ISSUE BRIEF
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INDIA GHG PROGRAM

Promoting profitable, sustainable and competitive businesses.

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EXPLORING GREENHOUSE GAS MAPPING WITHIN THE PERFORM, ACHIEVE & TRADE (PAT) REPORTING FRAMEWORK

SUBRATA CHAKRABARTY

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The India GHG Program 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 greenhouse gas emissions. The programme builds comprehensive measurement and management strategies to reduce emissions and drive more profitable, competitive and sustainable businesses and organizations in India. More program details could be accessed at www.indiaghgp.org

Contents

EXECUTIVE SUMMARY

Highlights

- Perform, Achieve and Trade (PAT) can be used to accurately determine bottom-up greenhouse gas (GHG) emissions data from the industrial sector in India.
- Analysis of two PAT sectors -- Indian Railways and thermal power plants -- reveals that GHG emissions information, monitoring, reporting and verification (MRV) can be integrated within the existing and future frameworks.
- Harmonizing energy and GHG emissions within the PAT framework would yield multiple benefits including informed policy decisions, monitoring reporting & verification, and the tracking and benchmarking of GHG emissions.
- India is progressing fast on delivering its commitment under the Paris Agreement. In its commitment, India agreed to subject its emissions inventory to the MRV process. Developing a bottom-up inventory well in advance would be of key significance. The time is now to explore and integrate GHG reporting into the existing PAT reporting framework. It is recommended that the PAT framework can also be used for consistently reporting energy, non-energy and process-related emissions.
- Such integration would require increased training and capacity building; development of comprehensive sector-specific calculation methodologies and tool-kits; as well as inclusion of modalities, procedures and guidelines related to monitoring, reporting and verifications.

Context

India's rapid economic growth propels its primary energy demand across sectors including energy services for lighting and cooking, space cooling, mobility, industrial production and office automation. The nation's primary energy demand in 2012 grew to 770 million tonnes of oil equivalent (TOE), up from 450 million TOE in 2000. It is further expected to increase to about 1,250 to 1,500 million TOE in 2030 (Energy Efficiency: Ministry of Power 2018).

India's gross domestic product is expected to rise by 6.8% every year between 2007 and 2030, according to a recent study by the World Resources Institute. Since India is heavily dependent on fossil fuels to meet its energy demand, this economic growth will have implications for its GHG emissions. Total GHG emissions (excluding agriculture, forestry and other land use emissions) are expected to rise to 5,292 million tonnes of carbon dioxide equivalent (CO_2e) by 2030, up from 1,904.73 million tCO_2e in the year 2007 (Mitra A. 2017).

The Government of India has a two-pronged approach to cater to rising energy demand while ensuring minimum growth in greenhouse gas (GHG) emissions. Its policy interventions stress the need for efficiently using energy to manage demand. On March 31, 2012, the Ministry of Power (MoP), in consultation with Bureau of Energy Efficiency conceptualized a domestic cap-and-trade scheme called Perform, Achieve and Trade (PAT) under the National Mission on Enhanced Energy Efficiency. PAT incentivizes efficiency initiatives among energy-intensive sectors of the economy. Overall, the scheme aims reduced energy consumption by 4.05% in energy-intensive industries, totaling energy savings of 6.686 million tonnes of oil equivalent (Energy Efficiency: Ministry of Power 2018). Such energy efficiency initiatives would lead to reduced energy consumption, thereby mitigating GHG emissions from energy-intensive sectors.

About this report

This issue brief explores opportunities available to integrate GHG reporting within the existing reporting framework of PAT by assessing two sectors included in the PAT scheme. Such integrated reporting would feed into the reporting of industry emissions in National Communications and Biennial Update Reports. Fungibility of PAT within existing and upcoming domestic and international carbon markets would further increase the effectiveness of the scheme. Case studies further reveal approaches to integrate GHG reporting within the PAT reporting framework.

The Research Problem

The Ministry of Environment, Forests and Climate Change (MoEFCC) currently uses a top-down approach for reporting emissions in National Communications and Biennial Update Reports, which may not paint an accurate picture of GHG emissions from key economic sectors like industries. In contrast, under the PAT scheme, the Bureau of Energy Efficiency collects primary energy consumption data from designated consumer (DC) units, which represents a bottom-up approach. It is possible to this data to determine GHG emissions at the designated consumer unit level, and this could be used by MoEFCC to report GHG emissions in National Communications and Biennial Update Reports.

In addition, integrating GHG emissions into the PAT framework could help companies and industries in India that voluntarily report their GHG emissions to international platforms such as the Global Reporting Initiative, CDP, etc. This would allow accurate tracking of GHG emissions from energy-intensive industries and reduce the duplication of efforts needed to report on multiple platforms. This issue brief aims to address these problems by examining two sectors under current PAT framework.

Key Findings

- Reporting of GHG emissions from overall energy use by industries within the PAT scheme would require inputs of relevant conversion factors and emission factors into the existing reporting templates (also known as proforma). Process-specific activity data collection is currently outside the prevue of PAT scheme.
- Apart from the 11 energy-intensive sectors notified under current cycle of PAT, there are other energy intensive industries such as sugar, distillery, automobile manufacturing and chemicals that contribute significantly to primary energy consumption and hence, GHG emissions. Currently, these sectors are outside the periphery of PAT scheme.
- Integration of GHG reporting in existing and future PAT frameworks would require development of modalities, procedures and guidelines for verification and certification of emission reductions, along with sector-wise GHG calculation methodologies and tool-kits.

- Under PAT scheme, specific energy consumption (SEC) is calculated based on total energy (all forms) input within the physical boundary of designated consumer units. Hence, it captures only the aggregated fuel consumption within the facility. Non-energy data and, therefore, GHG emissions from operations outside the boundary of the designated unit are not captured in the current reporting framework of PAT.

Recommendations

- To calculate GHG emissions from overall energy usage in industrial units under the PAT scheme, program relevant conversion and emission factors into existing and future reporting templates and integrate technology-specific emission factors to capture process-related GHG emissions.

- Include energy-intensive sectors outside the periphery of current PAT scheme, such as sugar, distilleries, automobile manufacturing and chemicals, which would provide a comprehensive picture of GHG emissions from Indian industry.

- Key stakeholders including, but not limited to, relevant ministries and nodal agencies such as BEE, SDAs and DCs should work together to develop modalities, procedures and guidelines to integrate GHG reporting into the existing PAT scheme, and to develop sector-specific calculation methodologies and tool-kits.

