Greenhouse Gas Accounting

Zareena Begum I

DISSEMINATION PAPER - 34

Centre of Excellence in Environmental Economics
(Sponsored by Ministry of Environment and Forests, Government of India)
MADRAS SCHOOL OF ECONOMICS

March 2017

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Centre of Excellence in Environmental Economics
Madras School of Economics
Gandhi Mandapam Road, Chennai 600 025
Email : coe@mse.ac.in

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ZAREENA BEGUM
Professor, Madras School of Economics
Chennai – 600025
zareena@mse.ac.in

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GREENHOUSE GAS ACCOUNTING

1. Introduction

Greenhouse gases absorb infrared radiation and contribute to the warming of the Earth's surface to a temperature much higher than it would have been without them. Earth's natural greenhouse effect is required to support life. Human activities, primarily the burning of fossil fuels and clearing of forests, have intensified the natural greenhouse effect, causing global warming.

Greenhouse gas emissions accounting is a method of calculating the amount of greenhouse gases (GHG) emitted by a region in a given time-scale (Brown et al., 2013). A National Emissions Inventory (NEI) measuring a country's GHG emissions in a year is required by the UNFCCC to provide a benchmark for the country's emission reductions, and subsequently to evaluate international climate policies such as the Kyoto protocol (although the original has now expired, extensions have been agreed as well as regional climate policies such as the EU Emissions Trading Scheme (ETS). There are two conflicting ways of measuring GHG emissions: *production-based* (sometimes referred to as territorial-based) or *consumption-based*.

Production-based emissions: These take place within national territory and offshore areas over which the country has jurisdiction. This approach includes exports but exclude imports and emissions embodied in international trade.

Consumption-based emissions: Encompass those emissions from domestic final consumption and those caused by the production of its imports. This means the importing country takes responsibility for emissions related to production of the exporting country's exports.

Each approach gives different NEI. Different NEIs would result in a country's choosing different optimal mitigation activities. The application of production-based emissions accounting is currently favoured in policy terms, although much of the literature favours consumption-based accounting (EIA, 2016). The Greenhouse Gas Protocol (GHGP), created by WRI and the World Business Council for Sustainable Development (WBCSD), is the leading international standard for companies to measure their carbon emissions so they can manage and reduce them.

2. Options for including all lands in a future greenhouse gas accounting framework

GHG Reporting

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is to avoid dangerous interference with the global climate system. To pursue this objective, comprehensive information on all GHG fluxes is required in order to provide a complete understanding of the pressures on the atmosphere, and to inform the planning of policy measures aimed at mitigating atmospheric impacts (EIA, 2016). Therefore, parties to the UNFCCC submit a national GHG inventory report. In the context, of the UNFCCC, 'estimation' is the process of calculating emissions and/or removals of greenhouse gases while 'reporting' is defined as the action of providing the results of the estimation of emissions and removals to the UNFCCC in a standardised manner. The current inventory reporting framework requires estimation of emissions and removals from managed lands only; unmanaged lands are excluded with the intention of distinguishing anthropogenic from natural emissions. The exclusion of unmanaged lands from reporting has proven problematic, however, as it is very difficult to compose definitions for 'managed' and 'unmanaged' that are applicable globally, and there is potential for countries to manipulate land categorisation to optimise their net carbon outcomes. The exclusion of unmanaged lands is also a disadvantage from a scientific perspective: GHG fluxes from unmanaged lands, such as from wildfire and pest attacks, can constitute a significant contributor to atmospheric impacts. A full understanding of these fluxes is, therefore, important for understanding the total GHG load on the global atmosphere, as indicated above. However, development of the capacity to deliver full GHG estimation for all land areas would be a difficult challenge, particularly for developing countries. It might be easier if this GHG estimation could be generated outside reporting requirements of individual parties through, for example, internationally funded monitoring programs conducted on a regional basis, rather than by individual countries.

