Regional workshop to facilitate development and use of tools and methodologies for modelling and assessing the impacts of response measures

21 to 23/09/2022 in M'Bour, Senegal

Andrei Marcu

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Outline

1. Experience in developing a response measures methodology and applying it to the African context
2. Main challenges faced
3. How other countries can make use of the work done by ERCST?

ERCST's work on Response Measures

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- ERCST has been part of the Response Measures (RM) discussions throughout the years and supported the advancement of its work programme
- The best way to identify and address the risks to RM is by conducting **empirical studies**
- **In 2018, a methodology** to identify, measure and analyse the impacts of domestic and internationl RM **was developed**
- The methodology was tested with a **Case Study in Chile and later on in Ghana**

ERCST,2019

ERCST,2019

ERCST, 2021

Ghana Case Study

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- Started in Dec 2020 and culminated with a presentation at COP26 in Nov 2021
- The project was jointly implemented with the Environmental Protection Agency in Ghana
- Support with data collection and data disaggregation was given by the Ghana Statistical Service
- The case study was conducted as a live iterative activity with workshops held at the different stages of the project, leveraging local knowledge

epa

GHANA STATISTICAL SERVICE

Methodology for Ghana Country Case Study

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STEP 1 Describe the country and its characteristics

STEP 2 Identifying important sectors to the Ghanaian economy

STEP 3 Identify sectors potentially vulnerable to international response measures

STEP 4 Employ stakeholder input to identify vulnerable sectors that might have been missed in step 3

Identifying Vunerable Sectors

STEP 5 Identify relevant response measures

Identifying Response Measures

STEP 6 Assess the impacts of international response measures

Assessing Impacts

STEP 7 Look at possible domestic and international tools and support which may be needed to address the impacts

Description of methodology

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Step 1: Describe the country and its characteristics

- Overview Ghana country characteristics, including general geography, historical context, political system, main sectors of the economy, economic performance

Step 2: Identifying important sectors to the Ghanaian economy

- Sectoral value added, GDP, will be taken as an indicator, then the sectors of the economy will be ranked based on their value-added contribution to national GDP.

Description of methodology (2)

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Step 3: Identify sectors potentially vulnerable to intl' response measures

Two indicators will be taken into account for the vulnerability indicator:

a) **Trade intensity:** to understand which sectors are most trade-exposed
b) **GHG intensity:** to identify the sectors with low/no GHG emissions, as they will be less - or not at all - exposed to climate mitigation policies

$$Vulnerabillity\ Indicator = \underbrace{\left(\frac{\text{Export + Imports}}{\text{GDP sector+ Imports}}\right)}_{\text{Trade Intensity}} \text{ x } \underbrace{\left(\frac{\text{GHG emissions}}{\text{GDP sector}}\right)}_{\text{Emissions Intensity}}$$

Step 4: Identify relevant response measures

- Identifying which countries are Ghana's main trading partners for different sectors will allow an examination of relevant measures and help to identify which climate policies with international implications were put in place from their part, if any, that will affect Ghana
- To retrieve this information, international trade databases will be used

Description of methodology (3)

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Step 5: Assess the impacts of international response measures

Analyze the impacts of the identified vulnerable sectors and the relevant RM with either qualitative and/or quantitative methods:

a) **Quantitative assessment:** via modelling and performed for a limited number of RM **Qualitative assessment:** to inform the quantitative assessment by highlighting areas of concern that may need to be addressed in more detail

Step 6: Look at possible domestic and international tools and support which may be needed to address the impacts

- Several domestic and international mitigation tools which can help Ghana reduce its vulnerability to RM
- This step will be mainly qualitative and informed by discussions with local stakeholders

ERCST methodology: vulnerable goods/sectors

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HAZARD

High GHG intensity
Highly traded

\+

EXPOSURE

Significant portion of GDP
Significant labor component

=

RISK

This is a data-hungry process

Two types of challenges

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1. **Data availability:** GDP, GHG emissions, labour and tourism
2. **Effort to process data:** double concordance for trade intensity data and going through databases for identification of RM

Data availability: GDP

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- **GDP Data:** from Ghana Statistical Service. GDP figures available, but not always well disaggregated
- GDP data refers to activities - ISIC Rev.4 system. Usually available at the 1- or 2-digit level (public data from national accounts), but for a comprehensive overview we should have 4-digit level data
- For example, in Ghana, cocoa was a disaggregated to the 4-digit level, however for other products only 2-digit level is available, e.g.:
  - Mining and quarrying without oil and gas and gold > includes manganese ores & concentrates
  - Manufacture of food products > includes fixed vegetable fats & oils (incl. jojoba oil)
  - Both important products for the Ghanaian economy and to RM but not disaggregated

Table 1. ISIC Classification - example of disaggregation to gold products

Sector	Gold	
Section	B, Mining and Quarrying	
Division	07, Mining of metal ores	2-digit level
Group	071, Mining of iron ores	
Class	0729, Mining of other non-ferrous metal ores (this class includes gold)	4-digit level

Source: UN ISIC Rev 4, 2008

Data availability: GHG emissions

GHG emissions data conforms to IPCC categories from the National Inventory Report (NIR) not ISIC

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Data gaps for the GHG values of certain sectors/products

Table 2. ISIC Rev 4 products and NIR GHG emissions categories correspondance

Sector Description		GHG intensity	
ISIC Rev 4 Code	Description	IPCC Code (NIR)	Notes
2420 & 0729	Gold	na	Own elaboration based on Ashanti Gold Sustainability Report values
0610 & 0620 & 1920	Oil and gas	1.A.1.b , 1.B.2 , 2.D	Refining, fugitive emissions from oil and gas, non-energy products from fuels and solvent use
0113	Yam	na	Emissions intensity derived from total production in Ghana (FAO) multiplied by average emissions intensity per unit of product (WWF)
05, 07 (- gold of 0729), 08,09	Mining and quarrying without oil and gas and gold	1.A.2.i	Mining (excluding fuels) and Quarrying
11 & 10 (-1073, -1020)	Manufacture of beverages & food products	(part of) 1.A.2.e	Food Processing, Beverages and Tobacco
14	Livestock	3. A	Livestock
20	Manufacture of chemicals and chemical products	1.A.2.c	Chemicals
122	Plantain	na	Emissions intensity derived from total production in Ghana (FAO) multiplied by average emissions intensity per unit of product (WWF)
113	Cassava	na	Emissions intensity derived from total production in Ghana (FAO) multiplied by average emissions intensity per unit of product (CIRAD)
0127 & 1073	Cocoa	na	Emissions intensity derived from total production in Ghana (FAO) multiplied by average emissions intensity per unit of product (WWF)
2	Forestry and Logging	(part of) 1 A 4 c	Agriculture, forestry, fishing, fish farms
111	Groundnuts	na	Own elaboration based on average GHG intensity of product
23	Manufacture of other non-metallic mineral products	1.A.2.m	Manufacturing Non-specified Industry
3,1020	Fishing	1.A.4.c.iii	Fishing (mobile combustion)
25	Manufacture of fabricated metal products, except machinery and equipment	1.A.2.a	Iron and Steel
126	Palm oil	na	Own elaboration based on average GHG intensity of product (Siat Group Sustainability Report) and total production in Ghana (FAO)
119	Maize	na	Emissions intensity derived from total production in Ghana (FAO) multiplied by average emissions intensity per unit of product (WWF)

Source: own elaboration, 2021

Data availability: labor data and tourism sector

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Labour data: ILOSTAT LFS (2017) survey

- Typically, not available at the necessary disaggregated levels, goes up to 2-digit level, for e.g.:
  - Cocoa and palm oil fall under broad category ISIC 01 – Employment in crop and animal production

Tourism data: UNWTO Tourism Statistics Database 2018

- Tourism data never available along with sectoral data for goods. It is scattered across various sectors (accommodations, restaurants, transportation, guiding services, etc.)

Table 3. Tourism data for Ghana

World Tourism Organization (2019), Compendium of Tourism Statistics dataset [Electronic], UNWTO, Madrid, data updated on 18/12/2019.
Conceptual references and technical notes are available in the Methodological Notes to the Tourism Statistics Database:
http://statistics.unwto.org/method_notes_tourism_stat_database_2019ed

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Cod.	Basic data and indicators	Notes	Units	2014	2015	2016	2017	2018
1.	**INBOUND TOURISM**							
	Data							
	Arrivals							
1.1	Total		('000)	..	..	..	..	..
1.2	♦ Overnight visitors (tourists)	(1)	('000)	825	897	..	..	..
1.3	♦ Same-day visitors (excursionists)		('000)	..	..	..	..	..
1.4	* of which, cruise passengers		('000)	..	..	..	..	..
	Expenditure							
1.33	Total		US$ Mn	1,027	911	952	919	996
1.34	♦ Travel		US$ Mn	897	819	846	850	944
1.35	♦ Passenger transport		US$ Mn	130	92	106	69	52
	Expenditure by main purpose of the trip							
1.36	Total		US$ Mn	897	819	846	850	944
1.37	♦ Personal		US$ Mn	269	246	254	255	283
1.38	♦ Business and professional		US$ Mn	628	573	592	595	661
3.	**OUTBOUND TOURISM**							
	Data							
	Expenditure							
3.4	Total		US$ Mn	947	1,405	1,571	1,581	1,329
3.5	♦ Travel		US$ Mn	458	737	792	693	450
3.6	♦ Passenger transport		US$ Mn	489	668	779	888	879
	Expenditure by main purpose of the trip							
3.7	Total		US$ Mn	459	737	792	693	450
3.8	♦ Personal		US$ Mn	138	221	238	208	135
3.9	♦ Business and professional		US$ Mn	321	516	554	485	315
4.	**TOURISM INDUSTRIES**							
	Data							
	Number of establishments							
4.1	Total		Units	..	..	..	..	..
4.2	♦ Accommodation for visitors		Units	2,578	..	..	..	..
4.3	* of which, "hotels and similar establishments"		Units	..	..	..	..	..
4.4	♦ Food and beverage serving activities		Units	..	..	..	..	..
4.5	♦ Passenger transportation		Units	..	..	..	..	..
4.6	♦ Travel agencies and other reservation services activities		Units	..	..	..	..	..
4.7	♦ Other tourism industries		Units	..	..	..	..	..
	Accommodation for visitors in hotels and similar establishments							
	Non-monetary data							
4.13	♦ Number of establishments		Units	2,578	..	..	..	..
4.14	♦ Number of rooms		Units	..	..	..	..	..
4.15	♦ Number of bed-places		Units	..	..	..	..	..
5.	**EMPLOYMENT**							
	Data							
	Number of employees by tourism industries							
5.1	Total	(2)	('000)	354.0	..	..	..	..
5.2	♦ Accommodation services for visitors (hotels and similar establishments)		('000)	..	..	..	..	..
5.3	♦ Other accommodation services		('000)	..	..	..	..	..
5.4	♦ Food and beverage serving activities		('000)	..	..	..	..	..
5.5	♦ Passenger transportation		('000)	..	..	..	..	..
5.6	♦ Travel agencies and other reservation services activities		('000)	..	..	..	..	..
5.7	♦ Other tourism industries		('000)	..	..	..	..	..

