Greening the African Continental Free Trade Area *

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Abstract

The African Continental Free Trade Area (AfCFTA) Agreement aims to create a single market for goods and services, increase intra-African trade, and promote sustainable social-economic development of Africa. However, African countries balance efforts to address these goals with the urgency of climate change. Up to COP27, most African countries have submitted their Nationally Determined Contributions (NDCs) to mitigate the impact of climate change and establishing a carbon market is now on their policy agenda. This paper aims to assess the economic and environmental impacts of the AfCFTA Agreement's implementation under the possibility of establishing African carbon markets, or a common carbon price along the IMF's proposal of a differentiated carbon price floor. This paper answers the following questions: how industrial transformation and economic development led by the AfCFTA reform can be made consistent with Africa's climate ambitions? And how to promote a green transition through the adoption of climate change policies in the context of the AfCFTA? Using a dynamic general equilibrium model featuring different sources of energy including renewable energy, and an in-depth presentation of greenhouse gas emissions, the paper evaluates various policy scenarios under the implementation of the AfCFTA Agreement along with the mitigation ambitions. It shows that implementing the AfCFTA Agreement and Africa's climate objectives are compatible. Continental coordination among African countries in terms of emissions reduction is more efficient.

Key Words: International Trade, Climate Change, AfCFTA.

JEL Codes: F13, F17, F18, Q56.

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1 Introduction

The African Continental Free Trade Area (AfCFTA) Agreement entered into force on 30 May 2019. The AfCFTA agreement creates the largest free trade area in the world, considering the number of countries involved. It establishes a liberalized market through multiple rounds of negotiations. Phase I focuses on trade in goods, trade in services, and a dispute settlement body. While almost completed, a few outstanding issues remain under this first phase[1]. Phase II includes investment, intellectual property rights, competition policy, digital trade, and women and youth in trade.

Climate change and green transition considerations have however not been considered in the negotiations so far, while establishing a national carbon market is now on the agenda of many African countries. Indeed, Africa contributes a relatively low part (around 7 percent in 2020) of the global greenhouse gas (GHG) emissions, but it is one of the most vulnerable regions in the world that would be hurt by climate change – as for low-income economies it is more difficult to cope with climate change (Tol, 2009). Africa is also the region with a relatively higher average temperature compared to many developed regions. The climate issues will become a central issue in the coming decades as Africa's relatively high foreseen economic growth and its anticipated trade expansion will translate into additional GHG emissions. In such context, how to achieve sustainable economic development, while seizing the opportunity to stay low-carbon and accomplish a green transition is a significant concern for Africa. Up to the 27th session of the Conference of Parties (COP27) of the United Nations Framework Convention on Climate Change (UNFCCC), many African countries have updated their Nationally Determined Contributions (NDCs) with usually more ambitious commitments. A few countries have fully unconditional NDCs (i.e. to be met with domestic resources), while most have NDCs constructed with a combination of an unconditional target and a conditional target (i.e. to be met through international support). The next step, along with full trade integration of the continent, is to contemplate the various options for introducing market instruments aiming to abate emissions.

Few studies address the potential environmental effects of the AfCFTA. Bengoa, Mathur, Narayanan & Norberg (2021) show that AfCFTA enhances production reallocation, increases CO2 emission marginally, and non-CO2 GHG significantly. Overall, free trade agreements (FTAs) with environmental provisions tend to reduce CO2 emissions and pollution (Baghdadi, Martinez-Zarzoso & Zitouna 2013, Zhou, Tian & Zhou 2017). From the perspective of energy, trading electricity and developing electricity markets across the continent may also alleviate environmental constraints (African Development Bank 2022).

[1]Those include rules of origin in textile and apparel and automotive industry, and finalization of tariff offers on goods and lists of services commitments by all State Parties.

How to make industrial transformation and economic development led by the trade reform consistent with climate ambition is the issue addressed in this paper. It provides detailed results on: i) The impacts of the AfCFTA on African and regional trade; ii) The impact of the AfCFTA on GHG emissions; iii) The implications of adopting climate policies under different scenarios, including different designs of the African carbon markets, along with AfCFTA Agreement's implementation on GHG emissions; iv) The level of carbon price required to meet the targets as set in the most recent NDCs of the African countries; v) The achievements in terms of abatement with an exogenous carbon tax set at the level suggested for low-income countries by the International Monetary Fund (IMF).

The remaining of the paper is organized as follows. The first section provides details on the policy background. The second section discusses the model, the data used and the scenarios. The third section presents the economic and environmental results. The last section concludes.

2 Background

2.1 The AfCFTA

The Agreement establishing the AfCFTA was signed at the 10th extraordinary summit of the AU Assembly on 21 March 2018 in Kigali, Rwanda. The proposal was set to come into force 30 days after ratification by 22 of the signatory states. On April 2, 2019, The Gambia became the 22nd state to ratify the agreement, and on April 29, the Saharawi Republic made the 22nd deposit of instruments of ratification. The agreement went into force on May 30 and entered its operational phase following a summit on July 7, 2019. As of 24 May 2023, 54 of the 55 African Union (AU) member States have signed the Agreement, with 47 countries having ratified it. While trading under the AfCFTA Agreement officially commenced on 1 January 2021, this took place in practice in October 2022, following the launch by the AfCFTA Secretariat of the Guided Trade Initiative (GTI), involving 8 pilot countries (i.e. Cameroon, Egypt, Ghana, Kenya, Mauritius, Rwanda, Tanzania and Tunisia). The GTI is expected to test and subsequently facilitate the implementation of the AfCFTA Agreement by all participating countries.

The AfCFTA builds the largest FTA in the World, considering the number of member countries. It has the objective to create a single market, deepening the economic integration of the continent, resolving challenges of multiple and overlapping memberships and setting the ground towards the establishment of a future continental customs union. It establishes a liberalized market through multiple rounds of negotiations' phases. Its scope is large, making the agreement ambitious. It covers issues beyond traditional FTAs. The first phase of the negotiations focused on standard trade

areas (trade in goods-including non-tariff barriers and trade in services). The second phase includes investment, intellectual property rights, competition policy, digital trade, and women and youth in trade. While climate change and green transition matters have not been considered in the AfCFTA negotiation so far, those issues are gaining importance across the world, and Africa is no exception.

