

Developing a Framework for CGE Model: Analysing the Implications of CBAM

The Context

- The imposition of CBAM will inevitably affect various facets of India's economy, including trade, GDP, employment, household incomes, and overall economic development.
- Utilising indigenously developed ESAM along with the CGE model can help assess economic scenarios and evaluate policy interventions effectively.

The Context

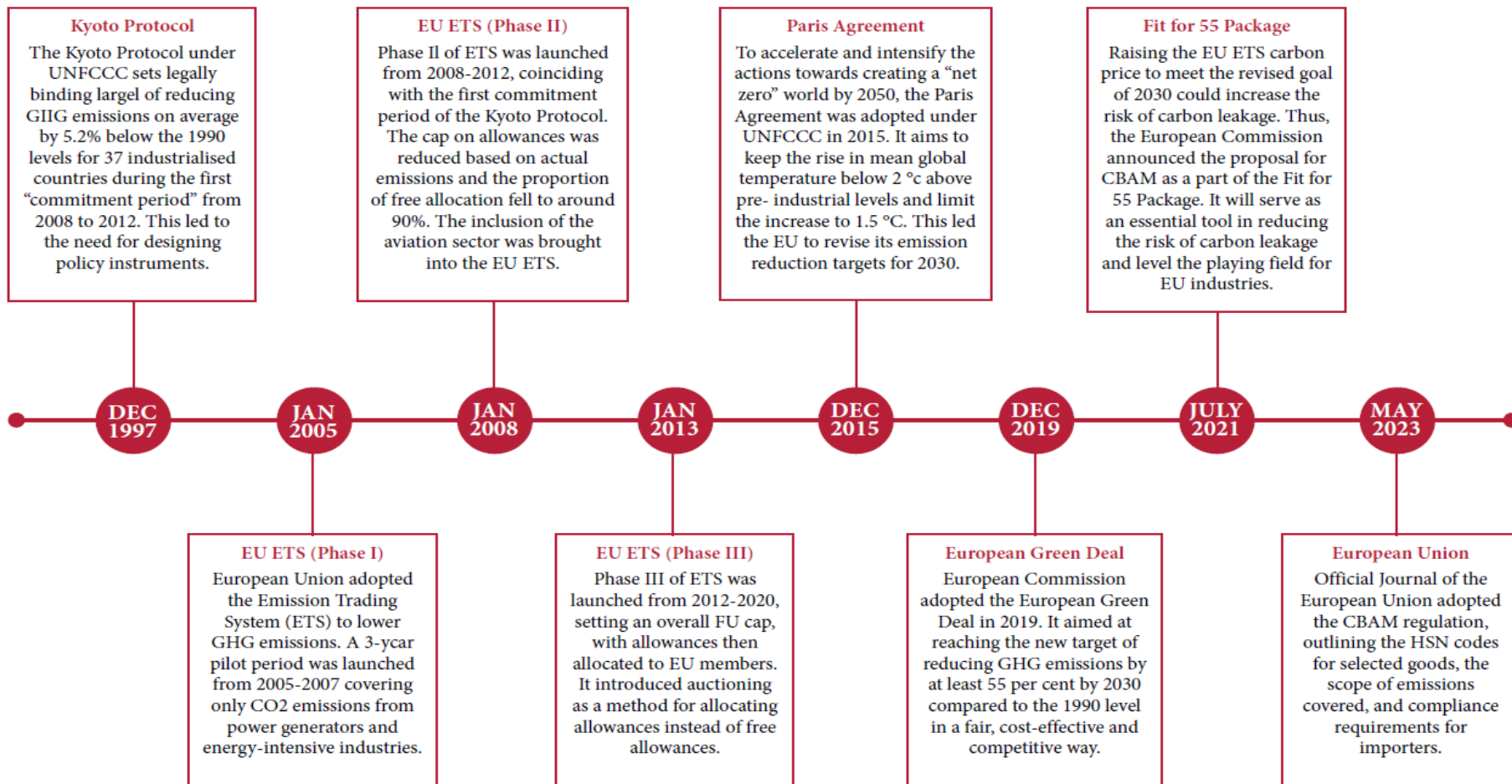
- **Objective**

- A critical review of the methods used for computing the effects of carbon pricing policies.
- To develop a framework for the CGE model for India allowing granular analysis of CBAM's impacts.

- **Research Questions**

- What different approaches have been used to assess the potential impacts of CBAM?
- How to design a CGE model framework for India?
- How the CSEP CGE model framework can be used to assess the impacts of various policies including CBAM on the Indian economy?