GHG Accounting

'Accounting', with respect to the Kyoto Protocol, is defined as 'comparing emissions and removals ... with commitments assumed by Annex I Parties under the Kyoto Protocol' (UNFCCC, 2003). This definition of accounting is here broadened to mean calculating 'debits' and 'credits' with reference to an agreed target, and assumed to apply also to future climate policy regimes after 2012. Accounting should isolate the anthropogenic component of estimated emissions/removals in order to provide appropriate incentives/disincentives for beneficial/detrimental actions, and to assess the effectiveness of policy measures. The current implementation of the accounting framework for the Kyoto Protocol as elaborated through subsequent Conferences of the Parties (COP) to the UNFCCC includes specific land use changes, that is, afforestation, reforestation and deforestation under Article 3.3, and specified land management under Article 3.4. This land use based approach to defining which emissions and removals are to be included in accounting is partially successful in distinguishing anthropogenic from nonanthropogenic greenhouse gas emissions, but it introduces a potential loophole through the possibility of manipulating the categorisation of land to influence the outcome (Chen et al., 2013). Thus, to avoid potential manipulation of defined land use categories, GHG accounting should ideally be applied to all activities and to all lands rather than just managed lands.

On all lands, it will be necessary to isolate direct anthropogenic impacts from fluxes due to natural factors or indirect anthropogenic causes which could otherwise result in large debits (for example, fluxes due to wildfire in Australia, Russia and Canada) or potential 'windfall gains 'from effects such as CO_2 fertilisation, nitrogen deposition or regrowth after fires that may be enhancing forest growth independently of any direct management effects. The necessity for 'factoring-out' these indirect effects will be substantially increased if all lands are included.

Advantages of GHG accounting on all lands

In comparison with the current framework, the advantages of accounting GHGs on all lands within a country's jurisdiction are that: It covers all significant anthropogenic sources and sinks within the land use sector.

Article 3.3 of the Kyoto Protocol covered only a narrowly defined set of land-use based activities. Inclusion of other land-management based activities is voluntary for the first commitment period, and it is not yet clear how this can be operationalised in a consistent manner.

It reduces biases such as double-counting or selective inclusion of activities. With specifically defined land categories or activity classes, it is possible that the same activity could be counted twice, or not at all (Loughlin et al., 2011; Kesicki and Yanagiasawa, 2014)). For example, grazed woodlands could be classed as grazing land and also as forest necessitating guidance to avoid double-counting of specific land units.

The combination of defined land categories and non-land based activity (revegetation) in the current framework still perpetuates the possibility of double-counting. For the first commitment period, countries decide whether or not to include forest management, cropland management, grazing land management and revegetation in their accounting. Hence, countries have the option to select only those activities that result in favourable accounting outcomes.

To provide incentives for improvements in all activities, it is important to prevent such biases. Inclusion of all lands ensures there is no risk of double-counting and no selectivity. It minimises the issue of within-country leakage as no activities are outside the accounting boundary. When only specific activities are included, there is a danger that carbon-depleting activities might be carried out in those categories where carbon-stock changes are not counted, and carbon-increasing activities in categories that are counted. For the first commitment period, for example, there could be an incentive to harvest wood from stands that were forested prior to 1990 (assuming that a country elects not to include forest management in its accounting), but leave forests planted since 1990 untouched. For example, under a domestic emissions trading scheme (such as that operating in NSW, Australia (IPART, 2006)), forests planted after 1990 may generate tradeable credits, whereas forests planted before 1990 do not. Hence, forest owners would have the economic incentive to harvest the pre-1990 portion of their estate and retain post-1990 forests in order to maximise returns from emissions trading. Thus, a country could generate

removal credits while there may be no actual increase in carbon stocks for the country as a whole. All lands accounting would preclude such within-country leakage, although international leakage could still be a problem unless all countries are included in future obligatory greenhouse gas control agreements (Leinert et al., 2013; USEPA, 2013, 2015 and 2016). Another example of leakage could arise if disturbances, such as storms or fire, affect unmanaged land, causing large carbon losses that are not counted. If the land is subsequently managed to aid regeneration or for other eligible land use activities, the removal through regrowth could be counted. It partly covers non-permanence. Biospheric carbon stocks are inherently vulnerable to accidental or deliberate release, so biospheric removals are not permanent. Therefore, it is critical that if a carbon stock increase has been accounted, any subsequent loss of this carbon stock is also recognised.

Under all-lands accounting approaches, all losses of C stocks are compulsorily accounted, so any subsequent reversal of a removal will be recorded. It requires no artificial fixes to correct unintended consequences. The current accounting system of the Kyoto Protocol reflects an agreement that was developed with imperfect knowledge and from an initial primary focus on controlling fossil-fuel emissions. Net emissions from the biosphere were included as well, but the approach developed initially was found to lead to a range of problems.