2.2 African NDCs and the perspective of carbon markets in Africa

To date, many African countries have submitted their NDCs which are pledges to reduce GHG emissions as part of the global effort to limit global warming to below 2 degrees Celsius. However, African countries continue to face challenges in financing and implementing their NDCs. As such, most African NDCs are usually constructed with unconditional commitments – expected to be fulfilled unconditionally through domestic resources, and conditional commitments that rely on the availability of international funds.

Targets committed in the NDCs can be reached by a variety of instruments, namely market-based instruments, subsidies, tax credits, or regulations. However, given the scarcity of national budgetary resources, the fragility of numerous tax systems, and the low level of income per capita, carbon markets – provided that prices are in line with income levels, sound as a promising avenue. Different carbon initiatives are established, along with national efforts, to promote development of carbon market in Africa. Examples such as the Africa Climate Change Fund (ACCF) by the African Development Bank (AfDB) can be mentioned. Moreover, at COP27 held in Sharm El-Sheikh, Egypt, the Africa Carbon Markets Initiative (ACMI) was officially launched. With thirteen steering committee members of African leaders, CEOs, and carbon credit experts, ACMI has for objective to support the growth of carbon credit production and create jobs in Africa. It is in this context that United Nations Economic Commission for Africa (ECA) and the African Export-Import Bank (Afreximbank) co-convened on 20 February 2023, in cooperation with the African Union Commission (AUC), the Congo Basin Climate Commission, the Climate Commission for the Sahel Region, the African Islands Climate Commission, the African Development Bank (AfDB) and the ACMI, the 2023 Africa Business Forum (ABF) on the theme "Making carbon markets work for Africa", thereby offering a platform to take the conversation on the issues forward between governments, private sector, and investors.

The challenge for African countries is indeed to identify ranges of carbon prices that achieve both emission reduction targets and economic development goals. The IMF has promoted the idea of differentiated carbon price floors, through the International Carbon Price Floor (ICPF) proposal, which would correspond to a US$ 25 floor for African and other developing economies, US$ 50 for emerging economies such as China, and US$ 75 for high-income countries (Parry, Black & Roaf

2021). These targets are indicative but may help figure out what the economic and environmental consequences of such approach might be.

3 The model and the scenarios

3.1 Mirage-Power: A general equilibrium model

We perform the policy assessment with MIRAGE-Power, a recently enhanced version of the MIRAGE computable general equilibrium (CGE) model[2]. MIRAGE-Power is a multi-regional, multi-sector, dynamic computable general equilibrium model, featuring a detailed representation of energy use. It is an extension of MIRAGE-e (Fontagné, Fouré & Ramos (2013)) incorporating a detailed representation of electricity power generation taking advantage of data recently released by the Global Trade Analysis Project (GTAP). In MIRAGE-Power, electricity is generated from multiple sources including renewables (i.e. hydro, solar, wind, and others), nuclear, coal, oil, and gas. The regional/national electricity producer provides aggregate electricity for intermediate consumption and households. Electricity as such can also be traded. As renewables are large sources of African electricity generation, this feature is of particular interest to the African electricity market.

Beyond electricity power generation, specific features of MIRAGE-Power help analyze in more details trade policy with a focus on energy. First, it is an energy-oriented model: energy is not considered as an intermediate consumption but directly substitutes with capital in the production function. In addition, energy is subject to independent productivity improvements, expressly calibrated. Second, GHG emissions are incorporated from both the production process and household consumption. Firms emit CO2 from the intermediate use of fossil fuels (coal, refined oil, and gas). Non-CO2 gases (namely methane, nitrous oxide, and fluorinated gases) are considered to be associated with the production process, so are modeled as production factors. Households emit CO2 and non-CO2 gases based on their consumption.

Climate policy is implemented in the model by two mechanisms: a cap-and-trade mechanism such as the European Union Emissions Trading System (EU ETS) of exchange of emission quotas[3], and for the part of the economy which is not covered by such mechanism, a carbon tax. The latter is implemented in the model as an implicit carbon price which includes not only carbon tax, but also regulations, standards. Last, the model also accounts for trade policies, based on highly disaggregated databases of the equivalents of bilateral tariff and non-tariff protection.

The model relies on the GTAP-Power 10.1 database as a global social accounting matrix (SAM)

[2]MIRAGE stands for Modelling International Relationships in Applied General Equilibrium.
[3]EU-ETS stands for European Union Emissions trading Scheme.

and is accordingly calibrated on the 2014 base year. The database features a decomposition of electricity transmission and electricity generation activities that is consistent with GTAP 10.1 standard database. It represents the world economy considering 76 sectors in each of the 147 regions of its geographic decomposition. We aggregate this data into 23 sectors and 28 regions or countries. The GTAP 10.1 satellite non-CO2 GHG emissions database has been used to calibrate the representation of greenhouse (GHG) gases in MIRAGE-Power.

3.2 The dynamic baseline

As climate policy always has a long-term objective, we need to determine a business as usual (BAU) economic scenario to reflect economic growth until 2045 for the purpose of the analysis, and considering the AfCFTA Agreement is expected to be fully implemented by 2035[4].

To that purpose, we use long-term macroeconomic projections (e.g. for GDP, labor participation rate and skills, current account, investment and saving rates) from the up-to-date estimates (Fontagné, Perego & Santoni 2022) of the Macroeconometrics of the Global Economy (MaGE) model (Fouré, Bénassy-Quéré & Fontagné 2013).