- The current and future reporting framework of PAT should consider emission-intensive activities occurring outside the designated boundary (based on gate-to-gate approach) designated consumer unit due to its operations.

INTRODUCTION: PERFORM, ACHIEVE AND TRADE (PAT)

Perform, Achieve and Trade is an energy efficiency scheme conceptualized under the National Mission for Enhanced Energy Efficiency (BEE, NMEEE 2015). It is a regulatory instrument meant to reduce specific energy consumption of energy-intensive industries. It has an associated market-based mechanism to enhance cost-effectiveness through the certification of excess energy savings, which can then be traded.

The PAT framework assigns targets to designated consumers (DC) to reduce specific energy consumption on three-year cycles (BEE and MoP 2015). The target reduction assigned to each designated consumer is based on its specific energy consumption for the baseline year. The scheme emphasizes the concept of energy efficiency by allocating sectoral targets in such a manner that less energy efficient designated consumers will have more stringent targets. While calculating specific energy consumption, a "gate-to-gate" approach (refer section 3.2 for details) is adopted, thereby including all energy consumption against the total production. The Ministry of Power, in consultation with the Bureau of Energy Efficiency, identified a list of energy intensive industries and other establishments for cycle 1 of the PAT scheme (MoP, Ministry of Power Notification 2007):

Table 1: Sector-wise minimum annual energy consumption for DCs

SECTOR	MINIMUM ANNUAL ENERGY CONSUMPTION FOR DCS (IN TOE/YEAR AND ABOVE)
Thermal power stations	30,000
Fertilizer	30,000
Cement	30,000
Iron & Steel	30,000
Chlor-Alkali	12,000
Aluminum	7,500
Textile	3,000
Pulp & Paper	30,000

Source: (Booklets: BEE India 2017)

Phase 1 (FY2012 -13 to FY2014 -15) of PAT had cumulative target of 6.686 MTOE across all the eight sectors. The target was arrived at by looking at baseline data for the period of FY2007 – '08 to FY2009 – '10 for all eight sectors (Sharma 2017). The compliance period for phase 1 ended in FY2014 – '15 and analysis of the phase reveals there was cumulative energy savings of 8.67 MTOE, which resulted in GHG emission reductions of 31 million tonnes of carbon dioxide equivalents (tCO_2e) (BEEIndia 2015).

Energy saving certificates (ESCerts) are issued to those DCs who have overachieved their targets. They are issued by the central government after verification by an accredited auditor and recommendation by BEE. EScerts are tradeable commodities and can be sold at two energy exchanges -- Indian Energy Exchange and Power Exchange India Limited -- and bought by industrial units looking to meet their compliance requirements under PAT. Units that are unable to meet the targets either through their own actions or through purchase of ESCerts are liable to financial penalty in accordance with the Energy Conservation Amendment Rules, 2016 (MoP, Notification: PAT 2016).

APPROACH AND METHODOLOGY

Measuring and reporting of GHG emissions data and analyzing trends is crucial for targeting mitigation actions and developing mitigation strategies for the energy-intensive industrial sector in India. GHG emissions data from 2009-'10 (the baseline year for the PAT scheme) onwards would be necessary to influence the emission trajectories of energy-intensive industries, assess climate risks and identify GHG mitigation opportunities.

Reporting obligations: The Government of India is obligated to report its GHG emissions in Biennial Update Reports (BURs) to United Nations Framework on Climate Change (UNFCCC), which essentially includes updates of national GHG inventories, including a national inventory report and information on mitigation actions, needs and support received. In addition, National Communications also provide information on GHG inventories every four years (2/CP17 2012). Such reporting obligations require an accurate accounting of GHG emissions.

Tracking NDCs: Article 4 of the Paris Agreement specifies that each Party should communicate a Nationally Determined Contribution (NDC) every five years and, furthermore, that each Party's successive NDCs should represent a progression beyond their initial contributions and reflect their highest possible ambitions (UNFCCC 2015). GHG emissions data from all economic sectors, including energy-intensive industries, would be a pre-requisite to formulate India's NDCs and mitigation policies.

National GHG Inventory Management Systems (NIMS): Recommendations by the Indian Network on Climate Change Assessment to the Government of India includes establishing a NIMS under the MoEFCC (INCCA 2010). An interim report, *Low Carbon Strategies by Inclusive Growth*, by the Planning Commission of the Government of India laid emphasis on a systematic approach for measuring and reporting of GHG emissions data annually (Planning Commission 2011). Setting up NIMS would be useful for archiving, updating and producing bottom-up information on GHG emissions reductions or removals by sink on a yearly

basis, and would include information from all key economic sectors, including industries.

The PAT scheme establishes unit-specific targets based on the specific energy consumption of each unit. This requires total energy input data, which can be converted into GHG emissions. This issue brief explores the opportunities to integrate GHG reporting within the existing reporting framework of PAT by assessing two sectors in detail.

This brief includes a detailed literature review of government notifications and publications about the PAT scheme, international carbon trading and other market-based schemes. PAT reporting templates (called proforma) were reviewed and analyzed to understand the parameters reported by designated consumers and the possibility of integrating GHG reporting within existing reporting templates. The findings were discussed with a representative of BEE. The discussions with the representative of BEE were loosely structured to allow a free flow of thoughts and opinions. It included a non-intrusive use of agenda points and a presentation of facts and analysis to ensure content-rich discussions.

This issue brief includes a detailed analysis of reporting templates for two sectors under the PAT scheme. It explores the possibility of integrating GHG emissions reporting in the existing reporting framework of PAT and proposes plausible methodologies to do so. The issue brief is further extended to analyze a case study of integrated reporting of energy and GHG emissions internationally.

ASSESSING THE NEED FOR GHG EMISSIONS REPORTING

Measurement and reporting of GHG emission data is a pre-requisite for identifying emission hotspots and then strategizing mitigation actions and policies for emissions reductions. This will require emission data from all the key economic sectors, including energy-intensive industries. The PAT scheme has the potential to induce positive behavioral shifts, technological advancement and enhanced capacities. Such shifts will lead to the reduction of GHG emissions from energy-intensive industries.

To integrating GHG reporting into the existing and future PAT reporting frameworks, this section assesses the need of three key stakeholders.