Source: UNWTO, 2019

Effort to process data: two-step concordance

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Trade intensity data: from UNCOMTRADE

Double concordance: ISIC Rev. 4 → ISIC Rev 3.1 → HS2007 Code

- Trade data refers to products (Harmonized System HS2007)
- GDP data refers to activities (ISIC Rev.4)
- Some ISIC Rev. 4 activities had more than 500 corresponding HS2007 export products

Table 4. Double concordance example for chemicals and chemical products

ISIC Rev 4 Code		**ISIC Rev 3.1 Code**		**HS 2007 Code**	
ISIC Rev 4 Code	Description	ISIC Rev 3.1 Code	Description	HS 2007 Code	Description
20	Manufacture of chemicals and chemical products	24	Manufacture of chemicals and chemical products: manufacture of basic chemicals, plastics in primary forms, synthetic rubbers, man-made fibres, fertilizers, paints & varnishes, other chemical products, soap and detergents (excluded manufacture of pharmaceuticals, medicinal chemicals and botanical products)	1518,1520, 2707,28 (-284330), 2901-2934, 2942, 300670, 31-38, 3901-3914, 4002, 4402, 5402-5405, 5501-5504, 710410, 710420, 8523	All products under the described categories (e.g. polymers, silicones, soaps, washing preparations) of ISIC Rev 3 (subtracted 24330 Gold comps.)

Source: own elaboration based on ISIC Rev.4, ISIC Rev.3, UNComtrade

Effort to process data: going through databases to identify RM

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Going through all the policies from the 17 databases and selecting the relevant RM to the identified vulnerable sectors is also a labor-intensive process

Table 5. Sources for identification of RM

Sources
1. EEA database
2. OECD database
3. NDCs
4. WTO environmental database
5. IEA Building Energy Efficiency Policy Database
6. ICAP carbon market database
7. FAOLex database
8. Global Climate Legislation Database
9. IEA/IRENA Joint Policies and Measures Database
10. ITC Sustainability Map, Standards Map
11. International Civil Aviation Organization (ICAO), CORSIA
12. International Maritime Organization (IMO)
13. UNFCCC Synthesis Report
14. World Bank, Carbon Pricing Dashboard
15. IEA Global EV Outlook
16. LSE Climate Change Laws of the World
17. Relevant government websites

Source: own elaboration, 2020

The two types of challenges

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1. **Data availability:** means using proxies, best-effort assumptions, non-traditional data sources
2. **Data challenges:** just means putting in the hours

Other challenges

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- Some sectors will be at risk of impacts BUT from **voluntary measures, soft-incentives and/or shareholder pressure**. Should these be considered then?
- Difficult to anticipate future sectoral growth. There may be other sectors of the future whose **growth would be inhibited by response measures and are not captured in the analysis**
- **Ensuring that recommendations and mitigation measures are taken into account** and escalated to the national, regional and local decision making levels
- **Workshops were conducted online due to COVID-19,** in-person workshops would have had a stronger impact with local actors and fostered collaboration
- Co-benefits are not included in the analysis due to the challenge in measuring them

We talked about the challenges … but now the benefits

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How can African countries make use of the work done by ERCST?

- The methodology can be easily replicated in other countries bearing in mind the local socio-economic context, as well as information availability (data challenges discussed previously)
- The case study can carried out by national experts (Ministry of Environment, EPA, etc.) without the need to carry a modelling exercise. Inclusion of modelling however does give a better overview of potential future impacts.
- Case study can be carried out in a timeframe of 1-3 months without modelling and 4-8 months with modelling

We talked about the challenges … but now the benefits

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- African countries can carry out the case study and use the research to better prepare and mitigate the potential impacts of response measures
- Allows for better informed decision-making in policy-making at the national (government and local) and international levels
- Empower its country representatives in international negotiations (COP, CMP, CMA, SBI, SBSTA meetings)
- Build a regional competitive advantage and focus on sectors not vulnerable to RM by supporting them politically and technologically wise
- Give a stronger case to apply for international cooperation support for either financial aid and/or capacity building from: Technology Mechanism, GCF, Adaptation Committee, Capacity Building Framework, REDD+, GCCA+, CIF, GEF, MDBs, development agencies (GIZ, AFD), bilateral support, etc.

Thank you!

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What are 'Response Measures' and why they matter?

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- **Response measures:** are mitigation policies that countries implement to alleviate the adverse effects of climate change
- **Impacts:** response measures may have cross-border positive and negative impacts on other countries (employment changes, change in trade patterns, carbon costs, etc.)
- **Important component of the Paris Agreement** and has its grounding in UNFCCC discussions
- Finds resonance in the just transition discussion, economic diversification and the need to manage the transition to a low carbon economy
- The issue of response measures, especially in its international dimension, is not yet well understood

Figure 1. Example of impacts of RM for palm oil sector in Ghana

Palm oil production in Ghana

- More than USD 110M in exports value during 2019
- Priority export product in the National Development Strategy (NEDS) to 2029

Exports

Impacts of RMs to the sector

Law 2010-22 Regulating the Biofuels Industry, grants biofuels fiscal benefits
POSITIVE IMPACT

Nigerian Bio-fuel Policy and Incentives
POSITIVE IMPACT

Revised Renewable Energy Directive 2018/2001/EU, limits high ILUC-risk biofuels (palm oil) until 2023 and will gradually decrease to zero by 2030
NEGATIVE IMPACT

ERCST's work on Response Measures

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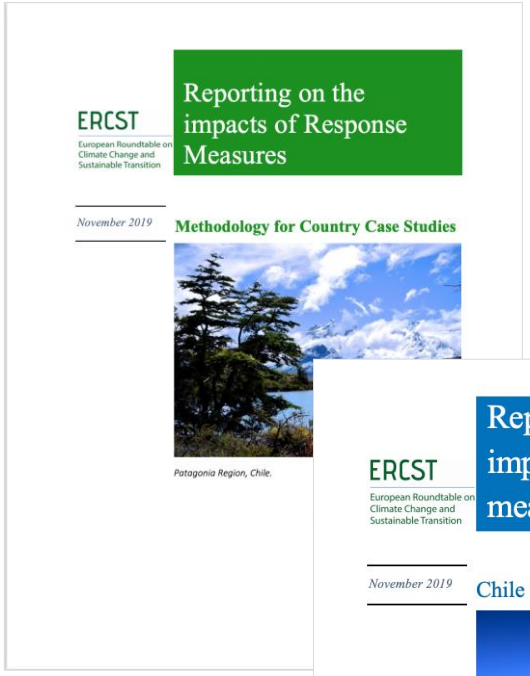
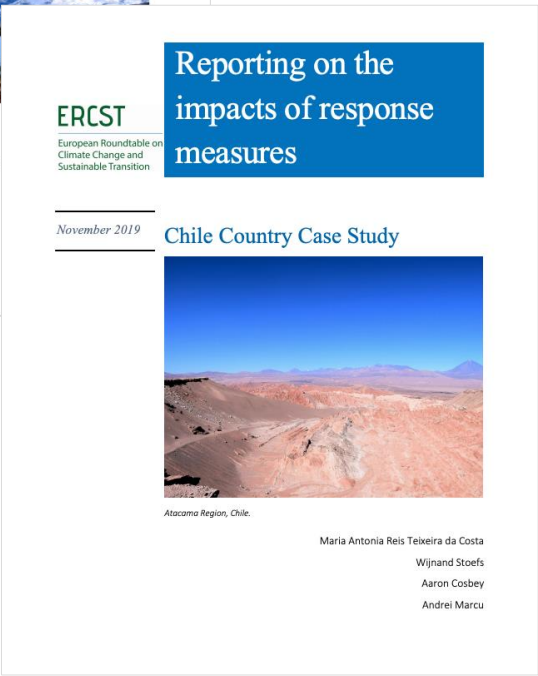
- **In 2018,** ERCST launched an informal dialogue on response measures, bringing together UNFCCC negotiators and key stakeholders to discuss this issue
- **In 2019,** ERCST continued this informal dialogue on response measures, focusing on the agreed work programme in Katowice. ERCST also carried out a case study on "reporting on response measures under biennial update reporting" in Chile
- **In late 2020,** ERCST has started developing a new case study for Ghana. This work will continue throughout 2021 and the information of the dialogue will be shared with the KCI
- ERCST's work has been pioneering in developing a methodology and by practically applying it with country case studies.