Energy price projections used (for oil, coal, and gas) are from the U.S. Energy Information Administration (EIA) database. In the macroeconomic baseline in 2020, Africa accounts for 3.5 percent of the world GDP, 3.3 percent of the world trade, and 7.3 percent of world GHG emissions. In the macroeconomic projection in 2045, African GDP and trade's shares would increase to 5.8 percent and 5.5 percent, respectively, thanks to the anticipated economic growth in Africa, while Africa's share in world GHG emissions is expected to become 11.4 percent.

We also include in the baseline the evolution of key policy variables between 2014 and 2019. These include the latest information on current FTAs, based on the 2014 and 2019 versions of the Market Access Map (MAcMap) database (Guimbard, Jean, Mimouni & Pichot 2012). In particular, the entering into force of the Economic Partnership Agreements (EPAs) between the European Union (EU) and African countries (i.e. Cameroon, Cote d'Ivoire, Comoros, Madagascar, Mauritius, Seychelles, Zimbabwe, and SADC EPAs), as well as between the EU and Caribbean and Pacific regions are accounted for until 2019. In addition, changes in the European GSP and GSP+ for other developing countries are integrated. Changes in the Chinese most-favored-nation (MFN) treatment and in the common external tariff (CET) set in 2015 for the Economic Community of West African States (ECOWAS) are integrated. Non-tariff measures (NTMs) in services are estimated using the standard gravity approach (Fontagné, Mitaritonna & Signoret 2016), based on the GTAP 10.1 database. NTMs

[4]Although full consideration of the reform on NTMs is announced for 2033, we conservatively consider 2035 for the modalities on NTMs.

in goods are estimated using World Bank estimations (Nicita & Olarreaga 2007). Lastly, the updated NDCs from COP27 build on the climate policy baseline are modelled[5]. Following Bellora & Fontagné (2022), we integrate in the baseline the fulfilling of unconditional NDCs of the COP27, but only for those countries with a national carbon market in place by 2021 (i.e. Argentina, Canada, China, Colombia, EFTA, EU27, Japan, Korea, Mexico, New Zealand, Kazakhstan, UK, and Ukraine[6]). We assume that these countries reach the commitments they have taken in the Paris Agreement by 2030, and that the emissions of these policy regions are thereafter capped at their 2030 level till 2045.

3.3 The scenarios

We implement the AfCFTA agreement in all simulations. The AfCFTA reform considered includes progressive liberalization (97% of tariff lines) for trade in goods in line with agreed AfCFTA modalities, starting in 2021 and spread over periods 10 years for developing countries and 13 years for least-developed countries[7], along with a 50 percent reduction of actionable restrictions to trade in the five AfCFTA priority services sectors (i.e. communication, tourism, transport, financial and business services) plus health and education services sectors, as well as a 50 percent cut of actionable NTMs, all within the African continent only.

Along with the AfCFTA reform, we consider the realization of climate policies under five scenarios.

The first three scenarios assume that African countries reach the NDCs commitments they have summited, through national African carbon markets. An endogenous carbon tax is implemented in the model to reach the emissions' national objective: it is the shadow price of all measures – explicit carbon price, regulations, subsidies – combined to reach the announced abatement target. In order of ambition, we have:

1. **AfCFTA + 100% Unconditional NDCs (AfCFTA + 100U NDC):** as long as African countries have submitted an NDC, they fully reach their unconditional targets in 2030.

2. **AfCFTA + 100% Unconditional & 25% Conditional NDCs (AfCFTA + 100U25C NDC):** on the top of AfCFTA + 100U NDC, African countries fulfill 25% of their conditional commitments (if any) by 2030.

[5]All submitted NDCs can be retrieved from the UNFCCC NDC Registry (https://unfccc.int/NDCREG).

[6]South African is excluded from the carbon policy region in the baseline although there exists a national carbon market, as its NDC is conditional.

[7]Each African Union State Party of the AfCFTA Agreement is required to put forward a tariff offer with clearly specified "non-sensitive", "sensitive" and "excluded" tariff lines. Developing countries have 5 years to eliminate tariffs on 90% of their tariff lines, deemed "non-sensitive" (representing not less than 10% of their imports from the rest of Africa) and 10 years to eliminate tariffs on an additional 7% of tariff lines categorized as "sensitive". African LDCs have 10 years to eliminate tariff on 90% of their tariff lines deemed "non-sensitive" (representing not less than 10% of their imports from the rest of Africa) and 13 years to eliminate tariffs on an additional 7% of tariff lines categorized as "sensitive". 3% of the tariff lines are therefore excluded from tariff liberalization.

3. **AfCFTA + 100% Unconditional & 50% Conditional NDCs (AfCFTA + 100U50C NDC):** on the top of AfCFTA + 100U, African countries fulfill 50% of their conditional commitments (if any) by 2030.

Under each of the above three scenarios, an *endogenous* carbon price is implemented in the model to reach the emissions' national objective. Moreover, the level of commitments reached in 2030 remain in place until 2045. It should be noted that achieving 100% of conditional NDCs is not considered in this study due to the uncertainty to mobilize sufficient international support required.

Alternatively, we consider a fourth scenario in which a common carbon price is introduced in African countries, in line with the IMF ICPF proposal of US$ 25/ton of carbon such as:

4. **AfCFTA + US$ 25 uniform carbon price (AfCFTA + US$25 CP):** an *exogenous* and uniform carbon tax of US$25 per ton of carbon is imposed on all African countries. The price US$25 per ton is reached by 2030, and kept unchanged thereafter and until 2045.

The fifth and last scenario assumes the establishment of carbon markets in Africa and distributes the decarbonation efforts across countries in order to obtain the same overall abatement as under the IMF ICPF proposal, but proportionally based on each country's baseline GHG emissions in 2045. In other words, a country generating 10% of Africa's total GHG emissions in the baseline in 2045 would need to contribute 10% of the targeted reduction of GHG emissions. The motivation for this fifth scenario is twofold. First, one can compare the results with "AfCFTA + US$ 25 CP" scenario and verify to what extent the common carbon price of US$ 25 per ton is or is not linked to the actual national contribution to African emissions. Second, one may compare the induced carbon price with the one associated with each African country's NDC, which helps seizing the ambition of these NDCs.

