Trade in Environmentally Sound Technologies in the East African Region

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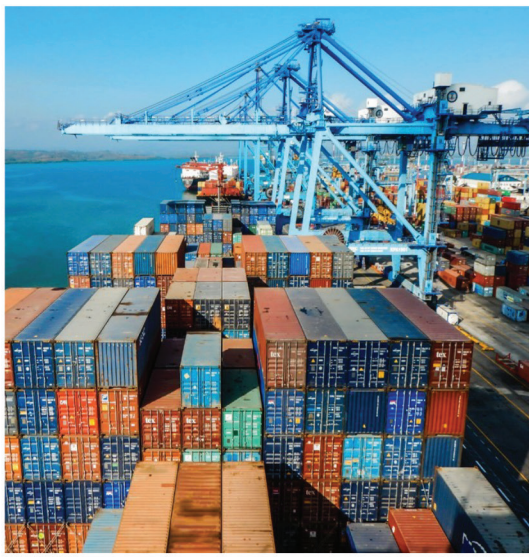




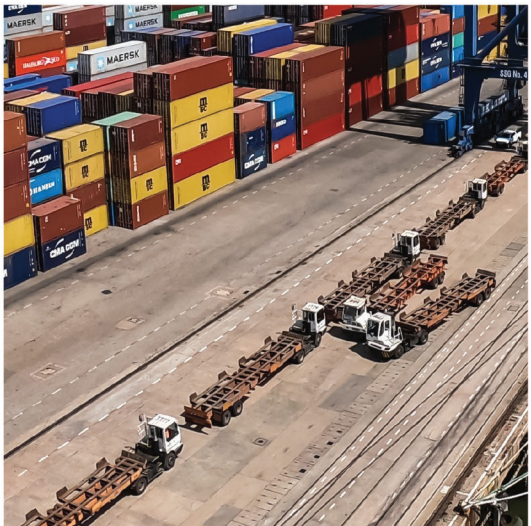
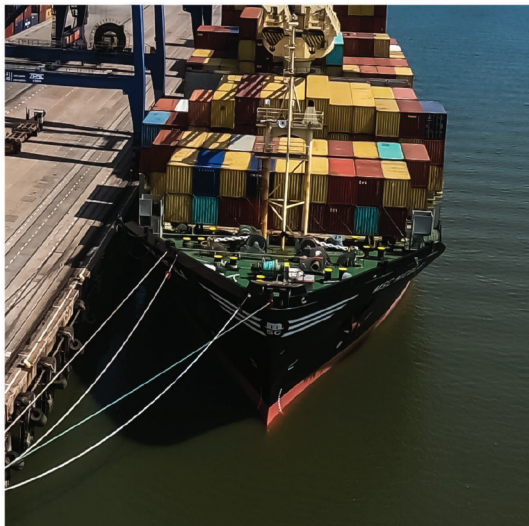

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List of Abbreviations

ACTS	African Centre for Technology Studies
AfCFTA	African Continental Free Trade Area
APE	Applied Partial Equilibrium
CO_2	Carbon Dioxide
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
EACREEE	East African Centre for Renewable Energy and Energy Efficiency
EGA	Environmental Goods Agreement
EPA	Economic Partnership Agreement
ERC	Energy Regulatory Commission of Kenya
EST	Environmentally Sound Technology
EUR	Euro
FDI	Foreign Direct Investment
GATT	General Agreement on Tariffs and Trade
GATS	General Agreement on Trade in Services
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GII	Gender Inequality Index
GiZ	German Agency for International Cooperation
GSIM	Generic Statistical Information Model
GW	Gigawatt
HDI	Human Development Index
HS	Harmonised System
ICTSD	International Centre for Trade and Sustainable Development
IDF	Import Declaration Form
IRENA	International Renewable Energy Agency
KRA	Kenya Revenue Authority
kW	Kilowatt
kWh	Kilowatt-hours
kWp	Kilowatt Peak
LDC	Least Developed Country
LED	Light-Emitting Diodes
MFN	Most Favoured Nation
MWp	Megawatt Peak
NTB	Non-Tariff Barrier
OECD	Organisation for Economic Co-operation and Development
PV	Photovoltaic
SADC	South African Development Community
SDG	Sustainable Development Goal
SWH	Solar Water Heater
TFTA	Tripartite Free Trade Area
TRIPS Agreement	Agreement on Trade Related Aspects of Intellectual Property Rights
UN Environment	United Nations Environment Programme
UNCED	United Nations Conference on Environment and Development
UNEA	United Nations Environment Assembly
UNECA	United Nations Economic Commission for Africa
USD	United States Dollar
VAT	Value Added Tax
WTO	World Trade Organization

Executive Summary

Environmentally sound technologies (ESTs) are increasingly being promoted internationally, regionally and nationally as potential solutions to environmental challenges such as climate change and pollution, while building resilience and creating opportunities for trade, economic growth and jobs. In East Africa, several policies have been adopted regionally and nationally to promote the diffusion of, and trade in, various EST-related goods, such as solar photovoltaic systems, wind turbines and solar water heaters, and services, including installation and maintenance. However, some barriers continue to inhibit trade in ESTs in the region, hampering the distribution and uptake of such technologies.

This report provides an overview of trade in ESTs in the East African Community (EAC) and its drivers and barriers, aiming to support policy makers in knowledge-based decision making, enabling them to harness the opportunities that trade in ESTs offers. It therefore maps the policy landscape related to trade in ESTs and provides a detailed account of trade in five selected ESTs in the East Africa region, with a focus on identifying opportunities and barriers to such trade. The specific ESTs considered in the report are solar photovoltaic (PV) cells, solar water heaters, wind turbines, biomass boilers and hydroelectric technology. While the trade flow analysis focused on these goods, it should be noted that EST goods and services are oftentimes complementary and delivered in a joint manner. Barriers to the trade and diffusion of one therefore also often hampers the deployment of the other. The report also provides an in-depth case study of the national solar PV industry in Kenya, and analyses the main opportunities and barriers to trade and to the diffusion of solar PV products along the domestic value chain.

Collectively, the countries in the East African Community (EAC) have made efforts to promote regional trade in the selected ESTs, notably through the enactment of various policies and legislative frameworks, such as the EAC Customs Union and Common Market Protocol, the 'EAC Vision 2050' development strategy and the EAC climate change policy. At a larger scale, initiatives such as the African Continental Free Trade Area, once adopted, are likely to boost trade in both goods and services across Africa. Yet, a number of barriers, documented in this report, continue to hamper the trade in ESTs in the region, hindering the countries to fully benefit from the triple-win-opportunities for economy, environment and development that ESTs have to offer. These barriers include weak compliance with regional policies and protocols, fragmented tax incentives, and burdensome customs and administrative documentation procedures.

The nationwide case study of the solar PV industry in Kenya illustrates which barriers are currently impeding cross-border trade in solar PV cells and modules into Kenya. These barriers are especially important with regard to customs entry and importation procedures. A key challenge to trade in PV cells and modules in Kenya is delay in customs clearance. The report further points to a number of barriers to the diffusion of solar PV products within Kenya, including a low level of consumer awareness, high interest rates for companies supplying solar PV products, logistical challenges that are specially problematic in rural parts of the country, and the lack of skilled personnel who can install and maintain solar PV systems.

There is consistency in findings from the EAC study as well as the country-specific case study of Kenya, which indicate that generally the policy and legislative frameworks are in place to encourage trade in ESTs, the tariff barriers are few and value and net effect of non-tariff barriers is much higher.

The report further suggests several recommendations to enhance trade in ESTs in the East African region. Within the region, the EAC could consider improving

compliance and enforcement of trade liberalization commitments. Similarly, there is a need to expedite the adoption, ratification and full implementation of existing protocols and policies that support and facilitate trade in ESTs, such as the EAC Common Market Protocol and the Customs Union Protocol. Regarding EST related services, particularly those involving free movement of people and the right of establishment are essential. Moreover, when designing and negotiating new initiatives, provisions not only aimed at facilitating trade in ESTs but also at improving supply-side constraints and enhancing competitiveness in the countries should be considered. Improved competitiveness will also eventually enable EAC member states to fully benefit from preferential market access schemes of external trading partners. Not least, efforts could be made to harmonize regional standards for ESTs and to establish a regional investment fund in the EAC region to scale up investment in ESTs. Related to this is also the need for greater regulatory coherence within the EAC as well as other African regional economic communities, which would facilitate the implementation of obligations and supportive measures. Lastly, there is a need to bridge the knowledge and capacity gaps in EST trade that are common in the region, including gaps in women's participation in trade in ESTs. Building the capacity and skills of the local workforce can play an important role in the development of the domestic market and thereby promote both opportunities for local but also international actors.

Finally, the report includes national-level recommendations regarding strategies to promote trade in, and diffusion of, solar PV in Kenya. For example, the Kenyan government could consider implementing a training program for customs and port officials to increase the efficiency with which custom entry procedures for solar PV products and components are handled. A national consumer awareness campaign, aimed at catalysing the adoption of certified solar PV products in the country, is another potentially worthwhile undertaking. Furthermore, training programs targeted at increasing the number of skilled technicians in Kenya are needed. Not least, improving the financial conditions for domestic companies supplying solar PV products is advisable. To further promote trade in ESTs in the region, there is also a need for more and better data, including data for both trade in environmental goods and environmental services. The collection and sharing of more detailed and harmonized data would help to improve understanding trade in ESTs, and facilitate policy-making.

1. Introduction

Environmental issues, such as climate change, pollution, deforestation and forest degradation, desertification and the loss of biodiversity and ecosystem services, continue to escalate, exposing the world's populations to heightened risks (Ivanova *et al.*, 2012; MEA, 2015; FAO, 2015). Increased trade in environmentally sound technologies (ESTs) is promoted internationally, regionally and nationally as one among several possible solutions to address these environmental concerns. The United Nations Conference on Environment and Development (UNCED) defines ESTs as those technologies that "protect the environment, are less polluting, use resources in a sustainable manner, recycle more of their wastes and products and handle all residual wastes in a more environmentally acceptable manner" (UNCED, 1992). Furthermore, UNCED describes ESTs as "more than just individual technologies, but total systems, which include know-how, procedures, goods and services and equipment as well" (UNCED, 1992). ESTs include technologies for renewable energy such as solar photovoltaic (PV) panels, solar water heaters (SWHs) and wind turbines but also technologies for better waste management.

The upscaling and dissemination of ESTs can contribute to an inclusive green economy. UN Environment defines an inclusive green economy as "one that improves human well-being and builds social equity while also reducing environmental risks and scarcities" (UNEP, 2018). Increased diffusion and use of renewable energy technologies, recycling and waste management technologies reduce carbon dioxide (CO_2) emissions and other pollutants to air and water, while reducing the depletion of scarce resources. Further, increased diffusion of other ESTs such as early warning systems, water harvesting and flood protection, play a crucial role in reducing vulnerability and building resilience to climate change. Recent surveys conducted by the International Renewable Energy Agency (IRENA), showed that increased use of renewable energies also has a positive effect on the share of women in the workforce (IRENA, 2016, 2017) and that women benefit from having access to clean electricity and clean cooking in terms of reduced workload and reduced exposure to air pollution (ENERGIA, ESMAP and UN Women, 2018). ESTs are increasingly being adopted and traded on a commercial basis driven by market forces, and growth in global production and sales, for example, of wind and solar PV technologies which is currently growing at above 30% annually (Jäger-Waldau, 2017; REN 21, 2018).

Across the world, there are now several initiatives seeking to promote the adoption of ESTs at the international, regional and national levels. Under the framework of the World Trade Organization (WTO), negotiations have been held with the aim of reducing or eliminating tariff and non-tariff barriers (NTBs) to environmental goods and services. For instance, while it does not mention ESTs specifically, the Agreement on Technical Barriers to Trade seeks to ensure that countries do not enact regulations, standards or testing and certification procedures that create unnecessary obstacles to trade in their territories. The 2001 Doha Ministerial Declaration required member states to commence negotiations with the aim of reducing or, as appropriate, eliminating tariffs and NTBs to environmental goods and services (WTO, 2001; Sankar, 2008). Regarding intellectual property rights, the Agreement on Technical Barriers to Trade also calls for protection and enforcement mechanisms capable of promoting technological innovation and the transfer and dissemination of state-of-the-art technologies (WTO, 1994; Sankar, 2008). Article 66 (2) of Agreement on Trade Related Aspects of Intellectual Property Rights (the TRIPS Agreement) urges developed countries to provide incentives and instruments in their territories to promote and encourage technology transfers to least-developed countries (Sankar, 2008).

For its part, the United Nations Conference on Environment and Development, held in Rio de Janeiro (Brazil) in 1992, recognized the importance of international cooperation in environmental protection. Chapter 34 of the so-called Rio Declaration focused on technology and the environment and called for increased cooperation among countries to facilitate the adoption of ESTs, especially in least developed nations (UNCED, 1992). The Paris Agreement on climate change and the Kyoto Protocol also promote the adoption of ESTs as a strategy to reduce greenhouse gas (GHG) emissions. Article 10 of the Kyoto Protocol calls for member states to put in place an enabling environment supportive of access to and the adoption of ESTs, especially in least-developed countries (UNFCCC, 1998). Article 4(c) of the Paris Agreement urges member states to "promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases" (UNFCCC, 1992). The Montreal Protocol on substances that deplete the ozone layer requires that the best available, environmentally safest substitutes and related technologies are expeditiously transferred to developing countries under fair and favourable terms (Sankar, 2008). The Cancun Agreement of 2011 especially highlights the role of technology in building resilience against the adverse impacts of climate change by enabling action on mitigation and adaptation (UNFCCC, 2011).

In 2015, the 2030 Agenda for Sustainable Development and the Addis Ababa Action Agenda further underlined the role of ESTs in achieving the Sustainable Development Goals (SDGs). At the third United Nations Environment Assembly (UNEA III) in Nairobi in December 2017, members adopted the resolution to promote and facilitate development and diffusion of ESTs. They also called for actions to promote environmentally sound innovative policies for sustainable industrialization, agriculture, urban development, transport, tourism and trade, as well as sustainable consumption and production in those key sectors (Resolution 3/5 "Investing in innovative environmental solutions for accelerating the implementation of the Sustainable Development Goals"). Besides the overarching agendas outlined above, the call for promoting the dissemination of ESTs is also reflected in more targeted strategies, such as the recently published European Strategy for Plastics in a Circular Economy by the European Commission (EC, 2018a). This strategy, aimed at addressing the challenges posed by plastics throughout the value chain and especially plastic pollution, underlines the need for active cooperation between countries to scale up innovative solutions and technologies.

International trade is a critical enabler for the diffusion of ESTs. Trade policy instruments - be they tariff reductions, market access, elimination of environmentally harmful subsidies, standards and certifications, public procurement rules or trade finance - can support the scaling up of ESTs and provide opportunities for trade, investment, and jobs. The global renewable energy sector is for example projected to employ 28.8 million people by 2050, rising from 10.3 million in 2017 to 23.6 million in 2030 (IRENA, 2018).

To fully unlock these opportunities, a group of members of the World Trade Organization (WTO) initiated negotiations towards the Environmental Goods Agreement (EGA) in 2014. The goal was to eliminate tariffs on a list of environmental goods that could bring multiple benefits to trade, environment and development. The Sustainability Impact Assessment of the potential agreement conducted by the European Commission estimated that a successful conclusion of the EGA would lead to an increase of EUR 21 billion in international trade and a potential reduction of ten million tonnes of CO_2 emissions by 2030 compared to the baseline scenario. However, due to political and technical complexities in agreeing on the list of environmental goods, negotiations stalled after the latest discussion in Geneva in December 2016. The initiative nevertheless presents an important and encouraging step forward.

While the EGA was expected to cover more than 90% of international trade in environmental goods if successfully concluded, no African countries took part in the negotiation. Yet, a number of African countries, including some least developed countries (LDCs), expressed strong interest in understanding and assessing the implications of the EGA and trade liberalization in ESTs.

As one of the most dynamic regions in Africa, the East African Community (EAC) sees great potential in trade in ESTs and has made significant efforts to facilitate trade and value chain development in several ESTs. Nationally, several East African countries have established institutional and regulatory frameworks to foster trade in ESTs. For instance, Kenya (2010), Tanzania (1998) and Uganda (1995) have all laid solid constitutional foundations for trade in ESTs by providing their citizens with the right to clean energy. These countries have also incorporated the exploitation of alternative sources of energy into their national development visions and plans. Notwithstanding all these policy developments, several barriers still exist that inhibit trade in ESTs in the EAC region. Aiming to enable all countries to harness the opportunities and tackle the barriers related to trade in ESTs, this report provides an overview of trade in ESTs in the EAC and its drivers and barriers. It applies a two-folds approach: on the one hand, it provides an account of regional trade in selected ESTs within the East African Community, including the regional policies and regulations that affect trade in ESTs. On the other hand, it presents an in-depth case study at the national level, focusing on the barriers to trade in relation to solar PV in Kenya.

2. Regional assessment of the drivers and barriers to trade in ESTs in the East African region

The EAC was formed in the year 2000 as a regional trading bloc to "widen and deepen economic, political, social and cultural integration to improve the quality of life of the people of East Africa through increased competitiveness, value added production, trade and investment" (Oiro *et al.*, 2017). It comprises six states: Burundi, Kenya, Rwanda, South Sudan, Tanzania and Uganda. South Sudan is the newest member, having acceded to the Treaty on 15 April 2016 and subsequently becoming a full member on 15 August 2016 (EAC, 2018a). The EAC region, which covers 1.8 million square kilometres, was home to about 156.6 million people in 2014. This translates into 16% of the overall population of Sub-Saharan Africa. The majority of the population (78%) lives in rural areas (REN21, 2016). While women constitute over 60% of this population, they often remain marginalized and have limited access to education, finance and information and communication technologies as compared to men. In order to address this challenge, the Community acknowledged the important role of women in the socio-economic development of the countries (Article 121 and 122) and committed to mainstreaming gender into all EAC endeavours (Article 5e) in the Treaty (EAC, 2017a).

The EAC is the second largest single regional market in Africa, and one of the fastest growing regional economies in Sub-Saharan Africa. In 2014, EAC partner states witnessed a combined average growth in their gross domestic products (GDP) of 6.2%, higher than the Sub-Saharan African average of 4.4%. Since the 2000s, GDP has increased almost five-fold in Kenya and Tanzania, 3.5-fold in Burundi and 4.5-fold in Rwanda and Uganda (REN21, 2016). Agriculture is the single largest economic sector in the region. In recent years, EAC countries have begun diversifying their economy towards bigger shares of the industry and service sector. Yet, this structural change in economic activity has not led to an equally strong shift in the employment structure, with agriculture remaining the main employment sector in the EAC, especially for women (UNCTAD, 2018a). Despite strong economic growth rates, however, overall levels of human development as assessed by the Human Development Index remain relatively low in the EAC region (REN21, 2016). On the Gender Inequality Index (GII) (UNDP, 2018), all EAC partner states perform better than on the Human Development Index (HDI), but still low compared to the rest of the world. (UNCTAD, 2018a).

Since its formation, the EAC has registered various integration milestones, key among which was the creation of a Customs Union and a Common Market Protocol, which came into force in 2005 and 2010 respectively. The adoption of the Customs Union as the first pillar of economic integration signified the intention of the East African countries to "establish free trade on goods and services amongst themselves and agree on a common external tariff, whereby imports from countries outside the EAC zone are subjected to the same tariff when sold to any EAC Partner State" (EAC, 2018b). This was expected to increase trade and investment flows between member states and at the same time create a large market for the East African people (Reith and Boltz, 2011). The adoption of the East African Common Market Protocol, on the other hand, allowed the free and unrestricted movement of goods, people, labour, services and capital within the region (Calabrese and Mendez-Para, 2016).

The main instrument for trade liberalization provided under the Customs Union was the elimination of tariffs and NTBs between the partner states. This initiative was aimed at increasing economic efficiency and creating political and cultural relationships among

these states (Okumu and Nyankori, 2010). Furthermore, studies suggest that trade liberalization in the EAC also positively affects the overall female-to-total labour ratio in all countries, except for Burundi, leading to more gender equality (UNCTAD, 2018a).

Tariffs are taxes on imports or exports of commodities into a country or region. This government intervention in the economic activities of its territory serves various purposes. First, governments levy tariffs on imports or exports to raise revenues for their activities.

Second, governments often introduce tariffs on imports as protective instruments for domestic industries to provide them with a competitive edge over foreign imports. However, this protective tariff typically comes at a cost to domestic consumers, who consequently pay higher prices for import-competing goods (Ebrary, 2018).

Third, tariffs can also be levied for retaliatory or reciprocity purposes against another country's trade practices when these are perceived to be unfair (Ebrary, 2018; Sumner, 2001).

Non-Tariff Barriers (NTBs), on the other hand, refer to a wide range of policy or non-policy interventions other than border tariffs that affect the trade in goods or services. Some of these interventions include "import quotas, voluntary export restraints, restrictive state trading interventions, export subsidies, countervailing duties, technical barriers to trade, sanitary and phytosanitary policies, rules of origin, and domestic content requirement schemes" (Beghin, 2006:1).

Economists generally agree that tariffs as well as NTBs reduce the potential benefits of trade preferences, such as regional trading arrangements, and increase the cost of doing business, which ultimately leads to welfare losses (Karugia *et al.,* 2009).

Although East African countries have made great progress in eliminating tariffs, NTBs persist (Calabrese and Mendez-Para, 2016; Oiro *et al.,* 2017), as is especially the case with regard to the trade in ESTs, such as solar PV cells and modules, Solar Water Heaters (SWHs) and wind turbines,. In addition, the introduction of these technologies faces other impediments to their diffusion, such as a lack of awareness among decision-makers and potential users (Karekezi and Kithyoma, 2003; Wawa, 2012; Fatihiya *et al.,* 2015).

The presence of NTBs within the EAC region contravenes Article 13 of the Protocol on the establishment of the East Africa Customs Union, which calls on East African states to "remove, with immediate effect, all the existing NTBs to the importation into their respective territories of goods originating in other partner states" (EAC Secretariat 2004: 20). As Okute (2017) notes, the persistence of NTBs in the EAC region restricts market access for regional importers and exporters, thus denying EAC consumers' welfare-enhancing opportunities that arise from access to reasonably priced regional imports.

Based on a review of policy documents and reports, this section examines the main drivers and barriers to trade in ESTs in the East African region. It draws on inputs obtained from regional stakeholders at a workshop held in Nairobi in December 2017 on trade in ESTs in the East African region. The analysis targets five ESTs that are relevant to the region in terms of trade and value chain development. These are solar PV cells and modules, SWHs, wind turbines, biomass boilers and hydropower turbines. These technologies were selected as they have priority in national policies in East African countries, are among the most traded and diffused ESTs in the region and are becoming increasingly cost-competitive due to decreasing prices. Since the five selected ESTs share similar features as well as key differences, they allow for interesting comparison.

It is important to note that the deployment of EST goods in most cases also requires the provision of services such as engineering, consultancy, construction and maintenance services. The high complementarity between goods and services related to ESTs calls for a joint analysis. Given that data for trade in

services related to ESTs are not available, this report will provide insights into drivers and barriers of trade in environmental services through an in-depth review of the policy landscape in the EAC region related to EST services, to complement the analysis of overall trade in environmental goods in EAC.

2.1. Trade in the EAC region

To provide an overview over trade within the EAC, the following sections will outline intra-regional trade flows, trade barriers as well as measures taken to facilitate trade between the EAC member states.

2.1.1. Intra-regional trade flows in the EAC

Regional trade integration is a cornerstone of the trade policies of the EAC partner states, a process that entails the strengthening of public institutions and private-sector organizations involved in export promotion. The internal EAC market has about 146 million consumers (EAC, 2018c). In recent years, intra-regional trade and other economic indicators have continued to increase.

The EAC realized a total of USD 3.1 billion in intra-regional exports in 2015. Kenya registered the highest share of intra-regional exports at USD 1.3 billion, followed by Uganda, Tanzania, Burundi and Rwanda. Table 1 shows intra-EAC trade flows between 2011 and 2015. The value of intra-regional imports stood at USD 2.0 billion in the same year. The intra-regional trade mostly took the form of agricultural commodities and manufactured goods (EAC, 2015).

The overall combined GDP for the Community was around USD 146 billion in 2015, compared with USD 113 billion in 2011. Overall, the agricultural sector has been the largest contributor to GDP, followed by the retail and manufacturing sectors. The highest contributors to GDP growth over the period were the transport and communication sector and the construction

Table 1. Intra-EAC trade flows from 2011-2015 (USD million)

		2011	2012	2013	2014	2015	Percentage change			
							2011-2012	2012-2013	2013-2014	2014-2015
Imports	Uganda	692	646	616	684	630	-6	-4	11	-8
	Tanzania	378	678	397	709	278	79	-41	78	-60
	Kenya	302	364	334	416	407	20	-8	24	-2
	Burundi	160	168	346	126	151	5	6	6	7
	Rwanda	385	457	412	465	473	18	-9	12	1
	Total	**1,919**	**2,315**	**2,107**	**2,402**	**1,941**	**20**	**-9**	**14**	**-19**
Exports	Uganda	503	580	627	642	771	15	8	2	20
	Tanzania	409	613	1,118	779	924	49	82	-30	18
	Kenya	1,544	1,593	1,451	1,430	1,285	3.2	-8	-1	-10
	Burundi	25	24	35	25	27	-3	41	-27	6
	Rwanda	81	343	467	352	118	323	36	-24	-66
	Total	2,564	3,155	3,698	3,230	3,128	23	17	-12	-3
Total EAC trade value	Uganda	1,196	1,227	1,244	1,326	1,401	2	1	6	5
	Tanzania	787	1,292	1,515	1,489	1,203	64	17	-2	-19
	Kenya	1,847	1,957	1,786	1,848	1,694	6	-9	4	-8
	Burundi	186	193	382	152	178	3	98	-60	18
	Rwanda	466	801	880	818	593	72	10	-7	-28
	TOTAL	**4,483**	**5,470**	**5,806**	**5,633**	**5,070**	**22**	**6**	**-3**	**-10**

Source: EAC (2015).