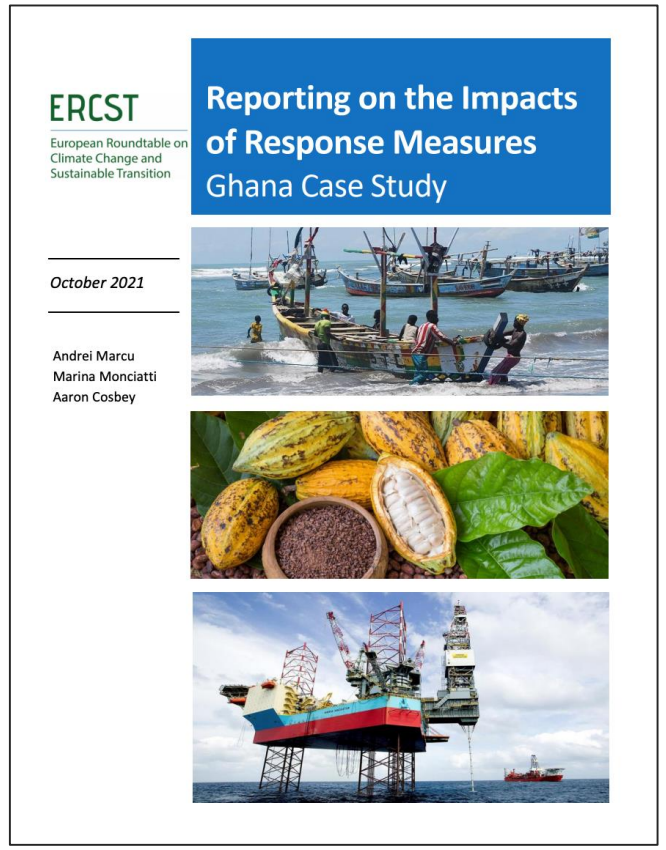
ERCST,2019



ERCST,2019

Ghana Case Study

- ERCST and the EPA in Ghana have been working together on **identifying, measuring and analysing the impacts of the implementation of response measures in Ghana,** as well as highlighting approaches to mitigate negative and unintended impacts
- One of the main objectives is to **test, refine and improve the methodology** that ERCST has developed in different countries.
- The research and information from this Informal Dialogue will be shared and will **feed into the discussions of KCI and the Forum** on response measures – Activity 4.
- To foster capacity building and stakeholder participation, virtual workshops are being organized at each stage of the development of the case study. Three workshops have been already organized.



ERCST, 2021

Methodology for Country Case Study: Ghana

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STEP 1 Describe the country and its characteristics

STEP 2 Identifying important sectors to the Ghanaian economy

STEP 3 Identify sectors potentially vulnerable to international response measures

STEP 4 Employ stakeholder input to identify vulnerable sectors that might have been missed in step 3

Identifying Vunerable Sectors

STEP 5 Identify relevant response measures

Identifying Response Measures

STEP 6 Assess the impacts of international response measures

Assessing the Impacts

STEP 7 Look at possible domestic and international tools and support which may be needed to address the impacts

Step 1: description of the country and its characteristics

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Step 1 in practice

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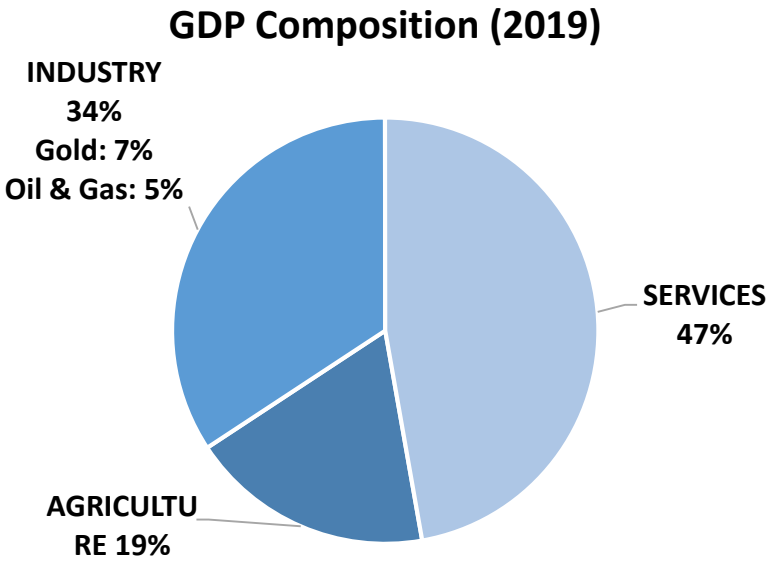
- Overview of Ghana's country characteristics, including: general geography, historical context, political system, main sectors of the economy and economic performance
- This step has been carried out mainly through desk research

FACTS & FIGURES

- Ghana is a lower middle-income country and the economy relies strongly natural resource extraction, forestry and agriculture
- 2nd largest economy in West Africa and 8th largest in Africa
- Population of 31M (GSS, 2020)
- Nana Addo Dankwa Akufo-Addo is the current president, serving his second term since 2020 and part of the New Patriotic Party (NPP)
- The oil and gas sector became important after the 2007 discovery of the Jubilee oilfield

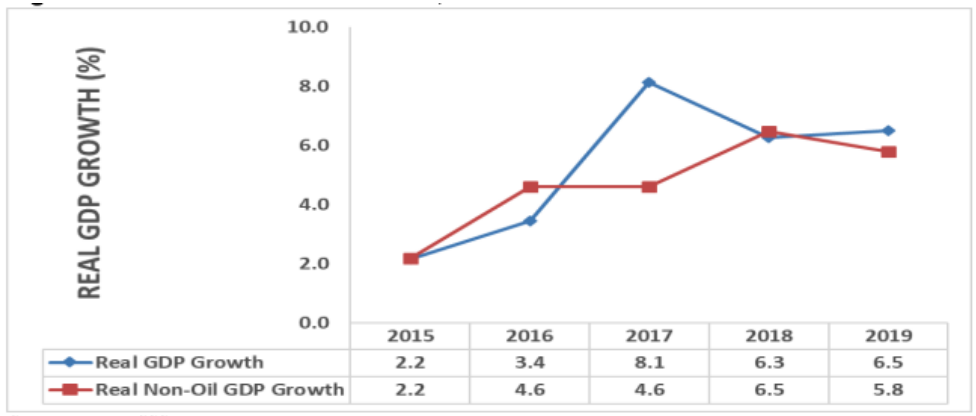


Source: own elaboration based on GSS data (2019)

Source: World Atlas

Overview of the Ghanaian economy and main sectors

Annual Real GDP Growth, 2015-2019



	2015	2016	2017	2018	2019
Real GDP Growth	2.2	3.4	8.1	6.3	6.5
Real Non-Oil GDP Growth	2.2	4.6	4.6	6.5	5.8

Source: Ghana Ministry of Finance and Ghana Statistical Service (2020)

Ghana's exports 2019 by country

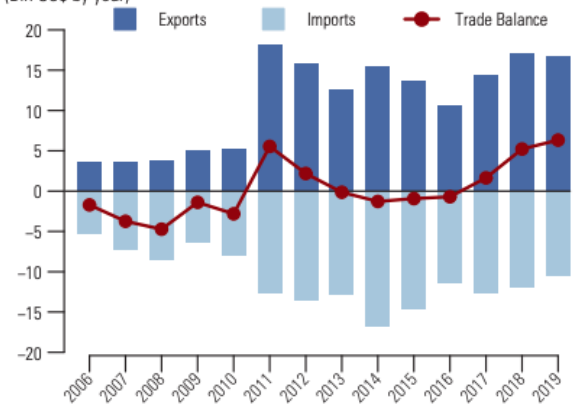
Top export destinations of commodities from Ghana in 2019:

- China with a share of 16.7% (2.8 billion US$)
- Switzerland with a share of 14.7% (2.46 billion US$)
- India with a share of 14.1% (2.38 billion US$)
- South Africa with a share of 11.7% (1.97 billion US$)
- Netherlands with a share of 5.76% (966 million US$)
- United Arab Emirates with a share of 5.36% (899 million US$)
- USA with a share of 4.2% (704 million US$)
- United Kingdom with a share of 2.47% (415 million US$)
- France with a share of 2.24% (377 million US$)
- Italy with a share of 1.84% (308 million US$)

Source: Trend Economy (2019)

Graph 1: Total merchandise trade, by value

(Bln US$ by year)



Graph 2: Total services trade, by value

(Bln US$ by year)

Table 1: Top 10 export commodities 2017 to 2019

HS code	4-digit heading of Harmonized System 2012	Value (million US$) 2017	2018	2019
	All Commodities	14358.5	17099.6	16768.3
7108	Gold (including gold plated with platinum)	5858.3	6092.6	6198.9
2709	Petroleum oils and oils obtained from bituminous minerals, crude	3619.7	5195.0	5251.7
1801	Cocoa beans, whole or broken, raw or roasted	1642.1	2437.2	1852.0
1803	Cocoa paste, whether or not defatted	407.4	396.4	409.6
0801	Coconuts, Brazil nuts and cashew nuts, fresh or dried	298.1	460.2	246.1
1804	Cocoa butter, fat and oil	276.5	287.2	337.3
2602	Manganese ores and concentrates	155.4	288.1	349.5
1604	Prepared or preserved fish; caviar	140.8	155.3	146.3
3924	Tableware, kitchenware, other household articles and toilet articles	213.3	115.8	44.6
4407	Wood sawn or chipped lengthwise, sliced or peeled	99.3	119.0	78.4

Source: International Trade Statistics Yearbook, UN Comtade (2019)

Step 2: identifying important sectors to the Ghanaian economy

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Step 2 in practice

To identify the main sectors of the economy, gross domestic production per sector has been taken as an indicator