Figure 1: Evolution of CBAM in the European Union



Approaches used to analyse impacts of CBAM

	Gravity Model	Input-Output Model	Accounting Approach	CGE Model
Description	<ul style="list-style-type: none"> A spatial interaction model that estimates the volume of interactions between two geographies based on factors like country size, distance, etc. 	<ul style="list-style-type: none"> Measures interdependence among sectors and tracks the flow of goods and services across those sectors. 	<ul style="list-style-type: none"> An accounting exercise to estimate CBAM-exposed trade and potential carbon payments. 	<ul style="list-style-type: none"> A theoretical model consisting of numerous simultaneous non-linear/linear equations used to compute the implications of various policies or shocks in the economy. This makes it a 'computable' general equilibrium model where all markets interact simultaneously.
Strengths	<ul style="list-style-type: none"> Captures bilateral trade flows. Can be used to examine the impacts of geo-economic issues other than international trade. 	<ul style="list-style-type: none"> Incorporates both direct and indirect effects. Provides detailed sectoral analysis. 	<ul style="list-style-type: none"> Provides an understanding of the potential implications of a trade policy in a relatively simpler yet effective framework. 	<ul style="list-style-type: none"> Incorporates the supply side of the economy, allowing for price movements. Allows for substitution effects in production and consumption. Allows for the inclusion of non-market activities alongside market mechanisms.
Weaknesses	<ul style="list-style-type: none"> Focuses on bilateral/bi-regional trade, limiting the scope Less adaptable to structural changes. Inappropriate to use for analysing impact of policies like CBAM, which do not treat trading partners differently based on geographical distance. 	<ul style="list-style-type: none"> Certain assumptions like fixed input proportions, constant returns to scale, no technological advancement limit its use. Lacks elasticities of substitution, hindering its ability to account for adjustments or technological changes. 	<ul style="list-style-type: none"> Does not consider behavioural changes or dynamic adjustments due to policy changes. 	<ul style="list-style-type: none"> Highly complex; requires accurate parameter estimation. Dependence on key economic parameters, like elasticity parameters, to capture behavioural responses.

Selected CGE Model Relating to Carbon Pricing/CBAM

Multi-Country CGE Model

- Estimates the effects of Border Carbon Adjustment Mechanisms
- Utilises GTAP database
- **Studies Include:**
 1. Takeda and Arimura (2023)
 2. Xiaobei et al. (2022)
 3. Devarajan et al. (2022)
 4. UNCTAD (2021)

Single Country CGE Model

- Estimates effects of Domestic Carbon taxes and international emission trading permit schemes.
- Utilises SAM/ESAM database
- **Models on the Carbon Pricing include:**
 - Ojha et al. (2009)
 - Pradhan and Ghosh (2012)
 - Pal et al. (2015)
 - Banerjee (2021)
- **Models for estimating CBAM:**
 1. Bao et al. (2012)- Impact of Border Tax Adjustments on China's sectoral carbon emissions.

Missing Links in Existing CGE Models

- Level of Disaggregation of Households (HH) as an Institution is not detailed.
 - Majority of CGE models use aggregated households.
 - **Pradhan and Ghosh (2012) and Pal et al. (2015):** Disaggregates households to analyse the welfare allocation and social equity effects using occupational categories of HH.
 - Ojha (2009) disintegrates the households using consumption expenditure for 5 urban and rural categories each.
- Exports/imports and Customs have not been disaggregated into EU and non-EU countries to examine the effects of CBAM.

Structure of CSEP-CGE Model

- **CGE Framework:** Built on the basic structure of Pradhan and Ghosh (2012), which is based on the IFPRI model and DART 97, EPPA and EMPAX-CGE model.
- **Features of this Model:**
 - Recursive dynamic, Multisectoral, Neoclassical, Price-Driven CGE model that captures interactions with the energy system.
 - Distinct production structure for fossil fuel (coal, oil and gas) and non-fossil fuel sectors.
 - Aggregated ESAM which has 24 production sectors (3 fossil fuel and 21 non-fossil fuel sectors), 2 factors of production and 10 households evenly divided between rural and urban based on the expenditure quintiles is used.
- **Adequacy of this Model:** Detailed socio-economic impacts of CBAM could be analysed for India.