Table 2. GDP per capita in EAC and per country (current USD)

Country	2011	2012	2013	2014	2015	2016	2017
EAC	834	941	1,001	1,014	974	-	-
Kenya	987	1,153	1,229	1,335	1,355	1,463	1,508
Tanzania	733	820	903	951	872	878	936
Rwanda	624	680	689	707	712	711	748
Uganda	575	637	655	703	675	580	604
Burundi	260	265	283	313	301	286	320

Source: World Bank (2018b) and EAC (2016a)

sector, both of which consistently improved their contributions to GDP. Per capita GDP levels, at current prices, rose from USD 834 in 2011 to USD 974 in 2015. In 2017, Kenya recorded the highest annual GDP per capita (USD 1508). The rates for Tanzania, Rwanda, Uganda, and Burundi were USD 936, USD 748, USD 604 and USD 320 respectively, as shown in Table 2 (see EAC, (2016a) and World Bank (2018b) for a detailed exposition).

The treaty establishing the EAC provides the legal framework for partner states to develop and adopt an East African Trade Regime and cooperate in trade liberalization. This includes the simplification and harmonization of trade documentation and procedures, also provided for in the EAC Customs Union Protocol (Stanton, 2016). Given the institutional foundations of East African cooperation, some member states already traded with each other under the Preferential Trade Area for Eastern and Southern Africa. The trade and market integration processes are described under the provisions of Article 5 of the treaty establishing the EAC, which envisages a customs union followed by a common market, and culminating in political federation, as the gradual steps integrating the Community (UNECA, 2016a).

The EAC member states have taken steps to mainstream trade into their national development strategies. Kenya's trade policy, for example, has evolved from import substitution policies in the period between the 1960s and the 1980s to trade liberalization through structural adjustment policies in the 1980s and export-oriented policies in the 1990s. The latter led to the creation of export-processing zones in which companies could benefit from various government support schemes encouraging them to export their products, such as export subsidies and tax exemptions. At least since Kenya joined the General Agreement on Tariffs and Trade (GATT) in 1964, its trade regime has been guided by market-driven principles of liberalization. Such guiding principles have continued under the WTO, of which Kenya became a founding member in 1995.

The Protocol on the Establishment of the EAC Common Market *"requires member states to pursue macroeconomic policy convergence to benefit fully from a common market. The free movement of capital has therefore been a central element of the Protocol"*. The Protocol also commits partner states to harmonize other areas of cooperation, such as investment promotion and private-sector development. (UNECA, 2018).

2.1.2. Barriers to trade within the EAC

Following initial implementation of the EAC Customs Union in 2005, the value of intra-regional trade more than tripled, from USD 1.8 billion in 2005 to USD 5.5 billion in 2012 (Shinyekwa, 2015). Nonetheless, various barriers still exist that raise transaction costs and increase trade uncertainties[1]. The removal of such barriers would encourage vertical specialization and the emergence of regional production chains, which would create employment and promote export

1 By standard definitions, any restriction imposed on the free flow of trade is considered a trade barrier. According to the Library of Economics and Liberty, a barrier to trade is a government-imposed restraint on the flow of international goods or services (Econlib, 2013).

diversification (EAC, 2012). These barriers to trade can be categorized into tariffs and NTBs.

Whereas EAC member states have made great progress in eliminating tariffs to intra-regional trade, there are several NTBs that still adversely affect trade within the EAC (Calabrese and Mendez-Para, 2016; Mutai, 2015; Oiro *et al.,* 2017). They affect both enterprises and government departments across all the EAC countries and reduce the potential benefits that could be derived from the preferential trade opportunities offered through regional trading arrangements. These potential benefits include better access to partner country markets, export opportunities, improved welfare, increased job creation and faster economic growth. The East African Business Council (2005, 2018) identifies certain NTBs to intra-EAC trade. These are summarized in Table 3 below.

Table 3. NTBs recognized by the East African Business Council

Barrier	Characteristics
Customs and administrative documentation procedures	Varying systems for import declarations and the payment of applicable duty rates; limited customs working hours; varying interpretations of the rules of origin; application of discriminatory taxes and other charges on EAC originating imports; cumbersome procedures for verifying containerized imports; unfair competition from counterfeit products; and diversion of transit goods into the region.
Immigration procedures	Varying applications of visa fees and work permits; cumbersome and duplicated immigration procedures; and the lack of an East African passport on the part of many citizens who cross borders in search of business opportunities.
Cumbersome inspection requirements	Procedures on gross vehicle mass and axle-load regulations; costly quality inspection procedures; cases of a lack of recognition of inspection certificates issued by accredited laboratories; cases of a lack of mutual recognition of quality certification marks and test certificates issued by EAC Standardization Bureaus; varying quality inspection and testing procedures, which are also introduced without prior discussions and consensus; and varying procedures for the issuance of export certification marks.
Police roadblocks	Police officers stopping commercial vehicles at various intercountry road-blocks and at border crossings even where there is insufficient proof that the goods being transported are suspicious in nature.
Varying trade regulations among the three EAC countries	The most notable ones are the different axle loads and different specified maximum gross vehicle mass for commercial vehicles. Also, EAC countries have varying parameters on weights, labelling and quality, tolerance in measurements, and technologies used in packaging, which limits the ability of goods to cross borders.
Varying, cumbersome and costly transiting procedures in the EAC countries	Varying requirements on commercial trucks used in transit traffic; bottlenecks in offloading imports at the Ports of Mombasa and Dar es Salaam; unrealistic grace periods on imports before application of demurrage; and enforcement of insurance bonds even on goods traded within the region.
Duplicated functions of agencies involved in verifying quality, quantity and dutiable value of imports and exports	Numerous agencies involved in import and export inspections and in certifying compliance with procedures, which results in duplication of effort and wasted business time. Also, many inspection bodies have not established laboratories at major entry and exit points.
Business registration and licensing	Varying business registration procedures and lack of preferential treatment to EAC-originating businesses versus foreign originating businesses, which makes cross-border registration of business a difficult, cumbersome and expensive process. Others are manual processes used in business name searches, registration and payment of relevant charges, and multiplicity of licenses used in the production, distribution and sale of goods. These result in duplication and the prohibitive cost of doing business in the region.

Source: EABC (2018).

Other studies have mentioned corruption, as another issue that has implications for the economies of the EAC member states, as well as to trade flows between them (Hangi, 2010). All these factors work collectively to impede trade in the region and highlight the limitations of the customs union protocols signed by member states (Hangi, 2010).

2.1.3. Measures to address general trade barriers in the EAC

The EAC has embarked on several trade-liberalization measures aimed at eliminating tariffs and NTBs to trade. To this end, the EAC community has adopted provisions that allow its member states to establish manufacturing-under-bond schemes, export-processing zones and duty-drawback schemes. However, the sale of goods produced under any such scheme within the customs territory is limited to 20% of the overall production volume within the territory (WTO, 2006). Additionally, the member states have also committed themselves to introducing processes that seek to bring their trade regimes into conformity with WTO provisions outlined in the Trade Policy Review on EAC, which stipulates the "improvement of their multilateral commitments through the reduction of bound rates, enlargement of the scope of bindings on goods and services, elimination of applied compound tariffs, and removal of other duties and charges […]" (WTO, 2006: ix).

Article 21 of the Protocol on the Establishment of the EAC Customs Union obliges member states to prohibit any practice, undertaking or agreement that has as its objective or effect on the prevention, restriction or distortion of competition within the Community. This provision, however, does not apply to a practice, undertaking or agreement that improves the production or distribution of goods, or that promotes consumer welfare or technical or economic development (EAC Secretariat, 2004).

The EAC Competition Act of 2006 was enacted into law to prohibit anti-competitive practices, including price collusion, collusive tendering and market allocation, and quantitative restraints on investment and sales. It established an EAC Competition Committee, composed of one representative from each member state. The Committee was mandated to investigate, hold hearings and impose sanctions and remedies. The Act also contains provisions on mergers and acquisitions, consumer welfare (including unfair competition) and subsidies (EAC, 2006a).

The existence of NTBs within the EAC partner states also led to the enactment of the East African Community Elimination of NTBs Act, 2017. The Act outlines the various categories of some of the WTO's NTBs that are manifested within the EAC region. The Act established National Monitoring Committees to identify the NTBs within their nation states. It also outlined various approaches to eliminating NTBs within the region through mutual agreements by the affected partner states and time-bound programmes, whereby the partner states provide a written notification to the county responsible for the NTBs (EAC, 2017b; Oiro *et al.*, 2017).[2]

2.2. Policies related to EST services trade in the EAC

A liberal trade regime for the imports of services can facilitate the movement of foreign companies and individual service providers that may be required for cost-effective provision of such services in renewable energy projects. In addition, a liberal trade regime for services applied by a country's trading partners can also enable the tapping of export opportunities by domestic service providers. The downstream segment of the renewable energy value chain that involves delivery of these services has job-creation potential in the host economy, as very often services need to be locally supplied even if the goods are imported. A report on the solar PV industry in Europe noted that downstream activities of the solar

2 Cases may be brought to the attention of the EAC Council of Ministers to decide on the matter or to pass it on to the EAC Committee on Trade Remedies for guidance.

value chain were more labour intensive than the upstream (manufacturing) segment, accounting for 75% of the share of total jobs. Further, in the case of Europe in 2016, the rooftop solar PV segment supported almost three times as many jobs as the ground-mounted installations due to labour needs for installation, maintenance and operations (Ernst & Young, 2017). This has some significance for Africa as many, if not most PV installations are off-grid or roof-mounted in nature as compared to large-scale grid connected projects. However, the creation of such jobs will also depend on the local availability of skills which, as noted by the report, is in short supply in the EAC. Temporary movement of workers within the EAC as well as relaxing barriers to movement of service providers could be one way to temporarily bridge the skills gap and ensure smooth operations of renewable energy plants.

Trade within the EAC is very much centred around agricultural commodities and manufactured goods as the report points out, although services sectors such as construction are amongst the chief contributors to GDP growth in the region. Indeed, the report highlighted the presence of firms in Kenya with a profile in services such as engineering and construction importing equipment and components for solar PV systems within Kenya. According to a study on construction services for the Southern African Development Community (SADC) region, most African countries in the region, with a few exceptions (e.g. South Africa and Mauritius), are net importers of such services. Chinese, European and South African firms had an advantage in tenders in the SADC context given their large technology and capital base (Fernandes, 2014). This trend is likely true for the rest of Africa as well including the EAC.

Trade in services normally occur through four modes of delivery. These include:

- Mode 1: Cross-border trade in services (for e.g. the provision of environmental consulting services through the internet),
- Mode 2: The movement of consumers abroad to consume a service in the country of origin (e.g. construction service industry professionals attending a paid training or university programme abroad),
- Mode 3: Commercial presence involving the establishment of a foreign engineering service provider in the host country (e.g. A Singapore-based engineering, procurement and construction services contractor establishing a subsidiary in Indonesia to deliver services) and
- Mode 4: Temporary movement of natural persons abroad to deliver a service in the host country (e.g. Temporary movement of Malaysian maintenance professionals to perform periodic maintenance checks on a solar PV plant in Myanmar).

Restrictions on trade in services are often regulatory and 'behind the border' in nature and closely related to investment and immigration related policies as well. For example: A country might place equity restrictions on foreign direct investment (FDI) by foreign companies in the services sector affecting trade under Mode 3 or visa-related restrictions on entry of individual service providers which would constrain the delivery of services under Mode 4.

While reliable data is not available for trade in services specific to renewable energy within the EAC region as well as with the EAC's external trading partners, the report clearly points to the presence of various barriers (particularly related to Modes 3 and 4) that could well impede efficient and cost-competitive delivery of such services within the region. These include nationality related requirements prohibiting non-nationals from becoming majority shareholders in locally incorporated companies, cumbersome registration and licensing procedures and various and restrictive immigration procedures and inconsistencies such as varying applications of visa fees and work permits. Such measures continue to persist despite the Protocol on the Establishment of the EAC Common Market providing for "Four Freedoms", namely the free movement of goods, labor, services, and capital.

Photo by Mathilde Brix Pedersen: The hybrid mini-wind plant at NDEDA Island, Kenya

This section will briefly review the policy landscape and openness to trade in services involving EAC members at the multilateral as well as at the regional level focusing on specific services sub-categories relevant to the delivery of renewable energy, namely construction-related engineering services, professional engineering services, engineering related scientific and technical consulting and maintenance and repair services.

2.2.1. EAC member states commitments under the General Agreement on Trade in Services

A review of the various commitments in services sectors made by EAC members (except South Sudan that has not yet acceded to the WTO) under the WTO GATS (see Annex 1) show that EAC countries, with the exception of Burundi, have made little or no commitments in construction, engineering and maintenance services, including services related to ESTs. With EAC countries' GATS commitments having been made in 1994, there have been no new improvements since then at the multilateral level. At the same time, it is important to note that despite the lack of binding commitments, EAC countries like other WTO members can always autonomously liberalize the services sectors and sub-sectors that they choose even though making binding commitments at the multilateral level offers greater certainty and predictability of market access and national treatment for global companies interested in supplying such services.

2.2.2. Services liberalization under the EAC Common Market

The Protocol on the Establishment of the East African Common Market is fairly ambitious and provides for MFN and national treatment to service suppliers, the free movement of goods, people, services, labour and capital as well as the right of residence and establishment in addition to agreeing on harmonization and mutual recognition of academic and professional qualifications. Annex V of the Protocol sets out the schedule of commitments based

Photo by James Haselip: the Rwamagana Solar Plant in Rwanda in 2016

on progressive liberalization of services of EAC member states provided for by the Protocol. Annex 2 illustrates the nature of commitments on market access and national treatment in services critical to the deployment of renewable energy under each of the four modes of delivery. The tables show that among other sectors Burundi, Rwanda and Uganda have committed the maximum number of services categories relevant to delivery of renewable energy namely engineering services (CPC 8672), integrated engineering services (CPC 863) and services related to maintenance and repair of equipment (CPC 633 and 8861-8866). Kenya has included only advisory and consultative engineering services (CPC 86721) in its schedule while Tanzania has included engineering and integrated engineering services (CPC 8672 and 8673). Compared to the liberalization commitments under the WTO GATS, liberalization commitments in various engineering services made under the EAC protocol has been broader in scope as well as deeper. A notable absence in the EAC Annex V protocol schedule of commitments has been construction and related engineering services (CPC 51216) which was excluded from the priority sectors list selected for negotiation (Cattaneo, 2017). Under Mode 4, the parties have deferred to the Agreement under the Schedule of Free Movement of Workers, which does not cover all categories of professionals with different members prioritizing different categories.[3]

3 In the category of engineers for example, Kenya has included within the Schedule of Free Movement of Workers civil, mechanical and electrical engineers as well as electrical equipment fitters and installers, while Burundi has included all engineering professionals but excluded electrical equipment fitters and installers. Tanzania and Rwanda have included all engineers except electrical engineers and have excluded electrical equipment fitters and installers (although Rwanda includes engineering technicians). Uganda includes all engineers including electronics engineers but excludes electrical engineers while including electrical equipment fitters and installers. Uganda has also interestingly included the specific category of solar equipment fitters and installers. (Source: *East African Community: The East African Community Common Market Schedule of Commitments on the Progressive Liberalisation of Services: ANNEX V and East African Community: The East African Community Common Market (Free Movement of Workers) Regulations: ANNEX II.)*

Despite the ambitious nature of the Common Market Protocol, there has been some evidence of practical difficulties in implementing commitments. For instance, despite a mutual recognition agreement covering engineers being signed by Kenya, Tanzania and Uganda in 2012[4] and joined by Rwanda in 2016 (The New Times, 2018), there has been little improvement in mobility of engineers from one country to another, limiting the impact of the protocol. Complaints have also been made about local engineers being excluded from donor-driven infrastructure projects (The East African, 2018b). The movement of engineers may also have been hampered by stringent measures and fees put in place by some member states, making the free movement of both skilled and unskilled labour within the region difficult. Rwanda is reportedly the only country allowing permit free movement for East Africans to work in the country (The East African, 2018a). The need for recognition of mutual recognition agreements signed between competent professional bodies as a legal instrument for adoption within the EAC member states (as provided for under Annex VI of the Common Market Protocol)[5] has also been raised by some experts (Hook, 2014).

2.2.3. Services liberalization under other intra-African regional trade agreements

In addition to trade and market integration in the EAC, various EAC members have also joined other African regional trade agreements. Notably, Burundi, Kenya, Rwanda and Uganda are members of the Common Market for Eastern and Southern Africa (COMESA) while Tanzania is also a member of the SADC. Furthermore, all of the EAC members are also members of the COMESA-EAC-SADC tripartite free trade area (TFTA). The extent of liberalization for engineering, integrated engineering, construction-related engineering and maintenance and installation services, which also include services related to ESTs, under each of these initiatives is described further below.

The Southern African Development Community (SADC)

The SADC was established as a development coordinating conference in 1980 and transformed into a development community in 1992, aiming for economic and social development. The current member states of SADC include Angola, Botswana, Comoros, the Democratic Republic of Congo, Eswatini (Swaziland), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe. Tanzania is the only country in SADC that is also a member of the EAC (SADC). The eventual goals are for SADC to establish a customs union, common market and monetary union.

SADC has introduced a number of Protocols, including a Protocol on Trade, signed in 1996, and a separate protocol on Trade in Services, signed at the SADC Summit in 2012. The protocol replicates a number of general rules similar to GATS with stronger provisions in certain cases such as the right to regulate and introduce new regulations. Particular flexibility is granted to vulnerable members and all members have the right to use subsidies in connection with development programmes. The Services Protocol does not contain liberalization obligations, but Article 16 of the Protocol provides for progressive trade liberalization through three successive negotiating rounds, with the first round of negotiations covering six priority sectors including construction and energy services and succeeding rounds commencing three years after the conclusion of the previous round. A request-offer approach to negotiations has been adopted with the starting point being existing GATS commitments of member states and

4 Burundi and South Sudan are reportedly yet to join because they have not yet established legal and institutional frameworks that regulate and oversee engineering work. (The East African, 2018b)
5 The East African Community Common Market (Mutual Recognition of Academic and Professional Qualifications) Regulations 2011. See Kung'U, 2017.

an expectation of "some improvement" over existing GATS commitments to be offered by parties in each of the priority sectors (Cattaneo, 2017).

Also relevant to services trade is the SADC Protocol on Facilitation of Movement of Persons signed on 18 August 2005. The objective of the Protocol is to facilitate the entry of SADC nationals with lawful purpose, without visa into another member state for a maximum of 90 days, permanent and temporary residence in the territory of another state and establishing oneself and working in the territory of another state. The Protocol however has yet to come into force (SADC, 2005).

Common Market for Eastern and Southern Africa (COMESA)

The COMESA was established in December 1994 to replace the former Preferential Trade Area for Eastern and Southern Africa existing since 1981. It was established as an organization of independent sovereign states with the aim, among others, of achieving economic prosperity through regional integration. As of July 2018, there are 21 member states[6] covering a population of over 540 million and global trade in goods worth USD 235 billion. A subset of 15 members, namely Burundi, the Comoros, Djibouti, Egypt, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, the Sudan, Uganda, Zambia and Zimbabwe have established a free trade area since 2000 with the Democratic Republic of Congo joining in December 2015. A customs union was launched in 2009 although it has not yet become fully operational. COMESA has also agreed to harmonize its common external tariff with that of EAC. This is also significant to Kenya, Rwanda and Uganda who are the three EAC members who are also part of the COMESA. The harmonization of the common external tariff reflects the decision of the heads of state and government of COMESA, EAC and SADC, adopted at their Summit of 22 October 2008 in Kampala, that the three organizations should form a single free trade area and eventually a single customs union (COMESA).

Services account for about 53% of the GDP in COMESA (ITC and COMESA Business Council, 2016). The COMESA Protocol on the Free Movement of Persons, Labour, Services, Right of Establishment and Residence was adopted in June 1998. According to Article 10 of the Protocol, member states agree to remove barriers to services trade by 2004 in line with a liberalization programme to be adopted by the COMESA Council. While this target date was missed in 2009, the Council adopted the COMESA Regulations on Trade in Services to guide the negotiation process. The regulations provide, in Article 4, for the broadening and deepening of existing GATS commitments between COMESA member states using the request-offer method of negotiation and a scheduling approach similar to the GATS and SADC services negotiations. COMESA, like SADC, includes the same six priority sectors for services negotiations (communications, construction, energy-related, financial, tourism and transport services) in addition to business services. However, only four of these six sectors (namely communications, financial, tourism and transport services) have been included in the first round of negotiations (Cattaneo, 2017), given that they accounted for 90% of the COMESA regions services exports in 2012 (ITC and COMESA Business Council, 2016). Subsequently a second round of negotiations was conducted in three additional priority sectors - construction, energy and business services. Related engineering services are to follow (Cattaneo, 2017). Schedules of commitments for these second round sectors are yet to be finalized.

Also relevant to trade in services are COMESA legal instruments governing the Protocol on the Gradual Relaxation and Eventual

6 COMESA members include Burundi, the Comoros, the Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Sudan, Swaziland, Seychelles, Uganda, Zambia, Zimbabwe, Tunisia and Somalia. Tunisia and Somalia were the most recent members to accede in July 2018 (UNECA, 2016b; The East African, 2018c).

Elimination of Visa Requirements adopted in 1984 and the Protocol on Free Movement of Persons, Labour, Services, the Right of Establishment and Residence adopted in 1998. Since the adoption of the Protocol on Free Movement Protocol in June 1998, only Burundi, Kenya, Rwanda and Zambia have signed it, and Rwanda and Burundi are the only countries to ratify it. The Free Movement Protocol provides for elimination within six years of all restrictions to movement of labour and discrimination based on nationality, although public service is exempted. It also provides for free movement of services by 2004, progressive steps towards the right of establishment and eventual right of residence. The Visa Protocol removes visa requirements for COMESA citizens travelling to other COMESA countries and allows them to stay in the host country for up to 90 days for each visit, while any stays over 90 days would necessitate the required permits (COMESA, 2998; UNECA, 2014;a The Pan-African Citizens Network).

The Tripartite Free Trade Area (TFTA)

In October 2008, the heads of SADC, COMESA and the EAC resolved to set up a Tripartite Free Trade Area (TFTA) between the three regional blocs. Negotiations for a TFTA were launched in 2011 with Phase 1 to cover goods and Phase 2 to cover trade in services and other trade-related matters. However, it was agreed in 2014 that movement of business persons would be negotiated as part of Phase 1. The TFTA was launched in 2015 and negotiations on the legal texts and main Annexes were concluded in May 2017 and adopted in July 2017. So far, 22 of the 27 countries member states have signed the agreement and it will come into force once ratified by 14 member states. At the time of writing, only four countries, two of whom are also EAC members, namely Kenya, Uganda, Egypt and South Africa, have ratified the TFTA. Certain aspects related to trade in goods such as tax treatment of cars and dairy products are still pending a resolution (Cattaneo, 2017).

Article 45 of the TFTA Agreement on Phase II negotiations provides for the conclusion of the Protocol on Trade in Services within 24 months of the entry into force of the Agreement. The guidelines for services negotiations are based on Annex 12 of the 2009 TFTA Agreement which lays out a GATS-type positive list approach using a request-offer negotiations method to agree specific schedules of commitments (already adopted by the EAC, SADC and COMESA). The Annex also states that commitments would also include those made at the regional economic community level and that TFTA parties would also extend existing GATS commitments to TFTA countries that are non-WTO members. While member states are encouraged to make commitments in all twelve broad service sectors, the Annex states that commitments must be made in the seven priority sectors (six SADC priority sectors that includes construction services plus business services). Annex 12 also provides for a sanction: if members do not make a commitment in each priority sector they are denied any preferential treatment available under the regulations. While the Annex is a preliminary draft, the provisions suggest that commitments deeper than those provided for in SADC and COMESA processes are expected. According to some experts, revised TFTA services guidelines are likely to be issued only after progress on services negotiations under the individual regional economic communities and for the first Phase of the TFTA negotiations has been achieved. Further, there appears to be a shift in interest and momentum towards an ambitious and much broader continental free trade area for the countries of the African Union also known as the African Continental Free Trade Area (AfCFTA).

African Continental Free Trade Area (AfCFTA)

The decision to establish a continental free trade area was taken at the 18th Ordinary Session of the Assembly of Heads of State and Government of the African Union, in Addis Ababa, Ethiopia, in January 2012. The objective was to create a single continental market in Africa for goods and services with free movement of business persons and investments, thereby paving the way

for accelerating the establishment of the Continental Customs Union and the African Customs Union and supporting better harmonization and coordination of trade liberalization and facilitation of regimes and instruments across the various regional economic communities as well as Africa in general. It was moreover expected to resolve the challenge of multiple and overlapping memberships and expedite regional and continental integration processes while enhancing competitiveness at the industry and enterprise level through exploiting opportunities for scale production, continental market access and better reallocation of resources (African Union).