Step 2.1: Collection of data

- Gross Domestic Product (GDP) provided by the Ghana Statistical Service, year 2019
- For the tourism sector the WTO Tourism Statistics Database 2018 (UNWTO, 2018) was used as the main source, includes: travel and expenditure by main purpose of trip
- GDP data publicly available disaggregation level of 23 activities, with the collaboration of the GSS we got to 71

Step 2.2: Correspondence of GDP activities to ISIC Rev.4

- Correspondence from Ghanaian GDP activities data to the International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4

Step 2.3: First filter from 71 to 56 activities

- **Service activities** (e.g. financial and insurance activities) were left out since they mostly don't have significant emissions compared to the other activities
- **Domestic activities** (e.g. construction) with no exports were left out too since looking at international response measures

Step 2.4: Second filter to 20 activities

- Top 20 activities by GDP value were selected as as a basis to identify the top vulnerable sectors to international response measures

Step 2 results: important sectors to the Ghanaian economy

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Sector Description		Gross Domestic Product (GDP) at Current Market Prices	
ISIC Rev 4 Code	**Description**	**GDP 2019 (M Gh¢)**	**% of GDP**
2420, 0729	Gold	23.282	7,1%
0610, 0620, 1920	Oil and gas	14.848	4,5%
0113	Yam	10.870	3,3%
05, 07 (- 0729), 08,09	Mining and quarrying without oil and gas and gold	10.402	3,2%
WTO 1.33 & 1.36	Tourism	8.491	2,6%
0127, 1073	Cocoa	8.050	2,5%
14	Livestock	7.945	2,4%
20	Manufacture of chemicals and chemical products	5.964	1,8%
0122	Plantain	4.857	1,5%
11,10 (-1073, -1020)	Manufacture of beverages and food products	4.575	1,4%
0113	Cassava	4.333	1,3%
02	Forestry and Logging	4.329	1,3%
0129, 0116, 0127	Other tree crops (coffee, rubber, cotton)	3.772	1,2%
22	Manufacture of rubber and plastics products	3.626	1,1%
0111	Groundnuts	3.283	1,0%
023	Manufacture of other non-metallic mineral products	3.110	1,0%
03, 1020	Fishing	3.035	0,9%
25	Manufacture of fabricated metal products, except mach. & equip.	2.782	0,9%
0126	Palm oil	1.926	0,6%
0119	Maize	1.810	0,6%

Source: Own elaboration based on GSS and UNWTO data (2021)

Step 3: identifying sectors potentially vulnerable to international response measures

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Step 3 in practice

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Step 3.1: Collect trade and GHG intensity data

- To identify the sectors potentially vulnerable to international RM, two indicators taken into account:
  - **Trade intensity:** to understand which sectors are most trade-exposed
    - Data: exports and imports data for Ghana taken from UNComtrade - International Trade Statistics, 2019
  - **Emissions intensity:** to identify the sectors with low/no GHG emissions, as they will be less - or not at all - exposed to climate mitigation policies
    - Data: primarily from the Fourth National GHG Inventory Report from Ghana, 2016
    - Where GHG emissions data not available at 4-digit disaggregation level (gold and different crops), it was sourced form different sustainability reports and statistics reports from international organizations

Step 3.2 : Perform a correspondence of economic activities to international classification standard for goods

- **Double concordance**: ISIC Rev. 4 → ISIC Rev 3.1 → HS2007 Code

Example of double concordance example for chemicals and chemical products

ISIC Rev 4 Code		ISIC Rev 3.1 Code		HS 2007 Code	
ISIC Rev 4 Code	Description	ISIC Rev 3.1 Code	Description	HS 2007 Code	Description
20	Manufacture of chemicals and chemical products	24	Manufacture of chemicals and chemical products: manufacture of basic chemicals, plastics in primary forms, synthetic rubbers, man-made fibres, fertilizers, paints & varnishes, other chemical products, soap and detergents (excluded manufacture of pharmaceuticals, medicinal chemicals and botanical products)	1518,1520, 2707,28 (-284330), 2901-2934, 2942, 300670, 31-38, 3901-3914, 4002, 4402, 5402-5405, 5501-5504, 710410, 710420, 8523	All products under the described categories (e.g. polymers, silicones, soaps, washing preparations) of ISIC Rev 3 (subtracted 24330 Gold comps.)

Source: own elaboration based on ISIC Rev.4, ISIC Rev.3, UNComtrade (2021)

Step 3 in practice

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Step 3.3: Calculate trade and GHG intensity for each sector

Step 3.4: Filter the list of sectors according to their trade intensity

- The activities important for the economy but not highly exported, such as other tree crops (coffee, rubber, cotton), forestry and logging, plantain, maize, livestock, yam, groundnuts, cassava, were left out.

Step 3.5: Rank 12 selected activities by Vulnerability Indicator

- The selection of the most vulnerable sectors was done by applying the Vulneralibity Indicator which is an adapted methodology based on the EU ETS Phase 4 Carbon Leakage Indicator

Formula

$$\text{Vulnerabillity Indicator} = \underbrace{\left(\frac{\text{Export + Imports}}{\text{GDP sector+ Imports}}\right)}_{\text{Trade Intensity}} \text{ x } \underbrace{\left(\frac{\text{GHG emissions}}{\text{GDP sector}}\right)}_{\text{Emissions Intensity}}$$

Step 3 results

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Sector Description		GDP at Current Market Prices Gh¢	Employment by econ. activity*	(1) GHG Intensity	(2) Trade Intensity	(3) Vulnerability Indicator
ISIC Rev 4 Code	Description	% of GDP	% of tot. workforce	kgCO2e/$	Indicator	(1)*(2)
0127, 1073	Cocoa	1,35%	*0,36%*	2,624	1,70	4,449
0126	Palm oil	0,59%	*0,16%*	2,635	0,50	1,308
11, 10 (-1073, -1020)	Manufacture of beverages & food products	2,64%	7,95%	0,545	0,51	0,280
03,1020	Fishing	0,93%	0,09%	0,419	0,54	0,226
0610, 0620, 1920	Oil and gas	4,55%	0,03%	0,100	1,82	0,182
05, 07 (- gold of 0729), 08,09	Mining and quarrying without oil and gas and gold	3,19%	0,15%	0,356	0,33	0,118
23	Manufacture of other non-metallic mineral products	0,95%	0,21%	0,103	0,46	0,048
2420, 0729	Gold	7,13%	1,62%	0,027	1,44	0,039
25	Manufacture of fabricated metal products, except mach.and equip.	0,85%	0,52%	0,009	0,50	0,004
22	Manufacture of rubber and plastics products	1,11%	0,09%	0,005	0,54	0,003
20	Manufacture of chemicals and chemical products	2,43%	0,16%	0,005	0,48	0,003
WTO 1.33, 1.36	Tourism (travel, and expenditure by main purpose of trip)	2,77%	3,70%	-	-	-

Source: own elaboration based on GSS, ILOSTAT, BUR/NIR, UN Comtrade, UNWTO and other relevant sources for missing data points

*Employment figures for certain sectors might appear low since a large part of the economy is informal workers and for the study we are only taking into account formal workers statistics

Step 4: employing stakeholder input to identify vulnerable sectors that might have been missed in step 3

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Step 4.1: Employment Indicator

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Employment per sector for top 20 vulnerable sectors

	Sector Description	GDP at Current Market Prices (Gh¢ Million)	Employment		
ISIC Rev 4 Code	Description	% of GDP	Employment	% of total workforce	% of total workforce *2
2420 & 0729	Gold	7,13%	155.755	1,6%	-
0610 & 0620 & 1920	Oil and gas	4,55%	101.929	1,1%	-
0113	Yam	3,33%	85.644	0,9%	1,8%
05, 07 (- gold of 0729), 08,09	Mining and quarrying without oil and gas and gold	3,19%	13.573	0,1%	-
WTO 1.33 & 1.36	Tourism (travel, and expenditure by main purpose of trip)	2,77%	354.000	3,7%	-
11 & 10 (-1073, -1020)	Manufacture of beverages & food products	2,64%	761.662	8,0%	-
14	Livestock	2,47%	63.428	0,7%	1,3%
20	Manufacture of chemicals and chemical products	2,43%	15.032	0,2%	-
0122	Plantain	1,83%	46.992	0,5%	1,0%
0113	Cassava	1,40%	36.050	0,4%	0,8%
0127 & 1073	Cocoa	1,35%	34.800	0,4%	-
02	Forestry and Logging	1,33%	34.107	0,4%	0,7%
0129, 0116, 0127	Other tree crops (coffee, rubber, cotton)	1,25%	32.102	0,3%	0,7%
22	Manufacture of rubber and plastics products	1,11%	9.036	0,1%	-
0111	Groundnuts	1,01%	25.868	0,3%	0,5%
023	Manufacture of other non-metallic mineral products	0,95%	20.427	0,2%	-
03,1020	Fishing	0,93%	80.589	0,8%	-
25	Manufacture of fabricated metal products, except machinery and equipment	0,85%	49.915	0,5%	-
0126	Palm oil	0,59%	15.172	0,2%	-
0119	Maize	0,55%	14.259	0,1%	0,3%
		Total employment	9.580.143		

Source: Own elaboration based on ILOSTAT LFS (2017) data

Step 4.2: National planning data

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- Potential vulenerable sectors to intl' RM from category II: aluminum, iron & steel, automobiles, petrochemicals
- All these sectors already included in our analysis, apart from automotive, would need to see their plans of expansion and which countries are planned for exports
- Automotive unlikely to face a big threat unless exports are planned outside of Africa

National Export Development Strategy (NEDS) 2020 to 2029

PRIORITY PRODUCTS LIST

Category I: Existing high-performance products for contributing to the projected target	**Category II:** Strategic Anchor Industrial Products for industrial transformation
Processed Cocoa	Pharmaceuticals
Cashew (Processed & In-shell)	Aluminium Products
Horticultural Products	Iron and Steel Products
Oil Seeds (Processed)	Automobiles and Vehicles
Fish & Fishery Products	Garments and Textiles
Apparel	Industrial Salt
Natural Rubber Sheets	Petro-chemicals
Aluminum Products	Machines and Machine Components
Articles Of Plastic	Industrial Starch
Services	Oil Palm

Source: Mininstry of Trade and Industry GEPA (2021)

News from Ghana aluminium and automotive industry

Ghana Aluminium Industry: A sector to be worth $10 billion, can create 30,000 jobs

Category: General
Date: 22-Nov-2020
Source: AICircle
Edited By
Detail: Africa is a continent which is rich poor. The biggest reason for th exports its precious raw materia failing to add value to the res economical fall-outs and many the problem. Ghana, a West Af

Economy

Multinational car companies eye opportunities in Ghana

Automotive giants look for a way in as Ghana rises as a regional hub for car assembly.