As problems were encountered, amendments were subsequently adopted to remedy unintended consequences. The resulting accounting system is complicated and contains arbitrary adjustments and restrictions, including ad hoc caps on total credits and the requirement to elect to include or omit whole land-use categories. A comprehensive accounting system in which all lands are included, planned with the greater understanding now available, can be less complex and can be devised without the need for subsequent adjustments and corrections to achieve the intended outcome.

It avoids unbalanced accounting. It is important that accounting is balanced, that is, that both sources and sinks are included. In the first commitment period, countries that select inclusion of forest management must include both emissions and removals from forested land; therefore, accounting

on forest land is balanced (Shindell, 2015). Similarly, both emissions and removals are reported for cropland and grazing land if these options are elected. Countries may also elect to include the activity of 'revegetation', that is, enhancement of carbon stocks through establishment of vegetation other than forest. However, there is no requirement for countries to also, report 'devegetation', that is, the loss of biospheric carbon stocks that does not fall under the definition of deforestation. Therefore, the current accounting framework is unbalanced in this respect. If all land was included in the accounting system, such unbalanced accounting would not occur. Note that these advantages apply where all lands within a country's borders are included—not just 'managed' lands. Description and analysis of options:

Option 1: Gross-Net Accounting

Gross-Net Accounting would seem to be the simplest approach: emissions/removals for the land use sector during a commitment period would be balanced against a country's gross emissions from other sectors during the commitment period, and compared with a gross emissions baseline. The underlying assumption is that in the absence of anthropogenic effects, the biosphere would, on average, experience no net carbon-stock change. Hence, any change in carbon stocks in the land use sector could be equated with the human effect on a country's vegetation and should be credited or debited accordingly (Howard, 2014; Saari et al., 2015). This approach is attractive for its simplicity: it is easy to comprehend and implement, requiring no complicated accounting rules or global decisions/definitions to include/ exclude certain lands or activities. Furthermore, it provides an incentive to increase biospheric GHG removals. However, its simplicity also leads to serious anomalies.

Due to natural variability or climate change, or due to land management actions in previous decades, countries can potentially have large carbon gains or losses in individual years or commitment periods. For some countries, the gains or losses can even exceed fossil-fuel based emissions. It would be grossly unjust if countries received such large windfall gains or liabilities. Thus, Gross-Net Accounting fails to isolate the anthropogenic component of biospheric emissions/removals. Further, given that the emissions

target is based on gross emissions in some historical reference year or period. These problems render simple Gross-Net Accounting unsuitable as an option for consideration.

Option 2: Net-Net Accounting

Net-Net Accounting would overcome the inadequacies with Gross-Net Accounting to some extent, although it introduces new problems. Net-Net Accounting would compare land use emissions/removals during the commitment period with emissions/removals in a previous year or period (Wang and Brown, 2014). Thus, the debits/credits added to a country's gross emissions from other sectors would be based on the difference between net emissions from all lands during the commitment period and the corresponding net emissions in a reference period.

This goes a step further than simple Gross-Net Accounting and provides a partial means of isolating some of the anthropogenic causes of carbon-stock changes. A Net-Net Accounting system on all lands could be implemented in one of two possible ways:

1. by keeping a baseline in a fixed year or period: net emissions in a second commitment period could be compared against net emissions in a base year or period; or

2. by having a moving baseline: net emissions in a future commitment period could be compared to net emissions in the preceding commitment period.

3. Greenhouse Gas Accounting: A step forward for climate-smart agriculture

Agriculture is central to feeding the world and reducing poverty. But conventional forms of agriculture are often unsustainable and drive land degradation. Agriculture is also the world's leading anthropogenic source of methane (52 percent) and nitrous oxide (84 percent) emissions, and the principal driver of deforestation worldwide. Agriculture and agriculture-driven land-use change contribute 24 percent of global greenhouse gas emissions.

We can't fix what we don't measure, which is why quantifying greenhouse gas emissions from agricultural production is a necessary step for

climate-smart agriculture (CSA). Greenhouse gas accounting can provide the numbers and data that are important to solid decision making.