5. **AfCFTA + proportional abatement coordination (AfCFTA + coordination):** In the fifth scenario the model determines for each country the implicit carbon price associated with the abatement target in 2045, provided that this reduction in emissions is implemented linearly from 2023 onwards. Countries reduce their emissions in proportion to their contribution to the African emissions in 2045 in the baseline.

4 Results

4.1 Main economic impacts of the AfCFTA

We here firstly consider the impact of the AfCFTA Agreement implementation without any climate policy considered.

Following full implementation of the AfCFTA reform, and compared to a situation without AfCFTA, in 2045, Africa's total exports and imports would increase by 5.7% (or US$ 174.4 billion, at 2014 prices) and 5.4% (or US$ 173.9 billion), respectively (see Table 1). This is relatively modest because of the bulk of Africa's total current formal trade (around 85%) being realized with partners outside of the Continent which are not involved in the AfCFTA reform.

Narrowing down on intra-African formal trade, it is foreseen to increase by 33.5% (or US$196.4 billion) in the year 2045, following implementation of the AfCFTA Agreement, and compared to the baseline scenario without AfCFTA in place. All main sectors would benefit from the continental-wide reform, with intra-African trade to increase by 50.2% (or US$ 44.1 billion) in agrifood, 37.6% (or US$ 6.0 billion) in services, 36.1% (or US$ 119.8 billion) in industry, and 17.7% (or US$ 26.5 billion) in energy and mining.

Table 1: Macroeconomic effects from strict AfCFTA Agreement's implementation (percentage change compared to BAU in 2045)

GDP	0.94
Exports	5.7
Imports	5.4
Intra-African trade	33.5

Source: Authors' simulation results, MIRAGE-Power

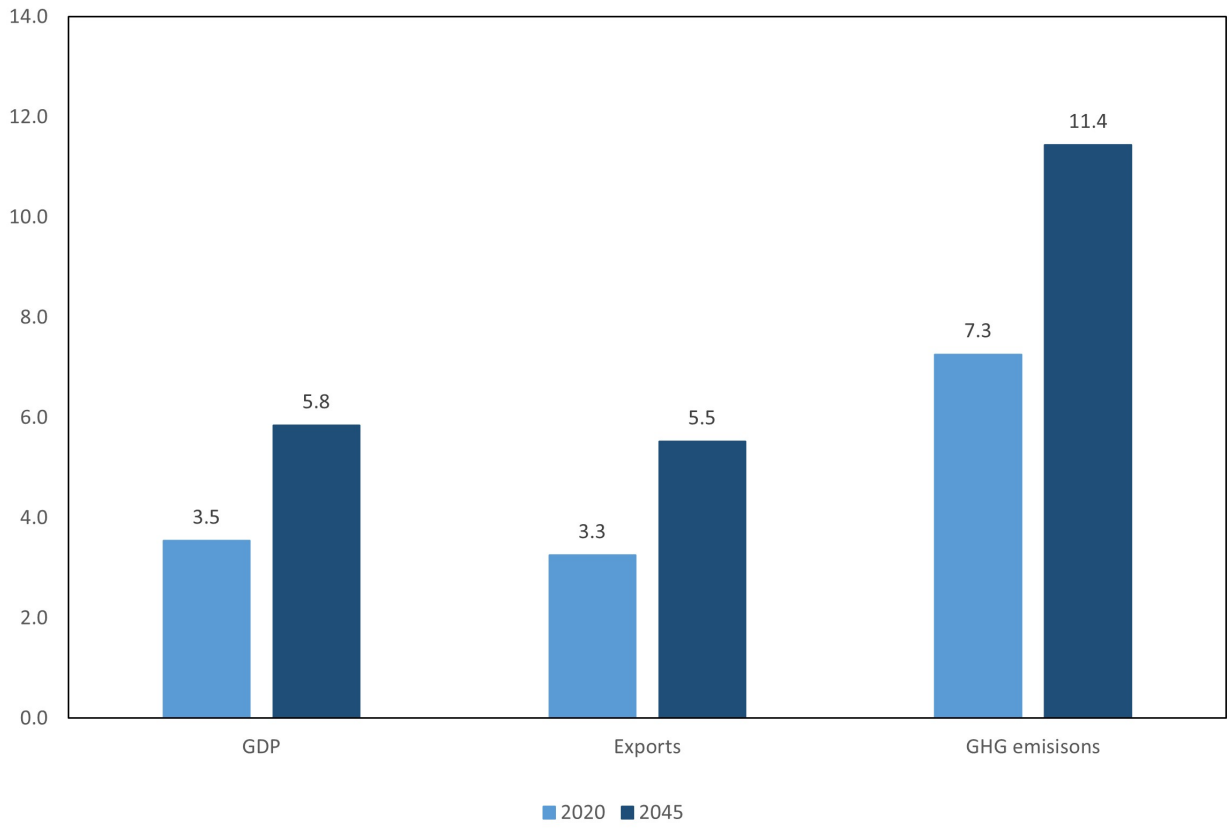
4.2 Impacts of the AfCFTA and climate policies on GHG emissions

Without the AfCFTA and a specific climate policy reforms, the African share in world GHG emissions is expected to expand fast. Notwithstanding expected gains in energy efficiency, while the Africa's share in world GDP would reach 5.8% in 2045 from 3.5% in 2020, Africa's contribution to world GHG emissions would reach 11.4% in 2045 from 7.3% in 2020, namely a 4.1 percentage points (or 56%) increase[8].