1. MINISTRY OF ENVIRONMENT, FORESTS AND CLIMATE CHANGE

MoEFCC is the nodal agency in the administrative structure of the Government of India for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry policies and programs. MoEFCC initiated a National Communication project for reporting to the United Nations Framework Convention on Climate Change (UNFCCC), the anthropogenic emissions of GHGs from various sources and their removal by sinks not controlled under the Montreal Protocol. This section assesses the need of integrated GHG reporting into the existing and future reporting framework of the PAT scheme:

Contribution to reporting obligations: As mentioned in the previous section, National Communications (NCs) and BURs contains updates on national GHG emissions from various economic sectors like energy, industries, waste, agriculture forestry and other land uses. The bottom-up industrial sector reporting of GHG emissions in the PAT scheme will enable the government to more accurately report emission numbers in NCs and BURs.

Contribution to the formulation of ambitious NDCs: The Government of India, under its commitment to Paris Agreement, defined a set of domestic targets in its NDC, which is to be communicated to UNFCCC every five years. Successive NDCs are required to have more ambitious targets than previous ones. If the PAT scheme were to integrate GHG emissions data from energy-intensive industries, it could help determine the emissions portfolio from the industrial sector. This data will be crucial to formulate NDCs and frame appropriate mitigation policies.

Contribution to the meta-registry: India's Market Readiness Proposal (World Bank and PMR 2016) proposed the development of a national meta-registry that will contain information on existing and future market-based mechanisms. The national meta-registry would help interlink existing and new market-based mechanisms, thereby making existing market-based mechanisms like PAT more effective and sustainable. Such interlinkage is possible if a single, standardized metric is used. Linking the meta-registry with NIMS will enhance the robustness of GHG accounting.

Contribution to the domestic carbon market and ensuring the sustainability of PAT: As India intends to pilot its domestic carbon market by 2020, it also acknowledges the fact that post-2020, a complex network of domestic and international carbon markets may exist. Integrating GHG reporting within the PAT framework would not only help the scheme link the domestic and international markets, it will also help in enhancing the sustainability of the scheme in long run. India's NDC targets can be achieved through a combination of multiple market-based policy instruments, including existing and new market-based mechanisms.

2. BUREAU OF ENERGY EFFICIENCY

The Bureau of Energy Efficiency was set up by the Government of India on March 1, 2002 under the provisions of Energy Conservation Act, 2001. The BEE assists in developing policies and strategies, with a thrust on self-regulation and market principles, within the overall framework of the Energy

Conservation Act, 2001. Its primary objective is reducing the energy intensity of the Indian economy.

Emission reductions achieved in PAT Cycle 1: The industrial sectors identified in the PAT scheme account for 25% of gross domestic product (GDP), about 45% of India's primary energy consumption, and 165 million tonnes equivalent of energy consumption annually (IEX 2013).

Table 2:

Annual energy consumption and estimated number of DCs in PAT cycle 1 sectors

Sector	Min. annual energy consumption for DCs (in TOE)	No. of DCs	Annual energy consumption (in Million TOE)	Energy reduction target under PAT Cycle 1	Achievement/ Savings	Percentage Change between energy reduction target and savings (in %)
Aluminum	7,500	10	7.71	0.456	0.730	60.00
Cement	30,000	85	15.01	0.815	1.480	81.60
Chlor-Alkali	12,000	22	0.88	0.054	0.093	72.00
Fertilizer	30,000	29	8.2	0.477	0.780	64.00
Iron & Steel	30,000	67	25.32	1.486	2.100	41.00
Pulp & Paper	30,000	31	2.09	0.119	0.289	143.00
Textile	3,000	90	1.2	0.066	0.129	95.00
Thermal Power Plants	30,000	144	104.56	3.211	3.060	-5.00
Total		**478**	**165**	**6.68**	**8.67**	

Source: (Booklets: BEE India 2017)

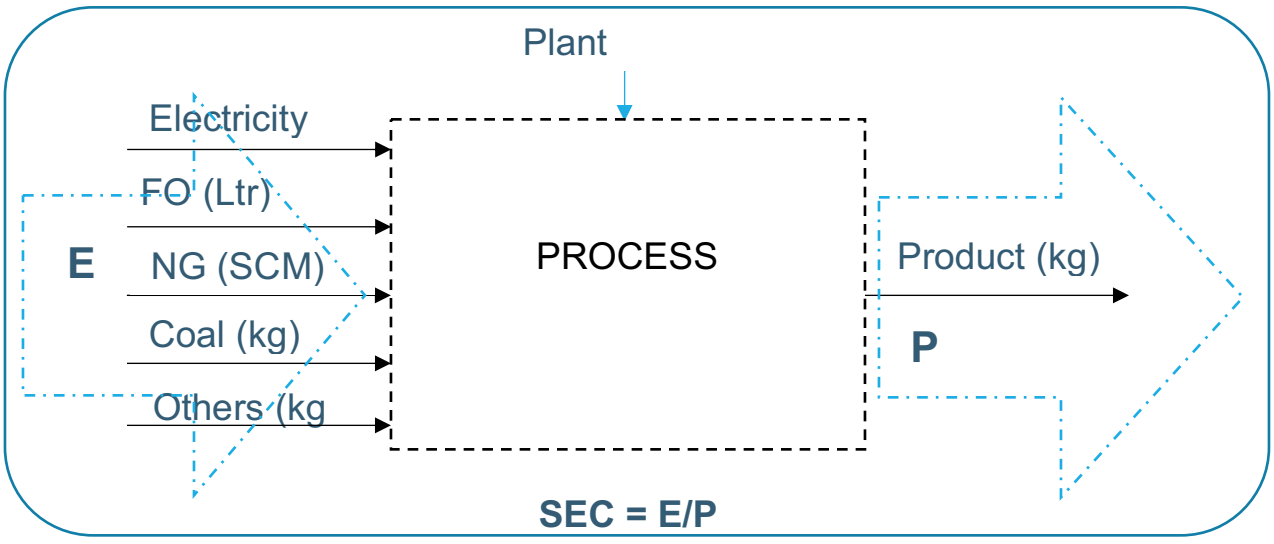
GHG emissions from these units under the identified industrial sectors would add up to a considerable number. The first PAT cycle resulted in GHG emission reductions of 31 million tCO_2e (BEE and MoP 2015). However, the methodology of calculations of emission reductions is unclear.