6 min. read

Ghana to emerge as an automotive production hub in West Africa for its developing aluminium sector: Fitch Solutions

Category: Automobiles (cars)
Date: 05-Oct-2020
Detail

Volkswagen opens vehicle assembly facility in Ghana

Volkswagen is expanding its footprint in Sub-Saharan Africa with the official opening of a vehicle assembly facility in Accra, Ghana

August 3, 2020

Source: local newspapers (2021)

Step 5: Identification of relevant response measures

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Step 5 in practice

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- **Step 5.1 Identify main export partners of the vulnerable sectors**
  - Identifying top 5 export partners per sector, took top export products (HS codes) representing 90% or more of the export category
  - Data: UNComtrade, 2019
- **Step 5.2: Match response measures to the vulnerable sectors and countries**
  - Our definition of response measures was used as a basis, along with the research of the identified countries and vulnerable sectors conducted in previous steps
- **Step 5.3: Search for response measures in international databases**
  - The research team identified 17 databases as sources of climate mitigation measures
- **Step 5.4: Gather results and filter**
  - Key step in the methodology, encompasses all the research from the previous steps by giving a clear overview of what are the international or out-of-jurisdiction response measures that could impact, either positively or negatively, the most important sectors of the Ghanaian economy

Step 5: Our definition of response measures and their impacts

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List of response measures, potential impacts and vulnerable sectors to each response measure

Response measures	Impacts in country undertaking the response measure	Possible impacts in other countries	Sectors vulnerable (negative impacts)
Carbon taxes	decreased demand for carbon-emitting goods; increased demand for low-carbon emitting goods	Negative effects: fossil fuel producers, carbon-intensive goods producers. Positive effects: low-carbon goods producers (e.g., renewable energy/EV components)	crude oil, refined oil, natural gas, coal
Subsidies			
for low-carbon transport	decreased demand for goods associated with internal combustion engines.	Negative effects: producers of fossil fuels, lead. Positive effects: producers of EVs, cobalt, lithium, vanadium.	crude oil, refined oil, lead, conventional automobiles
for low-carbon energy production	decreased demand for thermal fuels	Negative effects: coal, natural gas, oil producers. Positive effects: low-carbon energy technology (e.g., PV solar cells) and inputs (e.g., steel and cement for wind turbines)	coal, natural gas
removal of, for fossil fuel production	decreased production of fossil fuels	Positive effects: fossil fuel producers, alternative tech producers. Negative effects: fossil fuel consumers.	crude oil, refined oil, coal, natural gas
removal of, for fossil fuel consumption	decreased consumption of fossil fuels	Negative effects: fossil fuel producers. Positive effects: fossil fuel consumers, alternative tech producers.	crude oil, refined oil, coal, natural gas
for energy efficiency in buildings	decreased energy consumption, increased employment in construction sector	Effects depend on fuel source used in implementing country buildings. If imported fossil fuels used, negative effects on foreign producers.	any fuel source used for residential and commercial heating: gas and coal
Green procurement			
of energy	decreased demand for thermal fuels, increased demand for low-carbon energy technologies	Negative effects: coal, natural gas producers. Positive effects: coal and natural gas consumers (price decrease), producers of alternative energy tech.	coal, natural gas
of automobiles	decreased demand for goods associated with internal combustion engines.	Negative effects: fossil fuel producers. Positive effects: cobalt, lithium, vanadium producers, EV producers.	crude oil, refined oil
Cap and trade schemes	decreased demand for carbon-intensive goods; increased demand for low-carbon goods	Depends on details of scheme, but possible: Negative effects: fossil fuel producers. Positive effects: renewable energy/low-carbon transport tech producers; fossil fuel consumers.	coal, natural gas, steel and associated products, aluminium, cement, basic plastics, nitrate fertilizers, high-GHG electricity, oil, pulp & paper and associated products

For the full list, please refer to the report

Source: ERCST Chile Case Study and modifications

Example of results Sector 5: Oil & Gas (ISIC Rev 0610, 0620, 1920)

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China	South Africa	India	USA	United Kingdom	International Transportation
NEV Programme China - by 2025 25% New Energy Vehicle Programme (NEV) (includes PHEV, BEV,FCEV) - government introduced a mandatory credit policy for vehicle suppliers to boost domestic sales of NEVs	**Carbon Tax Bill** - Came into effect in 2019 - Applies to GHG emissions from the industry, power, buildings and transport sectors irrespective of the fossil fuel used, with partial exemptions for all these sectors	**National electric car purchase subsidy and income tax deduction on loans. Phase II of Faster Adoption and Manufacturing of Electric Vehicles (FAME II)** - Income tax deduction of $ 2000 on interest paid on electric vehicle loans - deployment of charging stations	**Zero-Emission Program (ZEV) for (PHEV, BEV,FCEV)** - by 2025 3.3 million ZEVs in 11 states - by 2050 all passenger vehicle sales to be ZEV in 10 States - Managed by The California Air Resources Board (CARB)	**UK carbon Price Floor** - Users liable for payment of the tax for all fossil fuels. - The tax covers all fossil fuels	• **International Maritime Organization (IMO) and other shipping climate change related measures** • **CORSIA/ICAO (for air freight)**
National electric car purchase subsidy and exemption of purchase tax (10%) - Maximum retail price USD 42 400 - USD 2 300 if BEV 300 km ≤ range<400 km - USD 3 200 if BEV range ≥400 km - USD 1 200 PHEV range ≥50 km	**Carbon dioxide vehicle emissions tax (2010)**	**National Electric Mobility Mission Plan (NEMMP) 2020** - Mix of incentive-based policies accompanied by regulatory reforms, and PPS to encourage EV adoption, expand charging infrastructure and support domestic EV and supply equipment manufacturing capacity and battery manufacturing	**CBAM (under consideration)** - implement a levy on carbon-intensive imports, albeit without a federal domestic carbon price - impose carbon adjustment fees or quotas on carbon-intensive goods from countries that are failing to meet their climate and environmental obligations	**UK ETS** - launched on 1 January 2021 - UK ETS closely follows the EU Emissions Trading Scheme ("EU ETS") - Established by the Greenhouse Gas Emissions Trading Scheme Order 2020 - The UK ETS will apply to energy intensive industries, the power generation sector and aviation.	
Fuel economy standard for light duty vehicles - Updated for period 2021-25 - Standard, to be phased in gradually from 2021, sets a 4L/100 km target for the country's new vehicle fleet in 2025		**Clean air standard**	**Tax reduction for electric car purchase** - Tax credit up to USD 7 500 (PHEV and BEV)	**United Kingdom (EV30@30 signatory)** - by 2030 50-70% EV - by 2035 No sales of new ICEe	
EV charging infrastructure policies - rollout of subsidies for EV charging infrastructure at national and subnational level (eg. Shenzhen) - The State Grid has announced plans to increase investment in charging stations - City of Beijing has outlined a policy to provide up to USD 28 300 in subsidies per station for operators		**National Mission on Transformative Mobility and Battery Storage** - manufacturing scope includes solar equipment, battery storage and charging infrastructure	**Transportation and Climate Initiative (TCI) ETS** - Transport fuel suppliers that produce the covered fuels within these states, as well as suppliers that import them to those states. - Program will cap CO2 emissions from the combustion of gasoline and on-road diesel fuel in the participating states	**National electric car purchase subsidy** - Up to USD 3 800 (BEV and PHEV)* - Capped at 35% of retail price. Only for cars < USD 63 600 - *If < 50 gCO2/km and electric range >112 km	

*For the full list of the Oil & Gas response measures please refer to the report

Summarizing the results

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Summing up all the response measures for all the different sectors, the team identified that the Ghanaian economy is potentially vulnerable to the impacts of 80 response measures.