Implementing the AfCFTA would not further threaten climate change as GHG emissions are foreseen to increase only by 0.2% with the trade reform in place in 2045, compared to absence of AfCFTA (Figure 1). Moreover, by offering an opportunity of reinforced regional economic cooperation, the AfCFTA might favor cooperation in environmental issues across the continent. The adoption of climate policies in parallel to the implementation of the AfCFTA could lead to a significant decrease

[8]Africa's contribution to world CO2 emissions would reach 4.5% in 2045 from 3.7% in 2020

Figure 1: Africa's shares in world GDP, exports and GHG emissions in 2020 and 2045 without AfCFTA or climate policy reforms (business as usual, BAU) - %



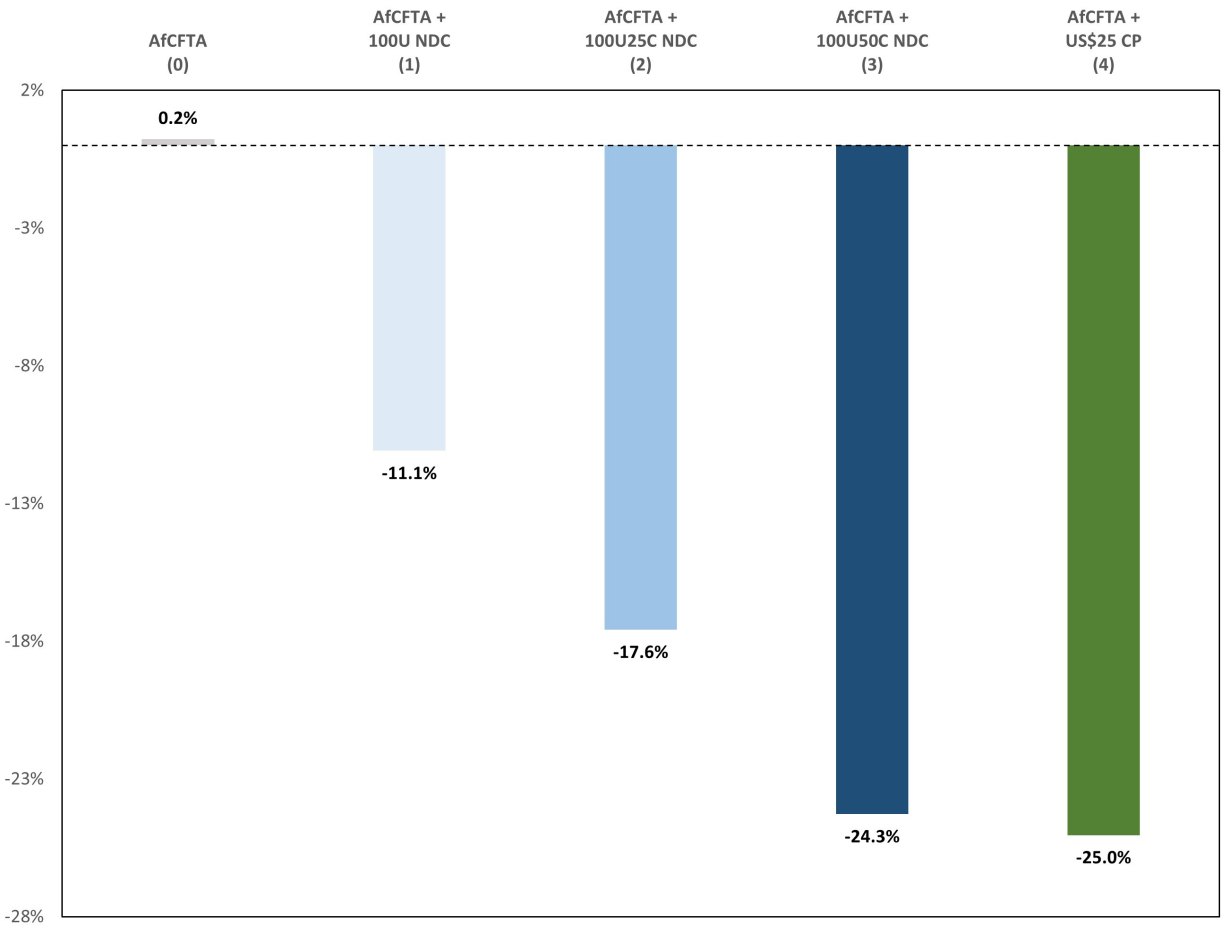
Note: The BAU includes energy projected efficiency gains reducing endogenously the carbon content of GDP

Source: Authors' simulation results, MIRAGE-Power

in African GHG emissions, assessed between -11.1% and - 25% depending on the level of ambition of the climate reforms envisaged in this analysis (see Figure 2).

The most ambitious scenario in terms of continent-wide GHG emission reductions appears to be the one assuming the establishment of African carbon markets, or a common carbon price in line with the IMF ICPF proposal for low-income countries (-25% in "AfCFTA + US$25 CP" scenario). To reach a comparable reduction in GHG emissions through the realization of their NDCs, African countries would have to not only achieve 100% of their unconditional target but also surpass 50% of their conditional targets. Indeed, a scenario assuming that African countries reach 100% of their unconditional targets and 50% of their conditional targets(AfCFTA + 100U50C NDC scenario) would lead to a 24.3% reduction in GHG emissions in 2045, which is slightly below the 25% reduction obtained through the carbon market approach.

Figure 2: Impacts of AfCFTA Agreement's implementation and climate policies on GHG emissions



Note: Scenario 5 ("AfCFTA + coordination") is not represented here as it is designed to produce the exact same overall cut in African GHG emissions as scenario 4 ("AfCFTA + US$25 CP"), but with a differentiated and coordinated effort among African countries.

Source: Authors' simulation results, MIRAGE-Power

4.3 Impacts of the AfCFTA reform and climate policies combined on economic outcomes

While African overall GDP is expected to grow by 0.94% in the year 2045 as compared to the baseline with the AfCFTA, abating emissions will come at a cost. Two remarks have to be made before commenting the results of our simulations on greening the AfCFTA. First, MIRAGE-Power, as a consequence of its CGE structure, departs from an integrated assessment model that would embark a loss function associated with temperature elevation. Hence there is no positive feed-back on GDP of the reduction in emissions. Absent this feedback, we underestimate the economic benefits of abatement policies. Second, within this modelling framework, the important question is whether a "green AfCFTA" can still deliver a positive outcome in economic terms while abating emissions.