The agreement establishing the African Continental Free Trade Area (AfCFTA) was presented for signature from 17-21 March 2018 in Kigali, Rwanda along with the Kigali Declaration on the launch of the AfCFTA and the Protocol to the Treaty Establishing the African Economic Community relating to the Free Movement of Persons, Right to Residence and Right to Establishment.[7] The Agreement and related Annexes were finally signed on 16 May 2018.

The AfCFTA will bring together all 55 member states of the African Union comprising a market of over 1.2 billion people and a combined GDP of more than USD 3.4 trillion. In terms of numbers of participating countries, the AfCFTA also constitutes the world's largest free trade area since the formation of the WTO (TRALAC, 2018). The United Nations Economic Commission for Africa (UNECA) estimates the potential of AfCFTA to boost intra-African trade by 52.3% through the elimination of import duties as well as the doubling of such trade if NTBs are also removed further. This once again reinforces the importance of removing NTBs as also highlighted by the modelling exercise for EAC countries in this report. Also endorsed at the Kigali Summit was the Boosting Intra-African Trade Action Plan outlining the areas in which investments are required, such as trade information and access to finance, to ensure that all African countries at varying levels of development can benefit from AfCFTA (UNECA).

In June 2018, 49 countries had signed onto the Agreement (African Union, 2018c).[8] So far only ten countries have ratified the Agreement (African Union).[9] The AfCFTA comes into force once ratified by 22 member states (TRALAC, 2018).

The Protocol on Trade in Services reiterates the objective of Article 3 of the AfCFTA as the creation of a single liberalized market for Trade in Services. The objectives laid out in Article 3 of the Protocol include, among others, the progressive liberalization of services, the right to regulate and the promotion of sustainable development in accordance with the SDGs (African Union, 2018a). Five sectors are to be given priority for the first round of negotiations: business services (including professional services), communication, financial, tourism and transport services.[10] Negotiating guidelines, currently being developed for negotiation with member states, are expected to establish that the format used in the WTO would also be used in the AfCFTA which implies a GATS-type positive list approach towards negotiations (ICT, 2018).

The Protocol on Free Movement of Persons provides for an African Passport as well as three phases of liberalization of movement of persons, with a first phase obliging states to implement right of entry and abolition of visa requirements, a second phase implementing the right of residence and a third phase allowing the right of establishment including for firms as well as self-employed persons. It also provides for mutual recognition of

7 The complete documents can be accessed on the website of TRALAC (2018)
8 A full list of signatories and ratifying countries is available on the African Union website (African Union, 2018b).
9 Kenya, Ghana, Rwanda, Niger, Chad, Eswatini, Guinea, South Africa, Uganda and Sierra Leone
10 Their prioritization can be attributed to most of the eight recognized regional economic communities having already included these sectors in their trade in services programmes, or because they contribute to the objectives of Boosting Intra-African Trade Action Plan including the African industrialization process.

qualifications either individually by states or through bilateral, multilateral or regional arrangements and obligates parties to establish a continental qualifications framework to promote free movement of persons (African Union, 2018). However, the much lower number of signatories to the Protocol indicate the non-readiness of many African states to open up borders to free movement of people. Among the EAC members, Kenya, Rwanda and Uganda have signed the Free Movement protocol.

The inclusion of professional services in the first round of AfCFTA negotiations implies that engineering services falling under this category will likely be included in commitments by parties. However, given that other African regional economic communities, e.g. SADC, have taken several years to finalize schedules of commitments for adoption, and that negotiations on schedules under the AfCFTA have not yet commenced, it is uncertain when those schedules will be decided upon. The second phase of negotiations are set to include issues such as investment, intellectual property rights and competition policy (ITC, 2018).

2.2.4. External free trade agreements and cooperation arrangements involving EAC members

EU-EAC Economic Partnership Agreement

In addition to the intra-African regional trade agreements, the EAC has also entered into an economic partnership agreement (EPA) with the EU which was finalized on 16 October 2014. It was signed by Kenya and Rwanda on 1 September 2016 with Kenya ratifying it. Once ratified by three additional EAC members, the agreement will enter into force. Presently, the EU-EAC EPA covers only trade in goods and development cooperation and also contains a chapter on fisheries, mainly to reinforce cooperation on the sustainable use of resources. The agreement provides for further negotiations on services and trade-related rules in the future including on investment, competition, intellectual property rights, and transparency in government procurement within five years of the entry into force of the EPA (EC 2018b, 2018c). When entering into force, the agreement potentially has significant implications for trade in EST related goods and services.

2.3. EST trade in the EAC

Moving from a general overview of trade in the EAC region, the following section takes a closer look at ESTs. First, the current state of diffusion of selected ESTs for the purpose of this report in the EAC member states is outlined (Section 2.2.1) and an analysis of the trade in those technologies is provided in Section 2.2.2. Sections 2.2.3 to 2.2.5 then discuss drivers and barriers to EST trade both at the regional and the national level. Finally, Section 2.2.6 presents the results of an analytical assessment of the welfare impacts of trade barrier removal.

2.3.1. Status of diffusion of ESTs in the EAC

Of the approximately 169 million East Africans (in Uganda, Kenya, Rwanda, Burundi and Tanzania), only 36% of the entire population had access to electricity in 2016. This rate was below the average electrification of 43% for Sub-Saharan Africa as a whole. Kenya has the highest electrification rate (56%), followed by Tanzania, Rwanda, Uganda and Burundi with 33%, 29%, 27%, and 8% respectively. Rural populations across the East Africa region remain highly marginalized in terms of electrification, with electrification rates of just below 20% in Rwanda, Tanzania and Uganda, but much lower in Burundi. By contrast, electrification rates in the urban areas of these countries are all at least 50% and in Rwanda and Kenya close to 80 % (World Bank, 2018b)

The share of the population using solid fuels for cooking is higher than 95% in all the EAC partner states except for Kenya, where the figure stands at 84% (REN21, 2016). ESTs are increasingly being embraced in the region to provide clean alternative sources of energy, although with varying rates of adoption. In the following paragraphs, the levels of diffusion

Table 4. Electrification rates at national level and in urban and rural areas of East African countries

Country	National	Urban	Rural
Burundi	8%	50%	2%
Kenya	56%	78%	39%
Rwanda	29%	80%	18%
Tanzania	33%	65%	17%
Uganda	27%	58%	18%
Sub-Saharan Africa	43%	76%	25%

Source: World Bank (2018b).

of solar PV cells and modules (including off-grid and grid-connected applications), SWHs, wind turbines, biomass boilers and hydropower turbines in the EAC region are presented.

Solar PV power

East Africa receives some of the highest levels of horizontal solar irradiance in the world, with some areas of East Africa having irradiance values of over 2,400 kilowatt-hours (kWh) per square meter (Armstrong and Nicoll, 2016; REN21, 2016). However, deployment of solar PV power varies widely in the region. It is estimated that, as of 2015, the region had installed solar PV panels rated at 9.15 megawatts of peak power output (MWp) (REN21, 2016).

While Burundi considers solar energy to be a solution for the energy crisis afflicting the country, especially in rural areas, where electrification is just 2%, solar technologies have yet to be widely adopted in the country. A 7.5 MWp, grid-connected solar PV plant is under construction around Gitega, in Central Burundi. The project is being developed by Gigawatt Global, which signed a 25-year power purchase agreement with the government of Burundi. This plant alone is expected to boost the peak electricity-generating capacity of the national grid by 15% (African Review, 2017).

Kenya, on the other hand, has one of the most active commercial solar PV markets in the region, with over 470,000 households using solar PV panels as of 2015 (Tigabu, 2016). While it is difficult to establish accurately the amount of installed solar PV capacity in the country (including solar home systems and mini-grids), it has been estimated that about 28 MWp of off-grid solar power had been installed by 2017 (IRENA, 2018).

In Rwanda, the solar energy potential is also significant for both electricity and water-heating purposes. Rwanda leads the region in grid-connected solar energy, having installed an 8.5 MWp plant in Agahozo, and with the 0.2 MWp Jali plant and the 10 MWp Kayonza project already in the pipeline (REN21, 2016). With regard to solar home systems, the Rwandan government aims to increase the share of electrified households to 22% by 2018 through the installation of off-grid solar home systems.

Tanzania is also facilitating the distribution of solar products through the Sustainable Solar Market Package Programme, which aims to have installed 120 MWp of solar-powered electricity generation by the end of 2018. Uganda is pursuing solar PV-based mini-and micro-grids to provide 26-30 MWp of off-grid energy by 2030, targeting villages with 500 to 600 households (EAC, 2014). According to IRENA (2018), an estimated 26 MWp of off-grid solar power had been installed by 2017. These policies notwithstanding, all the EAC countries are still far from reaching their full solar power potential.

Solar water heaters

Compared with other ESTs, such as solar PV cells and modules, SWHs have not been adopted extensively within the East African region. Kenya has the largest share of SWHs

in the region, accounting for approximately 80% of the region's total installed capacity (REN21, 2016). Some 140,000 SWHs were in use in the country as of 2015, with the number projected to reach 800,000 by 2020 (REN21, 2016). In Rwanda, approximately 12,000 SWHs were installed between 2012 and 2015, triggered by funding support from the World Bank and the Nordic Climate Fund (REN21, 2016). Over 30,000 SWHs have already been installed in rural parts of Uganda (RECP, 2015a). While information on the rates of diffusion of SWHs in Burundi and Tanzania is scarce, they are reckoned to be much lower than in the other EAC countries (REN21, 2016).

Wind turbines

Despite the vast potential of wind power across the region, Kenya is the only country with grid-connected wind power. Some 25.5 MWp has been connected to the grid, with the figure poised to increase as projects in the pipeline, including 310 MWp in Lake Turkana and 400 MWp in Meru, go online (REN21, 2016). The country plans to install 2000 MW of wind power capacity by 2030 (EAC, 2014). In Rwanda the wind energy potential is limited, and information on its installed wind capacity and country targets is not readily available (EAC, 2014). However, it is believed that the limited wind energy available could be sufficient to power mechanical windmills (for pumping water) and small-scale wind turbines, especially in areas around Kigali, Butare and Kamembe (RECP, 2015b).

Tanzania's promising wind energy potential has yet to be exploited, especially in the Kititimo and Makamako regions, where wind speeds on average are around eight and nine metres per second respectively (Danish Energy Management and Esbensen, 2017). Two 50-100 MW sites have already been identified for development in the Kitimo and Makabako areas (EAC, 2014). The country has set itself a target of 200 MW of installed wind power by 2025. In Uganda, average wind speeds are moderate, sufficient only for small-scale electricity generation and water pumping, mainly in the Karamoja region (Danish Energy Management and Esbensen, 2017). Data on installed wind capacity and country targets for Burundi and Uganda are not available (EAC, 2014).

Biomass boilers

The EAC countries have a total installed generating capacity of 74 MW based on the utilization of biomass resources, which includes direct combustion for power and heat generation (including co-generation) using biomass boilers (EAC, 2014). While there are vast biomass resources in the EAC region, they are not necessarily readily available for power generation, as in the case of the limited surplus of biomass resources derived from forests (IRENA, 2015). There are a number of examples of agro-industries in the region switching from oil to biomass to cover their process heat requirements, as with the utilization of bagasse in sugar mills, wood waste from sawmills, cotton and maize stalks and rice husks. In Uganda, for example, the Kakira Sugar Works company generates 34 MW, while in Kenya, the Mumias Sugar Company generates 26 MW. Bagasse is used for electricity generation for the processing plants, but in Kenya another 16 MW is fed back into the national grid. In Burundi and Tanzania, the sugar companies SOSUMO, TPC Moshi and Kilombero Sugar Power have installed four MW, nine MW and one MW respectively. There are also a number of wood-to-electricity and waste-to-energy projects, for example, Rwanda's cement factory uses peat to partially replace oil for process heating (EAC, 2014).

Hydropower

The majority of the EAC countries have a large potential for small-scale hydropower plants with capacities of up to 10 MW. In Burundi, for example, over 75% of the energy supply comes from hydropower, highlighting the fact that it is the predominant source of electricity (Danish Energy Management and Esbensen, 2017). The country has a hydropower potential of 1,700 MW, of which 20% is viewed as commercially viable. There is a large potential for small-scale hydropower given Burundi's topography and abundant precipitation (UNEP, 2017a). Kenya

has the potential to generate 3,000 MW from small-scale hydropower : for example, the catchment area of the Mau forest has a potential generating capacity of 535 MW. More recently, however, hydropower generation has been unstable due to prolonged periods of drought that have merely highlighted vulnerabilities (Danish Energy Management and Esbensen, 2017; UNEP, 2017b). Rwanda also has the potential for hydropower. Micro-hydropower in particular is seen as a source of electricity, with the country's two major rivers having 333 potential sites for micro-hydropower installations (Danish Energy Management and Esbensen, 2017). Mini- and micro-hydro currently provide 4.5 MW of generating capacity (UNEP, 2017c). Tanzania's hydropower potential is estimated at 4.7 GW, of which 315 MW is potentially in small-scale hydropower[11] (UNEP, 2017d; Danish Energy Management and Esbensen, 2017). Hydropower in Uganda provides large potential at around 2,000 MW along the Nile River (UNEP, 2017e). Several hydropower plants have already been installed (Nalubaale, Kiira and Bujagali), and others are under construction. The government has also identified eleven potential sites for micro-hydropower, with still significant untapped potential remaining (Danish Energy management and Esbensen, 2017).

2.3.2. Regional trade in the selected ESTs

Information on trade in the five selected ESTs in the EAC region has been obtained from the UN Comtrade (2018) and World Integrated Trade Solution (WITS, 2018) databases by using the Harmonised System (HS) six-digit level code of key technology components related to specific ESTs, as presented in Table 5. It should be noted that data are not available for Kenya for the 2011-2012 and 2014-2016 periods, nor for Burundi prior to 2006, since neither of the two countries have reported data on trade flows to UN Comtrade for these years. This is one of the limitations that can arise when using UN Comtrade data. Not all countries report their trade data on an annual basis, in particular developing countries, and there are thus often gaps in the data (Baltzer and Jensen, 2015). In Table 6, the import duties for tower and lattice masts are listed. The data reveal that, for the majority of the selected ESTs, the import duties are zero, except for tower and lattice masts (HS 730820), thus this is the only category represented in Table 6. Importantly, in accordance with the research design adopted, which draws on trade data in specific product categories obtained from the Comtrade database, the following focuses exclusively on trade in tangible goods and products. This approach has been used in similar studies conducted in this field of research, such as the report published by UN Environment in 2014 on South-South trade in renewable energy (UNEP, 2014).

However, important caveats need to be borne in mind when interpreting the trade statistics from UN Comtrade under the HS codes in the table above. In some cases, HS subheadings are too broad to cover mainly a renewable energy technology, and trade in other products may affect the analysis. Thus, the numbers presented in the figures in the following section should be viewed as the upper limits of the trade flows (UNEP, 2014). As the HS 854140 sub-division is based on the 2012 classification, before which it also included trade in light-emitting diodes (LED), up to half of the value of the trade in this category before this date could be in LEDs. In addition, an unknown share of the value of the trade under the HS 730820 sub-division could be in goods other than wind-turbine towers. This is due to the 2012 classification and prior versions of the HS, which also cover trade in a broad range of towers, such as steel lattice towers for power transmission, communication towers and other aerial masts. For biomass boilers within sub-divisions HS 840410 and HS 840290, the categories include trade in boilers fuelled by any energy source. Hence the international trade data is likely to exaggerate the actual

11 Classifications of small-scale hydropower in small-, mini-, micro- and pico-hydropower differ between countries. Kenya for example classifies capacities between 1 – 10 MW as small, 0.1 – 1 kW as micro and below 100 kW as pico (UNIDO & ICSHP, 2014).

Table 5. HS six-digit sub-headings of the five ESTs analysed

HS6 code	Product description
Biomass boilers	
840410	Boilers; auxiliary plant for use with boilers of heading no. 8402 or 8403 (e.g. economisers, super-heaters, soot removers, gas recoverers)
840290	Boilers; parts of steam or other vapour-generating boilers
Solar water heaters	
841919	Heaters; instantaneous or storage water heaters, non-electric, other than instantaneous gas water heaters
Solar photovoltaic cells and modules	
854140	Electrical apparatus; photosensitive, including photovoltaic cells, whether or not assembled in modules or made up into panels; light-emitting diodes (LED)
Wind turbines	
730820	Iron or steel; structures and parts thereof, towers and lattice masts
850231	Electric generating sets; wind-powered, (excluding those with spark-ignition or compression-ignition internal combustion piston engines)
Hydropower turbines (small-scale)	
841012	Turbines; hydraulic turbines and water wheels, of a power exceeding 1000kW but not exceeding 10000kW
841011	Turbines; hydraulic turbines and water wheels, of a power not exceeding 1000kW

Source: UN Comtrade (2018).

trade in PV cells and modules, biomass boilers and wind-turbine support towers (Vossenaar, 2014). Despite these limitations, as global trade statistics is available only under the HS subheadings, these only serve as proxies for trade in the given products (UNEP, 2014).

In the following figures, global trade refers to trade data reported by a given country (within the EAC) with any other country in the world, while regional trade refers to intra-EAC trade reported by each country. What is noticeable is that all EAC countries import up to 10 times more than they export in the selected ESTs.

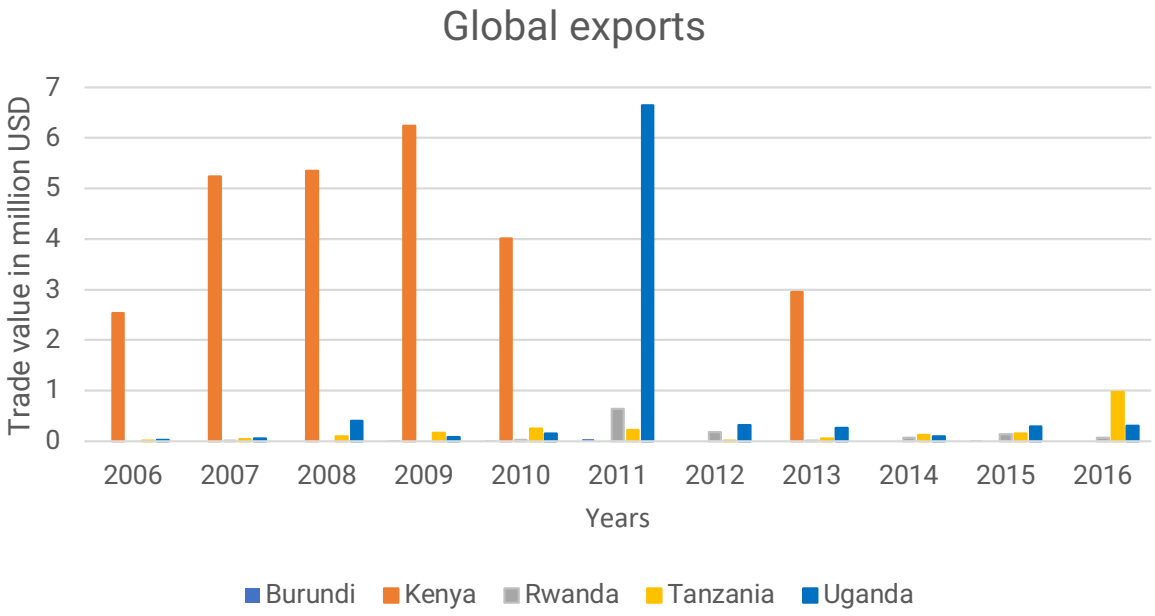
Table 6: Average applied most favoured nation (MFN) tariff ad-valorem duties, 2013-2016, in %, for tower and lattice masts (HS 730820)

	Burundi	Kenya	Rwanda	Tanzania	Uganda
2013	0	10	0	0	0
2014	10	10	10	10	10
2015	10	N/A	10	10	10
2016	25	25	10	25	25
Country Average	9	13	6	9	9

Source: Annex 6

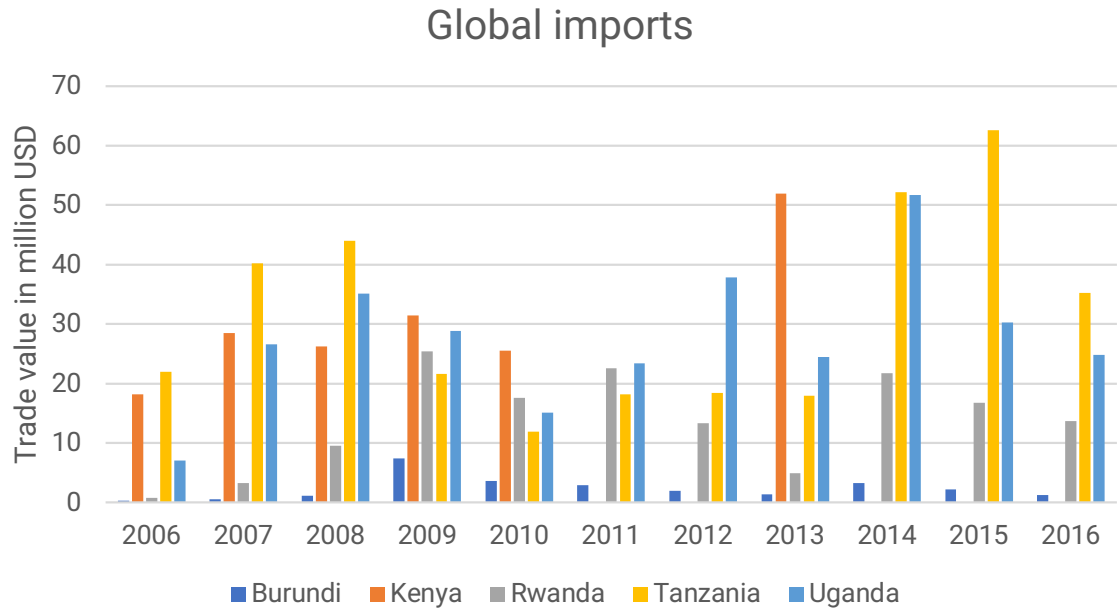
As shown in Figure 1, Kenya was the largest net exporter in 2006-2016. Exports from Uganda, Rwanda, Burundi and Tanzania were limited, except for an extraordinary export from Uganda in 2011. While imports in the selected ESTs fluctuate over time, Tanzania and Uganda were the largest net importers of ESTs in 2006-2016, accounting for 34% and 30% of total imports during the period respectively (bearing in mind that data for Kenya is lacking for the periods 2011-2012 and 2014-2016).

Figure 1. Aggregated export data of all selected ESTs globally across EAC countries, 2006-2016



Source: Calculations based on WITS (2018).

Figure 2. Aggregated import data of all selected ESTs across EAC countries, 2006-2016



Source: Calculations based on WITS (2018).

Table 7. ESTs share of intra-regional trade in ESTs

Year	Country				
	Burundi	Kenya	Rwanda	Tanzania	Uganda
Share of intra-regional imports (%)					
2006	11%	0%	7%	0%	3%
2010	30%	0%	2%	4%	2%
2013	2%	0%	8%	7%	5%
2016	9%		3%	2%	3%
Share of intra-regional exports (%)					
2006	0%	31%	0%	4%	79%
2010	100%	65%	0%	87%	4%
2013	0%	81%	21%	68%	85%
2016	0%		88%	1%	62%

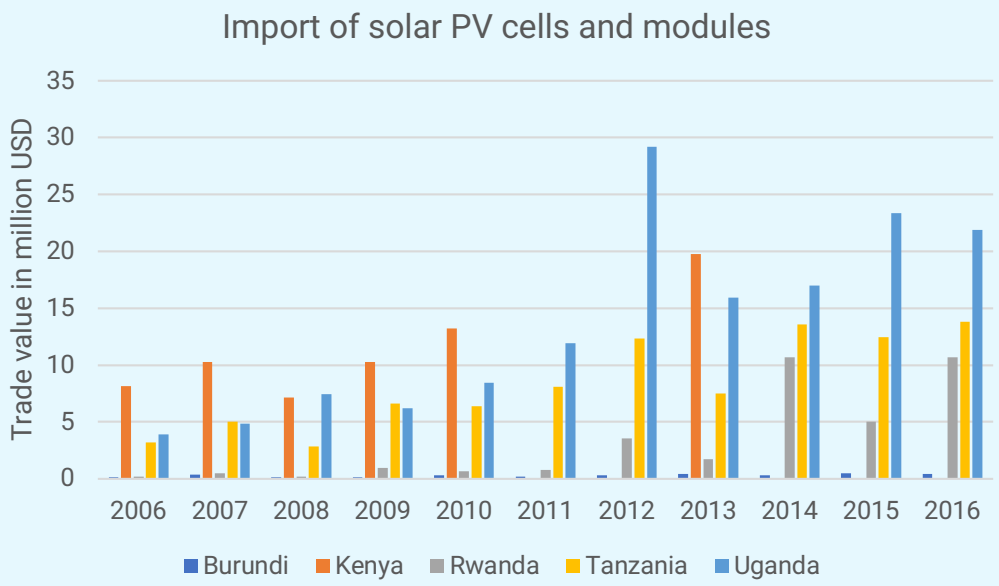
Source: Calculations based on WITS (2018).