Overview of relevant international response measures that could impact sectors deemed most vulnerable

ISIC Rev 4 Code	Sector Description	Number of response measures that could impact the sector
0610, 0620, 1920	Oil and gas	40
0127, 1073	Cocoa	9
3,102	Fishing	9
11, 10 (-1073, -1020)	Manufacture of beverages & food products	7
05, 07 (- gold of 0729), 08,09	Mining and quarrying without oil and gas and gold	6
126	Palm oil	3
2420, 0729	Gold	2
25	Manufacture of fabricated metal products, except mach. and equip.	1
22	Manufacture of rubber and plastics products	1
20	Manufacture of chemicals and chemical products	1
WTO 1.33, 1.36	Tourism (travel, and expenditure by main purpose of trip)	1
23	Manufacture of other non-metallic mineral products	0
Total		80

Source: Own elaboration (2021)

Step 2-4: main challenges

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1. National accounts data (GDP per sector) publicly available at a **low level of disaggregation.** With aid of stakeholders from the GSS able to get more disaggregated data (4-digit level)
2. **Unavailability of some disaggregated GHG emissions data** and issue with the reliability of GHG emissions data from other sources, excluding the BUR/NIR
3. **Tourism sector** no GHG emissions and trade intensity data as the sector does not report data in a manner comparable to other sectors, either through ISIC or HS Codes
4. **Concordance** from national accounts data to ISIC Rev.4 and from ISIC Rev.4 to to HS 2006 is a labour-intensive process
5. **Lengthiness** of undergoing through the different steps and filtering process for the different sectors

Step 5: Assessing the impacts of international response measures

Dorothee Flaig and Scott McDonald

UNIVERSITY OF HOHENHEIM

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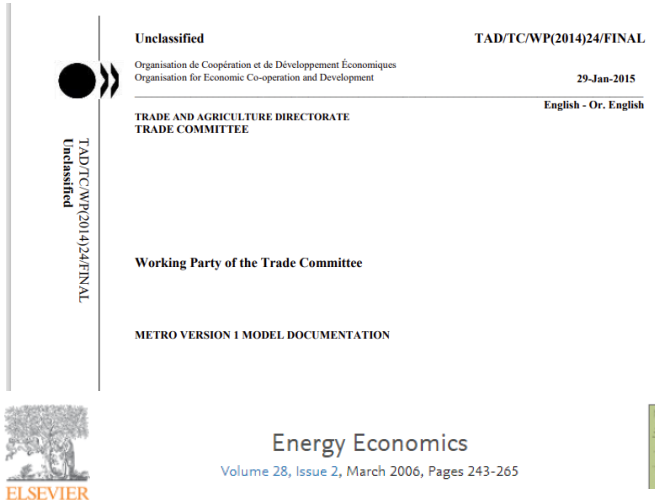
Outline

- Method
  - A Computable General Equilibrium (CGE) Model
  - Data
- Simulations
  - A carbon tax on international water transport (IMO),
  - A carbon tax on international air transport (ICAO/CORSIA),
  - A carbon border adjustment mechanism introduced by the European Union (CBAM)
- Results

Used widely in

international trade,
public finance,
regional economics, and
environmental economics.


Unclassified TAD/TC/WP(2014)24/FINAL

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

29-Jan-2015

English - Or. English

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METRO VERSION 1 MODEL DOCUMENTATION

ELSEVIER

Energy Economics
Volume 28, Issue 2, March 2006, Pages 243-265


Impact of switching production to bioenerg crops: The switchgrass example

Scott McDonald [a], Sherman Robinson [b], Karen Thierfelder [c]

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Csilla Lakatos*
Center for Global Trade Analysis, Purdue Univ
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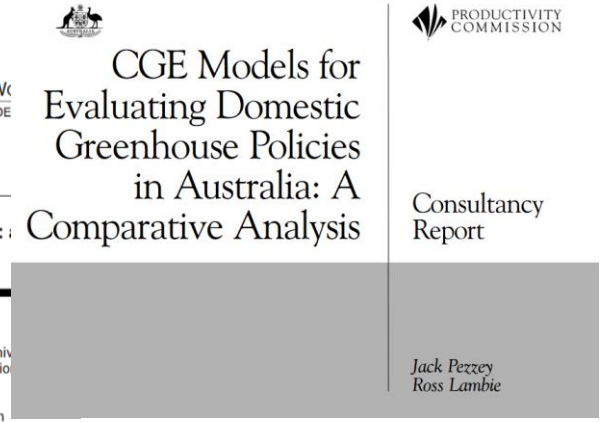
Tani Fukui*
U.S. International Trade Commission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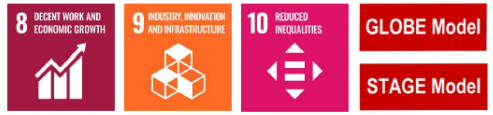
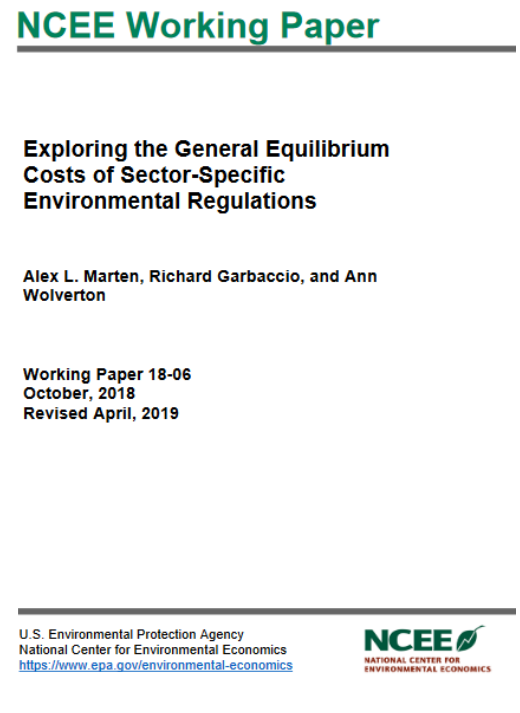
Assessing impacts of the implementation of response measures

The case study of Senegal and Kenya: A Computable General Equilibrium Analysis


8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
GLOBE Model
STAGE Model


NCEE Working Paper

Exploring the General Equilibrium Costs of Sector-Specific Environmental Regulations

Alex L. Marten, Richard Garbaccio, and Ann Wolverton

Working Paper 18-06
October, 2018
Revised April, 2019

U.S. Environmental Protection Agency
National Center for Environmental Economics
https://www.epa.gov/environmental-economics

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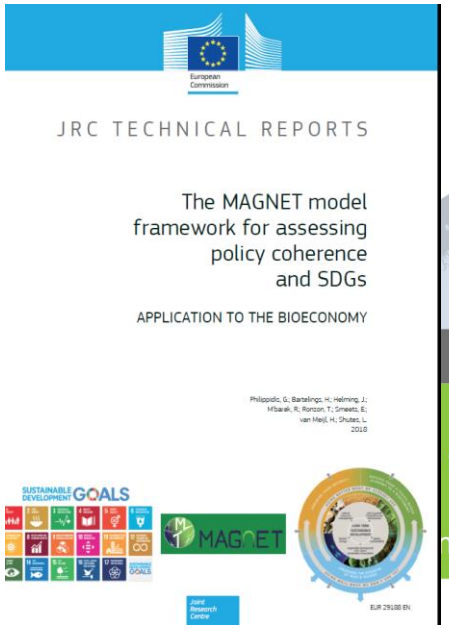
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The MAGNET model framework for assessing policy coherence and SDGs

APPLICATION TO THE BIOECONOMY

SUSTAINABLE DEVELOPMENT GOALS

MAGNET


OECD Environment Working Papers No. 169

Policy scenarios transition to a more resource efficient nd circular economy

Ruben Bibas,
Jean Chateau,
Elisa Lanzi

https://dx.doi.org/10.1787/c1f3c8d0-en


ORIGINAL ARTICL

The economic reductions in general equilil

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Jonathan Pycroft[1]

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[2]Department of Economics, Universidad Loyola Andalucia, Seville, Spain

Data & Model

- **GTAP Data**: v10 (2014) in SAM format
  - Energy data (satellite account to SAM):
  - Aggregated: Regions (13), Sectors (36), Factors (8)
- **ANARRES**: A Global Computable General Equilibrium (CGE) model
  - Static version
  - Nested production structure
  - Traded and domestic products are imperfect substitutes
  - Various taxes, including taxes on energy inputs and carbon emissions
  - Flexible exchange rates

Simulations

1. IMO carbon tax (maritime transport) – uniform carbon tax

   - Worldwide uniform carbon tax on maritime transport
   - Two alternatives: $50 and $100 per ton levy on greenhouse gas emissions

2. ICAO/CORSIA carbon tax (air transport)

   - Worldwide uniform carbon tax on air transport
   - Similar to IMO: Two alternatives: $50 and $100 per ton levy on greenhouse gas emissions
   - Including effects on tourism

3. EU CBAM tax:

   - On imports, worldwide, no exemption LDCs
   - Sectors: Cement, Iron & Steel, Aluminum, Fertilizers
   - Emissions: scope 1; Benchmark: national average by sector

Effects

- carbon taxes in any form, add constraints to the system, and *ceteris paribus* the economy will shrink.

- The results

  include the adjustments involved in response to the policy change, moving from the base situation to a new equilibrium and can be interpreted as effects in the medium run. (closure setup)