Need to report GHG emissions: The primary need for converting energy into GHG parlance stems from the MoEFCC's request to report GHG emission reductions achieved from the PAT scheme. In its current form, the total energy saved is reported in tonnes of oil equivalent and an average emission factor is used to convert this number into GHG. There are a few inherent challenges with this approach and it presents unique opportunity to improve the accuracy of GHG reporting from the PAT scheme.

- Currently, PAT scheme determines the energy input from overall fuel consumption based on a gate-to-gate concept, as illustrated in the figure below (refer figure 1). However, PAT also includes process industries which generate process-related emissions, and, in its current format, there are limitations in determining such emissions.

- For a few sectors like iron and steel, aluminum and cement, the existing plant boundaries (based on the gate-to-gate approach) does not include mining operations. Such operations also emit significant amounts of GHG emissions.

Figure 1: Gate-to-gate concept



Source: (Overview & Status: BEE India 2015)

The PAT scheme has the capacity to bring down energy-related GHG emissions and can also provide a basis for future monitoring, reporting and verification in the energy efficiency sector (First BUR to UNFCCC 2015). Such integration can assist in fairly representing energy-related GHG emissions from energy-intensive industries but would also help BEE cater to the MoEFCC's request with emission data and GHG reductions achieved under the PAT scheme.

Contribution to domestic carbon market and meta-registry: The Government of India intends to pilot a domestic carbon market by 2020. A complex network of domestic and international market-based mechanisms is likely post-2020. It opens up opportunities for inter-linking domestic market-based mechanisms for cost effective mitigation outcomes.
Furthermore, development of a national meta-registry will provide data and information from various domestic market-based mechanisms. Such a meta-registry will record GHG emissions data and interlink various market-based mechanisms by supporting issuance, transfer and cancellation of credits (India: Partnership for Market Readiness 2017).

Sustainability of PAT scheme: The results from PAT Cycle 1 are encouraging. Except thermal power plants, all sectors surpassed their respective targets (refer Table 2 for details). This raises concerns about the long-term sustainability of the scheme. If the targets are achieved too easily and there is no demand for ECerts, it may be challenging to generate adequate trading volumes for market liquidity. Exploring the linkage of PAT with carbon markets (domestic and/or international) would help address the issue of demand and supply of ECerts. Fungibility of PAT with domestic and international carbon markets will be driven by the use of a common metric. For example, carbon markets, such as the European Emission Trading Schemes (EUETS), have adopted tCO_2 as a standardized metric. To link and trade, calculations should be made to translate energy savings into tonnes of carbon dioxide equivalent and vice versa.

PAT has the capacity to spur innovation in the energy-intensive industrial sector in India, provided that specific energy consumption targets are stringent. Exploring linkages with carbon market mechanisms, both

domestic and/or international, will help generate required demand-supply of ECerts, thereby ensuring the long-term sustainability of the PAT scheme.

3 . DESIGNATED CONSUMERS

Designated Consumers (DC) are facilities that are classified as large-scale energy-intensive industries under the Energy Conservation Act, 2001. Currently, the central government has notified industrial units from 11 energy-intensive sectors as Designated Consumers. Apart from the eight sectors included in Cycle 1 (refer to Table 2), railways, refineries and distribution companies (DISCOMs) are also included. This section assesses the need for integrated GHG reporting in the existing and future reporting frameworks of the PAT scheme.

Avoid duplication of efforts in reporting GHG emissions: As discussed above, a complex network of domestic and international market-based mechanisms may exist in the future. This could pose challenges in terms of double counting and environmental integrity, while at the same time, opening up opportunities for interlinking existing and future market-based mechanisms for cost-effective mitigation outcomes. Such interlinkages can be facilitated through the development of a meta-registry, which synthesizes information from the registries of various market-based mechanisms (both existing and future) and provides a platform to interlink domestic and international market-based mechanisms (India: Partnership for Market Readiness 2017). For DCs, it provides a singular platform to report specific energy consumption and GHG information, thereby avoiding duplication of efforts. In cases where organizations need to report GHG data on other platforms, they can easily do so by retrieving information from the meta-registry. This will save resources and lower costs.

Increment in cost savings: The trading metric of the proposed domestic carbon market will likely be 1 tonne of carbon dioxide equivalent. The PAT scheme is an existing market-based mechanism that will be linked with the domestic and other new carbon markets, according to preliminary reports (India: Partnership for Market Readiness 2017). Incorporating GHG

reporting into the existing framework of PAT would enable industrial units to increase cost savings by trading emission units in the domestic and new carbon markets.

Enhancing the outreach of DCs to international markets: It is likely that the domestic carbon market will be interlinked with international carbon markets post-2020. Reporting GHG emissions data under the reporting framework of PAT would open up myriad opportunities for DCs to venture into unexplored markets, thereby increasing international reachability, securing better prices for emission credits and enhancing cost savings.

MERITS & CHALLENGES OF INTEGRATED (ENERGY & GHG) REPORTING

While the previous section assesses the need to integrate GHG reporting in the existing PAT framework, it is equally important to understand the merits and challenges of such an integration. Integration would have following merits:

- Data from such reporting can inform overall country policy. For example, the annual greenhouse gas (GHG) data collected through Australia's reporting program (National Greenhouse and Energy Reporting 2017) is the basis for emissions projections that inform climate change policy. The program also collects data on energy production and consumption, which informs energy efficiency policy development.
- Such reporting would provide a better understanding of individual sources of emissions, thereby leading to decarbonization of the energy-intensive industrial sector. It would also help in developing source-specific annual GHG reduction strategies.
- Integrated reporting also supports domestic and new market-based mechanisms and future carbon markets by providing reporters with a uniform methodology to calculate, report, monitor and verify emissions. This is essential in building trust in carbon markets, which depend on reliable data for smooth and efficient functioning.
- This form of combined reporting would lead to regular tracking of emissions and benchmarking. It will enable industries to understand emissions-related risks and opportunities so they can efficiently focus on mitigation activities that produce the greatest GHG reductions.

Box 1: International Example on integrated reporting

National Greenhouse and Energy Reporting scheme (NGER), Australia: The National Greenhouse and Energy Reporting (NGER) scheme, established by the National Greenhouse and Energy Reporting Act 2007 (NGER Act), is a single national framework for reporting and disseminating company information about GHG emissions, energy production, energy consumption and other information specified under NGER legislation.