Nesting Structure

Figure 1 : Fossil Fuel Sector

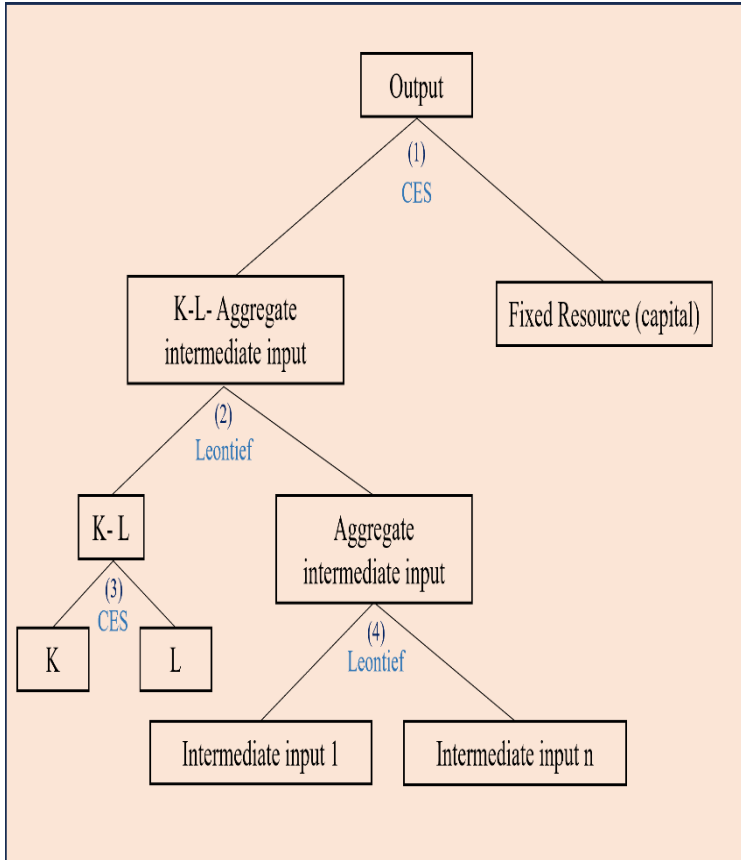
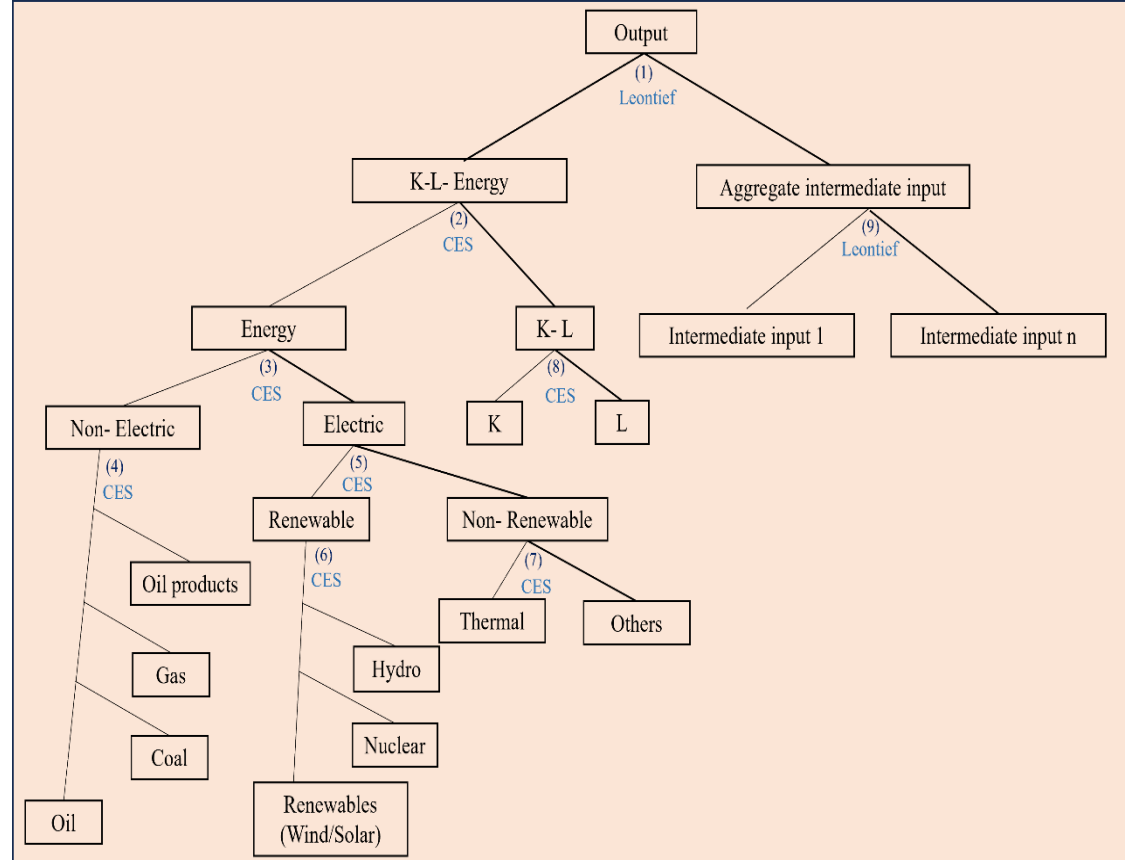
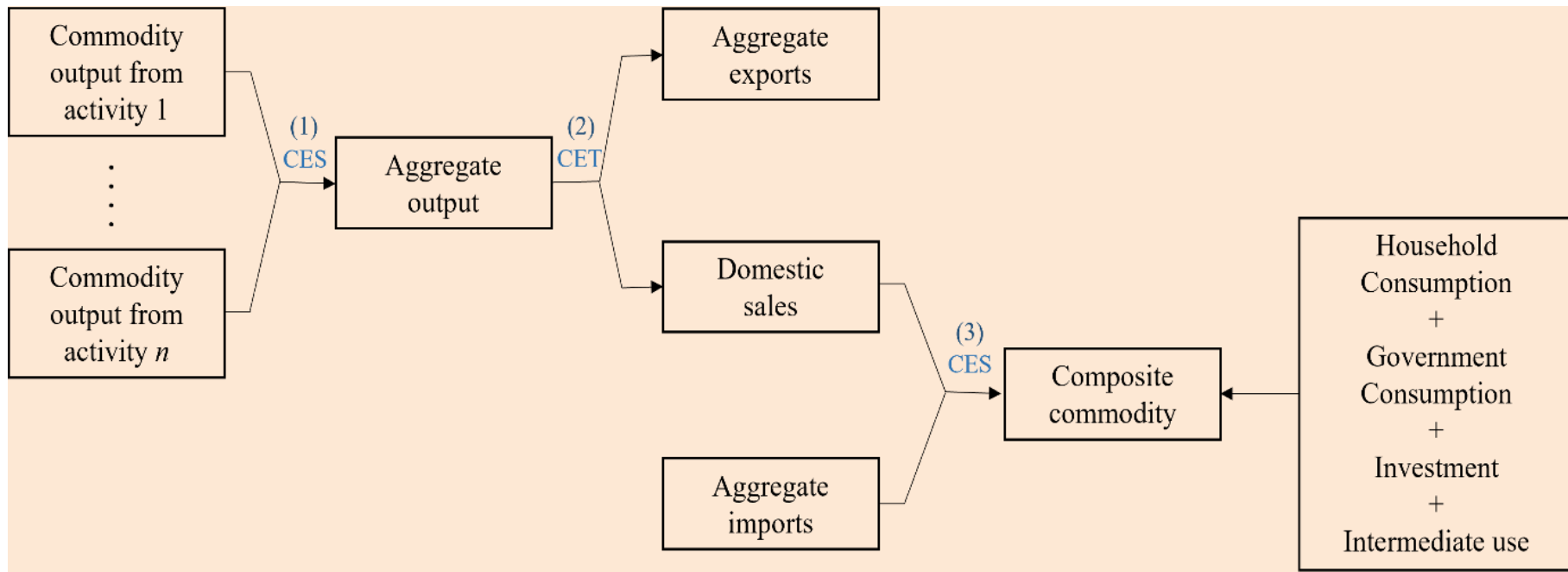