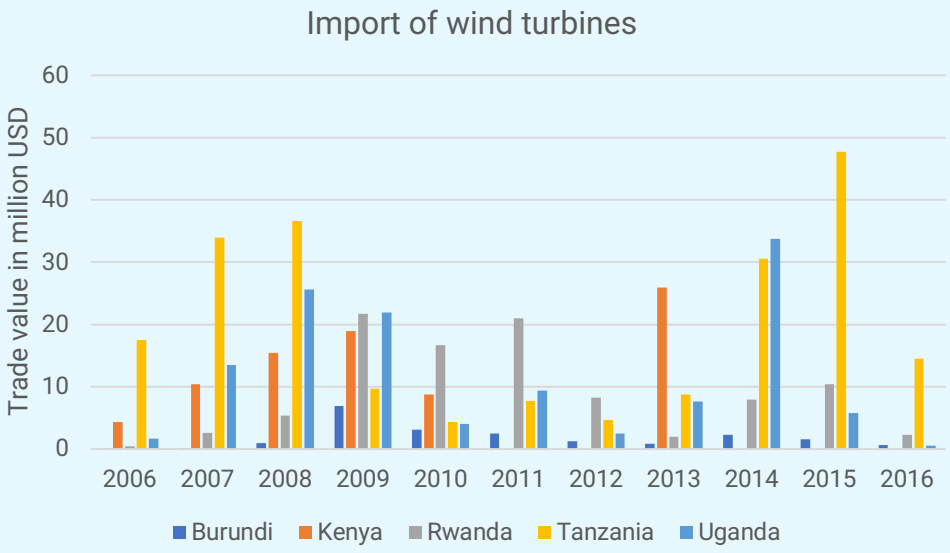
Table 7 shows the share of EAC countries' trade in the selected ESTs with other EAC countries compared to their global trade, both imports and exports. As shown, Kenya's imports of the selected ESTs that originated from other EAC countries have never been above 0.04% of its total imports of the same ESTs in recent years. Hence, imports of the selected ESTs in Kenya originate from countries outside of the EAC region. However, Kenya's exports of the selected ESTs is increasingly directed towards other EAC countries, as shown in the increase in the share of regional exports compared with exports for the global market (from 31% in 2006 to 81% in 2013). Overall, as also illustrated in Figure 1, the general pattern is that intra-regionally the EAC countries (other than Kenya) export very little to each other. The high values for some EAC countries in terms of exports – for example Rwanda in 2016 and Uganda in 2013 – should be considered in light of the very low total value of trade. The low level of intra-regional trade in the selected ESTs could be related to the low level of manufacturing and production of these products within the region and the fact that a large share of the trade in the EAC region is in agricultural products as discussed above.

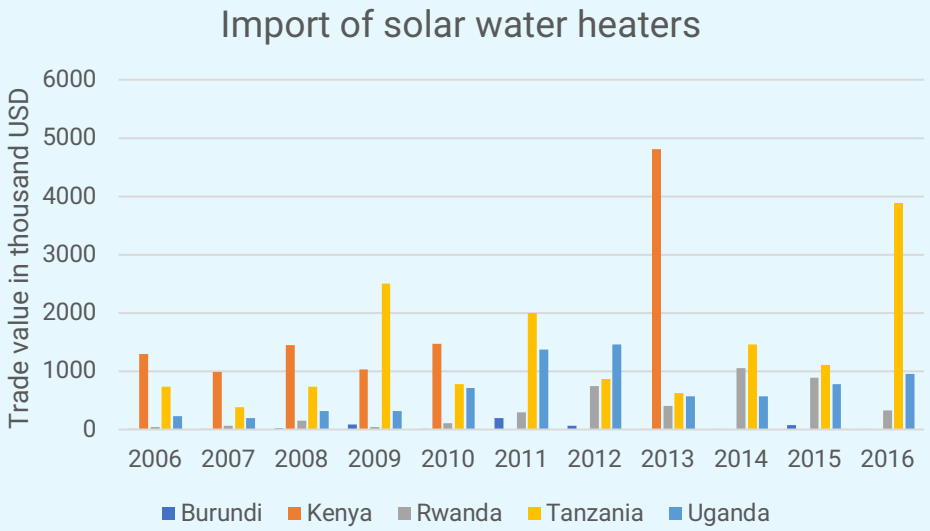
Figure 3 shows the global value of imports of the selected ESTs to the EAC. The highest net value of trade within the HS subdivision, which includes solar PV cells and modules, and wind turbines and masts, is measured in millions of USD, in contrast to thousands of USD for the other ESTs. In spite of a lack of HS trade data for Kenya from a number of years, imports of PV cells and modules show a generally increasing trend, with Uganda, Tanzania and Kenya as the main importing countries. Similarly, the import of wind turbines and masts has increased recently, with Tanzania, Uganda and Kenya as the main importing countries. Noteworthy, the increasing trend for solar PV cells and modules is even higher when counted in MW PV capacity, as the price per MW in 2017 was reduced to 20 % of prices in 2010. The same can be noted with respect to the import of wind turbines, as their price fell on average by 38% from 2009 to 2017, and performance improvements have improved yields (IRENA, 2017).

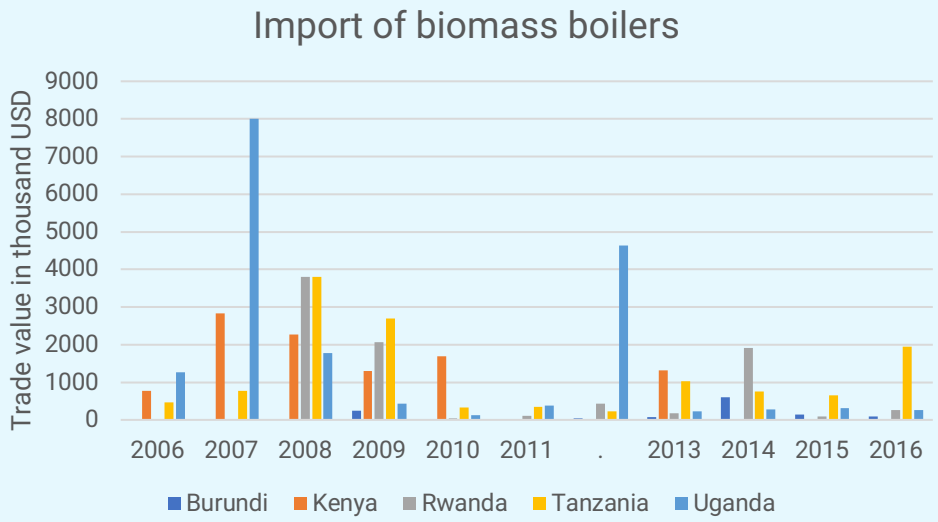
Imports of biomass boilers, SWHs and small-scale hydroelectric turbines into the EAC region show a more diffuse pattern over time across the EAC countries. The observed hike in import values in specific years could indicate that imports of these ESTs are closely related to specific projects underway at specific times in the individual countries.

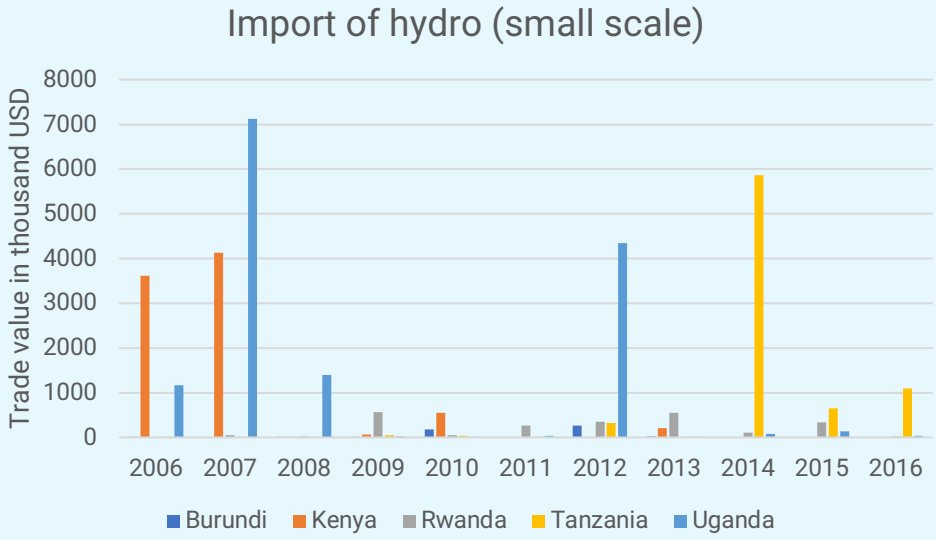
Figure 3. Imports of five selected ESTs to the EAC from the rest of the world, 2006-2016











Source: Calculations based on WITS (2018). Note: trade data for the HS6 codes for biomass boilers (840410 and 840290), for wind (850231 and 730820) and for hydropower (841012 and 841011) have been combined.

Table 8 lists the top five exporting countries to the EAC in the selected ESTs. Over the period between 2006 and 2016, China was the largest net exporter of PV cells and modules and SWHs to the region, while India was the largest net exporter of wind turbines and masts, as well as of biomass boilers. Table 8 demonstrates the significance of the EAC regional market for Chinese and Indian suppliers of solar PV and wind turbines and masts compared to the other ESTs. The United Kingdom was the largest net exporter of small-scale hydroelectric turbines.

Table 8. Top five net-exporting countries to the EAC in the selected ESTs, 2006-2016

Wind turbines and tower and lattice masts

Rank	Country	Trade value (million USD)
1	India	162
2	South Africa	79
3	China	70
4	Turkey	39
5	Israel	25

Solar PV cells and modules

Rank	Country	Trade value (million USD)
1	China	191
2	India	41
3	Germany	19
4	United States of America	13
5	Kenya	9

Biomass boilers

Rank	Country	Trade value (million USD)
1	India	20
2	United Kingdom	10
3	South Africa	4
4	Germany	4
5	Finland	3

Solar water heaters

Rank	Country	Trade value (million USD)
1	China	12
2	Israel	4
3	India	3
4	Turkey	3
5	Australia	2

Hydro (small-scale)

Rank	Country	Trade value (million USD)
1	United Kingdom	10
2	United Arab Emirates	9
3	Japan	8
4	India	7
5	Austria	3

Source: Calculations based on data from WITS (2018).

2.3.3. Regional initiatives that enable trade in ESTs

Since its formation in 2000, the EAC has made several efforts with positive implications for the adoption of, and trade in, ESTs within its borders. The region has developed several policies, strategies and initiatives to (i) promote the adoption of the five ESTs considered in this analysis, and (ii) mobilize private-sector investment in the production and trade of these ESTs.

Several protocols supportive of the trade in solar, wind, biomass and hydropower technologies have been developed. For instance, the EAC Customs Union and Common Market protocols, which came into force in 2005 and 2010 respectively, are key regional measures of integration with positive implications for trade in general (Shinyekwa, 2015) and potentially with positive implications for the trade in ESTs in particular. These policies generally seek to allow free trade among EAC member states and to subject imports from countries outside the EAC zone to the same tariffs when they are sold to any EAC partner states (EAC, 2018b). Article 13 of the protocol on the establishment of the EAC Customs Union commits EAC partner states to remove all existing NTBs to trade and not to impose any new ones. It mandates the partner states to formulate mechanisms for identifying and monitoring the removal of NTBs. The protocol in Article 23 seeks to catalyse inter-regional trade by exempting the partner states from paying export and import duties on re-exports (EAC, 2004). This means that, if any member country imports ESTs, its export to any other member state would be duty-exempt.

However, there are indications that the ideals underlying these protocols are far from being realized. A total of 78 NTBs were reported between July 2013 and December 2015 (EAC, 2016b). For example, whereas Kenya, Rwanda and Uganda have abolished work permit charges for East Africans, Tanzania still charges USD 500 for a residence permits for those East Africans who wish to stay and work in the country. Additionally, non-Tanzanian residents intending to establish businesses in Tanzania are required to pay USD 1,500 in permit fees. Burundi, on the other hand, charges between USD 60 and USD 84 for work permits. These permit fees are a barrier to increased flows of people, as well as to trade in goods and services, including ESTs, in the region (The East African, 2016a; The East African, 2016b), since they increase the overall costs of doing business.

As with the EAC Customs Union and Common Markets protocols, a protocol on environmental and natural resource management, developed in 2006 to guide cooperation in the sustainable utilization and management of natural resources in the region, has yet to be fully implemented by all EAC member states. With respect to energy, Article 19(a) of the protocol commits partner states to "develop common strategies for ensuring the development and efficient use of renewable energy sources, promotion of alternative sources of energy, particularly solar energy, wind energy and geothermal energy" (EAC, 2006b). Article 19(b) of the protocol calls on partner states to "disseminate renewable energy technologies, among others solar, wind, mini-hydro and geothermal, in order to increase the access to electric energy among the population".

The EAC, through its Vision 2050 development blueprint, has prioritized energy as one of the key economic pillars spurring the region's desire to transform itself into an upper-middle income region by 2050. The region seeks to exploit its energy resources in a manner that meets the needs of the region, while also protecting and conserving the environment (EAC, 2016c). This long-term development blueprint, which was launched at the 17th Ordinary East African Community Heads of State Summit in 2016 (TMEA, 2016), set an ambitious target of ensuring 100% access to modern energy services by 2050, with more than 50% of energy being supplied from renewable and clean energy sources such as solar and wind power. The document calls on member states to ensure enabling business environments to attract private investments and joint ventures in the exploitation of these clean sources of energy

(i.e. ESTs) and thus ensure the availability of sufficient, reliable and increased access to electricity (EAC, 2016c).

The region has given much emphasis to fostering a development that is private-sector driven. The adoption of an EAC Private Sector Development Strategy in 2006 sought to spur private-sector participation in the region's development through strategies such as reducing the costs of doing business, eliminating regional barriers to trade and harmonizing policies, laws and regulations so that investors can access similar incentives and benefits in the region. Not least, the strategy seeks to promote private-sector investment in electricity generation through the exploitation of solar and wind among other sources of energy (EAC, 2006c).

In 2009, the EAC adopted a Regional Strategy on Scaling up Access to Modern Energy Services. The strategy targets urban and peri-urban areas and all public institutions such as schools and hospitals (EAC, 2009; REN21, 2016). Specifically, the EAC calls upon member states to install solar PV and improved biomass-burning technologies in all public buildings, including schools, hospitals and prisons. The region also urges its member states to develop policies and strategies to provide funding opportunities to private-sector investments to encourage the adoption and use of small wind turbines and solar panels to power street lighting. Since there is no direct government involvement in the import and sale of wind and solar products, this demand is largely met by the private sector. As such, the strategy encourages investors in ESTs to bid and supply the energy resources just mentioned, which are largely ESTs in nature, to public utilities.

In 2010, the East African Community secretariat published the EAC Climate Change Policy, following a directive by the heads of state of the EAC partner states at their 11th summit meeting in Arusha in 2009. The policy, which sought to address the adverse impacts of climate change in the region, prioritized the diversification of energy sources to include renewable energy technologies. This, it argued, would mitigate climate change within the region, as well as cushion it from the uncertainties and shocks that affect the regional energy sector due to an overreliance and emphasis on biomass and hydropower as the main sources of energy (EAC, 2010). In effect, this policy promotes the deployment of wind, solar and improved biomass technologies by encouraging member states, and encourages the use of economic and financial measures, such as zero-rated taxes and other financial measures, to support such deployment.

In 2011, the EAC developed the EAC Climate Change Master Plan, a long-term plan for adaptation to, and mitigation of, climate change in the region, in line with the United Nations Framework Convention on Climate Change (UNFCCC) and its 1997 Kyoto Protocol. The master plan identifies the diversification of energy sources in the region (such as solar, wind and geothermal) as a means to contribute to the realization of Article 2 of the UNFCCC. The plan asserts that the region's energy sector remains vulnerable to climate change due to its overreliance on hydropower, thus exposing it to the shocks resulting from reduced water flows to hydroelectric dams. The EAC also observes that overreliance on biomass in the region contributes to climate change through emissions of greenhouse gases (EAC, 2011). The masterplan advances the zero-rating of taxes and other financial measures on some forms of renewable energy as a means of ensuring the increased adoption of clean-energy technologies in the region. As such, the masterplan presents an enabling framework for private-sector investment in ESTs that improve climate resilience and contribute to mitigation and adaptation to climate change.

The region has also ratified various multilateral environmental agreements that are supportive of ESTs. In 2002, for example, the EAC Heads of States Summit decided that the EAC should negotiate multilateral issues and agreements as a bloc (EAC, 2018d). To this end, a draft framework for joint participation in, and implementation of, multilateral agreements was finalized to

guide the EAC states in the implementation of various multilateral agreements to which the partner states are party (EAC, 2018e). Specifically, the EAC Post-Rio+20 Plan of Action was developed and approved by the EAC Council of Ministers, with the goal of implementing the outcome of the Rio+20 Summit on sustainable development, which advocated the development, transfer and dissemination of clean ESTs, especially to developing countries.

Finally, the establishment of the East African Centre for Renewable Energy and Energy Efficiency (EACREEE) is also seen as a positive development for trade in ESTs within the region. The Centre, which is based at Makerere University in Uganda, is charged with steering the adoption of clean energy sources in the region, working towards the elimination of barriers that hinder the adoption of ESTs, developing appropriate polices to promote ESTs, and offering testing and certification services for ESTs, among other roles (EACREEE, 2017; EAC, 2016c). Through this work, the EACREEE is helping to address the technical specifications and quality standards that have impeded the adoption and deployment of various ESTs.

2.3.4. National policies supporting the adoption of ESTs

Beyond the above initiatives, which operate at the regional level, various policies, projects and programs have been implemented nationally to promote the trade in and diffusion of ESTs. The following paragraphs provide country-specific summaries of the most relevant measures.

Burundi

In Burundi, the law on the Liberalization and Regulation of the Public Services of Water and Electricity of 2000 opened the door – to some extent – for private investors to participate in the production of electricity (UNDP, 2012; EAC, 2014). In 2011, the Burundian Agency for Rural Electrification (ABER) was established to develop and implement rural electrification projects and programs, notably through ESTs (UNDP, 2012; EAC, 2014). This created opportunities for trading in ESTs in Burundi (UNDP, 2012).

Burundi's energy policy and energy strategy, which was developed in 2011, has also given prominence to ESTs in reversing the low electrification rate in the country. The policy has prioritized use of solar energy in the electrification of social infrastructure (such as schools and hospitals) in remote off-grid areas. The policy has also set a medium- to long-term plan for connecting solar stations to the electrical grid (EUEI, 2011). A few programs have also been launched in Burundi that offers opportunities for trading in ESTs. These include the PV street-lighting program in Bujumbura and the promotion of PV electrification of social centers in rural areas (EAC, 2014).

Kenya

Kenya has developed several policies, programs and projects that can be perceived as driving the adoption of ESTs. In 2004, through its Sessional Paper on Energy No. 4, the government of Kenya recognized the need to promote solar energy as an alternative to fossil fuels. This policy document called for expanded rural electrification programmes to provide electricity to many Kenyans living in areas that are not connected to the national grid. In order to catalyse the adoption of renewables, the policy proposed various incentives, such as providing tax breaks and allowing the duty-free importation of renewable energy hardware (Kenya, 2004).

The Energy Act of 2006 was enacted to provide coordination and coherence in the energy sector. The Act promotes the development and use of solar energy, among other renewable sources of energy. It mandates the cabinet secretary in charge of energy to provide an enabling framework for the production and distribution of solar energy. The Act also created the Rural Electrification Program, aiming at increasing off-grid renewable energy generation for households and income-generating activities. The Act also established the Energy Regulatory Commission (ERC) to, among other objectives, draw up the necessary

regulations to facilitate access to efficient and sustainable energy in the country (Kenya, 2006).

Further, Kenya has developed its Action Agenda on Sustainable Energy for All (SE4All) for 2015-2030. The SE4All Initiative is a UN program launched in 2011 by the UN Secretary General, the aim of which is to promote universal access to energy, improve energy efficiency and double the share of renewable sources of energy. Kenya's Action Agenda outlines the country's path towards universal access to modern energy, increased efficiency and 80% renewable energy by 2030 (Kenya, 2016).

Kenya has also adopted a National Climate Change Response Strategy (NCCRS) and a National Climate Change Action Plan. The NCCRS outlines adaptation and mitigation strategies in key sectors of the economy, including the energy sector. The Action Plan (NCCAP 2013-2017) makes the case for a low-carbon development pathway that would reduce Kenya's emissions by up to 70% by 2030 through, for instance, the adoption of clean alternative sources of energy (Kenya, 2013a).

This commitment is also reflected in the Draft National Energy Policy, the mission of which is "to facilitate provision of clean, sustainable, affordable, competitive, reliable and secure energy services at least cost while protecting the environment" (Kenya, 2014). Besides the important role of technology, this policy draft also acknowledges the "need to enhance regional, gender and environmental considerations in energy planning and development". As the main challenges, the policy identifies the gender imbalance in energy and petroleum institutions, the inadequate implementation of gender inclusive or mainstreamed policy, the inadequate public awareness regarding adverse impacts of fuelwood and kerosene on women and children's health and women's limited ability to access and afford modern and clean energy The policy therefore calls for the implementation of the principle that that no more than two-thirds of the members of representative bodies in each county government shall be of the same gender, as provided for in the Constitution, and the mainstreaming of gender into energy sector policies as well as educational measures, especially on the efficient use of bio-energy.
Kenya has also enacted a feed-in-tariff (FIT) policy to promote investment in renewable energy. The FIT Policy provides for power supplied to be paid for at a rate not exceeding 20 US cents per kilowatt-hour (kWh) for renewable energy projects of up to ten MW of installed peak capacity, and a rate not exceeding 12 US cents per kWh for projects above 10 MW of installed capacity. The FIT policy offers a twenty-year project lifespan (EAC, 2014).

Various tax incentives supportive of renewable energy were also put in force in Kenya. For instance, Kenya has exempted solar PV cells and modules from taxes. Other incentives geared towards promoting ESTs include duty waivers on renewable energy plants and equipment, government letters of comfort to independent power producers (IPPs), resource assessments and feasibility studies for investors and a waiver on licensing requirements for small power plants of less than 1 MW (EAC, 2014).

Rwanda

The Rwandan Energy Policy of 2015 aims to diversify power generation resources by exploiting indigenous resources such as solar energy. To achieve its objectives, the policy seeks to create an enabling environment for increased private-sector participation in energy supply. It seeks to do so by (i) streamlining investment promotion processes for Independent Power Producers (IPPs), and (ii) streamlining the regulatory framework for developing off-grid solutions to attract more local private investors (Rwanda, 2015).

The Rwandan Rural Electrification Strategy of 2016 aims to facilitate private-sector investment in off-grid and mini-grid solutions for rural electrification to enable low-income households to gain access to modern energy services. It commits the government to playing a key role in establishing favourable

environments for such investments. In order to promote private investments in the production of electricity, the Rwanda Utilities Regulatory Agency is charged with issuing various licenses, including concession to IPPs and to off-grid private suppliers (Rwanda, 2016).

The Rwandan government also offers a variety of non-fiscal and fiscal incentives (Tax exemptions on some renewable energy equipment, as well as investment allowances) to promote private-sector investment in the energy sector (EAC, 2014). Rwanda developed a Renewable Energy Feed-in-Tariff (REFIT) in February 2012, which obliged the national utility to purchase the electricity generated by private micro and mini-hydro installations at a certain tariff. REFITs for other sources of energy, such as solar energy, are negotiated on an individual project basis (EAC, 2014).

Tanzania

Tanzania's National Energy Policy of 2015 provides an overall policy framework for the energy sector in the country. The policy seeks to enhance the development and utilization of renewable energy, while also reducing the country's dependence on fossil fuels (Tanzania, 2015). The coming into force of the 2008 Electricity Act opened up a space for IPPs, thus effectively ending the long-term monopoly of the government as the sole producer of electricity in the country. Consequently, IPPs are now slowly engaging in power production, including from solar PV plants (Tanzania, 2008).

The Rural Energy Act of 2005 promotes improved access to modern energy in rural areas. This law established a Rural Energy Fund, which provides grants to developers of rural energy projects. This represents a major financial incentive for investment in solar energy systems and technologies. The Act also established the Rural Energy Board (REB) and Rural Energy Agency (REA), which are responsible for promoting improved access to modern energy services in rural areas (EAC, 2014).

The Electricity Supply Industry Reform Strategy and Roadmap (ESIRSR) (2014-2025) set out reforms in the electricity sub-sector, aligning it with Tanzania's blueprint, Vision 2025. The ESIRSR identifies renewable energies, such as solar and wind power, and hydroelectricity, as key to the country's transition to a low-carbon economy (EAC, 2014). The Public-Private Partnerships Act of 2010 provides a legal framework within which the government of Tanzania can partner with private entities in a range of projects, including energy-related projects. Tanzania also exempts solar PV cells and modules from tax to reduce their costs for end-users (Tanzania, 2010).

Uganda

The Energy Policy of 2002 is the main policy document guiding the energy sector in Uganda. The key objective and theme highlighted within the Energy Policy is the need to eliminate energy poverty in the country by deploying untapped sources of energy and increasing investment within the sector. To achieve this, the Policy introduces the framework required to liberalize the industry and create favourable, transparent and equitable investment conditions. Furthermore, the Policy identifies key sub-sectors in which the government seeks to invest, including petroleum, nuclear power, hydroelectricity, geothermal, solar and biomass energy (EAC, 2014).