Objectives: NGER scheme serves the following objectives:

- Informs government policy
- Informs the Australian public

- Helps meet Australia's international reporting obligations
- Assists commonwealth, state and territory government programs and activities
- Avoids duplication in reporting requirements required by states and territories

Reporting on: Scope 1 and Scope 2 emissions along with energy production and consumption. Scope 3 GHG emissions are not reported under the NGER scheme but can be used under Australia's National Greenhouse Accounts.

Coverage of Greenhouse Gases: Greenhouse gases reported under the NGER Scheme include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6) and specified kinds of hydro fluorocarbons and perfluorocarbons.

Integration may also pose some challenges, which are outlined below:

- Capacity building among the DCs could be one of the challenges of integrating GHG reporting within the existing PAT framework. In the current PAT cycle, 621 DCs (448 existing, 89 additional DCs from existing sectors and 84 DCs from new sectors, that is, railways, electricity DISCOMs and refineries, were identified. The three new sectors add to the eight sectors already identified in PAT cycle 1. Hence, building capacity on GHG reporting among all the identified DCs would be a time- and resource- consuming activity.
- Training and capacity building needs should not be restricted to DCs and should involve other actors such as state designated agencies (SDAs), entrusted with a crucial role in enforcement of compliance; accredited energy auditors, who do primary energy audits and verify and certify energy savings; and representatives from BEE.
- There is a corresponding need to develop comprehensive guidance documents and tool-kits on GHG calculation methodologies and reporting requirements for day-to-day reference. Further, the GHG calculation methodologies for different sectors will differ and hence, development of sector and sub-sector specific guidance documents and tool-kits will be prudent.
- Verification and certification procedure under PAT scheme will have to undergo changes to incorporate GHG component and its subsequent certification. This would essentially initiate empanelment of organizations and/or individuals who have expertise in GHG audits along with inclusion of GHG verification procedures and guidelines.
- Sector-specific reporting templates (also known as proforma) designed by BEE will also have to undergo changes to integrate GHG reporting. Currently, the proforma captures complete energy and production profile. Additional data input field can be incorporated to capture the GHG emissions numbers.

FUNGIBILITY OF INTEGRATING GREENHOUSE GAS DATA POINTS

REPORTING SPECIFIC ENERGY CONSUMPTION UNDER PAT SCHEME

Specific energy consumption (SEC) is total energy input (usually expressed in kilocalories) per ton of product. Under the PAT scheme, all designated consumers are required to file information on a yearly basis in the proforma designed by BEE.

Box 2: Proforma

BEE designed reporting template (or proforma) for key sectors for ease of collating data and reporting on specific energy consumptions. These reporting template are essentially programmed (and locked) excel-based templates, which are used to collect activity data (e.g. grid electricity consumptions, fuel use such as coal, diesel, compressed natural gas (CNG), liquified petroleum gas (LPG), etc.). The data once collated are converted into energy units by applying appropriate conversion factors, which are already programmed into the Excel sheets. Specific energy consumption (SEC) is arrived at by the dividing the energy input per tonne of product, which is programmed in the Excel sheet as well.

Each DC covered under the notified sectors consuming energy above the threshold limit of that sector submits this proforma, duly signed and stamped by the plant head and plant's energy manager. The submission is made to the concerned SDA and BEE. The below table provides a snapshot of sector-specific proforma for all the identified sectors under the PAT scheme:

Table 3: Sector-wise details on proforma

SECTOR	NO. OF PROFORMA	NAME OF PROFORMA	SUB-SECTOR
Aluminium	2	Sa1, Sa2	Smelter and cold sheet
Cement	1	Sb	Cement
Chlor – alkali	1	Sc	Chlor – alkali
Fertilizer	1	Sd	Fertilizer
Iron & steel	2	Se1, Se2	Integrated steel and sponge iron
Paper & pulp	1	Sf	Paper & pulp
Textile	4	Sg1, Sg2, Sg3, Sg4	Composite, fiber, spinning, processing
Thermal power plants	1	Sh	Thermal power plants

Railways	General format of the data collection is available in BEE official website. The sector specific proforma of these sectors are under finalization.
Distribution companies	
Petroleum refinery	

Source: (PAT Proforma 2015)

Some key highlights of the proforma are:

1. Proforma have been customized for individual sectors and sub-sectors with 13 different forms for eight sectors
2. These proforma are easy to download and provides instructions for appropriate filling
3. Proforma has been customized to reflect details such as production and capacity utilization; electricity (fossil fuel based) and renewable energy generation; fuel consumption (solid, liquid, gas, biomass or alternative fuel); heat rate of different power sources; fuel analysis; and normalization data
4. Proforma also provides flexibility to include details of equipment installed due to environmental concerns
5. Proforma provides flexibility for adding additional data input fields
6. Proforma has an inbuilt SEC calculation sheet
7. Formula cells are locked due to data security and reliability (Proforma BEE India 2016)

For demonstration on fungibility of GHG data points, proforma of thermal power plants and railways have been considered and analyzed. During PAT Cycle 1, 144 DCs were identified under the thermal power sector and 22 additional DCs were identified for PAT Cycle 2, thereby taking the tally to 154 DCs. This is the highest number of DCs notified under PAT as compared with other sectors. Thermal power plants contribute 66.20% of total installed capacity, which is highest among the other sources of power generation (Power sector at a glance: All India 2018). Hence, the thermal power sector has been chosen for analysis.

In India, the transport sector accounted for 13.2% of energy-related CO_2 emissions (272 million tCO_2) and for 14.9% (3.6 exajoule) of final energy demand in 2015. The rail sector accounted for 9.6% (26 million tCO_2) of CO_2 emissions from transport, second to emissions from road transport and for 5.0% (179 petajoule) of transport final energy demand in 2015 (Railway

Handbook 2017). The statistical summary of railways reveals that the consumption of diesel oil and electricity shows an increasing trend. Coal consumption witnessed a decreasing trend from 2006-07 (4000 tonnes) to 2015-16 (1000 tonnes).

Table 4: Fuel consumption details and incremental change

FUEL CONSUMED	UNIT	2006-07	2015-16	INCREMENT
Diesel oil	Kiloliters	2,211,531	2,874,350	30%
Electricity	Million kilowatt-hours	11,061.50	15,701.20	42%

Source: (Statistical summary Indian Railways 2016)

Railways is the first in the transport sector sub-group to enter the PAT scheme. Considering the rising trend in diesel and electricity consumption, it is likely that GHG emissions from the railways sector will rise in future, contributing to transport-related GHG emissions. Hence, it is selected for analysis.