Figure 2 : Non- Fossil Fuel Sector



Schematic representation- Flow of Marketed Commodities



Data and Institutions

- Social Accounting Matrix- primary database for CGE models
- This study utilises CSEP's ESAM 2019–20 for India (Chadha et al., 2023)
- ESAM has been aggregated into:
 - 24 production sectors (comprising three fossil fuel sectors—coal, oil, and natural gas—and 21 non-fossil fuel sectors),
 - Two factors of production (labour and capital),
 - 10 households categories,
 - Institutions such as private enterprises, public enterprises, government, Net Indirect Taxes, a capital account, and the Rest of the World.

Utilization of CSEP-CGE Model Framework

- Structured to analyse different climate policy scenarios, including carbon taxes, emissions trading schemes, CBAM
- Some policy scenarios that may be examined using this model are
- **Scenario 1: No Domestic Carbon Pricing Policy**
 - Impact on GDP, Employment, Trade, Emissions, Inequality, etc.
 - Identify redistribution policies to minimise the impacts of CBAM.
- **Scenario 2: With Domestic Carbon Pricing Policy**
 - To devise an optimal Carbon Pricing Strategy for India.
 - To simulate the generated revenue for technological advancement of the CBAM industries and for redistribution.

Utilization of CSEP-CGE Model Framework

- **Scenario 3: Other Policy Responses**
 - Imposition of equivalent trade measures like tariff and non-tariff barriers.
 - To examine the impact of a global carbon policy in curbing emissions efficiently.

Conclusion

- EU-CBAM aims to reduce carbon leakage and secure a level playing field for EU producers
- Has the potential to reshape how countries conduct international trade
- This paper provides a concise overview of CBAM and the methodologies used in analysing climate mitigation policies, such as CBAM, within the existing literature
- It underscores the advantages and drawbacks associated with existing economic models—such as gravity, Input-Output, and accounting approaches—in assessing the impact of CBAM on competitiveness, carbon leakage, and social welfare
- CGE models emerge as the preferred choice for conducting economy-wide impact assessments of CBAM
- This Study provides the structure for a single-country CGE model framework that can examine issues relating to the impact of CBAM on the Indian economy

Thank you