To answer this second question, we now examine in Table 2 the consequences of greening the

Table 2: The macro effects of Implementing AfCFTA and Climate policies (percentage change compared to BAU in 2045)

	AfCFTA	AfCFTA + 100U NDC	AfCFTA + 100U25C NDC	AfCFTA + 100U50C NDC	AfCFTA + US$25 CP	AfCFTA + coordination
	(0)	(1)	(2)	(3)	(4)	(3)
GDP vol	0.9	0.8	0.4	-0.2	0.3	0.5
Exports	5.6	4.3	3.3	1.8	3.4	3.3
Africa intra trade	33.5	33.5	32.5	30.3	32.6	32.5

Source: Authors' simulation results, MIRAGE-Power

AfCFTA: the implementation of the FTA is combined with progress in terms of climate policies. The comparison is with the baseline without AfCFTA and without abatement of emissions. Column 0 reproduces the results of Table 1 for sake of comparison, while the subsequent columns give the results of the five scenarios embarking a climate policy on the top of the implementation of the AfCFTA. In column 1 of Table 2 African countries implement the FTA and fully achieve their unconditional commitments in terms of emissions abatement. In columns 2 and 3, they also achieve respectively one quarter and one half of their conditional NDCs. In column 4, the AfCFTA is implemented in conjunction with the IMF proposal of a US$ 25 carbon price for African countries[9]. Column 5 adopts a proportionate reduction of emissions delivering the same abatement of emissions as in column 4. We expect the solution examined in column 5 to be more economically efficient as the most emitting countries will have to curb their emissions more. Results in table 2 confirm that more ambitious climate policies will reduce the expected macroeconomic impacts of the AfCFTA in terms of both GDP and trade. This is particularly true as the ambition to achieve conditional NDCs increases (thereby highlighting that African countries tend to have a significantly larger share of their submitted NDCs being conditional). Indeed, when countries achieve 50% of their conditional targets along fulfillment of their unconditional ones in parallel to AfCFTA Agreement's implementation, the increase in intra-African trade would be lower compared to a scenario considering only AfCFTA implementation (without climate policies), and Africa's GDP would even decrease. In all the other scenarios combining AfCFTA Agreement's implementation and climate policy, we however observe differences of relatively lower magnitudes in terms of anticipated macroeconomic impacts with the scenario assuming the sole implementation of the AfCFTA reform.

To sum up, greening the AfCFTA would not significantly undermine the increase in intra-African trade brought about by the AfCFTA reform. The scenario presented in the last column of table 2 (i.e.

[9]We consider here a price of US$ 25 USD of 2014 in 2045.

scenario "AfCFTA + coordination"), assuming the adoption of differentiated but coordinated carbon prices across African countries appear to be the most economically efficient option. Thereby, suggesting that regional cooperation in terms of climate policies, combined with regional trade integration, is a promising avenue for economic and environmental progress in Africa.

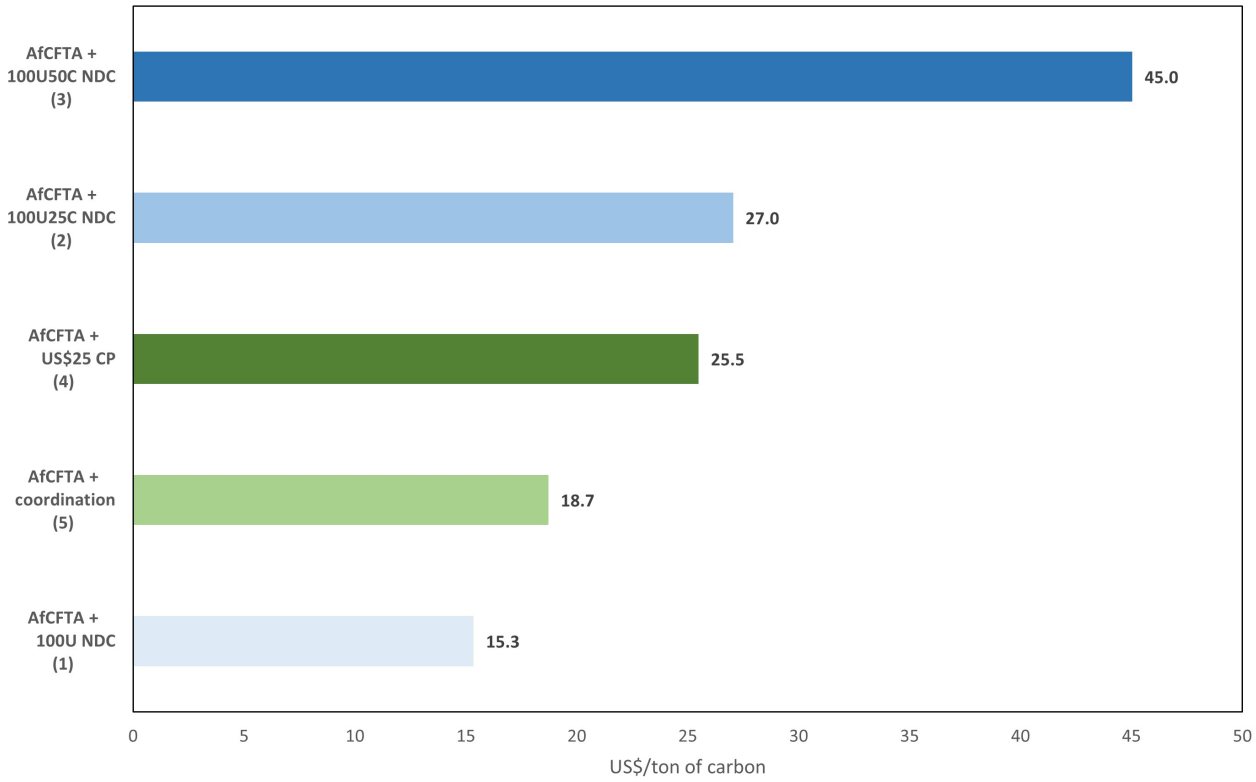
4.4 Abatement cost of climate policies in Africa