THERMAL POWER PLANTS

Unlike other sectors under the PAT cycle wherein the target energy consumption norms and standards are specified in TOE per unit of product, the target energy consumption norms and standards, in case of thermal power plants, are specified in terms of net heat rate (kcal/kWh).

PERCENTAGE REDUCTION TARGET METHODOLOGY

The energy consumption norms and standards for thermal power stations are specified in terms of their percentage deviation of net operating heat rate from a three-year average in baseline scenario. The power stations are grouped in various bands according to their present deviations of operating heat rate from design heat rates. The following table provides energy consumption norms and standards:

Table 5: Variation in net SHR and associated percentage deviation

Category	Variation in net station heat rate from design net heat rate	Reduction target for percentage deviation in the net station heat rate
I	Up to 5%	10%
II	More than 5% and up to 10%	17%

III	More than 10% and up to 20%	21%
IV	More than 20%	24%

Source: (Normalization, M&V: BEE India 2015)

NORMALIZATION AND ITS IMPACTS ON GHG EMISSIONS

Calculation of GHG emissions in the baseline year and assessment year should be comparable. Normalization is a concept that is devised to ensure that DCs are not placed at an advantage or disadvantage while gauging performance in assessment year as compared to the baseline scenario. It is a process of rationalization of energy and production data of a plant to consider the impact of quantifiable external variables that are beyond the control of DCs. This process of normalization may have an impact on the calculation of GHG emissions in the baseline and assessment years. The table below provides a snapshot of variables and its impact on overall GHG emissions of a thermal power plant.

Table 6: Impact of Normalization on technical parameters and GHG emissions

VARIABLE	ELEMENT	REASON/ REQUIREMENT	IMPACT ON	
			TECHNICAL PARAMETERS	GHG EMISSIONS
Fuel quality	Use of fuel with different calorific value in BY and AY	Fuel quality is beyond the control of plant. Inferior quality of fuel effects the Power Station Performance	Boiler efficiency, Net Heat Rate	Fuels have different grades based on the carbon content and different calorific value. GHG emissions will depend on type of fuel grade used along with the combustion efficiency.
Plant Load Factor	PLF, station heat rate	Plant load backing down due to lower power demand from the grid; variations in demand from estimated or	Boiler efficiency, PLF	As proposed above, GHG emissions are determined based on carbon content and calorific value at the

		forecasted values; Transmission outages resulting in reduced power availability		plant level. Impact on PLF will have impact on generation units.
Fuel mix	Use of different fuel in same unit	Separate net heat rate used for different fuel used in the unit	Boiler efficiency	Different fuels (like natural gas, naphtha) will have different carbon content and calorific values. GHG emissions will therefore, depend on type of fuels used.
Additional equipment installed due to environmental laws	Auxiliary power consumption	Energy to be normalized for additional energy consumption. This is to be excluded from APC.	APC	GHG emissions from APC would depend on the source of supply of power. GHG emissions will differ if energy consumed for additional equipment is supplied from grid.

Source: (Normalization, M&V: BEE India 2015)

Note: BY – baseline year; AY – assessment year; PLF – Plant load factor; APC – Auxiliary Power Consumption

PROFORMA DESCRIPTION FOR THERMAL POWER PLANTS

The proforma designed by BEE for thermal power plants is one of the most detailed reporting templates. In particular, Form 'Sh' in the proforma of thermal power plant sector requires rigorous reporting on many elements including, but not limited to:

1. Design data details for major fuel which includes design capacity, boiler efficiency, turbine heat rate, etc. as provided by the original equipment manufacturer (OEM) and as established during the performance guarantee test (PG test)

2. Operating data details such as operating load (in MW), loading factor (in %), gross generation (in MU), unit gross heat rate (in kcal/kWh) for both baseline and assessment/ current year
3. Station generation data, plant load factor (PLF), auxiliary power consumption, etc. (bifurcated between coal fired, oil and gas fired)
4. Details of electricity purchased from the grid
5. Fuel analysis details (as fired basis) – specifically for coal and lignite, both proximate and ultimate analysis, which provides percentage of carbon in unit mass of fuel
6. Electricity consumption for coal grinding mills, ID fan, ash handling unit
7. Details of fuel consumption (bifurcated between solid, liquid and gas) along with the calorific values
8. Loss of PLF due to non-availability of fuel/ schedule/backing down/ any external and/or unforeseen factors

To calculate the GHG emissions from the above, details pertaining to point No. 4, 5, 6 and 7 is required based on current gate-to-gate approach.

CALCULATION APPROACHES

Two approaches can be adopted:

Based on carbon content: Proximate and ultimate analysis provides us with the amount of net carbon in unit mass of fuel input among various other details. This approach provides us with the plant level emission factor and therefore, appropriate quantification of GHG emissions.

$Emissions_{CO2} = Q_{fuel} \times CC_{fuel} \times OF \times 44/12$

Where:

$Emissions_{CO2}$ CO_2 emissions in tonnes of CO_2

Q_{fuel} Quantity of fuel combusted in the thermal power plant (mass or volume unit)

CC_{fuel} carbon content in one unit of the fuel (mass or volume unit)

OF oxidation factor

44/12 ratio of molecular weight of CO_2 and carbon

Based on direct method: There might be a situation wherein the thermal power plant/ unit do not have the capacity and/or technical know-how to

conduct the fuel analysis. In such cases, GHG emissions can be calculated by considering the published emission factor.

$Emissions_{CO2} = Q_{fuel} \times NCV_{fuel} \times EF_{fuel}$

Where:

$Emissions_{CO2}$ CO_2 emissions in tonnes of CO_2

Q_{fuel} Quantity of fuel combusted in the thermal power plant (mass or volume unit)

NCV_{fuel} Net calorific value of the fuel (GJ per mass or volume unit)

EF_{fuel} CO_2 emission factor of fossil fuel used (tCO_2/GJ)

Both methods can be integrated in the proforma designed by BEE for thermal power plants. Electricity purchased from the grid and electricity consumed for the on-site application (presumably derived from the grid) can be calculated by multiplying the electricity units with the grid emission factor.

RAILWAYS

The railway sector is a recent addition to PAT Cycle 2 with 22 identified Designated Consumers, which includes 16 zonal railways for traction having annual energy consumption of more than 30,000 tonnes of oil equivalent (TOE) or above along with 6 production units.