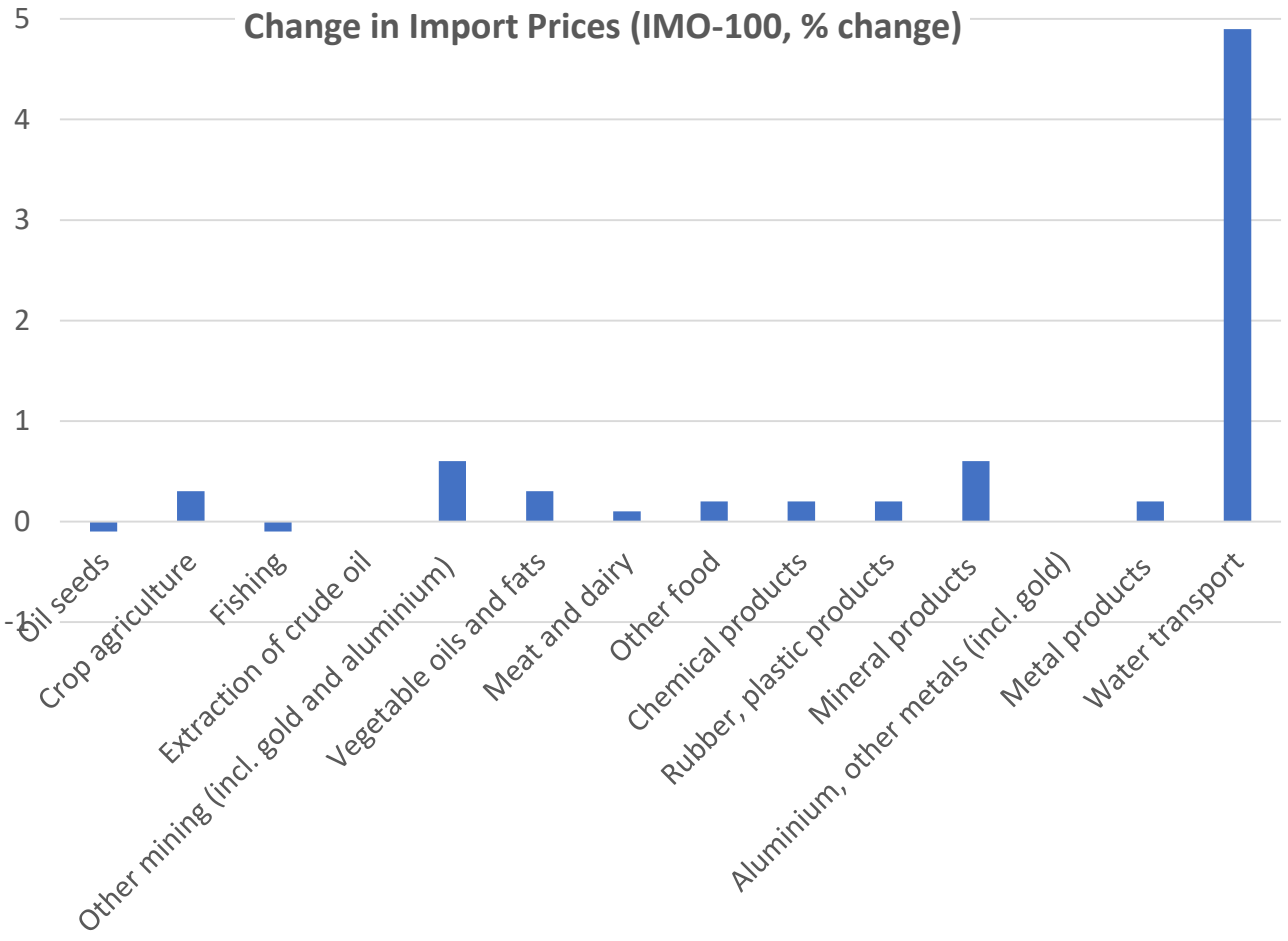
- The analysis is of *ceteris paribus* nature, i.e.,

  the reported changes show the effects of introducing the policies in the current situation, assuming no other changes.

- The study does not account for possible future developments such as technological change or adjustments over time. (available with ANARRES_DYN)

change in Million tons	IMO-50	IMO-100
CO2 Emissions	-7.6	-15.2

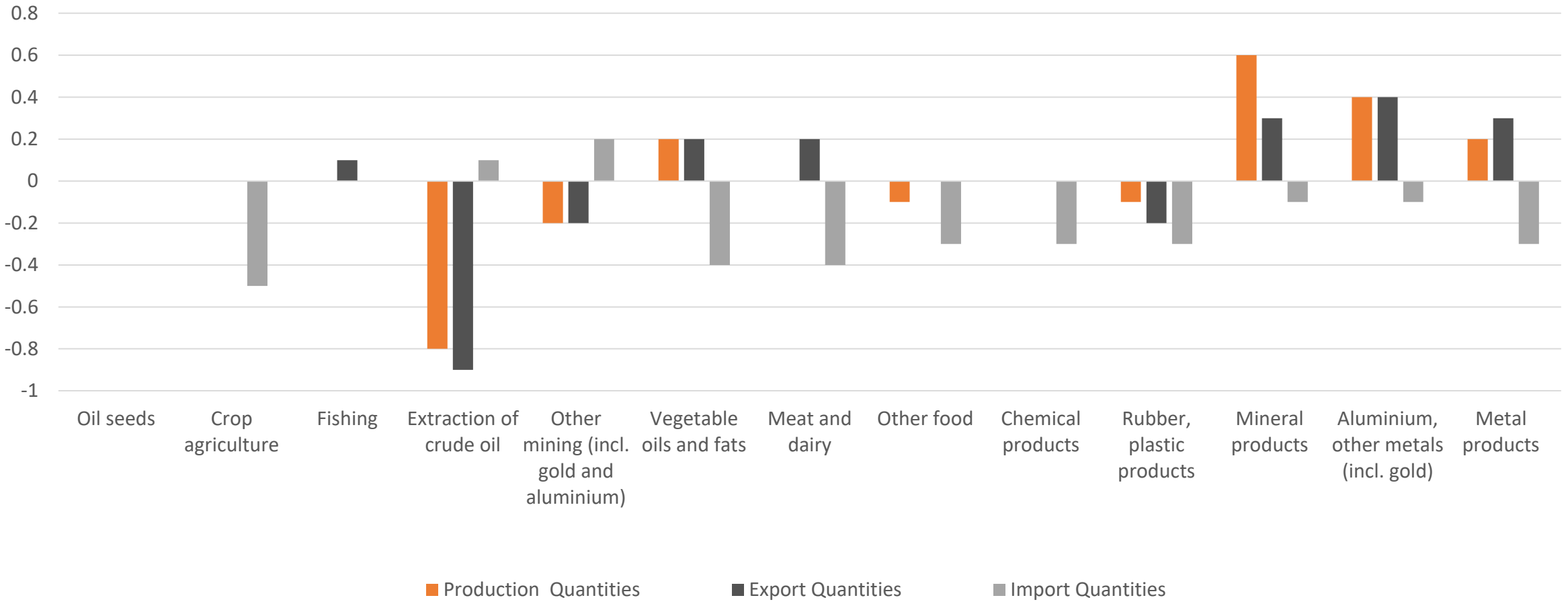
Results - IMO carbon tax (maritime transport)



Overall the effects of the IMO carbon tax on the economy of Ghana are small:

% change	IMO-50	IMO-100
Imports	-0.1	-0.2
Exports	-0.1	-0.1
Exchange rate	depreciates to incite exports and maintain the current balance	
GDP	0	0
Household consumption	-0.1	-0.1
Government consumption	0	0
Production	0	-0.1

IMO carbon tax: Effects on sectors (IMO-100, %change)



Results - IMO carbon tax (maritime transport)

- IMO carbon taxes depress production and wages, household income and consumption fall.
- Agri-food consumption and the corresponding prices go down.
- Triggered by increasing import prices, consumer prices for manufacturing rise slightly.

Effects on consumer prices:

% change	IMO-50	IMO-100
- agri-food	0	-0.1
- energy and water	0	0
- manufacturing	0.1	0.1
- services	0	-0.1

Results – ICAO/CORSIA carbon tax (air transport)

- A carbon tax on international air transport of 50 $/ton CO2 (100 $/ton CO2)

  reduces emissions by 5.7 (11.0) Million tons CO2 ,

  reducing direct emissions of air transport by 0.4% (0.9%)

- This carbon tax increases the price on international air transport worldwide by 4.5% (9.1%).

- The responsiveness of tourism arrivals to changes in air transport prices differs by type of traveller

  Business travellers: between -0.5 and -0.9 Leisure travellers: between -1.1 and -1.5

- Data on arrivals and expenditures of tourists in Ghana sourced from "Ghana Immigration Service and Ghana Tourism Authority and 2019 Tourism Report" (58% business, 42% leisure)

- **Increasing costs of air transport affect tourism:**

Tourist arrivals in Ghana decrease	**3-5%**	**(7-10%).**
Domestic service supply contracts by	**0.3-0.4%**	**(0.5-0.7%).**

Scheelhase, J. and W.G. Grimme (2007). Emissions trading for international aviation – an estimation of the economic impact on selected European airlines. Journal of Air Transport Management, 13, 253-261.

Results – ICAO/CORSIA carbon tax (air transport)

- For the economy as a whole negative impacts dominate, GDP and household consumption decreases due to income losses from shrinking production:

	ICAO-50-low el.	ICAO-50-high el.	ICAO-100-low el.	ICAO-100-high el.
Imports	-0.3	-0.4	-0.5	-0.7
Exports	-0.1	-0.1	-0.2	-0.2
Depreciation of exchange rate	0.3	0.3	0.5	0.6
GDP	0	-0.1	-0.1	-0.1
Household consumption	-0.2	-0.3	-0.4	-0.5
Government consumption	0	0	0.1	0.1
Production	-0.1	-0.1	-0.2	-0.2

Results – ICAO/CORSIA carbon tax (air transport)

- Effects on consumer prices by commodity group (% change to base)