The ultimate criterion of assessment of the efficiency of climate policies is the cost of one ton of carbon avoided. It is computed here as the loss in GDP per ton of avoided GHG emissions in presence of the AfCFTA Agreement. Figure 3 shows this abatement cost, for the various climate policy scenarios analyzed. For instance, fully achieving the African unconditional NDCs in presence of the AfCFTA (i.e. scenario "AfCFTA + 100U NDC) would abate GHG emissions at a cost of US$ 15.3 per ton of carbon avoided. The cost is indeed in line with the limited ambition of these NDCs. In contrast, achieving also one quarter of the conditional African NDCs (i.e. scenario "AfCFTA + 100U25C NDC") would end up in a US$ 27 per ton of carbon avoided, which incidentally is close to the scenario envisaged under the IMF ICPF proposal for low-income countries. Achieving conditional NDCs beyond 25% of their target would substantially raise the abatement cost. For instance, scenario "AfCFTA + 100U50C NDC") would lead to a US$ 45 USD per ton of carbon avoided. Lastly, and importantly in terms of the dynamics of African integration, scenario 5 ("AfCFTA + coordination") that envisages a differentiated by coordinated efforts among African countries to reduce emission through carbon pricing reduces the abatement cost to US$ 18.7 per ton of carbon. However, this exercise is disconnected from the bottom-up approach of the Paris Agreement as we computed the abatement cost of an efficient cooperative carbon pricing in Africa based on a determined (based on the outcome of harmonized carbon pricing across Africa suggested by the IMF ICPF proposal) one quarter drop in African GHG emissions in 2045 in presence of the AfCFTA. Nonetheless, it is worth exploring how this option compares with the NDCs (conditional or not) set by African countries in conformity with the Paris Agreement. This is done in the next section.

4.5 African NDCs in perspective

As carbon pricing is increasingly being set-up or discussed around the world, including in Africa, and as the problem of collective action induced by climate may be alleviated by a differentiated carbon price floor, we examined in the previous section the economic and environmental impact of the adoption of a uniform US$ 25 carbon price across the African Continent and sectors, in parallel with the implementation of the AfCFTA Agreement. This homogenous carbon pricing across the

Figure 3: Abatement cost of climate policies



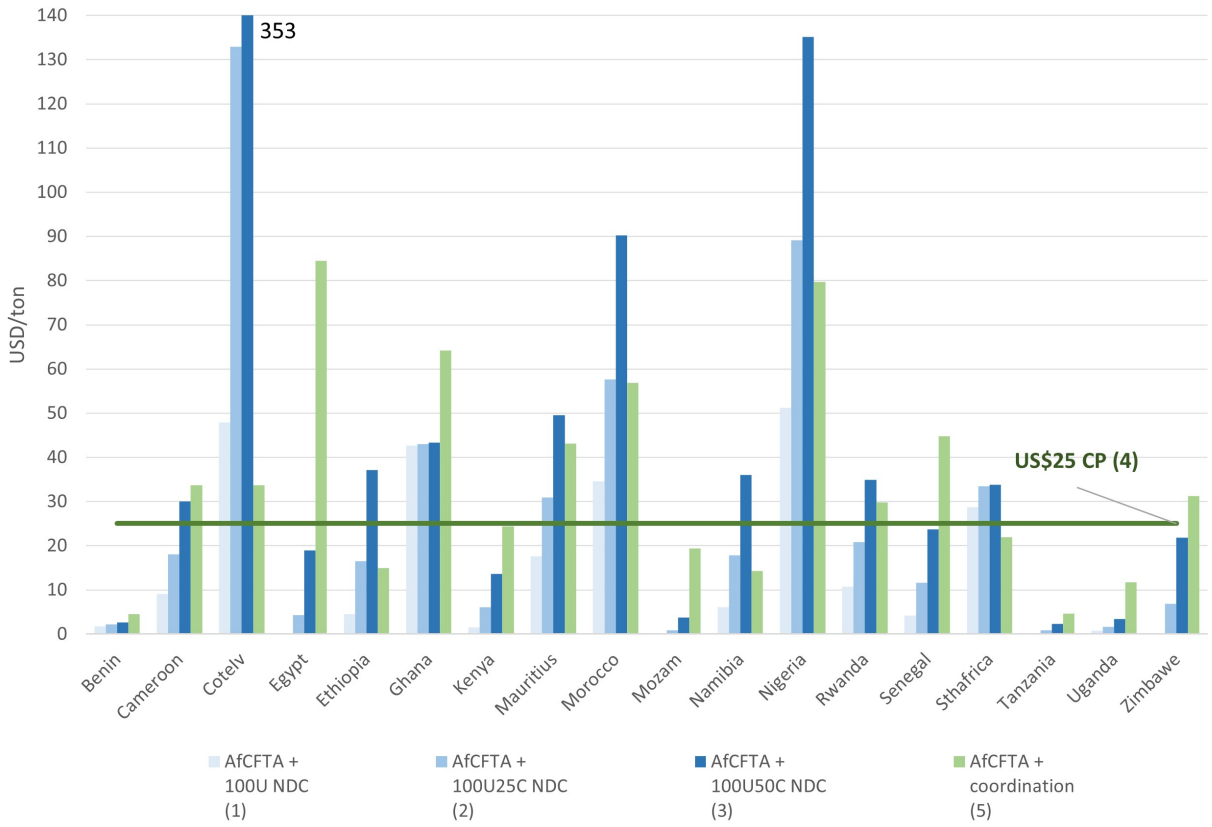
Source: Authors' simulation results, MIRAGE-Power

African continent delivered a one-quarter reduction in African GHG emissions, which could be more efficiently obtained with a differentiated and coordinated effort among African countries. Indeed we have shown (see Figure 3) that the latter solution was more efficient as it would result a lower overall abatement cost. However, this solution would have to be backed by differentiated national policies such as more emitting countries would have to adopt more aggressive abatement policies. In other words, more emitting countries would end up with an implicit carbon price – the equivalent carbon price of their abatement policies – above the African average. This outcome is nonetheless not different from the induced variability in implicit prices of carbon across the continent that would be needed to fulfill national NDCs.