It will help identify management practices and opportunities that reduce greenhouse gas emissions while also providing improved food security, more resilient production systems, and better rural livelihoods. In practical terms, greenhouse gas emissions data can support farmers in adopting less carbon-intensive practices, guiding low-emissions development, assessing product supply chains, certifying sustainable agriculture practices, and informing consumers on the carbon footprint of their choices.

While greenhouse gas emissions data are useful for mainstreaming climate-smart agriculture, implementing greenhouse gas accounting is fraught with several challenges. One major challenge is the lack of functional tools that people can actually use: Tools that work across scales and agricultural land use systems, help prioritize mitigation actions and are flexible when it comes to requirements for country-specific data (EIA, 2016; USEPA, 2016). Useful greenhouse gas accounting tools should include confidence thresholds in greenhouse gas emission estimates and offer understandable metrics for tracking greenhouse gas emissions. Equally important is the need to build technical capacity in land use monitoring and greenhouse gas accounting, especially in developing countries.

To address these challenges, the World Bank recently partnered with the FAO to develop the EX- Ante Carbon Accounting Tool (EX-ACT) and an e-learning course for greenhouse gas accounting in agricultural landscapes.

EX-ACT is a land-based accounting system used to measure and to project changes to the carbon balance over time. Carbon balance refers to the amount of carbon released into the atmosphere through emissions, relative to the amount of carbon stored in the soil and plant material of an area, and relative to the carbon that soil and plant material is actively removing or "sequestering" from the atmosphere. Emissions of greenhouse gases, which differ dramatically in the intensity of their effects on the atmosphere, are measured in terms of carbon dioxide-equivalence. The measurements are expressed in terms of tons of carbon dioxide-equivalent (tCO2-e) per hectare over a period of one year. In addition to spatial, area-based measurement, EX-

ACT can also be used to measure changes to the carbon balance per unit of produce.

Ex-ante estimations of how this balance will change as the result of human activities associated with land-use change in development projects are particularly valuable in sectors that use a great deal of land, such as agriculture, forestry, pastoral livestock, and watershed management.

4. International Standard for GHG Emissions Inventories and Verification: ISO 14064

ISO 14064, an international standard that addresses the quantification and reporting of greenhouse gas emissions and the verification of this information provides an overview of the structure of the standard and present key aspects of its design and application. ISO 14064 is a technical specification and is climate policy neutral (Wintergreen, J. and Delaney, T, 2004). ISO 14064 exists as a guide for the private and public sector in developing GHG inventories for their organization as well as foundation for policy makers and program developers for initiatives to address the global environmental challenge of climate change.

Background

ISO 14064 is a standard developed under processes of the International Standards Organization. A non-governmental organization located in Geneva, Switzerland, the International Organization for Standardization (ISO) coordinates efforts by groups of technical experts representing individual national standard institutes to develop consensus-based voluntary technical standards on variety of issues. ISO has issued over 16,000 standards including the well-known ISO 9000 and ISO 14000 standard series on quality and environmental management, respectively. The objective of ISO standards is to facilitate international cooperation, especially business and trade, by facilitating communication on technical issues between industry, government, consumers, and other stakeholders and allowing consistency of products and services within and across national boundaries. The development of ISO 14064, an addition to the ISO 14000 environmental management standard series, began in 2002. Recognizing quickly emerging interest in

addressing the environmental issue posed by climate change combined with the lack of international standards for businesses to take action, a work group was formed to attempt to define how to quantify and report GHG emissions from an organization, as well as how GHG reports could be verified. A key objective of the process was to create a technically rigorous but policy neutral product that would be applicable regardless a country's current climate change policy, especially its participation in the United Nation's Kyoto Protocol. Through a process that included continuous interaction and cooperation of national technical advisory committees consisting of 175 experts representing 45 countries and a series of international in-person negotiating meetings, a standard on these issues was developed and issued by ISO for international use in March 2006. In August 2006, ISO 14064 was also approved by the American National Standards Institute as an American National Standard.