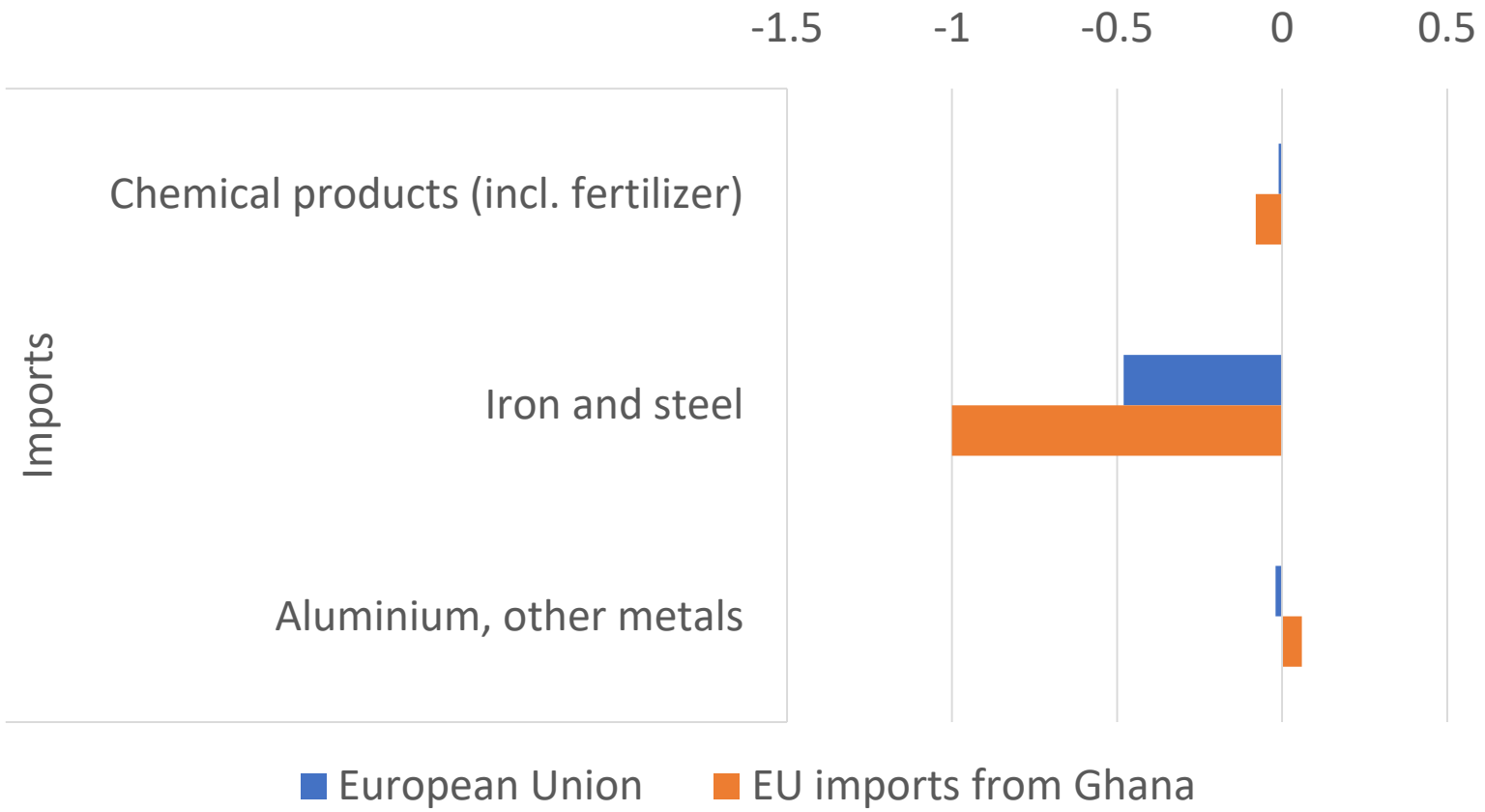
	ICAO-50-low el.	ICAO-50-high el.	ICAO-100-low el.	ICAO-100-high el.
agri-food	-0.1	-0.2	-0.3	-0.4
energy and water	0.0	-0.0	0.0	-0.0
manufacturing	0.1	0.1	0.2	0.2
services	0.2	0.4	0.5	0.8

- Agri-food consumer prices fall

  positive for poor consumers, but negative for farmers.

- In addition, income of low and unskilled workers decreases stronger compared to skilled labour (decrease in tourism).

EU CBAM – Effects on EU imports (% change)



- Ghana exports to the EU go down for
  - fertilizer and
  - iron and steel
- Ghana can increase its exports in aluminium to the EU, benefitting from a lower CO2 intensity in the production process compared to other regions.

EU CBAM – Effects on Ghana exports (% change)

- Effects on Ghana total exports are small.
- Decreasing trade with the EU is compensated by increasing exports to other regions

	Ghana total exports	by partner											
		EU	Africa LDCs	Rest of Africa	Rest of Central Europe	North America	Latin America a. Carib.	Oceania	East Asia	LDCs Asia a. Oceania	South a. SE Asia	Eastern Europe	Western Asia
Chemical products (incl. fertilizer)	0	-0.08	0	-0.01	0.04	0.02	0	0	0.01		0	-0.12	0
Iron and steel	-0.05	-1	-0.08	0			-0.02				0.02		-0.06
Aluminium, other metals	0	0.06	0.01	0	0.02	0.01	-0.01	0	0		-0.04		-0.02

Step 6: Look at possible domestic and international tools and support which may be needed to address the impacts

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Step 6 in practice

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- The goal is to highlight any domestic tools and international cooperative approaches that are helping or could help the country address the impacts of the implementation of response measures
- Both domestic and international tools can be used to address the impacts
- This step is important for reporting under BURs and BTRs, as countries can highlight what support they could use with respect to addressing impacts
- Impacts can be addressed ex-ante and ex-post and tools can be applied in both instances

Step 6: domestic tools

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1) **Domestic safety nets:**
   - Productive Safety Net Project supported by the World Bank (GPSNP)
2) **Just transition efforts**
   - Ghana's existing efforts in ensuring a Just Transition include: training on the social and employment implications of climate policies and NDC, National dialogue on decent work and just transition and development of a Green Jobs Assessment Model (GJAM), by the ILO Economic diversification
   - Example: South Africa, inclusion of Just Transition in NDC, Presidential Climate Change Commission (P4C), state and private company plans
3) **Economic Diversification:**
   - Ghana's National Export Development Strategy
   - Some tools for addressing high-emitting sectors are: improving energy efficiency and technology deployment in the industry and fisheries sectors, using alternative fuels, deploying carbon capture and usage (CCU) and carbon capture and storage (CCS) in the oil & gas industry; moving to a more circular economy.
4) **National climate funds**
   - Financial mechanism that allows countries to collect, blend, and manage all the incoming revenue streams, both international and national, related to climate change into one, centralized fund
5) **Domestic/National Carbon Markets**

Step 6: international tools

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1) **Financial aid from:**
    - Development cooperation agencies
    - Bilateral support and finance institutions
    - Multilateral finance institutions and development banks
    - UNFCCC programs and aid
- Examples of international support sources in Ghana (related to capacity-building support): GEF, GCF, NAMA, UNDP, UNFCCC, bilateral support and loans from Germany, Korea, Sweden, etc.
- Even though there are a multiplicity of international funding programs and initiatives in Ghana, this is not enough to meet the projected climate finance needs towards a sustainable transition and mitigate the impacts of international response measures

2) **Capacity-building**

3) **Inclusion of impact mitigation measures in international climate change policies such as**
    - Offset mechanisms
    - Recycling revenues for assisting affected developing and vulnerable countries
    - De minimis thresholds (DMT)
    - Effective timing and slower phase-in for developing and vulnerable countries
    - Crediting for foreign policies – e.g. EU CBAM

Conclusions and main findings

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- **12 sectors of the Ghanaian economy** have been identified as most vulnerable to the impacts of response measures (mitigation policies) with **80 international response measures impacting them**
- **China, Switzerland, India and South Africa** are Ghana's top trading partners for the 12 identified vulnerable sectors. **Total value of exports from Ghana to those countries amounted to USD 9.4 Billion in 2019**
- **Vulnerable sectors at risk of impacts:** cocoa, manuf. of beverages and food products (jojoba oil); palm oil; fishing; oil & gas; mining and quarrying without oil and gas and gold (alum. and mang.)
    - **Response measures:** carbon taxes; subsidies; CBAM; organic standards and labelling requirements for agri. goods and basic materials; aviation and shipping measures
- **Not all the 12 identified vulnerable sectors are at risk of impacts from country-led response measures**. Mainly due to **strong asymmetry of climate targets** and mitigation actions taken between countries/regions
- **Vulnerable sectors that don't appear at risk of impacts:** gold; manuf. of other non-metallic mineral products; manuf. of fab. metal products (iron & steel); manuf. of rubber and plastics; manuf. of chemicals
    - While those sectors are not at risk from country-led response measures, some may still be **vulnerable via soft-incentives, voluntary commitments and shareholder pressure (**ICMM Mining Principles, ISO 14001 Environmental Management, organic and sustainability standards (e.g. UTZ, MSC), and others)

Conclusion and main findings

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- International response measure chosen for quantitative assessment: **IMO, CORSIA/ICAO and EU CBAM**
  - **Effects of the IMO carbon tax on economy of Ghana are small**
  - **ICAO/CORSIA will have a stronger impact than IMO**
  - **For the EU CBAM, macroeconomic effects are too small to be meaningful, but they could reshuffle export destination patterns**
- **At the domestic level, Ghana could implement several tools including:** national exemptions for vulnerable countries, domestic safety nets, just transition efforts, economic diversification, national climate funds and domestic and national carbon markets
- **Ghana should leverage support from available international tools:** financial aid, capacity building and inclusion of impact mitigation measures in international climate change policies
- Ghana announced in its Transmittal Letter for the Updated NDC that it **will require $1,24 Billion per year** to achieve its climate targets in the next 10 years, this is way above the climate investments from the past 5 years which were only **$3,08 Million per year**
- Even though currently there are a multiplicity of international funding programs and initiatives in Ghana, this is **not enough to meet the projected climate finance needs towards a sustainable transition and mitigate the impacts of international response measures**

Case study main findings

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- **12 sectors of the Ghanaian economy** have been identified as most vulnerable to the impacts of RM with **80 international RM impacting them** (not mutually exclusive)
- **Response measures:** carbon taxes; subsidies; CBAM; organic standards and labelling requirements for agri. goods and basic materials; aviation and shipping measures (ICAO/CORSIA and IMO)
- International response measure chosen for quantitative assessment: **IMO, CORSIA/ICAO and EU CBAM**
  - Effects of the IMO carbon tax on the economy are small
  - ICAO/CORSIA will have a stronger impact than IMO
  - For EU CBAM, macroeconomic effects are too small to be meaningful, but they could reshuffle export destination patterns
- Some sectors are not at risk from country-led response measures, but may still be **vulnerable via soft-incentives and voluntary commitments and shareholder pressure** [ICMM Mining Principles, ISO 14001 Environmental Management, organic and sustainability standards (e.g. UTZ, MSC), and others]

IPCC risk definition

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