We now compare implicit carbon prices induced by the various scenarios considered, recalling from Figure 3 that the most ambitious enforcement of NDCs (scenario 3 "AfCFTA + 100U50C NDC") corresponds to a 24.3% reduction in African GHG emissions, which is just below the outcome for carbon market scenarios (scenario 4 "AfCFTA + US$25 CP" and scenario 5 "AfCFTA + coordination). Results are displayed in Figure 4.

The first takeaway is that the climate policy ambition of NDCs in Africa differ considerably

Figure 4: The implicit prices of African NDCs and of the cooperative burden sharing, in presence of AFCFTA



Note: residual regions in aggregation (Rest of...) are absent from the figure

Source: Authors' simulation results, MIRAGE-Power

across countries. For instance, under scenario 1 ("AfCFTA + 100U NDC"), only Cote d'Ivoire, Ghana, Morocco and Nigeria have announced commitments that correspond to ambitious climate policies as they translate in implicit carbon prices well above the benchmark of US$ 25 per ton of carbon used in the analysis (in line with IMF ICPF proposal for low-income countries). South Africa would have an implicit carbon price that is closer to this benchmark. Remaining African countries in our simulations would all have implicit carbon prices significantly below the benchmark. Egypt, Mozambique, Tanzania and Zimbabwe would even have null implicit carbon prices revealing an absence of unconditional targets (their NDC targets being 100% conditional).

Turning to the scenario with 50% of conditional commitments fulfilled on top of 100% achievement of unconditional target (i.e. scenario "AfCFTA + 100U50C NDC"), 10 African countries out of 18 for which data is available individually (the other African countries being aggregated in rest of African countries' groupings) would have an implicit carbon price above the benchmark of US$ 25 ton of

carbon, with another 2 countries with implicit carbon price above US$ 20. Interestingly, and this is shedding light on the issues raised by the bottom-up approach endorsed in the Paris Agreement, the large differences observed in implicit prices associated with the African NDCs are totally disconnected from the implicit prices of a carbon price scenario with differentiated but coordinated efforts (i.e. scenario "AfCFTA + coordination") whereby more emitting countries would reduce more their GHG emissions because the abatement cost is lower. Indeed, if the implicit prices of carbon in scenario 5 ("AfCFTA + coordination") and in scenario 3 ("AfCFTA + 100U50C NDC") are relatively comparable for countries such as Benin, Cameroon, Mauritius, Rwanda and Tanzania, for the divergence is large in other African countries. Cote d'Ivoire, Morocco and Nigeria we would have prohibitive implicit carbon prices under the most ambition NDC scenario considered ("AfCFTA + 100U50C NDC") would see their implicit prices and therefore their contributions to GHG emissions hugely reduced under a carbon price scenario based on differentiated but coordinated efforts ("AfCFTA + coordination").

Notwithstanding, it should not be overlooked that for meeting their climate objectives most African countries will require external financial support and technology transfer. Continental coordination for the establishment of African carbon market(s) shows promising results in terms of the potential it offers for reducing Africa's GHG emissions moving forward and in the context of AfCFTA Agreement's implementation.

5 Conclusion

The completion of the AfCFTA reform will promote intra-African trade without having a significant negative impact on climate change. This contrasts with the expected increase in African emissions due to the continent's economic growth prospects, even in the absence of a regional trade agreement. AfCFTA has the potential to renew regional political perspectives, and climate policies could be added to the agenda, as suggested by emerging discussions on carbon pricing.

If adopting climate policies in line with Africa's climate objectives on top of the AfCFTA would somewhat undermine anticipated economic gains from the sole implementation of the AfCFTA Agreement, the increase in intra-African trade would still be substantial. Interestingly, the two considered scenarios around carbon pricing (either a uniform price across Africa or differentiated implicit national prices determined through Continental coordination) would lead to substantial reductions in GHG emissions (-25%), while preserving intra-African trade increases induced by the AfCFTA (intra-African trade gains would increase by around 32.5% against 33.5% with AfCFTA alone).

If we assess the effectiveness of the various climate policies that could be combined with the

AfCFTA, the scenario involving differentiated national prices thanks to continental coordination, and guaranteeing a level of reduction in African emissions similar to that of the uniform carbon price of US$ 25, not only shows the greatest reduction in greenhouse gas emissions (-25%), but also a limited abatement cost (US$ 18.7/tonne of carbon).

Putting the African NDCs in perspective, through the lens of their implicit carbon prices in comparison to the benchmark of the proposed US$ 25 uniform carbon price from IMF ICPF for low-income countries, it is clear that climate policy ambition of NDCs in Africa greatly differ across African countries, including for their often relatively smaller shares of unconditional target. Only a handful of African countries (i.e. Cote d'Ivoire, Ghana, Morocco and Nigeria) would have implicit carbon prices above the benchmark of US$ 25/ton of carbon. This is only under a more ambitious scenario assuming that unconditional NDCs are fulfilled along with 50% of conditional NDCs, that the majority of African countries would have implicit carbon prices above the benchmark. Also, those prices would be extremely variable across countries, with gaps totally disconnected from the differences in implicit prices of carbon in the scenario with differentiated but coordinated efforts.

In sum, pricing carbon in Africa seems to be an effective mechanism to help African countries meeting their climate objectives defined under their NDCs, and continental coordination shows the most promising results. Setting a uniform price of US$ 25 per ton of carbon across Africa or differentiated national prices through Continental coordination to ensure they provide a similar level of reductions of African GHG emissions seem to be viable benchmarks. More could certainly be achieved but as the level of carbon price increases, the tradeoff between environmental and economic ambitions seriously comes at play.

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