Structure

ISO 14064 consists of three parts, each with a different technical focus. Part 1 of the standard is titled "Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals." This part of the standard addresses conducting greenhouse gas emission inventories of organizations such as corporations using a bottom up approach to data collection, consolidation and emissions quantification. Part 3 of the standard is titled "Specification with guidance for the validation and verification of greenhouse gas assertions." This part of the standard establishes a process for verification of a greenhouse gas statement, including organization inventories, regardless of whether or not the inventory was developed under Part 1. This verification process is also applicable whether the verification is being conducted by an independent third party verifier or by an organization's internal auditors. Part 2 of the standard addresses quantification and reporting of emission reductions from project activities. Because of the different approach to emissions accounting associated with project activity relative to organizational inventories,

5. GHG Accounting: International Scenario

A carbon tax is usually defined as a tax based on greenhouse gas emissions (GHG) generated from burning fuels. It puts a price on each tonne of

GHG emitted, sending a price signal that will, over time, elicit a powerful market response across the entire economy, resulting in reduced emissions. It is a form of carbon pricing (Howard 2014; EIA 2016). Carbon is present in every hydrocarbon fuel (coal, petroleum, and natural gas) and is released as carbon dioxide (CO_2) when they are burnt. In contrast, non-combustion energy sources - wind, sunlight, hydropower, and nuclear - do not convert hydrocarbons to CO_2. CO_2 is a heat-trapping "greenhouse" gas which represents a negative externality on the climate system. Since GHG emissions caused by the combustion of fossil fuels are closely related to the carbon content of the respective fuels, a tax on these emissions can be levied by taxing the carbon content of fossil fuels at any point in the product cycle of the fuel.

Carbon taxes offer a potentially cost-effective means of reducing greenhouse gas emissions. A number of countries have implemented carbon taxes or energy taxes that are related to carbon content. Carbon taxes can be introduced as an independent instrument or they can exist alongside other carbon pricing instrument, such as an energy tax. While the experience with direct carbon tax implementation is relatively new, such instruments are being introduced at a fast pace.

In 2011, the GHG Protocol launched two new standards in response to demand from both the market and stakeholders for greenhouse gas emissions information across a company or product's value chain. The Corporate Value Chain Standard can help a company identify which parts of its value chain it should target to reduce emissions (Jenkins, 2014; Islam et al., 2013). The Product Life Cycle Standard may be used to develop new low-carbon product lines that can give companies a competitive edge or pinpoint climate-related risks in a product's life cycle. The Greenhouse Gas Protocol (GHGP) provides accounting and reporting standards, sector guidance, calculation tools, and trainings for business and government (Burniaux et al., 2009; Plambek 2012). It establishes a comprehensive, global, standardized framework for measuring and managing emissions from private and public sector operations, value chains, products, cities, and policies.

The new standards took three years to develop. Close to 2,500 partners worldwide participated and 60 companies from 17 countries road-tested the

standards. Even before their release, two major initiatives – The Sustainability Consortium and the Consumer Goods Forum – committed to use the standards. Their endorsement is a breakthrough and a clear signal that the new standards will be widely adopted by companies globally. The Consumer Goods Forum, for example, represents over 400 companies and retailers with a combined three trillion dollars in sales.

By enabling corporations to reduce their use of carbon, the new GHGP standards can play a role in significant global GHG emission reductions. The Greenhouse Gas Protocol offers businesses a number of resources to measure their emissions, including:

1. The GHG Protocol Corporate Accounting and Reporting Standard: Used by thousands of companies worldwide, this document provides guidance on how to prepare a corporate greenhouse gas emissions inventory. It covers scope 1 and 2 emissions, defined as the emissions from a company's own operations or leased assets (scope 1) and emissions from purchased energy (scope 2).
2. The GHG Protocol Scope 2 Guidance: This document provides important additional information on accounting for emissions from purchased electricity, steam, heat and cooling.
3. The GHG Protocol Corporate Value Chain (Scope 3) Standard: For companies, already able to measure their emissions from their own operations and energy use, the next step is to measure emissions from other locations of the company's value chain in order to comprehensively account for the company's total carbon footprint. The Scope 3 Standard provides guidance on accounting for emissions categories both upstream and downstream of the company's operations.
4. GHG Protocol Online Courses: Convenient, online courses are available to help corporate sustainability officers get up-to-speed on the GHG Protocol standards.
5. CDP Climate Change Reporting Program: Once a company has conducted a greenhouse gas inventory, it can join the ranks of

thousands of companies that are reporting their emissions to CDP. This can improve a company's standing with investors and, as aforementioned, critical customers such as the US federal government.