The Renewable Energy Policy of 2007 is the current policy framework for renewable energy in Uganda. It seeks to "increase the use of modern renewable energy from the current 4 per cent to 61 per cent of the total energy consumption by the year 2017" (EAC, 2014). The policy seeks to diversify the country's energy sources while creating a more robust legal and institutional framework to promote investments in renewables. To attract investment in the sector, the government has committed itself to pursuing public-private partnerships, provide subsidies and allow preferential tax treatment to promote large-scale investment. The government has committed

itself to develop financing schemes to enable rural households to access finance for the purchase of renewable-energy technologies, such as solar home systems. Another development brought about by the policy is the publication of standardized power-purchase agreements and a FIT aimed at reducing transaction costs and ensuring the predictability of investments in renewable-energy projects. The FIT, which is reviewed periodically, will reflect cost changes over time (EAC, 2014).

Uganda has put in place a Rural Electrification Strategy and Plan (RESP), a ten-year strategy to increase rural electrification in the country (Uganda, 2013). The RESP seeks to guide the government in increasing the rate of rural electrification through the promotion of different off-grid energy technologies. One such technology category is solar PV electric power (RESP, 2013-2022). Finally, the Ugandan National Climate Change Policy of 2015 demonstrates the country's commitment towards adaptation to, and mitigation of, climate change. The Policy prioritizes the promotion and development of new clean-energy technologies in order to reduce greenhouse gases (Uganda, 2015).

2.3.5. Tariff and non-tariff barriers to trade in ESTs in the EAC

While the analysis above shows that the EAC has prioritized the adoption of alternative energy technologies, developed supportive policy and legal frameworks, and encouraged private investment and trade in ESTs, several barriers still exist that are hindering the trade in ESTs.

For one thing, some protocols supportive of ESTs have not been adopted or ratified. For example, the Protocol on Environmental and Natural Resource Management, which was signed in 2006 and promotes the development and efficient use of renewable energy sources such as solar, wind and geothermal, has not yet been fully adopted and ratified by all EAC partner states. Burundi, Rwanda and South Sudan have not adopted the protocol. While Tanzania has adopted it, it has yet to ratify it. Only Kenya and Uganda have both adopted and ratified it (EAC, 2018c). This is important because only ratification of regional protocols commits the partner states to realize the aspirations set out in such protocols.

Similarly, there have been several challenges to the implementation of the customs union and common market protocols that pose a threat to free trade in general (Chepkoech, 2016). For instance, the Common Market protocol commits the partner states to promote the free movement of goods, services and people within the EAC (Mutai, 2015). However, this provision has not yet been fully implemented. One example, as is pointed out later in this report, is that trade in solar PV technology in Tanzania is constrained by the prohibitive requirement that forbids non-Tanzanian residents from being majority shareholders in companies incorporated in Tanzania. This circumstance effectively constrains citizens of other East African countries from establishing companies trading in solar PV or other renewable energy technologies in Tanzania. Another example is the various hurdles at border crossings, such as inefficiencies in customs clearances. According to Trade Mark East Africa, the processing of a single customs territory document in Tanzania takes up to ten days instead of the expected three days (TMEA, 2017). This is corrobated by Mr. Kassim Omar, the vice chairman of the East Africa Business Council (EABC), who claims that on average it can take up to ten days to clear goods in East African countries. He attributed this delay to complicated documentation and compliance activities for importers and exporters (The Citizen, 2016). Further details are provided in a recent report pointing to a number of difficulties related to doing business in various EAC countries that inhibit trade within the region (World Bank, 2018a).

Low levels of compliance with regional policies targeting the removal of trade barriers have been cited as another barrier to free trade within the region, with potential implications for the trade in ESTs. In 2009, the EAC established a monitoring mechanism for the identification and elimination of barriers

to trade within the Community. Partner states can deploy three measures to remove trade barriers: i) elimination by mutual agreement; ii) elimination though time-bound programs, whereby partner states provide a written notification to the country responsible for the trade barriers; and iii) elimination through a decision of the EAC Council of Ministers or the EAC Committee of Trade, Regional Cooperation and Integration. However, these measures are largely ineffective in addressing the persistence of trade barriers due to their non-legally binding nature and lack of sanctions for non-compliance (Oiro *et al.,* 2017).

Corruption among regulatory officials, such as police and custom officials, has been cited as another major constraint to free trade within the East Africa region, with implications for the trade both in ESTs specifically and generally. A study conducted by Transparency International-Kenya and supported by Trade Mark East Africa in 2011 showed that Tanzanian regulatory officials received on average USD 12,640 in bribes per month, followed by Kenya (USD 6,715), Uganda (USD 3672), Rwanda (USD 679) and Burundi (USD 293). When presented as percentage of the total value of goods handled by transport companies per month, monthly bribery costs represent 18.6% of the value of goods transported in Tanzania, 1.4% in Kenya, 0.5% in Rwanda, 0.1% in Burundi and 0.1% in Uganda (Transparency International, 2012: 39). This has negative implications for the costs of doing business by increasing the costs of trade.

Obtaining the capital to finance renewable-energy projects in the region is a significant challenge. This constraint has been attributed in part to the reluctance of major international development banks, such as the World Bank and the African Development Bank, to commit to long-term financing until the potential buyers of the power thereby generated reach an agreement. Banks across the region still insist on collateral of up to 120%, as observed in Kenya, Rwanda and Uganda. Commercial banks in the region also charge varying interest rates, with Tanzania and Rwanda attracting some of the highest rates (19% and 20% respectively). This makes it difficult for small companies and new entrants in the market to secure credit facilities to trade in the five ESTs in the study (Danish Energy Management and Esbensen, 2017). Additionally, uncertainties about political stability in the region and the lack of institutional trust compound this problem (REN21, 2016).

The East African Community strategy for scaling up access to modern energy noted the low adoption of solar PVs in the region partly due to the high prices for the solar PV system (EAC, 2009). Previously, Karekezi and Kithyoma (2003) observed that solar PV projects in Africa, particularly in the East Africa region, mainly benefit high-income segments of the population due to their high costs. The EAC's climate-change policy echoes these concerns by attributing the over-reliance on traditional sources of energy, such as biomass, to the low level of financial investments in the development of other types of renewable energy technologies, thereby constraining their adoption, especially in rural areas.

Concerns have also been raised regarding the low quality standards of some ESTs, consequently leading to counterfeiting and market spoilage in the region. For instance, it has been observed that substandard solar home systems are spoiling the markets in Rwanda and Uganda, reducing consumer confidence in these ESTs and thus slowing down trade in them (Danish Energy Management and Esbensen, 2017).

Finally, a lack of the technical capacity to install and maintain some of these ESTs has also been highlighted as a major challenge hindering their successful adoption, diffusion and trade in them. For instance, most EAC countries, including Kenya, lack a sufficient pool of skilled labour that can install and maintain solar PV systems (KCIC, 2018).

In general, additional costs due to tariff and NTBs mentioned above are transferred to the final consumers, thus constraining the adoption of clean energy technologies such as solar PV panels. This finding was

confirmed by our interviews for the national case study (see Chapter 3). As the interviews reveal, in general, costs incurred as a result of barriers to the trade in solar PV are transferred to the end-user. This may result in the slower adoption of clean energy in the region, and it undermines the business case for the trade in such technologies.

2.3.6. Welfare impacts of removing trade barriers

As part of the present study, an assessment of the possible welfare impacts of the removal of various trade barriers was carried out, examining three possible scenarios (see Annex 6). The first scenario involved the elimination of tariffs on EAC imports of the selected ESTs from all sources. In the second scenario we assumed that the EAC countries remove all tariffs and NTBs to imports from all sources. In the final scenario, it was assumed that tariffs and NTBs are removed on intra-EAC trade only. For each of the three scenarios, the simulated output and welfare effects were calculated, as well as the impact on trade flows.

Modelling to calculate the effects of EST trade liberation was done on the basis of the Generic Statistical Information Model (GSIM) (Francois and Hall, 1997, 2009). The study used the applied partial equilibrium (APE) analysis of international trade, where despite global outlook, the study itself was limited to a single industry. Furthermore, as is characteristic of partial equilibrium, the interest was in the effects of specific policies on specific markets, not across multiple markets in an economy[12]. In the case of this study, the specific market was the East African Community as a one trading bloc. Thus, the effects from each of the three scenarios that are examined in the report are obtained for each individual EST independently.

GSIM has some well-known limitations. To begin with, as a representative agent model, it assumes identical demand and supply elasticity for all groups of consumers and producers. This would suggest that price changes across the different income groups and geographies are similar, which is usually not a realistic assumption. Despite being a trading bloc, the producer and consumer groups present within the EAC are diverse and therefore both income elasticity of demand and supply as well as levels of response to changes in border parity prices and consumption and production responses to EST liberalization are most likely not identical.

Secondly, the GSIM assumes a complete price transmission mechanism to estimate the welfare effect of a policy change. However, to the extent that changes in border parity prices emanating from EST liberalization are only partially transmitted to the households and producers, the GSIM may tend to overestimate the actual impact due to aggregation of information on price without recognition of internal household and producer dynamics.

Thirdly, being a partial equilibrium model, the GSIM does not consider inter-sectoral linkages that may exist between ESTs and other sectors of the economy as well as the effects of other policy interventions on general trade activity. Therefore, actual equilibrium responses to tariff and NTB liberalization may again be imprecisely estimated.

Fourthly, unlike a general equilibrium model, the GSIM is unable to predict income and resource reallocation effects. Moreover, being a static model, it compares effects at a given point of time, failing to assess dynamic effects during the transition period. Finally, because the GSIM analysis is based on observed trade volumes, it can only capture the intensive margin i.e. effects originating from countries already in a positive trading relationship with each other. The GSIM thus fails to capture the extensive margin i.e. 'new trade' that may be created from EST liberalization with countries currently not trading with each other due to restrictive tariff and NTBs. This implies that the predicted

12 "Rationale for Partial Equilibrium Modelling": https://wits.worldbank.org/wits/wits/witshelp/Content/SMART/Rationale%20for%20Partial%20Equilibrium.htm

values again underestimate the actual trade effects of EST liberalization.

In the first scenario, in which tariffs on EAC imports of the selected ESTs from all sources are eliminated, there are modest effects on trade output and welfare. The reason is that EAC most-favoured-nation (MFN) tariffs are zero for most of the selected ESTs. In the second scenario, where the removal of all tariffs and NTBs to imports from all sources is assumed, much larger effects in terms of welfare and output changes can be observed. In particular, the combined welfare gain for all EAC countries is one order of magnitude larger (USD 16.1 vs. USD 1.6 million) in the second than in the first scenario. This clearly illustrates the greater relative importance of NTBs compared to tariffs. Finally, in the third scenario, where tariffs and NTBs are removed on intra-EAC trade only, the welfare gains are very small because there is little intra-EAC trade in ESTs. Therefore, the results of the analysis suggest that a broad liberalization agenda as set out in the first and second scenarios will lead to bigger welfare gains, compared with regional integration as in the third scenario. Should the intra-EAC trade in ESTs go up, there is a likelihood that the results for the third scenario would approach the ones for the prior scenarios.

2.3.7. Domestic market constraints

While trade liberalization is an essential tool for providing access to ESTs, it should be borne in mind that the removal of tariffs and NTBs alone will have a limited impact on the deployment of ESTs in developing countries if there are no or weak markets for such goods. Creating markets for clean technologies may therefore be even more important than just improving market access (Vossenaar, 2010). This can also be observed in the case of Africa: while many African countries already have very low or even zero tariffs on many ESTs, import levels remain very low in some due to a lack of purchasing power and technological capabilities, among other things (Zhang, 2013).

There are several factors that can facilitate market creation and drive demand. In many countries, markets for ESTs have largely been driven by regulations and government incentives such as requirements of specific shares of renewable energy in the total energy supply or favourable feed-in tariffs. Besides government regulations and the degree of enforcement of such rules, markets and demand can also be influenced by the private sector and consumer attitudes (cf. Vossenaar, 2010). Considering the demand side of markets, a number of factors play a role in how successful technology diffusion will be, such as consumer attitudes towards new technology, the relative price of energy supplied by new technologies as compared to traditional fuels and the initial cost of technology adoption, among other things (UNECA, 2014b).

In order to shed light on factors driving green markets in East Africa, Gordon (2018) analysed the drivers of renewable energy investment in Ethiopia and Kenya, the two largest economies in eastern Africa. Gordon finds that while the appetite for renewable energy projects in Africa has grown over the last few years (not least due to falling cost of solar and wind equipment), the major obstacle for many projects in this area has been and remains financing. Whereas in Ethiopia, the government followed a state-dominated approach to economic development and limited private sector growth until it opened the energy market to international investors in 2017, Kenya has a reputation as a business-friendly destination, with a government that welcomes private investment. Here, the power sector is influenced rather by market needs than the government's overall development plan. This is also evident in the fact that of the 2,700 MW capacity additions that are planned in the power sector over the next five years, 80% will likely come from private investments. On the one hand, the Kenyan government has put a relatively strong legislative and regulatory framework for renewable energy investors in place, including targeted policies such as net metering proposals and feed-in tariffs. On the other hand, investors in Kenya also face bureaucratic inefficiencies and an unstable political environment with a high frequency of political crises in the past, which presents major risks (Gordon, 2018).

Such strong markets and private sector presence cannot however be observed in all East African countries. Uganda and Tanzania for example still heavily rely on institutional arrangements to develop the energy sector (UNECA, 2014b), and many African countries face challenges in terms of poor technological capacities, lack of long-term finance and weak private sector initiative, impeding technological and economic progress and market creation (AFDB, 2014).

2.4. Summary of EST trade in the EAC region

The previous section explored the status of cross-border trade in the EAC region in the selected EST goods focusing on intra-regional trade as well as import into EAC countries from abroad. As shown, EAC countries generally import more than they export in the selected ESTs. Tanzania and Uganda were identified as the largest importers of the selected ESTs in the EAC region. Intra-regional trade in the selected ESTs is generally limited, especially in the case of Rwanda, Burundi and Tanzania, who export very little to other EAC countries. Kenya is the largest exporter of the selected ESTs within the region and Kenya's exports is increasingly directed towards other EAC countries.

Additionally, an overview of policies related to trade in EST services was provided. Services play an important role for several reasons. Firstly, services are often required in the deployment of EST-goods and barriers related to services therefore do not only hamper trade in these services but also constitute indirect barriers to the diffusion of related goods. Secondly, services provide great economic opportunities, being one of the chief contributors to GDP growth in the region. Moreover, they are often considered a great entry point to global and regional value chains. While commitments by EAC member states to liberalize trade in services are limited under the GATS, other initiatives and policies such as the Protocol on the Establishment of the East African Community however are fairly ambitious regarding the free movement of services, labour and people. While still in the process of negotiations, the African Continental Free Trade Area, once adopted, also represents a promising step towards liberalized trade in service.

Looking at the diffusion of the selected ESTs across the EAC region, a pronounced variation in the diffusion rates across the EAC countries became apparent. Indeed, while some ESTs, such as solar PV cells and hydropower, have been adopted extensively within the region, others have only been diffused to a limited extent, such as SWHs. Kenya may be considered a frontrunner country in terms of the high levels of diffusion rates across most of the selected ESTs compared to other countries in the region.

Furthermore, a number of regional initiatives that have been adopted in order to enable trade in ESTs in the EAC region have been identified, notably the EAC Customs Union and Common Market protocols. These initiatives are complimented by a number of national policies supporting the adoption of ESTs in the region. These regional and national policies have been instrumental in creating the enabling framework conditions for enhancing investments and establishing a market for the ESTs.

3. Trade and value chain development in solar PV products in Kenya

Kenya is an economic hub in the East African region where regional trade policies relevant to ESTs are largely designed, influenced and cascaded. Kenya has adopted a plethora of strategies, polices, regulations and incentives supportive of ESTs. Accordingly, it is widely perceived as the regional leader in providing such support (REN21, 2016). However, information about the numerous players and their roles in trade in ESTs in general and solar PV-related technologies in particular, remains scarce. Moreover, there is a paucity of literature on the barriers to trade that intervene at various stages of the solar PV value chain in Kenya.

While the previous section provided a broad overview of drivers and barriers of trade in the EAC region, this section will take a closer look at Kenya, aiming to provide an improved understanding of trade and value chain development in solar PV products in the country. It focuses on solar PV products for three reasons. First, solar PV is the most widely traded EST in Kenya and in the EAC region. Secondly, there is an increasing interest in solar PV in Kenya (and indeed in the region) partly due to the falling global prices of PV. Prices of solar PVs dropped from USD 5 per watt in 2000 to USD 0.5 per watt in 2014, leading to an increase in the national solar market of more than 100% (KCIC, 2018; REN21, 2016). Lastly, several players are now entering the Kenyan solar PV 'deployment chain', which comprises importers, wholesalers, retailers and local distributors (AHK, 2013; Hansen, 2018; Lema *et al.,* 2018).

Specifically, this section aims to: (1) examine the organization and structure of the solar PV value chain; (2) assess the status of trade in solar PV cells and modules, including installed capacity and governance structure in Kenya; and (3) examine the tariff and NTBs to trade in solar PV in Kenya and the general challenges to the diffusion of solar PV technologies. First, the conceptual approach will be outlined, followed by the data and analytical framework used in this analysis. Section 3.3 will then provide a detailed overview over the Kenyan solar PV market and value chain, before Section 3.4 describes the barriers to trade that were found.

3.1. Conceptual approach

3.1.1. Conceptualizing the green economy and ESTs

The concept of the green economy is being promoted as one of the strategies for solving the myriad environmental problems that the world is currently grappling with, such as climate change, pollution and the degradation of ecosystem services. UN Environment (2011) defines green economy as one *"that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities"*. It is an alternative to today's dominant economic model, which exacerbates inequalities, encourages waste, triggers resource scarcities, and generates widespread threats to the environment and human health.

Over the past decade, the concept of green economy has spread across the world with growing endorsements from country governments and private sector players. So far, 65 countries have embarked on transition towards an inclusive green economy and related strategies. Trade can serve as an important vehicle for the transition towards inclusive green economy. Trade, particularly in ESTs, offers opportunities to tackle environmental challenges and facilitate development of green industries in Africa. For example, ESTs used for generating electricity, improving energy efficiency, managing waste and recycling and reducing impact of natural disasters could help African countries tackle pollution, improve resilience and respond to

climate change. It could also bring economic and social benefits such as new jobs and business opportunities, diversification of exports, deeper integration into regional and global value chains, accelerated industrialization, as well as improved access to energy, clean water and food (UNEP & WTO, 2018).

3.1.2. Conceptualizing tariffs and non-tariff barriers to trade

While ESTs can play an essential role in the transition to an inclusive green economy, their production, diffusion and uptake are being prevented by several international, regional and national tariffs and NTBs (Bucher *et al.,* 2014). Along the value chain, these trade barriers increase the costs of accessing relevant inputs for manufacturing, production, transportation and trade in ESTs. In this section, three types of trade-related tariffs are being distinguished. The first are the 'most favoured nation (MFN) tariffs'. These are the tariffs that countries promise to impose on imports from other members of the WTO external to a preferential trade area. The second are 'bound tariffs', which involve specific commitments regarding the maximum MFN tariff levels for a given commodity line. The third are the 'preferential tariffs', which are special tariffs that countries impose on imports from countries within a preferential trade area (Kaushik, 2016).

There is widespread agreement in the literature that currently trade is often more significantly influenced by NTBs than by tariffs due to the general reductions in tariffs globally across various types of products,

Table 9. Non-tariff barriers to trade

	NTBs	Examples
1	Restrictive practices by governments	Export subsidies, government export and import monopolies, state trading and preferences for domestic bidders or suppliers, requirements for counter trade, flawed government procurement policies.
2	Customs and administrative entry procedures	Government-imposed anti-dumping duties, arbitrary customs classifications, misinterpretation of rules of origin, import licensing, decreed customs surcharges, additional customs, international taxes and charges levied on imports, and other tariff measures.
3	Technical barriers to trade	Restrictive technical regulations and standards that are not based on international standards; inadequate or unreasonable testing and certification arrangements or requirements; disparities in standards; lack of intergovernmental acceptance of testing methods and standards, packaging, labelling and markings.
4	Specific restrictions	Quantitative restrictions, exchange controls, export taxes, quotas, import licensing requirements, local content requirements, minimum import price limits, embargoes, prohibitions, quantitative safeguard measures, export restraint arrangements.
5	Charges on imports	Prior import deposits and subsidies, administrative fees, special supplementary duties, import credit discriminations, variable levies and border taxes.
6	Transport, clearing and forwarding challenges	Overly restrictive border operating hours, delays at borders, immigration requirements, infrastructure problems, road-user charges or fees, issues related to transit, and transport-related corruption.
7	Procedural barriers	Arbitrariness, discrimination, costly procedures, lack of information on procedures and charges, requirement for complex or a wide variety of charges and documentation, and corruption.
8	Quality and safety standards	Measures geared towards ensuring the safety and quality of goods and services.

Source: EABC (2018); EAC (2017); Calabrese and Mendez-Para (2016).

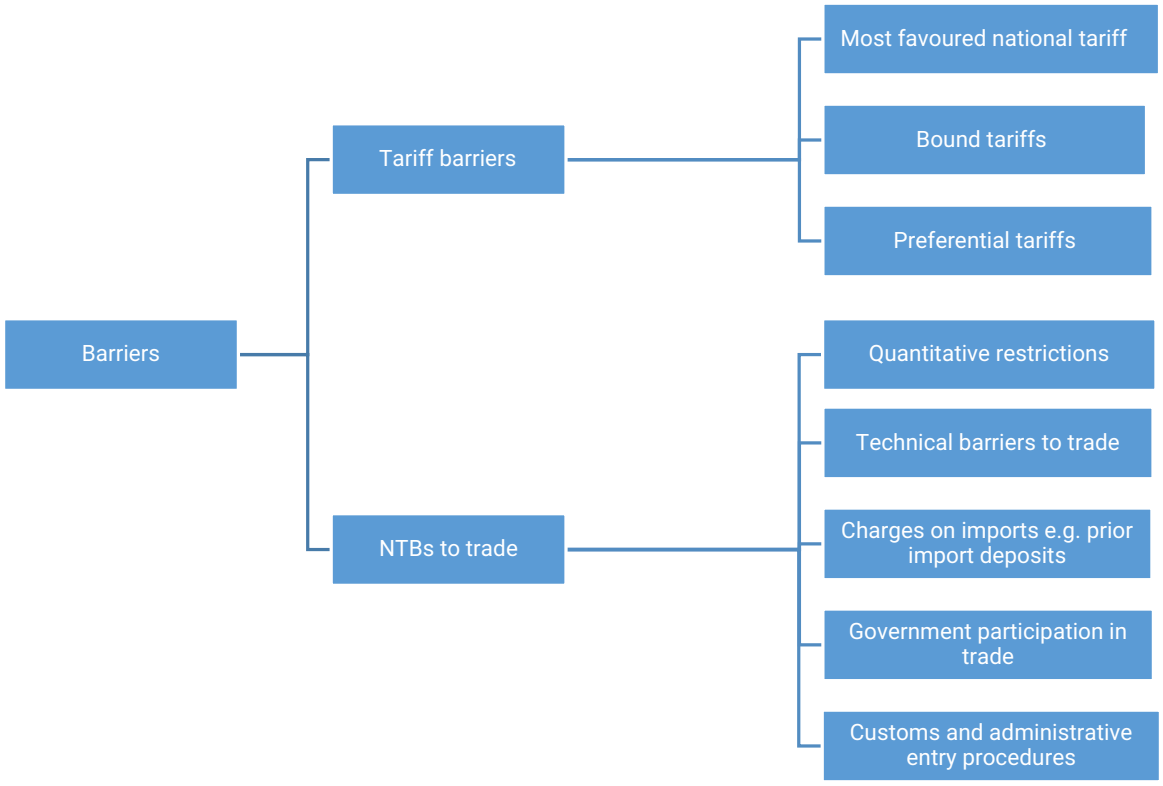
including in ESTs (Cosbey, 2014; Buscher *et al.,* 2014). This is also reflected in the EAC context where this study found that costs of NTBs comprise a substantial component of cost of doing business. Furthermore, the increased cost of doing business finds its way to the consumers consequently reducing product diffusion and access. Table 9 outlines several NTBs at play within the EAC from various organizational sources.

Drawing on the different categorizations of tariffs and NTBs to trade, this section adopts the conceptual framework presented in Figure 4 to guide analysis of barriers to trade in solar PV technologies in Kenya.