PROFORMA DESCRIPTION FOR RAILWAYS

PAT captures the information from these 22 DCs under Indian Railways by categorizing them into three broad categories, namely zonal, production units and workshops. The format of data collection remains the same across the three proforma. The proforma is divided into two workbooks:

- **General Information**: General information section captures non-technical information such as identification, location or contact details for production unit, workshop or zone. It also aims to capture other details of zonal head. This is common across all the three formats.

- **Data format**: As mentioned above, the data format remains consistent across all the three proforma. For all the three proforma, the following details are required:

Table 7: Information required in three proforma designed for railways

ZONAL	PRODUCTION	WORKSHOPS
Grid electricity consumption (in million kWh)		
Own generation (DG set) (in million kWh)		
Coal used (in tonnes)		
Gross calorific value of coal (kcal/kg)		
Diesel used (in kL)		
Gross calorific value of diesel (kcal/kg)		
Liquid Fuel Consumption (state type Furnace oil, Kerosene etc.) (in kL)		
Gross Calorific Value of Liquid Fuel (kcal/kg)		
Gaseous Fuel Consumption (state type CNG, LPG, Gas generated used as fuel etc.) (in million SCM)		
Gross calorific value (kcal/SCM)		
Wood used (in tonnes)		
Gross calorific value of wood (kcal/kg)		
Gross Tonne Kilometrage (Goods)	-	-
Gross Tonne Kilometrage (Passenger)	Number of unit produced; (locomotive, coach, traction motor, etc.)	Number of units worked upon for maintenance (locomotive, coach, traction motor, etc.);

Source: (PAT Proforma 2015)

CATEGORIES OF RAILWAYS NOTIFIED UNDER PAT

Zonal Railways: Each zonal railway provides transport services for both passenger and goods. The energy input for the mentioned services is in the form of diesel or electricity. In view of the above scenario, specific fuel consumption or specific energy consumption of zonal railways for services (both passenger and goods) shall be taken in terms of diesel (L/1000GTKM) and electrical energy (kWh/1000GTKm). Four performance matrices are identified accordingly. For calculating specific fuel consumption or specific energy consumption for a specific service (passenger or goods), the total amount of fuel input in liters or kWh shall be divided by the total gross tonne kilometrage for the respective service.

Production Units: Production units of Indian Railways manufacture a variety of products like locomotives, coaches, wheels axles etc. The SEC of production units shall be taken in terms of kilogram of oil equivalent (KgOE)/ units produced. For production units manufacturing, more than one variety of product under the same category, equalized number of units will be taken to calculate SEC. (For example, under the category of coach, there can be both AC and non-AC coaches having different energy demands and hence, they will be converted into equalized units to measure specific energy consumption).

Workshops: Specific Fuel Consumption or Specific Energy Consumption of workshops units of Indian Railways shall be taken in terms of KgOE/ units worked upon or maintained. For workshop units maintaining or working upon more than one variety of product under the same category, an equalized number of units will be taken to calculate SEC. (For example, under category of coach there can be both AC and non-AC coaches having different energy demands hence they will be converted into equalized units to measure specific energy consumption).

CALCULATION APPROACHES

To calculate GHG emissions from the data above, two approaches can be adopted:

Based on fuel consumption:

$Emissions_{CO2} = Q_{fuel} \times NCV_{fuel} \times EF_{fuel}$

Where:

$Emissions_{CO2}$ CO_2 emissions in tonnes of CO_2

Q_{fuel} Quantity of fuel combusted in the thermal power plant (mass or volume unit)

NCV_{fuel} Net calorific value of the fuel (GJ per mass or volume unit)

EF_{fuel} CO_2 emission factor of fossil fuel used (tCO_2/GJ)

For calculation of GHG emissions from purchase of electricity from the grid, following can be used:

$Emissions_{CO2}$ = EU_{grid} × $EF_{CO2, grid}$

Where:

$Emissions_{CO2}$ CO_2 emissions in tonnes of CO_2

EU_{grid} Quantity of electricity purchased from the grid (in MWh)

$EF_{CO2, grid}$ CO_2 emission factor of electricity grid (tCO_2/MWh)

This approach is suitable for all three proforma designed by BEE as it is based on the quantity of fuel used and amount of electricity purchased from the grid.

Based on gross tonne kilometrage:

This method is applicable where the data pertaining to gross tonne kilometrage and emission factor for both passenger and goods from railways is known. GHG emissions can be calculated as:

$Emissions_{CO2, passenger}$ = passenger km performed × emission factor (tCO_2/ passenger-km)

And

$Emissions_{CO2, goods}$ = goods tonne km performed × emission factor (tCO_2/tonne-km)

India GHG Program provides transport emission factors for rail transport (Transport Emission Factor: IGHGP 2014), which is country-specific and derived following good practice guidance that is internationally acceptable.

Both the above-mentioned methodologies can be integrated into proforma designed by BEE to facilitate calculation of GHG emissions without altering the existing proforma.

FINDINGS

Based on the assessment of the need for integrated reporting (energy and GHG); merits and challenges; and fungibility of integrating GHG data points for two sectors notified under PAT scheme, this section provides set of key findings, which are as follows:

- **Emissions from energy usage**: From the above analysis of two sectors, it is feasible to integrate GHG reporting into the existing reporting framework based on the total fuel input parameters in terms of fuel consumption (solid, liquid and gaseous), purchased grid electricity, etc. entering the defined boundary of DC. This can be achieved by programming the relevant conversion factors and emission factors into already built proforma without altering the proforma.

- **Process-related GHG emissions**: The DC units under the PAT scheme includes process industries such as aluminum, cement, fertilizer, iron and steel, pulp and paper, textiles, chlor-alkali, refinery, etc.

  Apart from the emissions from the energy (all forms) use (based on gate-to-gate concept), DC units under the above-mentioned sectors also emit GHG emissions from processes. For example, primary aluminium production includes process emissions from the consumption of carbon anodes in the reaction to convert aluminium oxide to aluminium metal. The consumption of prebaked carbon anodes and søderberg paste is the principal source of process related carbon dioxide emissions from primary aluminium production.

  Emissions from industrial process can be included in the current reporting framework if technology specific emission factors are known. In the case of primary aluminium production, prebake technology specific emission factor (tCO_2/tonne aluminium produced) and søderberg technology specific emission factor (tCO_2/tonne aluminium produced) can be programmed into the existing proforma.