GHG is measured with carbon footprint. Carbon footprint is the total set of greenhouse gases emitted in the atmosphere and is expressed as CO_2e. In industry, the source of carbon emissions related to an industry premise can be categorized into two major types, i.e., direct carbon emission source related to the on-site carbon emission, for instance the emission due to fuel combustion within the premises itself and indirect carbon emission source that is related to the carbon emission at external premises, due to the resource consumption within the business premises (Canadell et al., 2007). For instance, electricity, fuel consumption, water consumption, solid waste and waste water will lead to the carbon emission at the power plant, due to the power generation requirement to treat and handle these resource and waste. Therefore, all these five main criteria, i.e., electricity, fuel consumption, water consumption, solid waste and waste water will be selected as carbon performance indicators (CPI). An integrated carbon accounting and mitigation (INCAM) framework can be developed that may serve twofold purposes, tracking of emission in onsite specific area and identify potential emissions reduction strategy in a holistic manner. The systematic steps to develop INCAM includes: -

(1) Define carbon accounting centre (CAC)
(2) Establish carbon emission indicators (CEI) for each CAC and CPI
(3) Identify the hot spot for each CAC
(4) Propose emission reduction strategies and rank emission mitigation measures according to cost effectiveness.

INCAM provides relevant information that makes carbon profiling visible to various levels of an organization, enabling industry to plan, make decisions and take effective action to reduce emission towards greening the industry.

Full cost accounting has been applied in many industrial settings that include the oil and gas, energy, chemical and waste management industries. A Sustainability Assessment Model developed by British Petroleum and Aberdeen University has been proposed as a well-developed and potentially

practical tool for automotive applications. The Sustainability Assessment Model can be used by both academics and practitioners to translate a range of conflicting sustainability information into a monetary unit score. This is an effective way of communicating trade-offs and outcomes for complex and multi-disciplinary sustainable decisions in the automotive sector (Hoffmann, 2005). It measures a broad range of economic, environmental, resource and social effects (internal and external), which is currently lacking in existing automotive systems. Its other strengths are the ability to provide both monetary and physical metrics for sustainability assessment, its flexibility and the ability to combine multiple sustainability dimensions.

In greenhouse gas emission accounting, co-product emission allocation is an important issue, for three reasons. First, roughly half of all anthropogenic greenhouse gas emissions may be attributed to the production of food and basic materials. Second, the production of food and basic materials commonly generates co-products, and co-production is increasingly prevalent in emission intensive agricultural, steel and chemicals industries wherein firms are converting process waste into a co-product. Third, some specific products with co-products- palm oil, for example- have immense associated emissions. Indonesia is the world's third largest emitter of greenhouse gases (behind China and the U.S.) primarily due to its emissions associated with palm oil production. The issue of co-product emission allocation is contentious in the context of voluntary greenhouse gas emission accounting. At present, the standards for greenhouse gas emission accounting (GHG Protocol, ISO14041 and PAS2050) allow for process emissions to be allocated in proportion to the economic value of a co-product, in proportion to the mass of a co-product, or based on a system expansion. The latter accounts for avoided emissions from other sources that would produce a market substitute for a co-product.

However, observers complain that a buying firm can under-state its supply chain emissions by choosing the allocation rule that assigns the minimum emissions to an input; observers and some buying firms want to eliminate the flexibility to choose the allocation rule (WRI 2011). Despite engagement by NGOs, Walmart, PepsiCo, and other prominent buyers this issue remains unresolved.

6. GHG Accounting: An Indian Scenario

India has cut subsidies and increased taxes on fossil fuels (petrol and diesel) turning a carbon subsidy regime into one of carbon taxation, by putting an effective price on emissions. This has significantly increased petrol and diesel price while serving as price signal to reduce fuel burnt and hence CO_2 emissions. Calculating CO_2 emission reductions from measures taken for petrol and diesel suggests that there will be a net reduction of 11 million tons of CO_2 emissions in less than a year compared to the baseline or 0.6 percent India's annual emissions. In addition, India has increased the coal cess from Rs. 50 per ton to Rs. 100 per ton, which is equivalent to a carbon tax of about US$ 1 per ton. A higher tax on coal offsets the domestic externalities including health cost of coal for power generation. The Economic Survey points out that any rationalization of coal pricing must take account of the implications for power prices and hence access to energy for the poorest in India which is and must remain a fundamental objective of policy.