3.2. Data collection and analytical framework

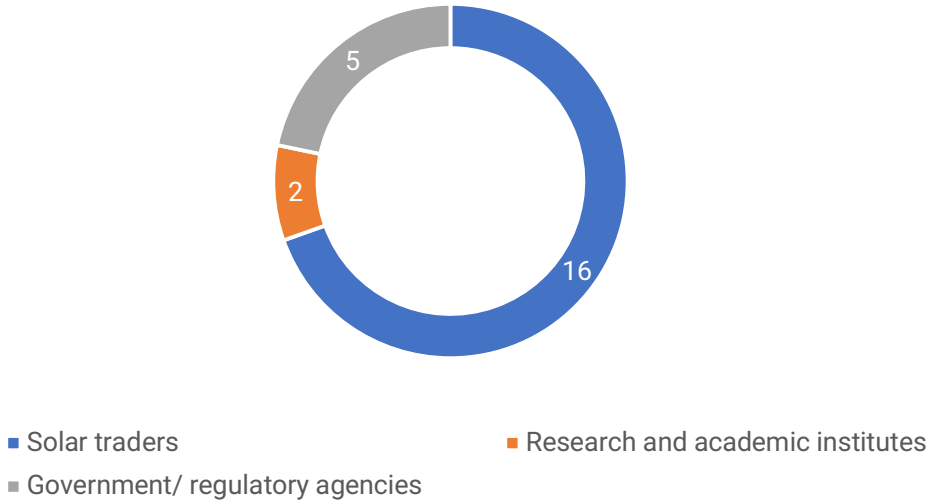
Data and information for the analyses presented in this report were obtained through in-depth interviews with representatives of government agencies, solar PV importers and traders, and research and academic organizations. The interviewees were selected with the intention to provide a broad and balanced understanding covering a variety of perspectives representing the various groups of actors involved in the solar PV value chain in Kenya, thus reducing potential biases in the results. A total of 23 interviews were conducted, as summarized in Figure 5. Annex 3 provides a full list of the respondents. The interviews lasted from forty to ninety minutes. The interviews with the solar PV importers were guided by an interview guideline (Annex 4), which elicited information on a range of issues, including a short background to the company, with information on the main solar products traded and where these products are sourced from (upstream market) and sold (downstream market); the main tariff-related barriers experienced along the solar PV value chain; and specific NTBs and their relative importance. Specifically, questions on NTBs elicited information on infrastructure constraints; limitations to trade in terms of quotas, technical standards and their specifications; sanitary and sanitary regulations; government participation in

Figure 4. Conceptual framework for analysing tariff and NTBs to trade



Source: Based on EAC (2017); Kaushik (2016) and EABC (2018)

Figure 5. Number of respondents by category



Source: Annex 3.

trade; government procurement policies; administrative and port regulations; customs entry procedures; charges on imports; internal taxes and the tax system.

The interviews with the government agencies and research and academic institutions were aimed at obtaining their reflections on the main barriers to imports and the trade in solar PV technologies in Kenya (see Annex 5).

To further reduce potential biases or limitations of the results, data and information from the interviews were triangulated with data from secondary sources, which were obtained mainly from a review of the relevant national policy documents, peer-reviewed articles and papers in the grey literature. Data from the various sources were cross-analysed using a thematic approach whereby emerging issues were condensed into different types of tariff and NTBs as outlined in Figure 4. To guarantee the anonymity of the respondents, a coding system for interviewees was developed: thus CR denotes Company Respondents, GR government respondents and AR respondents from academic or research organizations. While attempts were made to reduce potential biases as much as possible, it should be kept in mind that the relatively small sample size could lead to a bias.

3.3. Solar PV market and value chain in Kenya

This section presents the main results of our analyses in five steps. First, trends in the installation of solar PV products in Kenya are reviewed, and in doing so the organization and structure of the solar PV value chain is discussed. Then, an overview of solar PV companies and the value chain is presented, including the companies' specific distribution channels. This includes a description of the imported solar products, the types of companies involved and upstream characteristics. The third section discusses the tariffs and NTBs affecting the trade in solar-energy products. This includes a description of importation and taxation procedures, the tariffs and NTBs, and general challenges to the diffusion of solar PV products in Kenya. The fourth and fifth sub-sections discuss the impact of trade barriers on solar importers and on manufacturers' or importers' decisions respectively.

3.3.1. Structure of the solar PV market in Kenya

The Kenyan solar PV market has gone through various stages of development since the 1970s to become the regional leader in solar PV power in terms of installed capacity

and sales (REN21, 2016). In the 1970s, the solar PV market was largely dominated by the government, which used solar energy to power signalling and broadcasting installations in remote areas (Hansen *et al.,* 2014). The 1980s and the 1990s witnessed the entry of non-governmental organizations and private-sector players into the market. The private sector market grew rapidly during this period, due to falling prices of PV cells (Hankins, 2009). It has been estimated that 1.5 MWp of solar PV capacity was installed during this period, the majority of which served the institutional market segment in schools, health centres and missions located in rural areas off the grid (Hansen *et al.,* 2014).

The installed capacity more than doubled to 3.5 MWp in 2000, with 75% of all new installations serving the solar home systems market segment (Ondraczek, 2013). A decade later an estimated eighteen MWp of solar PV capacity had been installed in the country, with solar home systems taking the biggest market share at approximately 80%, compared with 20% of the institutional installations (Hankins, 2009). More recently, several organizations have invested in grid-connected solar PV plants: Strathmore University, with about 600 kilowatts (kW) (REN21, 2016); the UN Environment located within the United Nations Office in Nairobi with 575 kilowatt peak (kWp); SOS Childrens Village in Nairobi with 60 kWp installed capacity; and an installation of 72 kW at a flower farm in Naivasha (Hansen *et al.,* 2014; Tigabu, 2016).

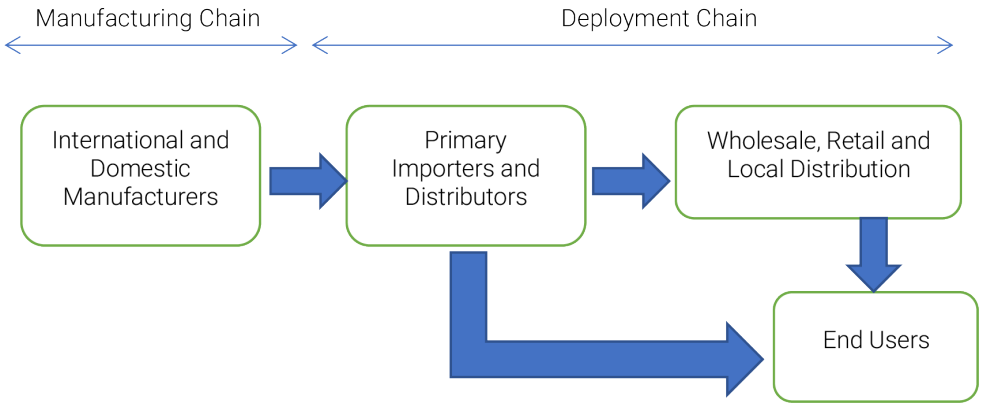
The capacity of grid-connected solar PV power plants is expected to increase, with the Kenyan government entering several agreements under signature or negotiation, such as the 2015 landmark agreement between the Ministry of Energy and Petroleum and Skypower to develop a one gigawatt (GW) solar PV plant over the next five years (REN21, 2016). Additional policy considerations by government to increase uptake of solar energy include potential for an energy auction system as well as national development plans to increase access to grid-connected solar PV systems for up to 25,000 schools in rural Kenya (Future Watch, 2016). The current general power generation capacity nationally stands at less than 2,300 MW (PowerAfrica, 2015, Futurewatch, 2016). Small-scale, so-called 'Pico', solar systems, including lanterns, lamps, chargers and torches, are also gaining popularity in Kenya's solar PV market. According to REN21 (2016), an estimated 947,000 Pico solar products, quality-verified by Lighting Global Quality Standards, were sold in Kenya between the second half of 2014 and the first half of 2015.

3.3.2. Overview of solar PV value chain in Kenya

The solar PV value chain in Kenya can be divided into manufacturing and deployment chains (Lema *et al.,* 2018). The manufacturing chain comprises international and domestic companies that assemble and manufacture solar PV components. Most of the solar components in the Kenyan market are manufactured in and then imported from China, Europe or the United States (Lema *et al.,* 2018). Local assembly and production of solar PV components are limited to a few companies, such as Solinc East Africa Ltd., which assemble solar modules, and Associated Battery Manufactures, which is the only domestic manufacturer of batteries for solar PV systems (AHK, 2013; Hansen, 2018). The deployment chain comprises primary importers of key components of solar PV systems and the downstream activities, which involve "wholesale, retail vendors and local distributors of solar panels and components toward the final installation stage and end-use" (Hansen, 2018:14). Figure 6 provides a simplified overview of the Kenyan solar PV value chain.

While there are evidently numerous traders and distributors in the Kenyan solar PV value chain, especially at the deployment stage (AHK, 2013; Hansen, 2018), official data from the Energy Regulatory Commission (ERC) of Kenya indicate that as of 2017 a total of 996 solar PV companies had been licensed to conduct trade in solar PVs in the country. Table 10 and Figure 7 below summarize the distribution of solar PV traders by type of license. Figure 7 shows a higher configuration of licensees involved in importation of solar

Figure 6. Solar PV value chain in Kenya.



Source: Based on Muchunku (2013); Lema et al. (2018); Hansen et al. (2014).
Note: the graph is a simplified illustration of the solar PV value chain in Kenya, which does not include the full range of actors involved directly or indirectly in the import and further diffusion of solar PV technologies (such as project developers, installers and financiers) and the surrounding innovation system. For a more detailed description, see Hansen (2018).

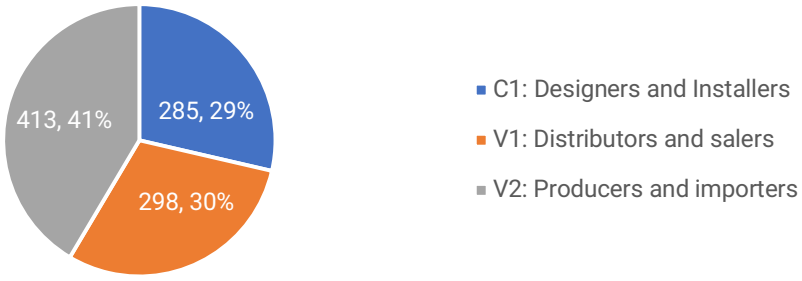
PV systems and components (catergory V1) compared to designers and installers (category C1) and producers and importers (category V2). The presence of only one local solar PV manufacturer is consistent with the indicated (low) level of solar PVs exports from Kenya to her regional counterparts and by extension the low level of intra-EAC exports of ESTs within the trade area.

Table 10. The number of solar PV traders by license category

License	Activities	Total number of license holders
V1	Entitles the holder to design, distribute, promote, sell or install solar PV systems	298
V2	Entitles the holder to manufacture or import solar PV systems or components	413
C1	Entitles the holder to carry out design and installation work for solar PV systems	285

Source: Based on ERC (2017).

Figure 7. Solar PV traders by type of license



Data source: Based on ERC (2017).

Figure 8. Classification of solar PV and related products based on end-use

Closely solar-related		Loosely solar-related
• Solar modules • Solar tiles • Solas lanterns • SOlar cells	• Change controllers • Inverters • Mounting structures • Solar batteries	• Aluminum frames • Switch gears • Glass • Junction box • Cables • Bolts and nuts

Source: Authors' own elaboration.

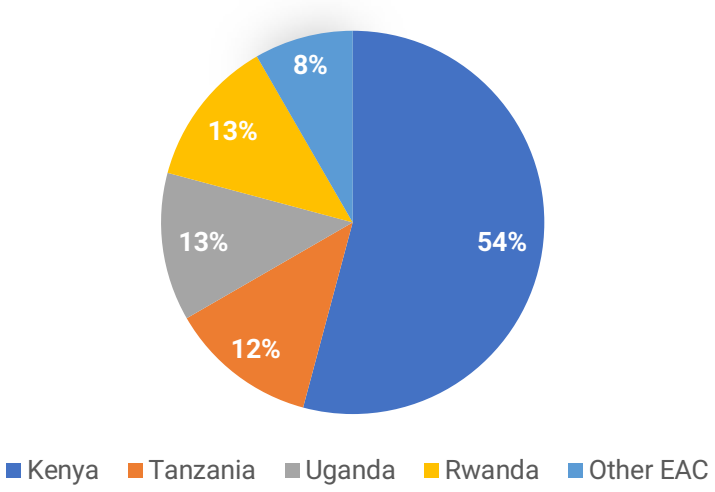
3.3.3. Types of imported solar products

Several solar PV and associated products are imported into and traded within Kenya. These products can be grouped on a scale according to their relevance to solar PV systems (Figure 8). At one end of the scale are items such as solar modules or panels, solar lanterns, integrated modules and solar tiles. In the middle of the scale are products that are integral components of solar PV systems, such as charge controllers, inverters and solar batteries. At the other end of the scale are components that, though essential for many solar systems, can also be used for other purposes. These include inputs for manufacturing solar modules, such as aluminium frames and glass, and components such as switch gears, cables and nuts and bolts used in turn-key projects.

Types of companies and upstream characteristics

The interviews for this study were conducted with sixteen private-sector players, that is, fifteen solar traders and one industry lobbying group (Figure 5). The fifteen companies vary significantly in size, products sold, market focus and regional scope (Figure 9). As shown, most (54%) of these companies sell their products in Kenya. The analysis also revealed that 56% of them sold their products to commercial consumers (e.g. industrial consumers, hotel and tourism companies, and other businesses). The remaining

Figure 9. Solar PV companies by geographical market



Source: Authors' own elaboration.

companies sold their products to individual product consumers such as households.

In terms of upstream characteristics, solar PV importers can be divided into three categories: (i) system importers, (ii) component importers and (iii) input importers. System importers (category A) comprise companies that import wholly or partially prefabricated solar systems such as 'plug and play' pico products (solar lanterns, solar home systems, etc.). The imported items typically include an integrated solar panel and require no or minimal assembly. Of the fifteen solar PV companies interviewed, six can be characterized as system importers, namely CR2, CR7, CR9, CR11, CR13 and CR15. The key characteristics of system importers include:

- Some companies, such as CR9 and CR13, design their own products and outsource their manufacture to their partners in China.
- Some companies import some components separately (e.g. solar modules, solar radios, solar televisions and solar fridges, among others), while other products are imported as complete products (e.g. solar lanterns). Examples of these companies include CR2 and CR11.
- Other companies such as CR11 and CR15 have moved from being importers of components to importers of pre-fabricated systems.

Companies in the 'component importers' category (category B), such as CR1, CR3, CR4, CR5, CR6, CR10 and CR12, are typically providing a combination of design, construction, operational and engineering services for mostly commercial or industrial clients. Some of these companies (e.g. CR3) can also be characterized as engineering, procurement and construction companies. The key characteristics of component importers include the following:

- They import a wide range of components, many of which are loosely related to solar energy and appear on the right side of the spectrum presented in Figure 8.
- They provide project-based services such as turn-key off-grid solar PV systems[13].
- They mostly have a commercial and industrial focus.
- They typically engage in business-to-business (B2B)[14] sales.

'Input importers' (category C) are companies that import raw materials and basic (mostly low value-added) components as inputs for the manufacture or assembly of solar products. These raw materials may include solar cells, aluminium frames, glass and junction boxes. Some of these products are generic in the sense that they can be used in other industries or for another non-solar PV uses. CR14, an assembly plant for solar PV modules, falls into this category.. The key characteristics of input importers include the following:

- Imports raw materials and (mostly) low-value added goods.
- Its core business is manufacturing or the assembly of solar products, e.g. modules or solar home systems.

An overview of the companies interviewed according to the categorization above and the distribution channels they employ is provided in Table 11 and Figure 10.

13 A turnkey system involves the delivery of a complete and fully operational solar PV plant by a total system supplier.

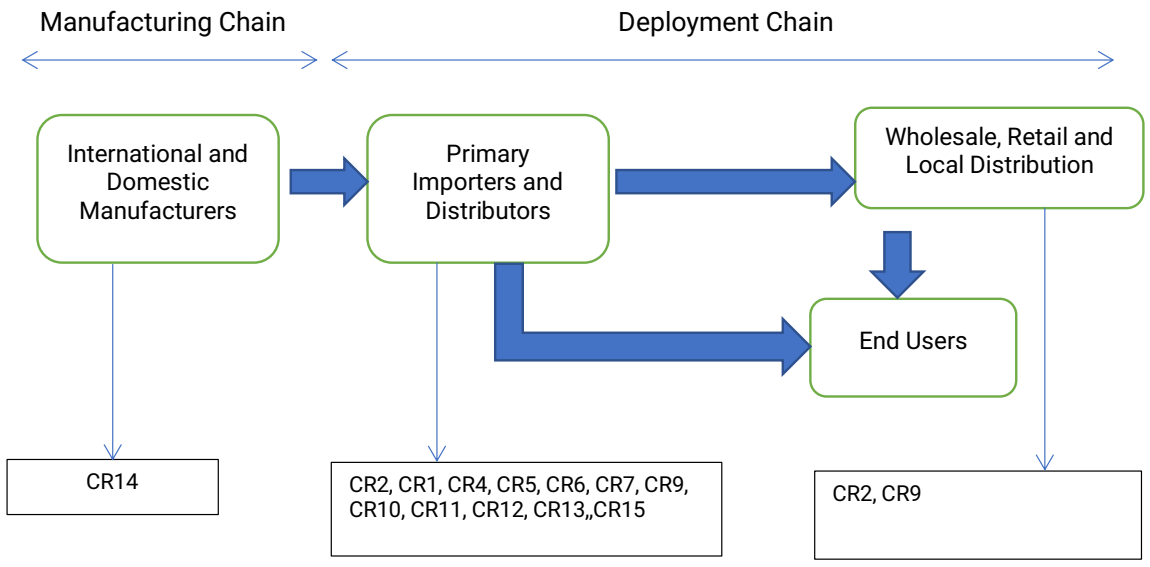
14 According to INVESTOPEDIA, business to business (B2B) is a type of transaction that exists between businesses, for example, involving a manufacturer and a wholesaler, or a wholesaler and a retailer. It therefore refers to business that is conducted between companies, rather than between a company and individual consumers or between a company and a government entity. For more information, see Investopedia (2018).

Table 11. Overview of the companies interviewed

Company Code	Ownership	Category: Input importers, System importers or Component importers	Distribution Channels: Direct Sales, Business to Business, Distributors
CR1	Foreign	Component Importers	Direct Sales, Business to Business
CR2	Kenyan	System Importers	Direct Sales, Business to Business, Distributors
CR3	Kenyan	Component Importers	Direct Sales, Business to Business
CR4	Foreign	Component Importers	Direct Sales, Business to Business
CR5	Kenyan	Component Importers	Direct Sales, Business to Business
CR6	Foreign	Component Importers	Direct Sales, Business to Business
CR7	Foreign	System Importers	Direct Sales
CR8	Kenyan	N/A	N/A
CR9	Foreign	System Importers	Direct sales, Business to Business
CR10	Kenyan	Component Importers	Direct Sales, Business to Business
CR11	Foreign	System Importers	Direct Sales
CR12	Foreign	Component Importers	Direct Sales, Business to Business
CR13	Kenyan	System Importers	Distributors
CR14	Kenyan	Input Importers	Business to Business, Distributors
CR15	Kenyan	System Importers	Direct Sales
CR16	Foreign	System Importers	Direct sales

Source: Authors' own elaboration.

Figure 10. Overview of value chain/distribution channels of the solar PV companies interviewed



Source: Based on Muchunku (2013); Lema et al. (2018); and Hansen (2018).

3.3.4. Sourcing locations and supply chain

The interviews revealed a spread of sourcing locations of solar PV inputs and components. The companies interviewed imported from suppliers in Europe, Asia, North America, the Middle East and Africa, and almost all of them imported products from China. The interview data suggest an abundance of companies (particularly in China) supplying solar products of relatively good quality, allowing Kenyan importers to switch suppliers, for example if a given supplier fails to meet expectations. Some products imported from China are sourced from European or North American companies that have manufacturing agreements with Chinese firms.

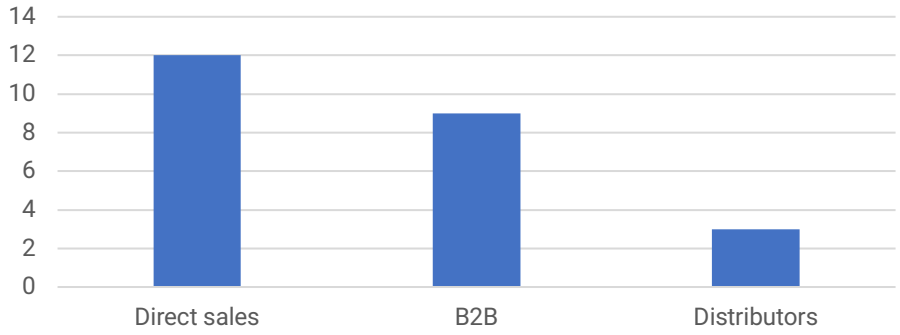
System importers (category A) tend to import from fewer locations, in some cases importing all their products from a single 'one-stop-shop' supplier. Several companies in category A, such as CR13, design and patent their own products, which are manufactured via agreement with their (typically) Chinese supplier. Companies in categories B and C tend to source from a wider spread of countries, likely due to the wider variety of products they can import. Interestingly, companies building and operating turn-key solar projects tend to import many of their products from suppliers in Europe. Some companies in categories B and C also provide solar home systems, although this is not their main focus. In contrast to category A companies, which tend to import solar home systems pre-assembled, category B and C companies assemble solar home systems in Kenya.

Distribution channels for solar PV products in Kenya

The interview data reveal that most of the companies employed more than one distribution channel to supply their products to the market. The 'direct sales' channel involves a solar PV company – whether a system importer, component importer or input importer – selling directly to the final consumers (e.g. households and industrial or commercial users). Sales through a 'distributor' involve a company selling to its authorized sales agents or distributors, who then sell to the final consumers. These distributors may be company-appointed distributors, wholesalers or retailers. The 'business-to-business' distribution channel involves one company selling the solar PV product to another company. The latter may then add value to the product by using it to assemble another product – e.g. a solar home system – or to provide a turn-key solar PV installation for the final consumer.

Only five companies rely on single distribution channels for this end. CR13 relies on its distributors as its sole supply channel, while CR9, CR7, CR15 and CR11 all rely on direct sales alone. CR14 relies on distributors and business–to-business, while the remaining eight companies (CR6, CR10, CR12, CR1, CR5, CR4, CR3 and CR16) rely on both business-to-business linkages and direct sales as their main distribution strategies. Figure 11 shows proportion of companies by distribution channel.

Figure 11. Number of companies by distribution channel



Source: Authors' own elaboration.

3.4. Barriers to trade in solar PV in Kenya

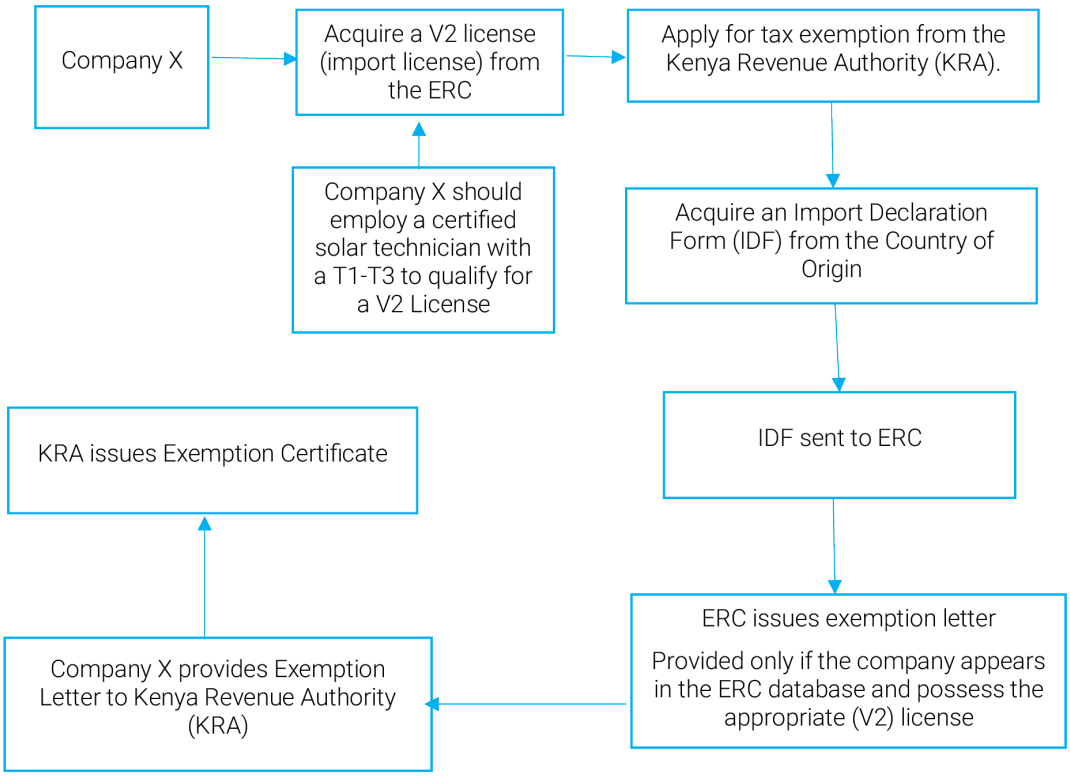
This section discusses the barriers to trade in solar PV in Kenya as highlighted by our respondents. The first sub-section describes the general import procedures and legislation for solar products. The second presents the main barriers to the import and sale of solar PV products in Kenya. The third discusses the general challenges to the diffusion of solar PV systems in Kenya.

