Lack of sharing of such data results in duplication of efforts. This policy aims to provide an enabling provision and platform for providing proactive and open access to the data generated through public funds available with various departments/ organizations of Government of India (MoST, DST, 2012). Such a platform should be made use of and adjusted as per the inventory needs so that the data in the required format flows in easily from various government departments on an annual basis.

VI. Strengthening the Annual Survey of Industries (ASI): The industrial sector is one of the important sectors of the Indian economy and, hence, compilation of industrial statistics assumes a crucial importance. The Annual Survey of Industries (ASI) is the principal source of Industrial Statistics in India. Till ASI 2009–10, the survey was conducted annually under the statutory provisions of the Collection of Statistics Act 1953 and Rules framed there under in 1959. From the ASI 2010–11, the survey is being conducted under the statutory provisions of the Collection of Statistics Act 2008 and Rules framed there under in 2011. Statistics officers have been appointed under the Act with jurisdiction over different areas to collect and/or authorize collection of information from any individual and commercial concern. Minor changes in the questionnaire used for collecting information and awareness of statistics officers regarding inventory data can upgrade the system.

While these acts provide opportunities and consist of

provisions to include inventory-specific legalities, it may be possible to issue central inventory preparation and management guidelines under the EP Act.

Financial Needs

The NATCOM is currently funded by the GEF-UNDP-GoI project 'Preparation of Third National Communication and Other New Information to the UNFCCC'. This project can play a critical role in the initial phase of setting up NIMS. Due to the increased reporting burden and the needs to enhance transparency in inventories, it is likely that funds will keep flowing from GEF for inventory preparation and under capacity-building initiative for transparency (CBIT). This finance has been and will be crucial for the completion of the inventory in the near future. Therefore, opportunities need to be explored to utilize this finance to set up NIMS for the next phase of the inventory cycle.

In addition to GEF funds, the national entity/CDA could also be supported with funds from international developmental agencies, such as GIZ or World Bank, who have evinced interest in associating with such a project. The learnings of such a project-based NIMS can be used to set up a full-fledged sustainable NIMS. For this to materialize, new and sustainable financial resources will be required and, infrastructural and manpower costs will rise. Budgetary support will become necessary at that stage. This has been thought through in the past. The 12-Five Year Plan had sanctioned budgetary support of INR 20 crore for a National Institute for Climate Change Studies and Action (NICCSA), which would also host NIMS.

Conclusion

India needs a strengthened and reformed NIMS that can enable it to meet its national and international obligations following the Paris Agreement. The reporting burden has increased because of MPGs. The evolving dynamic in the economic fields also makes it imperative that India has an effective and comprehensive system to measure and track its emissions nationally and sectorally. The NIMS should make it easier for the country to formalize the process of inventory preparation with standardized templates, provide more sustainability, make it low-cost, more frequent, complete, accurate, and possibly dynamic. There are other reasons that justify the institutionalization of NIMS. The NIMS will provide easy access to new information relating to sectors and activities, help in building capacity, and establishing the structures and systems for better data gathering and sharing. NIMS will also be able to help engage different stakeholders, increase awareness, and facilitate strategic actions for addressing climate by identifying needs, gaps, and difficulties. The data and evidence gathered by the NIMS will be useful in informing policies and strategies, and developing synergies with Sustainable Development Goals.

India has submitted two national communications (2000 and 2012) and two BURs (2016 and 2018). However, these reports were prepared and submitted in a project mode and there is a lack of institutional and financial capacity at the national level to prepare these reports sustainably, keeping in view the emerging challenges. This system can be transitioned into a sustainable system, taking advantage of the existing infrastructure.

A central agency (a wing of the government or an external centre of excellence) needs to be designated as the focal agency for planning, preparation, archiving, and improvement. The collection and reporting of data may be institutionalized through an agency that will enable data access to sectoral institutions, upgrade emission factors, and provide inventory numbers annually on a platform provided by the central agency. The central agency will then undertake QA/QC and final reporting. The institutions need not to be contracted for each inventory cycle as at present. To make the data available to them, legal provisions as given in Section 6.2.4 may be followed. The CDA should be empowered to gather data from all the arms of the government. This will not only make the inventory consistent and sustainable but also aid in monitoring, reporting, and verification of the mitigation mechanisms, further strengthening the reporting on NDCs.

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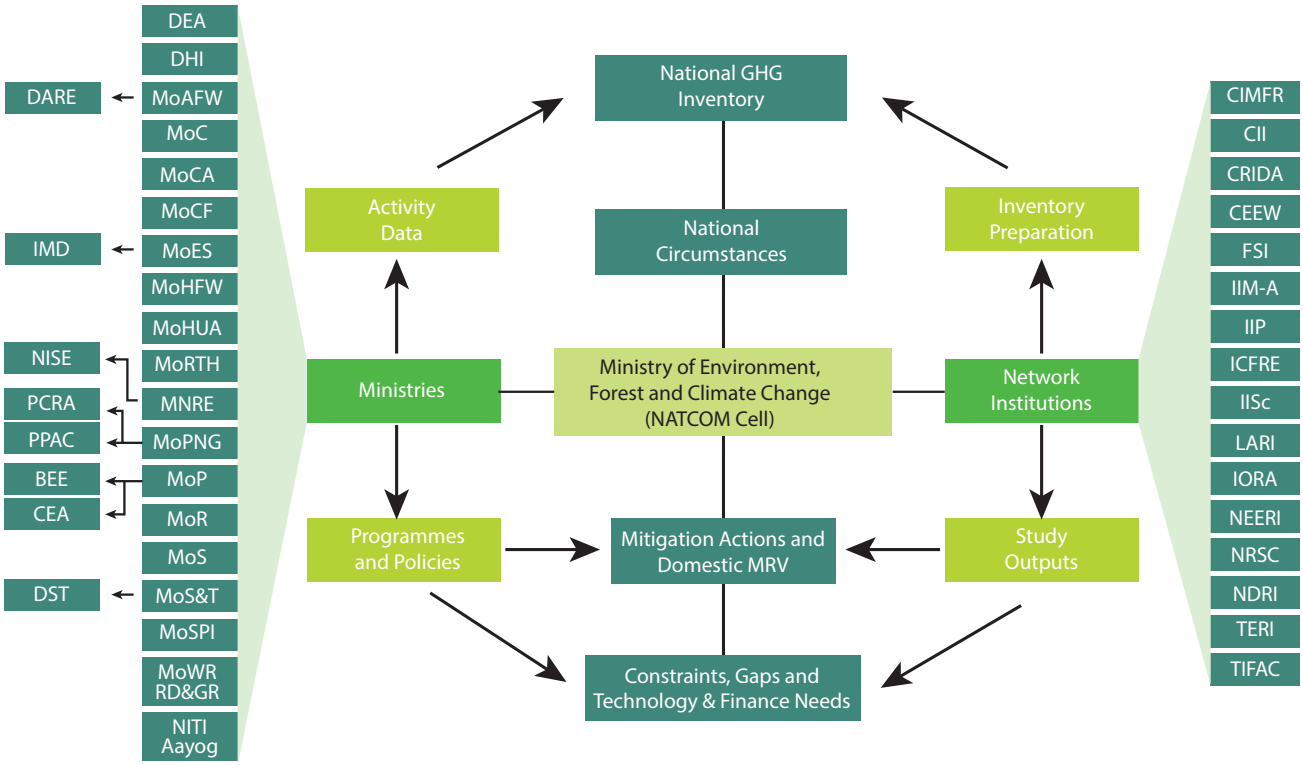
Annexure 1: Current institutions engaged in inventory preparation for India



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