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 organisations in India. The programme is supported by the Shakti Sustainable Energy Foundation, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and Pirojsha Godrej Foundation.

Over the last few years, with the release of India's National Action Plan on Climate Change, the Low Carbon report, the pilot initiative on trading of pollutants from power plants and the mandatory scheme on energy efficiency trading, the discourse regarding the role and involvement of Indian industry in achieving the country's energy and carbon intensity goals has matured considerably. At the same time, a small number of Indian companies are becoming more open to their stakeholders, investors and consumers about their environmental footprint, including carbon footprint, as they realize the business benefits of doing so.

The India GHG Program (2014) therefore aims to establish a robust and effective institutional set-up providing access to;

- **Internationally recognized and locally relevant GHG measurement and accounting tools**
  The program will provide companies with tools and technical assistance to build inventories, based on the GHG Protocol, to reduce emissions and drive more efficient, resilient, and prosperous businesses and organizations.
- **Customized training and capacity building initiatives** the program will create a pool of certified GHG practitioners, by developing and delivering training and course modules to help businesses make informed decisions and adopt a globally consistent approach to GHG reporting and accounting.
- **Relevant industry specific best practices, benchmarking data and analytics**
  The program will convene industry, sectoral and regional peers to foster collaboration, dialog and competition on a single platform.
- **Expertise on appropriate goal setting and voluntary targets**
  The program will establish both annual and long-term reduction goals, identify reduction opportunities, and track their progress for efficient and effective emissions management.
- **Business solutions to facilitate GHG emission reductions**
  Programs such as Green Power Market - Development Group, Offset Platforms and Market Mechanisms offer businesses this opportunity.

Moving beyond the widespread enthusiasm about the private sector's engagement in climate action, it is essential that there should evolve clarity and consensus on the potential roles that businesses can play and the kind of activities they can engage in. In doing so, it is crucial to understand and address some of the key barriers facing the private sector in implementing climate projects to its full potential. The government needs to reciprocate business actions by creating friendly regimes backed by incentives and returns. In turn, the private sector needs to learn to look beyond opportunities for

monetization of carbon credits and rather invest in long-term projects of scale. Furthermore, Indian corporates need to play an effective role in the shaping of the post-2015 climate agenda. Business participation is vital to leverage market forces in favour of environmental sustainability and climate action. The government needs to convene resources and expertise of different stakeholders and create an enabling environment to undertake climate projects at the domestic level. The Indian private sector can certainly emerge as the green champion of the country by contributing towards the overall goal of low-carbon inclusive development.

7. Conclusion

The issue of co-product emission allocation is crucial and unresolved also in the context of international trade and climate policy. A quarter of global CO_2 emissions from fossil fuels occur in production of goods for export. Food production accounts for a quarter of anthropogenic greenhouse gas emissions. Production of basic materials (metals, chemicals, minerals, paper, and petroleum products) accounts for between 23% and 30% of all anthropogenic emissions, based on. Industrial emissions (in large part, the emissions caused by energy generation for industrial use) amount to 32% of all anthropogenic greenhouse gas emissions (IPCC 2014; Lontzek et al., 2015), and production of basic materials accounts for approximately 85% of all industrial energy use (IPCC 2007). Regions with climate policy are contemplating "border adjustment". Border adjustment would apply an emissions tax (or requirement to purchase emissions permits within a cap-and-trade system) to goods imported from a region without climate policy. Specifically, under WTO law, a border adjustment must apply the same tax (or permit price) per unit emissions that is in effect in the importing region with climate policy. The crucial unresolved issue is how to assign an amount of emissions to an imported product. To facilitate implementation, governments are likely to apply border adjustment only to emission-intensive basic material and agricultural products some of which have co-products, so the question of how to allocate process emissions among co-products must be resolved.

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Centre of Excellence in Environmental Economics
Madras School of Economics
Gandhi Mandapam Road
Chennai - 600 025
Ph: 2235 2157/2230 0304/2230 0307
Fax: 2235 4847/2235 2155
Email: coe@mse.ac.in
Web: http://coe.mse.ac.in