3.4.1. Description of the import and taxation process

Kenyan law outlines the procedures and processes involved in the importation, manufacturing, distribution and sale of solar PV products. Kenyan tax law provides tax exemption for solar products. This includes exemptions from import duty and value added tax (VAT). The VAT Act treats solar products as "Specialized solar equipment and accessories, including SWHs and deep cycle-sealed batteries which exclusively use or store solar power" (Kenya, 2013b:33)[15]. To import solar and related equipment and components, an importer must follow the following procedure[16]:

1. The company must acquire a V2 license (import license) from the Energy Regulatory Commission (ERC). To qualify for the license, the company must employ a certified solar technician with a T1-T3 license depending on the type of equipment imported.
2. With the V2 license the company can then apply for a tax exemption from the Kenya Revenue Authority (KRA).
3. The importing company must acquire

Figure 12. Solar PV import process in Kenya



Source: Based on Muchunku (2013); Lema et al. (2018); and Hansen (2018).

15 Tax exemption for solar PV pertains specifically to the HS code 854140 (Ikiara, 2009).
16 This is a crude overview of the import procedure. Other processes are also involved. The recently adopted "single window system" is intended to streamline and improve interaction with the ERC and KRA (Sichilima and Gikonyo, 2017).

and present an Import Declaration Form (IDF) from the country of origin.

4. The IDF is then sent to the ERC, which issues an exemption letter. However, this exemption is provided only if the company appears in the ERC database and possesses the appropriate (V2) license.
5. The ERC Exemption Letter is presented to the KRA, which issues the exemption certificate, which is then shown to the customs officials at the port. It should be noted that, while products such as solar modules are explicitly exempted from tax, others such as cables and mounting structures are not. It is thus at the discretion of the KRA whether to issue tax exemptions for the different solar PV and associated products.

3.4.2. Barriers to trade in solar PV products imported into Kenya

In line with the conceptual framework presented in Figure 4, the findings on the main barriers to trade in solar PV products are organized into different categories. These are presented and discussed under two broad groups: tariffs and NTBs to trade in solar PV products. The tariff barriers include MFN tariffs, bound tariffs and preferential tariffs. The NTBs include government participation in trade, quota restrictions, technical barriers to trade, and customs and administrative entry procedures (see Section 3.2). The main NTBs to trade in solar PV are summarized in Table 12. Additionally, we discuss the general challenges to the diffusion of solar PV technologies in Kenya.

All of the interviewed respondents stressed that tariff-related barriers only play a very minor role in influencing the cross-border trade in solar PV systems in Kenya mainly because solar PV components are exempted from taxes. Furthermore, the interviews revealed that the government of Kenya does not regulate prices for solar PV systems in the country. All respondents reported that the market is largely free and that a company can price its products as it wishes. Respondents also noted that there are no import quotas, since solar PV companies are not restricted in the quantities they can import at any one point. These observations direct attention to addressing the importance of the various NTBs that are currently restricting trade in solar PV products in Kenya. The specific NTBs identified in this study are addressed in the following paragraphs.

Several respondents mentioned barriers related to customs entry procedures. Most of the company representatives we interviewed regarded the legal definition of tax-exempted goods as ambiguous, and noted that it is particularly unclear how solar accessories are taxed. According to the respondents this is mainly due to two overall reasons.

Firstly, a lack of a clear agreement between the ERC and the KRA on what constitutes solar products was highlighted as a key barrier to trade in solar PV products in Kenya. Various respondents observed that, although the ERC may certify certain products as subject to tax exemption, the KRA has the discretion to decide whether these products are exempted or not. In most cases, the KRA does not agree with the ERC on what constitute solar products, which poses challenges in terms of taxation (CR12). All the companies interviewed agreed that solar PV systems are tax exempted, but it emerged that some vital solar components are not recognized as eligible for tax exemptions. Mounting structures, solar cables and batteries, for example, are not exempted from import duties, according to several companies (CR1, CR3, CR4, CR5, CR12). Various respondents noted that in some cases a company must convince the ERC that their goods, such as inverters and charge controllers, qualify for tax exemptions. The imposition of taxes on some solar PV components, such as mounting structures, solar cables and batteries, was confirmed by one respondent from the government. According to the respondent, all the solar components previously enjoyed tax exemptions. This was changed when it was realized that several traders were using this avenue to evade taxes.

Secondly, a tendency by customs officials to categorize components for tax exemption

or otherwise incorrectly was also reported. Several company respondents described situations in which customs officials were not able to identify tax-exempted solar goods due to a lack of adequate training on solar PV components and accessories (CR1, CR5, and AR1). The lack of well-trained customs officials on ESTs in general, and solar PV in particular, was also confirmed by respondents from government agencies (GR3 and GR4). This was also reported to result in lengthy negotiations and delays in clearance. According to respondents, these lengthy negotiations and delays led, in most cases, to losses of time and money, ultimately leading to an increase in the cost of the solar products.

On top of the non-clarity on which components should be taxed, there is also a lack of clarity on the rules and procedures for valuing goods for taxation purposes. According to one respondent, customs officials have their own ways of costing products that is not clear and that may conflict with the actual market prices of the products.

Pre-shipment inspection was mentioned by some respondents as a barrier to trade in solar PV products. Various company respondents stressed that pre-shipment inspection is carried out by private inspection companies, such as SGS, Bureau Veritas or Intertech, for each shipment. These inspections are typically conducted at the port of origin to ensure that the goods imported are of good quality and meet the required standards. A so-called "Certificate of Conformity" is issued by the inspection companies upon successful inspection of the consignments. While most companies did not have any problem with the pre-shipment procedures, one respondent was critical of the costs incurred by these pre-shipment inspections, which significantly increase the cost of solar PV products.

Respondents also reported the existence of various administrative barriers to trade in solar PV systems in Kenya, such as requirements for license applications and acquisition. For instance, the ERC requires that all traders applying for V1, V2 and C1 licenses must be or employ licensed technicians. This requirement has been criticized, as it can put companies in a vulnerable position, especially given the relative scarcity of technicians in Kenya compared with solar companies.

Finally, respondents reported lengthy and costly business registration formalities as a barrier to the trade in solar PV products. Several complained that foreign companies must undergo lengthy and costly formalities to be able to operate in the country. This includes business registration with the national and country governments. Additionally, the proprietors and foreign employees of such companies are required to secure work permits, which are quite costly.

3.4.3. General challenges to the diffusion of solar PV technology in Kenya

Apart from the NTBs to importing and trading in solar PV at the state border discussed in the preceding section, company respondents also reported several challenges to the wider diffusion of solar PV in the country. Most important barriers to diffusion within Kenya included economic or financial constraints, socio-technical challenges, low levels of awareness and logistical constraints.

One problem highlighted by many company representatives is that the specifications developed for government PV installation tenders are of poor quality and do not guarantee an adequate level of energy performance by the solar PV systems to be installed.

A lack of sufficient skilled personnel in the solar industry and the presence of counterfeits PV cells on the market were also identified as challenges that interfere with the trade in solar PV products in Kenya. Regarding skilled labour, data from ERC showed that there are approximately 700 licensed technicians for the 996 companies that have been licensed to engage in trading in solar PV systems. However, if each company is to have at least one technician (to use a conservative figure), then there is a shortfall of almost 300 technicians. Hence, the number

Table 12. Summary of NTBs identified in the solar PV industry in Kenya

NTBs	Examples
Government procurement	• Government requires sufficient liquidity, a requirement that small companies especially find prohibitive. • Government usually requires the company to install and commission the solar PV systems before it can be paid. • Government imposes a minimum work experience requirement which locks out many qualified companies.
Customs entry procedures	• Ambiguity in the legal definition of tax-exempted goods. It is unclear how solar accessories should be taxed. • Lack of a clear agreement between the ERC and KRA on what constitutes solar products • Taxation of mounting structures, solar cables and batteries, for example, are not exempted from import duties. • A tendency by customs officials to incorrectly categorize components for tax exemptions. • Delays at the ports due to lengthy negotiations with customs officials result in losses of time and money, ultimately leading to an increase in the final cost of the solar products.
Lack of clarity on rules for valuation of goods for taxation	• Customs officials having their own ways of costing that are not clear and that may conflict with the actual market prices of the products.
Pre-shipment inspection	• High costs incurred for pre-shipment inspections, which significantly increases the cost of solar PV products.
Administrative barriers	• Prohibitive licensing requirements that require that all traders applying for V1, V2 and C1 licenses must be or must have in their employment a licensed technician. Yet, there is a scarcity of these technicians in the country.
Lengthy and costly (business registration) formalities	• Foreign companies undergo lengthy and costly formalities to be able to operate in the country, such as business registration with the national and country governments. • The proprietors and foreign employees of foreign companies are required to secure work permits, which are quite costly.

Source: Authors' own elaboration.

of technicians in Kenya cannot effectively serve the whole solar market in the country. Given that there are many other (informal) companies that have not been licensed by the ERC and that there are also individuals who are installing solar PV systems in their homes and establishments, the shortfall in trained technicians is very high.

The proliferation of poor-quality products was mentioned by several companies as a challenge that disadvantages the overall sale of solar PV products and thus undermines consumers' trust in solar products. One of the respondent from government agencies also raised concerns over the lack of monitoring and maintenance programs for installed solar PV systems, which affects their performance.

While many company representatives indicated that new companies and

organizations are now emerging as the financiers of solar PV (and other green energy) projects, the cost of solar PV systems remain high, and many companies have difficulties in accessing the credit facilities of financial institutions. This posed a major challenge to most traders in solar PV products in the country, especially new entrants in the solar PV business. Regarding access to financial capital, respondents CR3, CR4, CR7, CR10 and CR15 reported that many financial institutions still require collateral to advance credit facilities to traders. This, they argue, is quite restrictive, as it presents a challenge and an entry barrier for new companies interested in entering the solar PV market. With regard to interest rates on credit facilities, one company respondent argued that the 10-15% interest rates on loans charged by several financial institutions is still high and is likely to be challenging for many companies needing finance.

The majority of company respondents observed that there are generally low levels of market awareness concerning the possible social, economic and environmental benefits of solar energy. Specifically, several companies (CR2, CR4, CR5, CR7, CR9) observed that most consumers still lack awareness about the affordability of solar PV and its benefits over other traditional sources of energy. According to one company respondent, the low level of awareness is especially common among the rural population compared to the urban population.

The low levels of awareness were reported to provide a fertile ground for counterfeits to thrive, as most consumers cannot differentiate between genuine and counterfeit products. According to one company respondent (CR2), these counterfeits ultimately spoil the market for solar PV systems by lowering consumer confidence in them.

Several companies (CR4, CR5, CR7) mentioned the poor state of Kenya's roads, especially in the interior of the country, as a major constraint in accessing these markets. The constantly changing price of fuel in the country was also pointed out as contributing to the unpredictable costs of the transportation of goods, which in turn affects the prices of solar PV products in the country. One company respondent (CR12) identified the constant congestion on the roads and the many accidents as one of the major challenges affecting the transportation of goods to the market, especially from the port of Mombasa. Although this respondent recognized that this bottleneck could be bypassed by taking rail transport, he noted that rail cargo is not well managed, with poor cargo handling and insufficient customs clearance at the Nairobi terminal.

3.4.4. Impact of trade barriers on solar importers

The barriers described above affect the importation of and trade in solar PV products in several ways. First, the time spent by an importer in proving that imported solar products qualify for tax exemptions redirects human resources that could have been utilized for other commercial purposes and leads to additional costs, such as accommodation costs. In addition to demurrage fees, the time spent at the ports negotiating with the KRA can result in additional costs. One company respondent (CR5) explained that these additional costs can include accommodation and transport in cases where a company representative must travel to the port and wait several days for the products to be cleared.

Interview data suggest that companies in categories B and C are especially impacted by the taxation on components and inputs, which are either not legally recognized or are not correctly identified as solar-related products. Although these products are often essential for solar projects or as inputs in solar manufacturing, their relationship to solar PV can be less obvious (see Figure 8). According to interviews with company representatives, these companies can end up either paying tax on some of their components and inputs, since they are not included on the list of tax-exempted goods, or spending extra time and resources convincing the authorities that their inputs or components are in fact included on the list according to the legal definition of tax-exempted goods. Such negotiations may be repeated for each consignment, as was reported by company respondents from

CR5, CR6, CR12 and CR14, thus causing additional delays in clearing products at the port of entry.

The ambiguous interpretations of tax exemptions restrict importers' sourcing options. For example, one local company (CR11) originally imported complete solar home systems from Thailand. They subsequently discovered that it was cheaper to purchase solar modules separately from China while continuing to import the remaining components from Thailand. However, they experienced difficulties in proving that the solar home systems and accessories qualified for a tax exemption, since the Solar Home Systems was no longer being imported together with the solar module, which is the obvious solar product in this case. Although all the components were ultimately the same, the company ended up paying a premium – in their view – due to inconsistencies in how tax-exempted solar products are defined.

One company representative (CR6) noted that tax exemptions may have less of an impact on companies whose focus is on business-to-business sales, since in such cases the tax is absorbed by the client. Furthermore, the costs incurred from pre-shipment inspections, as noted above, are likely to have a greater (relative) impact on companies in categories B and C. Since importers must pay for each consignment to be inspected, companies such as those in categories B and C, which source from a greater number of different suppliers – owing to the variety of components and materials they require – are likely to suffer more than companies in category A. Smaller companies are likely to face higher fees relative to their shipping consignments, which tend to be smaller. As mentioned during interviews with representatives of one specific company (CR6), larger companies have more economical option of paying for inspection fees 'in bulk'. Although solar panels and items with integrated solar modules such as solar lanterns or tiles were reported to be imported with relative ease, one company representative (CR13) estimated that clearing-agent fees represent 15-20% of the cost of importing the consignment.

Finally, companies in categories B and C were shown to be particularly vulnerable to the tax regimes related to solar PV products. The interview data indicate that tax exemptions and how they are defined can have a significant impact on these companies, thereby affecting fundamental decisions, such as whether to manufacture locally or outsource the manufacturing and assembly functions to companies in Asia or Europe. This impact is illustrated by the following three examples:

1. One company initially aimed to manufacture its main product, the solar roof tile[17], locally in Kenya. To do so, they needed to import the three main components of the solar tile, namely the PV cells, the plastic and ceramic housing, and the junction box. However, while the PV cells are exempt from tax, the other two components are not considered solar-related products under Kenya's current tax regime and are fully taxed. Since the solar tile as a complete unit qualifies for tax exemptions, it made economic sense for the company to import the prefabricated solar tile from China.
2. The only local manufacturer of PV panels in Kenya must pay tax on many of the imported sub components and materials used to produce the panels. The company compete with imported panels, which are 100% exempted from tax, including its subcomponents. This means that the current tax exemption on PV products is a disadvantage for this company.
3. A representative of another local company estimated that it would save itself 40% of the cost of its solar lantern if it was assembled locally by components exempted from tax. However, taxes on imported components prevent the company from doing so.

17 Solar tiles, also known as solar roof shingles, roof shingles, solar roof tiles and building integrated photovoltaic panels or BIPV, are designed to look like and function as conventional roofing materials while at the same time harnessing the sun's energy. See Alternative Energy (2018).

4. Conclusion and recommendations

This section will present the key findings of the two main sections of the report. First, the main conclusions regarding the drivers and barriers to trade in the selected ESTs in the EAC region will be presented and specific recommendations that may be key in eliminating some of the barriers to regional trade in ESTs are outlined. Subsequently, the main conclusions and policy recommendations on the analyses of the barriers to trade in solar PV in Kenya are presented.

4.1. Drivers, barriers and measures to unlocking trade in EST in the EAC region

As discussed, the EAC has made several efforts to promote trade and deployment of the selected ESTs (solar PV panels, SWHs, wind turbines, biomass boilers and hydro-electric power) as well as related services. Policy frameworks shaped by the EAC Customs Union and Common Market Protocols, the EAC Vision 2050 Development Strategy, the Private-sector Development Strategy, the EAC Climate Change Policy, the EAC Climate Change Master Plan, the EAC post-Rio+20 Plan of Action and the establishment of the East African Centre for Renewable Energy and Energy Efficiency (EACREEE) have played an important role in the adoption and diffusion of, and trade in ESTs.

The EAC Customs Union and Common Market Protocols have sought to advance the free movement of people, goods and services across the EAC region. While there are still challenges to fully implement these protocols, there is no doubt that they have boosted the trade in ESTs by facilitating the movement of people, goods and services across the region. The EAC Vision 2050 development blueprint has laid a solid foundation for the trade in ESTs by setting the ambitious target of ensuring universal access to modern energy services, with more than 50% of energy being supplied from renewable and clean sources of energy, such as solar and wind power. The role of private-sector investments in ESTs has also been boosted by the introduction of the EAC Private-sector Development Strategy, which commits the member states to promote private-sector investment in renewable energy facilities by introducing financial incentives for such investments.

The Environment and Natural Resource Management Protocol commits member states to promote investments in alternative sources of energy. The EAC Climate Change Policy and Climate Change Master Plan both promote the diversification of energy sources into ESTs as a strategy for the adaptation and mitigation of climate change within the region. The Master Plan urges the EAC's member states to zero-rate taxes, specifically import duties and VAT for ESTs, and to provide other financial incentives that help promote private-sector trade in ESTs. The development of the EAC post Rio+20 Action Plan also promotes the trade in ESTs in the region by furthering the key objective of the Rio+20 summit of developing clean energy and ETSs. Lastly, the establishment of the EACREEE, the objectives of which include steering the adoption of clean energy sources by working towards elimination of barriers to the trade in ESTs, is also seen as a positive development for the expansion of such trade in ESTs.

Barriers hindering the trade in ESTs in the region include non-compliance with regional policies; corruption on the part of regulatory officials; limited progress with the adoption, ratification or full implementation of the protocols that are supportive of ESTs, such as the Protocol on Environment and Natural Resource Management, the Customs Union and the Common Market protocols; financial challenges, such as high interest rates and high collateral requirements imposed by banks; lack of skilled labour force to install and maintain some of these ESTs; and low-quality standards on some ESTs, such as solar PV modules. The elimination of these barriers to trade is essential to fully

unlock the potential in trade and value chain development in the region

Recommendations for unlocking trade in selected ESTs in the East African region include:

- **Make the removal of trade barriers legally binding and reinforce compliance at national level.** Lack of compliance with regional trade liberalization policies has been cited as a barrier to trade within the region, including trade in ESTs. Improving compliance and enforcement of the regional trade policies could help to release the full potential of regional economic integration, including in sectors related to renewable energy and environmental technology.

- **Expedite the adoption, ratification and full implementation of the various protocols that are supportive of trade in ESTs.** This would include the protocol on Environment and Natural Resource Management, the EAC Common Market Protocol and the Customs Union Protocol.

- **Harmonize regional standards and labelling systems for renewable energy technologies.** The region has witnessed the increased proliferation of ESTs and renewable energy equipment with low standard, such as solar home systems. Harmonizing EAC technical standards and labelling systems would help to improve quality of products and services within the region, and reduce cost for production and value chain integration. It will also boost consumer confidence in these technologies and stimulate demand.

- **Improve trade data collection and sharing.** In order to fully understand drivers, barriers and implications of trade in ESTs, more detailed data is necessary, both for goods but particularly also for services. More and better data will enable a more in-depth analysis and provide the basis for policy measures to harness triple-win-opportunities.

- **Establish a regional fund that supports trade and investment in ESTs.** The lack of funding for ESTs is a major barrier to the diffusion and trade in ESTs in the region. Some countries already took steps. For example, Kenya Climate Ventures was launched in 2016 to support early start-up businesses in clean tech industry. A regional fund could build on this success and accelerate trade and value chain integration in ESTs that are most relevant to the region.

- **Develop a regional training programme for ESTs that bridges the various knowledge and capacity gaps.** The technical capacity currently available in the region cannot meet the demands of the market in an effective manner. As a result, some service providers lack the capacity required to offer high-quality installation and maintenance services. Improved skills and knowledge of the workforce could help to attract foreign investment and accelerate value chain cooperation within the region. This could be done through Public Private Partnerships with government agencies, business associations, and civil society groups. The training programme could be tailored to regional circumstances and market demands. In this context, special attention should be paid to the gender dimension. As woman in the EAC have more limited access to wage employment in the tradable sectors than men, they seem to benefit less from new employment opportunities arising from trade liberalization (UNCTAD, 2018a).

- **Raise awareness about the potential benefits of trade in ESTs.** Comprehensive assessments of the potential benefits and costs of trade in ESTs could facilitate evidence-based policy making and overcome scepticism. This could include impacts on exports, economic growth, environment, climate change mitigation and adaptation, energy security, resource efficiency, industrialization, value chain development, employment, gender equality, as well as overall implementation of the 2030 Sustainable Development

Agenda and Paris Agreement on Climate Change. This is a multi-stakeholder opportunity that would engage both governments and private sector actors.

While the main objective of this study was to explore drivers and barriers of trade in ESTs, it should also be borne in mind that trade liberalization initiatives will have limited effects if there are no or only weak markets for those goods in a country. Trade liberalization efforts should thus be implemented as an integral part of broader strategies and polices including targets, incentives and regulations. Such complementary initiatives might require international support in the form of knowledge sharing, capacity building and financial measures (Vossenaar, 2010).

4.2. Drivers, barriers and measures to unlocking trade in PV in Kenya

The national case study section investigated the barriers to trade in solar PV products in Kenya. To this end, the report has examined tariff and non-tariff barriers to trade in solar PV systems in Kenya, as well as the more general challenges to the diffusion of solar PV.

Our findings show that tariff barriers play a minor role in influencing the cross-border trade in solar PV cells and modules and integrated PV systems into Kenya. The Kenyan solar market is largely liberalized, with these products having been exempted from import duties and value added tax. Furthermore, the results also show that the government does not impose import quotas on solar PV products, nor does it regulate prices for them.

However, the findings also show that several NTBs and the more general challenges to the adoption of solar PV systems within the region are inhibiting imports of the requisite technologies into Kenya. For one thing, the government's procurement policy requires companies interested in providing grid-connected solar energy to demonstrate their liquidity. This was criticized by the companies we interviewed as not being favourable to market entry, especially for small and new companies. With regard to government participation in the solar PV market, it was observed that one of the government-run energy-generating companies is reluctant to opening up a space for private power generation.

With regard to customs entry and importation procedures, respondents pointed to the high costs of pre-shipment inspections in the country of origin. They also raised concerns about the often lengthy negotiations and clearance of goods at the ports, due in part to the inability of - and lack of clarity for - custom officials in classifying components for tax exemptions correctly. This issue is particularly problematic for solar PV input components like mounting structures, batteries and solar cables. Furthermore, the rules and procedures for valuations of goods for taxation purposes are not clear. Frequent ERP systems downtimes in the customs and clearing agencies were also highlighted as contributing to delays in clearing goods, which ultimately increases the costs of trade. The lack of any clear agreement between the ERC and the KRA as to what constitutes solar PV products or components was also noted as negatively affecting the trade in solar technologies in the country.

Other administrative barriers to trade include prohibitive licensing regimes that require all companies applying for trading licenses from the ERC to rely on a solar technician's license. Scarcity of solar technicians in the country, as well as lengthy and costly registration procedures for companies, presenting a barrier to the penetration of foreign companies into the Kenyan market.

Besides the barriers highlighted above, other general challenges to the adoption of solar PV energy in the country were identified.
First, most consumers are unaware of the affordability, benefits and availability of solar PV systems. One consequence of this low level of consumer awareness is the proliferation of counterfeits in the market, which has made consumers wary of even genuine solar PV products.

Second, economic barriers, such as the perceived high costs of investment in solar PV systems, high interest rates and financial institutions requiring collateral as security for advancing credit to solar PV traders, were highlighted as impeding the diffusion of solar PV energy.

Third, logistical challenges, such as poor road networks (especially in some rural parts of the country) and traffic congestion, were also highlighted as negatively affecting access to and sales of solar PV products in the country.

Fourth, a lack of adequate skilled personnel able to install and maintain solar PV systems was seen as slowing down the diffusion of solar technologies in Kenya.

Lastly, the lack of monitoring programs for installed solar PVs plants, which may reduce the life-spans of some installed systems.

To address challenges, the following actions are recommended:

- Improve capacity of customs and port officials to process and clear solar PV effectively.
- Review Solar PV Regulations and the Draft Energy Bill to specify and expand the number of solar components and accessories to be exempted from tax. This will greatly improve the affordability and uptake of solar energy in the country, thereby encouraging further investments in the sector.
- Improve policy and regulation coherence between ERC and KRA on what constitutes solar products and whether a given product will enjoy a tax exemption This could be done by organising inter-agency consultations.
- Improve predictability of rules and policies for valuing products for customs purposes. These rules should also be made available to importers.
- Cultivate an environment that supports private-sector involvement in power generation in the country. In particular, the government could incentivize and promote the engagement of 'independent power producers' in the generation and sale of energy from renewables such as off-grid solar PV systems.
- Implement quality-control systems to protect the market from counterfeit and low-standard products. Heavy penalties should be imposed on those found to be selling counterfeit and substandard solar PV systems and installations.
- Increase national consumer awareness on solar PV technologies.
- Develop national standards that, while aligned with international standards, are tailored to the specific conditions of Kenya.
- Organize targeted trainings and capacity building activities for EST related technicians, such as solar energy engineers. This could build on the work by the National Industrial Training Authority (NITA), and in partnership with business associations and private sector organisations. As already mentioned in the first part of the report, special attention should be paid to gender equality when designing trainings and educational measures. While Kenya has the highest share of women in wage employment (26%) among the EAC partner states, there is still a large gender gap, with 56% of men in wage employment (UNCTAD, 2018a).
- Develop financing schemes that support trade in ESTs. This can be done by partnerships between producers of solar equipment for mini-grids and the Kenya Power and Lighting Company and Kenya Electricity Transmission Company Limited to provide investors with an assured market and a transmission mechanism respectively. This is also imperative for the fast-track enactment of the 'Net Metering' policy, as provided for in the draft Energy Bill. This will enable both small and large solar PV producers to sell excess power to the grid, thereby increasing the business case for solar PV installations and investments.