- **Emissions from energy-intensive industries not included in PAT**: Although there are now 621 DCs included in PAT from 11 sectors, there are still some sectors which are energy-intensive but outside PAT scheme. The table below provides a snapshot of possible energy-intensive sectors that could be included into future PAT schemes:

Table 8: Future energy-intensive sectors likely to be included in PAT scheme

SECTOR	APPROX. ANNUAL ENERGY CONSUMPTION (MILLION TOE)	REMARKS
Sugar	4.455	There are 99 Plants with capacity above 5,000 tonnes (of sugarcane) crushed per day (TCD). These have annual energy consumption between 45,000 TOE to 90,000 TOE
Distillery	0.630	99 Major distilleries consuming 0.39 million TOE
Automobile Manufacturing	0.410	24 Major Plants consuming 0.34 million TOE
Chemicals	0.270	Includes 4 sub-sectors viz. carbon black, calcium carbide, titanium dioxide, and methanol. There are 14 Major Plants consuming 0.235 million TOE

Source: (pwc 2014)

Additionally, the Micro, Small and Medium Enterprises (MSME) sector, which is largely diversified and accounts for 8% of GDP, 45% of manufacturing output and 40% of India's total export is yet not included with PAT framework. This sector manufactures over 6,000 products with many energy-intensive sectors like foundry and forgings, glass and ceramics, bricks, diary and food processing (Niti Aayog 2017).

GHG emission data from all the above-mentioned sectors could significantly contribute to paint an accurate picture of GHG emissions from industries.

- **GHG-related reporting and verification framework**: To ensure smooth integration of a GHG component to the existing and future PAT framework, development of comprehensive modalities and guidelines on GHG calculation methodologies is a pre-requisite. Since all the sectors are different, sector-wise calculation methodologies and tool-kits development will be required. Furthermore, verification and certification of emission reductions would require empanelment of organizations with expertise on GHG audits. Modalities and procedure for such verification and certification would also have to be developed.

- **Restricted boundary**: Many sectors like iron and steel, aluminum and cement require auxiliary fuel consumption for various activities like internal transportation, energy consumed in major and minor construction works, mining activities and energy consumed in residential colonies. Such activities are currently outside the periphery of the PAT scheme.

- **Scope 3 GHG emissions**: Scope 3 emissions refers to the indirect emissions that are consequence of the activities of organizations and/or facilities (in context of PAT scheme, it is DC units) but occur from sources not owned or controlled by organizations and/or facilities. Scope 3 emissions can be included by extending the boundary of PAT scheme to include activities such as transportation of fuel and energy, in-bound and out-bound logistics for sold products, employee commute of DC units, etc.

- **Harmonization between PAT reporting and GHG Protocol-based reporting**: Many organizations and/or facilities in India voluntarily disclose their GHG emissions on platforms like GRI CDP, etc. For example, for DC units reporting under the PAT scheme, purchased goods and energy (e.g. coal) are transported through railways on many occasions. Energy consumed and, hence, the resulting GHG emissions from railways will act as scope 3 emissions for many sectors notified under PAT scheme. This will reduce the duplication of efforts for DC units to report scope 3 emissions.

RECOMMENDATIONS

In this issue brief, conscious efforts have been made to explore the possibility of incorporating GHG related information within existing templates (also known as proforma) designed by BEE for better bottom-up data collection from energy-intensive industries covered under the PAT scheme.

- **Fungibility of GHG component**: To calculate GHG emissions from all forms of energy consumption data (based on a gate-to-gate approach), the existing proforma should include relevant data on conversion factors and emission factors.

- **Inclusion of process-related GHG emissions**: Current proforma includes reporting on the overall energy input (fuel consumption data, gross calorific value, etc.) and total product. A slight deviation from this approach can help in capturing emissions due to processes as well. Inclusion of data on production per process and technology-specific emissions factors are the answers to this challenge. Process or activity level data would not only help in effective identification of energy saving opportunities but would also assist in getting a clear picture of the GHG emissions portfolio.

- **Inclusion of energy-intensive industries exempted from PAT so far**: PAT saw a significant increase in the number of DCs in PAT Cycle 2 as compared to PAT Cycle 1, along with addition of three new sectors. However, PAT should also include energy-intensive industries like sugar, distillery, automobile manufacturing and MSME. This would provide a clearer picture on total energy consumption and GHG emissions from industries within a single platform.

- **Alterations to the PAT reporting and verification framework**: The Ministry of Power, in consultation with BEE, should create an implementation committee consisting of subject experts and representatives MoEFCC, BEE and DCs. Such an implementation committee, through extensive stakeholder consultation, should finalize the modalities and procedures of GHG integration into the existing and/or future PAT framework. The implementation committee should also facilitate development of sector-wise GHG emissions calculation methodologies and toolkits.

- **Extension of boundary**: Currently, SEC is calculated based on the total energy input per unit of product, which excludes activities occurring outside the gate-to-gate boundary due to operations of DC units. Such activities also release a considerable amount of GHG emissions. Inclusion of these activities within the boundary of DC units will provide a more accurate picture of GHG emissions occurring due to operation of DC units.

- **Inclusion of scope 3 emissions**: The current boundary under the PAT scheme for each notified sector should be extended to include activities and hence, emissions occurring from the sources not owned or controlled by DC units. Integration of GHG reporting within the existing and future PAT framework would mean access to GHG emissions from railways that would act as scope 3 emissions for many notified sectors under PAT.

As demonstrated in the above sections, integration of GHG reporting within the current and future framework of PAT scheme is possible. However, this would require certain interventions. Such integration would require combined efforts from all stakeholders including ministries (MoEFCC, MoP, etc.), nodal agencies (BEE, SDA, etc.) and designated consumers. This exercise would be challenging, but worth the effort due to the various opportunities it presents. The present issue brief seeks to highlight these avenues to relevant stakeholders.

Moving forward and owing to the fact that each sector notified under PAT is different, detailed sector-wise analysis can be undertaken to analyze the fungibility of the GHG component in the existing and future reporting framework of the PAT scheme.

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About the Author

Subrata Chakrabarty works as Managing Associate with Climate Program of WRI India. His deeply engages on supporting institutional capacity building on measurement, reporting and verification aspects of climate action. Contact: subrata.chakrabarty@wri.org

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1st Floor, Godrej & Boyce Premises
Gasworks Lane, Lalbaug, Parel,
Mumbai, Maharashtra
India 400012