4.3 Implications to global and regional trade governance

The EAC is well-poised to take advantage of this growth in renewable energy sources.

As the report highlights, it is already one the fastest growing regional economies in Sub-Saharan Africa while at the same having an overall relatively low human development index with a majority of its people living in rural areas. Access to electricity is also particularly low in EAC member countries ranging from 7.6% of the population in Burundi to 56% in Kenya in 2016 (World Bank, 2018c). EAC countries have nonetheless established a number of institutional and regulatory frameworks to foster diffusion of ESTs. These also include creating and participating in trade policy frameworks that can play an important role in the diffusion of clean-energy ESTs in the EAC region.

Despite greater market integration efforts within the EAC as well as in the rest of the continent involving other African regional groupings with progress in eliminating tariffs (the majority of ESTs analysed in the report have zero import duties in EAC member states), the report still notes the widespread persistence of numerous NTBs, the removal of which could lead to significant welfare gains. Such barriers include customs related procedural delays and barriers to movement of people including service providers and will still need to be effectively addressed. Regional integration frameworks both within the EAC as well as those involving EAC members as part of SADC, COMESA and the AfCFTA are all highly ambitious in their objectives and requirements for trade in goods and services and will further help EST diffusion. However, it is evident that there is still a lot of ground to cover with regard to implementation. Examples include ratification of important treaties and protocols particularly those involving free movement of people and the right of establishment as well as the need for scheduling of commitments in important services sectors such as construction and engineering. In many aspects, there has been a number of noteworthy initiatives and remarkable progress. Some examples include the introduction of the EAC passport (with an electronic passport set to be issued from 2019 onwards) and steps taken by individual EAC members such as Rwanda enabling EAC nationals to work without a permit (East African Business Week, 2018b).

One of the recommendations laid out in the report is to expedite the adoption, ratification and full implementation of the various protocols that are supportive of trade in ESTs. At the same time negotiations and trade-related commitments made within the EAC as well as in other African regional economic communities point to the fact that the scope of country-specific commitments and the pace of market opening will vary widely. Regional trade policy frameworks and protocols in Africa - while being highly ambitious on paper - have also thrown up implementation related gaps and practical challenges. These have to do with the diversity of development levels, differing domestic priorities and sensitivities around protection of local jobs and national security. Moreover, regional trade agreements in Africa also enable to a certain extent modulation of the depth, breadth and pace of liberalization including through provisions providing for special and differential treatment and variable geometry. An important aspect towards enabling speedier implementation of trade-related provisions and treaty commitments is the need for further development of regulatory frameworks and institutional capacities and greater regulatory coherence within the EAC as well as with other African regional economic communities. Achieving such regulatory coherence will enable easier implementation of obligations such for example those related to mutual recognition of professional qualifications (ITC, 2018).

An interesting aspect of the trade analysis in the report is also the finding of much less trade in ESTs intra-regionally among EAC countries compared with countries outside the region such as China, India and those within Europe. Further the EAC region is also in overall terms a net importer of ESTs from these countries, even though Kenya is revealed as exporting ESTs to a certain extent to other EAC members. The negotiations of trade agreements do not therefore mirror the pattern and geography of EST trade. There have been no trade agreements negotiated with the EAC's external trade partners that are comparable in terms of scope and ambition to the type of trade agreements negotiated within the EAC as well as with other African

economies as in the case of AfCFTA. Even though an EPA with the EU covering trade in goods and development co-operation has been concluded, it can be expected that progress in areas such as services will be slower.

A significant number of NTBs in the EAC context appear to be related to customs procedures and trade facilitation measures. In that regard, the WTO's Trade Facilitation Agreement and related technical assistance, information exchange and capacity building measures as well as similar measures for customs co-operation and trade facilitation agreed in the context of bilateral arrangements such as the EU-EAC EPA will be of critical importance. EAC member states as well as donor agencies and international organizations may also wish to consider specific tailor-made technical assistance and capacity building measures for trade facilitation in ESTs which could specifically address some of the issues highlighted in the report such as capacity of customs and port officials to process and clear solar PV effectively.

While intra-African liberalization may open up large markets to EAC exports and also provide economies of scale to foreign investors, this may not automatically translate into a larger share of intra-regional ESTs trade, particularly EST exports. This will require active technical and financial assistance for domestic firms as well as additional foreign investment in creating and strengthening domestic EST manufacturing capacity to service local and export markets. Capacity building to upgrade and strengthen EST related product standards and conformity assistance measures can also help. Building up skills of local workforce will help create a workforce that can be readily hired for renewable energy projects and downstream services operations and maintenance as well as eventually in upstream manufacturing related activities. EAC countries could also include requirements for foreign companies to invest in training their local workforce as part of their schedule of services commitments in trade agreements signed with the more advanced economies. Such measures will ensure that 'green economy' jobs are created in the EST sector enabled by both imports of ESTs (for e.g. in downstream installation and maintenance of renewable energy plants) as well as through eventual domestic manufacturing and exports of RE ESTs (starting perhaps with components and lower technology segments of the value-chain).

Additionally, the provisions of the Economic and Development Co-operation Chapter (Part V) of EU-EAC EPA which has a number of provisions aimed at improving supply-side constraints and enhancing competitiveness in EAC member states is worth noting. Such provisions could perhaps be replicated for future trade agreements that the EAC members may sign collectively or as part of larger trading blocs such as the AfCFTA not only with developed economies but also with external trading partners such as China and India (EU and EAC, 2014). Improved competitiveness and moving up the EST value chain will also eventually enable EAC members to take full advantage of preferential market access schemes of external trading partners such as the EU's Everything But Arms Initiative, India's Duty Free Quota Free Tariff Preference Scheme for LDCs and China's Duty Free Quota Free Scheme for LDCs among others (see UNCTAD, 2017; UNCTAD, 2018b; EC Trade HelpDesk, 2018). Such measures could complement development-related assistance channeled to ESTs provided by bilateral donors as well as international organizations such as UN Environment, WTO, ITC, World Bank, UNIDO and the World Customs Organisation. All of the measures will go a long way in enabling that trade policy can support the renewable energy sector in the EAC and also deliver on a number of major SDGs including SDG 3 on good health and well-being, SDG 7 on affordable and clean energy and SDG 13 on climate change.

Annexes

Annex 1 – WTO GATS commitments of EAC states

WTO GATS Commitments of EAC member states (except South Sudan)[18] in Important Ancillary Services for Renewable Energy: Presence of Market Access (MA)/National Treatment (NT) Limitations

Limitations in Commitments		**Horizontal Commitments**		**Construction and related Engineering Services incl Installation and Assembly (CPC 512/513/514-6)**		**Professional Services: Engineering Services (CPC 8672/8673)**		**Other Business Services: Engineering related Scientific and Technical Consulting (CPC 8675)**		**Other Business Services: Maintenance and Repair of Equipment (CPC 633) and (CPC 8861 to 8866)**	
Country	mode of delivery	MA	NT	MA	NT	MA	NT	MA	NT	MA	NT
Burundi	Mode1	NHS	NHS	None	None	NS	NS	NS	NS	None	None
	Mode2	NHS	NHS	None	None	NS	NS	NS	NS	None	None
	Mode3	NHS	NHS	None	None	NS	NS	NS	NS	None	None
	Mode4	✔	✔	✔	✔	NS	NS	NS	NS	✔	✔
Kenya	Mode1	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode2	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode3	✔	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode4	✔	NHS	NS	NS	NS	NS	NS	NS	NS	NS
Rwanda	Mode1	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode2	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode3	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode4	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
Tanzania	Mode1	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode2	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode3	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode4	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
Uganda	Mode1	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode2	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode3	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS
	Mode4	NHS	NHS	NS	NS	NS	NS	NS	NS	NS	NS

1. NS: indicates sector not included in GATS schedule of commitments **2. Tick mark:** indicates qualified or restricted commitments made **3. NHS:** No horizontal commitments scheduled **4. None:** No restrictions on market access or national treatment

Source: WTO GATS Schedule of Specific Commitments for: ***Burundi****-GATS/SC/116, 30 August 1995;* ***Kenya****-GATS/SC/47, 15 April 1994;* ***Rwanda****-GATS/SC/107, 30 August 1995;* ***Tanzania****-GATS/SC/84, 15 April 1994;* ***Uganda****-GATS/SC/89, 15 April 1994.*

18 South Sudan has not yet acceded to the WTO.

Annex 2 – The East African Community Common Market: ANNEX V Schedule of Commitments on the Progressive Liberalisation of Services

Country	(Sub) Sector /CPC Code	Market Access	Elimination Date	National Treatment	Elimination Date
BUSINESS SERVICES					
Burundi	**A. Professional Services**				
	e) Engineering Services (CPC 8672)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010
	(f)Integrated Engineering Services (CPC 863)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010
	D. Other Business Services				
	(j) Maintenance and repair of equipment (CPC 633+ 8861 8866)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010
Kenya	**A. Professional Services**				
	(d) Advisory and Consultative Engineering Services (CPC 86721)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010

Country	(Sub) Sector /CPC Code	Market Access	Elimination Date	National Treatment	Elimination Date
Rwanda	**A. Professional Services**				
	(e) Engineering Services (CPC 8672)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers. (Residency requirements exist for accountants and architects)	2010
	(f) Integrated Engineering Services (CPC 863)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers. (Residency requirements exist for accountants and architects)	2010
	D. Other Business Services				
	(j) Maintenance and repair of equipment (CPC 633+ 8861-8866)	(1) None (2) None (3) None (4)In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4)In accordance with the Schedule on the Free Movement of Workers	2010
Tanzania	**A. Professional Services**				
	(b) Engineering & Integrated Engineering Services (CPC 8672 and 8673)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010

Country	(Sub) Sector /CPC Code	Market Access	Elimination Date	National Treatment	Elimination Date
Uganda	**A.Professional Services**				
	e) Engineering Services (CPC 8672)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010
	(f)Integrated Engineering Services (CPC 863)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010
	D. Other Business Services				
	(j) Maintenance and repair of equipment (CPC 633+ 8861-8866)	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010	(1) None (2) None (3) None (4) In accordance with the Schedule on the Free Movement of Workers	2010

Explanatory Notes for the Schedule on the Progressive Liberalisation of Services

1.(1) means Modes I: the supply of services from the territory of a Partner State into the territory of another Partner State.

2.(2) means Mode II: the supply of services in the territory of a Partner State to service consumers from another partner State.

3.(3) means Mode III: the supply of services by a service supplier of a Partner State, through the commercial presence of the service supplier in the territory of another Partner State.

4.(4) means Mode IV: the supply of the services by a supplier of a Partner State, through the presence of a natural person of a Partner State in the territory of another Partner State.

5.CPC: means the United Nations Central Product Classification Codes for services.

6.None: this means no restriction in market access and national treatment in the sub-sector under consideration.

7.Unbound: this means no commitment to fully liberalise the subsector until the mentioned date when there will be a full commitment or the commitment undertaken does not take effect until the mentioned date.

Schedule on the Free Movement of Workers means the Schedule under the East African Community Common Market (Free Movement of Workers) Regulations.

Source: East African Community: The East African Community Common Market Schedule of Commitments on the Progressive Liberalisation of Services: ANNEX V.

Annex 3 – List of respondents

List of Respondents

No.	Organization
1	Pawame
2	Strauss Energy
3	Energy Regualtory Commisssion
4	Energy Regualtory Commisssion
5	Strathmore Energy Research Centre
6	Kenya Climate Innovation Centre
7	Kenya Association of Manufacturers
8	Power Solutions
9	Astonfield Solesa
10	Go-Solar
11	Glosec
12	Equitorial Energy
13	Solinc
14	Ofgen
15	Greenspark
16	Davis and Shirtlif
17	Jua Letu
18	Solarpoa
19	M-Kopa
20	Barefoot
21	Ministry of Energy
22	Operations, Kenya Ports Authority, Mombasa
23	Tax Claims Officer, KRA, Port of Mombasa

Annex 4 – Interview guide – Solar companies

Interview Guide – Solar Companies

A) Introduction:

Who we are, purpose of study, etc.

B) General Background and Company Information

Table 1

Ownership (local, foreign)	The starters of the company are from Canada, so foreign ownership			
Age (Year of commencement)				
Annual turnover (current or average)				
Percentage of turnover from Solar PV related sales				
Number of employees (current)				
How many employees working mainly in Solar PV				
Employee training and education	Degree e.g. business or engineering		Specialist practical qualifications (electricians etc.)	
	Informal training courses e.g. in engineering or electronics		Self-taught	
	No. of technicians		Other training	
Respondent's details	Time spent working at the company			
	Main responsibilities and position			

C) Products and Trade Flows

What are your main products? (Enter these in Table 2)

c1) (Downstream)

To which customer segments are the main components sold (e.g. national/regional retailers, direct consumer sales etc.)? (Indicate with X in Table 2)

Table 2

	Retailers national	Retailers regional	Direct consumer sales (KE and region[19])	Companies to integrate in final product: KE or region			
Panels/Modules					Maximum 20 watts		
Inverters							
Charge controllers							
Batteries							
Mounting structures							
Lanterns							
Solar home systems							
Control box with battery inside							

19 Region defined as six EAC countries: Kenya, Tanzania, Uganda, Rwanda, Burundi and South Sudan.

Where are your main markets (countries/regions)? (Answers in Table 3)

How much (solar related products only) is sold per year in each market? (Answers in Table 3)

Table 3

Main market	How much is sold/year in USD or Ksh (if figure not known then percentage estimate)

Who are your main customers (according to type e.g. retailers national/regional market, direct consumer sales)? (Answers in table 4)

Table 4

Type	Customer (Name of company/organisation)

C2) Upstream

Where are the main components sourced?

Table 5

	Country of origin	Company	Remarks

D) Description of the main barriers to trade along the value chain

Can you tell me about any non-tariff barriers you have experienced for the components you are importing relating to solar PV?

1. Taxes
Probe: *import/export duty; *discriminative; *other tax.

2. Customs entry procedures
Probe: *Customs' knowledge of solar pv products (e.g. ability to categorise and value them accurately for tax/exemption purposes…do they follow correct procedures.? *Are pre-shipment inspection rules and processes for solar products clear? *Are the rules for valuation of goods (solar products) for customs purposes clear? *Other customs related procedures.

3. Port regulations
Probe: *import/export regulations; *domestic market regulations; *tax regulations; price regulations.

4. Other administrative barriers

Probe: *How clear and transparent / accessible is information on regulations and procedures? *Foreign exchange restrictions? Do importers/ exporters have to prove that they have enough foreign exchange? *How long does it take to receive / process an import/ export license? *Challenges with consular formalities (documents required/time/cost)

5. Government procurement policies (distorting)

Probe: *Regional/national policies

6. Government participation in trade

Probe: *Do you know of any state trading and preferential treatments? If yes, how do these affect trade in solar products?

7. Health and safety/sanitary regulations

8. Technical standards/specifications

Probe: *Are there any technical specifications that need to be met by solar product importers?

9. Import/export quotas

Probe: *Are there quantity restrictions for solar imports/exports?

10. Other quotas

11. Infrastructure constraints

D1) Importance of non-tariff trade barriers (in relation to end cost to product)

Indicate the importance on a scale from 1 to 5 (5 being the most important) of each of the following non-tariff trade barriers for the relevant products in your company.

Table 6

Non -tariff trade barriers	Panels	Inverters	Charge Controllers	Batteries	Mounting structures	Lanterns	Solar home systems (kits)	Other
1. Taxes (e.g. import/ internal taxes)								
2. Customs entry procedures								
3. Port regulations								
4. Other administrative barriers								

5. Government procurement policies (distorting)								
6. Government participation in trade								
7.Health/safety/sanitary regulations								
8. Technical standards/ specifications								
9. Import/ export quotas								
10. Other quotas								
11.Infrastructure constraints								

D2) Costs of non-tariff barriers

Indicate how much the indicated non-tariff barrier will increase the cost of your product (%), (e.g. due to waiting time, staff time to get items though custom, staff time for extra administration, etc.)

Table 7

Non-tariff barrier	% increase in cost of product
1. Taxes (e.g. import/internal taxes)	
2. Customs entry procedures	
3. Port regulations	
4. Other administrative barriers	
5. Government procurement policies (distorting)	
6. Government participation in trade	
7.Health/safety/sanitary regulations	
8. Technical standards/ specifications	
9. Import/ export quotas	
10. Other quotas	
11.Infrastructure constraints	

D3) Details of most important barriers

Please explain in more detail how the two most important barriers are experienced in your company.

Most important barrier:

Second most important barrier:

In your view, what could be some of the ways to address the above barriers to trade in solar PV systems?

E) Follow up questions relating to barriers to diffusion of solar PV products

1. Is it easy to access financing for solar PV systems (e.g. from banks, microfinance institutions; SACCOs, etc.)
2. How affordable are the interest rates?
3. How aware is the markets in terms of the benefits and (longterm) affordability of solar PVs?
4. What is the level of consumer awareness on the affordability or benefits of alternatives?
5. How does the level of awareness among consumers affect trade in solar PV systems?
6. What is the capacity of consumers to different between genuine and counterfeit/ substandard solar products?
7. How does this awareness or lack thereof affect trade on solar PV systems?
8. What standards/ specifications challenge do you face in importation and sale of solar PV (e.g. differences between KEBS and Tanzania Bureau of Standards specifications for solar PVs)
9. How easy or difficult is it to find skilled labour to install, service, maintain, repair and trouble-shoot in the solar PV subsector?
10. How does the availability of such skills enable or constrain trade in solar PVs? Please explain any measures to develop such skills
11. Are there challenges with regard to logistics (e.g. transportatition, handling facilities, etc.)?
12. In your opinion, how can each of the identified barriers be addressed to facilitate trade in solar PVs?

Annex 5 – Interview guide – Government, research and academic institutions

Interview Guide – Government, Research and Academic institutions

A) Introduction:

Who we are, purpose of study, etc.

B) General Background about the organization …….

C) General description of the solar PV market and value chain

What are the major solar products trades? (enter these in Table 2)
Where are the solar products sold (to which customers: retailers, direct sales etc.)?
How is the solar market organized (importers; distributors; installers; engineering, procurement and construction companies; etc.)

D) Description of the main barriers to trade along the value chain

1. Can you tell me about any tariff barriers you may have experienced for the solar products your members are importing relating to solar PV? (e.g. import/export duty; VAT; sales tax; import/ export regulations; domestic market regulations; tax regulations; and price regulation)
2. How does the above tariffs and regulations enable or constrain trade in solar products?
3. How easy or difficult is it to process imports (solar) at the ports of entry/ exit? Probe customs procedures and how they affect trade e.g. additional costs, delays, etc.
4. What government/ regional policies, legislations and regulations enable or constrain trade (importation, sale and use) of solar PV systems?
5. How does import/ export, domestic market, tax and price regulations, policies and legislations enable/ constrain trade in solar PVs?
6. Go you know of any state trading and preferential treatments? If yes, how these affect trade in solar products?
7. Are there any government programs (e.g. preferential procurement of RE or local goods) that facilitate or constrain trade in solar PVs systems?
8. Are there quantity and quota restrictions for solar imports/ exports?
9. Are there is import/ export licensing requirements and procedures? If yes, how clear, simple and transparent are these requirements and procedures?
10. Do you experience any foreign exchange restrictions? Probe whether importers/ exporters must prove that they have enough foreign exchange?
11. How long does it take to receive / process an import/ export license?
12. Are the rules for valuation of goods (solar products) for customs purposes clear?
13. How quickly and easy is it value solar products at the ports for purposes of calculation customs/ import duty?
14. Are pre-shipment inspection rules and processes for solar products clear?
15. Are there any technical specifications to be met by solar product importers? If yes, how does this affect your costs?
16. Are there requirements for importers to adhere and provide certain documentation? If yes, what are these documents and how easy is it to access them and how does this affect your costs?
17. How quickly and easy is it to conduct pre-shipment inspection of solar products?
18. Any challenges with consular formalities (documents required) and how this affect trade? Probe: Time to get documents; cost of such documents
19. What other non-tax barriers do you experience?
20. What is the significance of non-tariff barriers for your company (in terms of increased costs)
21. In your view, what could be some of the ways to address the above barriers totrade in solar PV systems?

Annex 6 - Economic modelling on impacts of trade liberalization of selected ESTs

Further detail on the assessment and methodology

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1. Introduction

This report quantifies and discusses the impacts resulting from a unilateral liberalization of trade in five selected ESTs by the East African Community (EAC) countries. We analyze three different scenarios. In the first scenario, and for all five ESTs, we consider an elimination of EAC import tariffs from all sources. In the second scenario, we assume that the EAC countries remove both tariffs and NTBs to imports from all sources. In the final scenario, we assume that tariffs and NTBs are removed on intra-EAC trade only. For each of the three scenarios we discuss the simulated output and welfare effects, and the impact on trade flows.

A comparison of the results from the first and second scenarios indicates the relative importance of tariffs versus NTBs. To explore the potential impacts associated with further regional economic integration within the EAC, compared to doing so beyond the EAC, we compare the results from the first and third scenarios, and from the second and third scenarios. Our analysis is underpinned by the outputs of an Applied Partial Equilibrium (APE) model of international trade, known as GSIM (Francois and Hall, 1997, 2009). The model is global in scope and disaggregated at the level of single industries. That is, the model allows us to analyze changes in global trade flows resulting from simultaneous policy changes in multiple countries, and to do so at a highly disaggregated industry level. Compared to the outputs that could be obtained with an Applied General Equilibrium (AGE) model, a key limitation of the APE modelling approach is that the analysis does not reflect inter-sectoral dynamics. Nonetheless, when the output of the industry considered is relatively small, as is the case with ESTs, inter-sectoral dynamics are small too and, therefore, overlooking them does not alter the overall conclusions. Compared to an AGE model, parsimony is a key advantage of an APE model: in addition to assumed post-liberalization tariff rates, an APE model requires pre-liberalization trade flows and tariff rates, and a small number of additional key parameters.

Our main findings can be summarized as follows.. Scenario 1, defined as a unilateral removal of tariff on EST imports from all sources by the EAC countries, leads to modest effects on output and welfare. The reason for the modest effect is that EAC MFN tariffs are zero for seven of the eight products comprising the five ESTs. Scenario 2, on the other hand, where the EAC countries eliminate all NTBs as well as tariffs, on imports from all sources, leads to much larger effects in terms of welfare and output changes. In particular, the combined welfare gain from scenario 2 to all EAC countries is one order of magnitude larger than the gain from scenario 1 (16.1 vs. 1.6 million $US) which clearly illustrates the relative importance of NTBs vs. tariffs. Scenario 3, where the EAC countries remove their NTBs only on intra-EAC trade (tariffs on intra-EAC imports of ESTs are zero) results in very small welfare gains due to the simple fact that there is little intra-EAC trade in ESTs.

The chapter proceeds as follows. Section 2 explains the model used to calculate the impacts from the different scenarios. Section 3 provides a background on the global and EAC trade in ESTs which ends with a discussion of the expected impacts from each of the three scenarios.

Section 4 presents the simulated effects from the three scenarios and section 5 discusses issues not covered in the main analysis. Finally, section 6 offers the concluding remarks.

2. The model

This section describes the economic model that we use to calculate the effects of trade liberalization. As mentioned in the introduction, it is an Applied Partial Equilibrium (APE) model of international trade known as GSIM (Francois and Hall, 1997, 2009). An APE model entails a focus that is global in scope but limited to a single industry. That is, the effects from each of the scenarios must be obtained for each individual EST independently.

2.1 Supply and demand

The model assumes national product differentiation meaning that imports of the same good from different source countries are treated as imperfect substitutes for each other. Countries therefore import the same good from different countries, even when they are sold at different prices, because they are considered different varieties. Specifically, when there are countries trading with each other, we can define a composite good consumed in country j as

$$E_j = c_j P_j^{\eta+1}, \qquad (1)$$

where x_{ij} denotes domestic consumption (in country j) of goods produced in country $i = 1,...,n$, α_{ij} is a weight such that $\sum_{i=1}^{n} \alpha_{ij} = 1, \ \forall j$ and $\sigma = \frac{1}{1-\rho} > 0$ is the (constant) elasticity of substitution between goods from two different countries l, J (including the home country). The aggregator function in equation is also referred to as a Constant Elasticity of Substitution (CES) aggregator. When the varieties are indexed over source countries it is also known as an Armington aggregator (see Armington, 1969). The composite good in has an associated CES price index that can be written as:

$$P_j = \left(\sum_{i=1}^{n} \alpha_{ij}^{\sigma} p_{ij}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \qquad (2)$$

where $p_{ij} = \bar{p}_i (1 + t_{ij})$; the domestic price of a good produced in country i and consumed in country j, $\bar{p}_i$ is the price received by exporter i on the world market and t_{ij} is the ad-valorem tariff in country j on imports from country $i = 1,...,n$ ($t_{jj} = 0$). Import demand in country j for a good from exporting country i can be written as:

$$x_{ij} = \alpha_{ij}^{\sigma} \left(\frac{p_{ij}}{P_j} \right)^{-\sigma} \frac{E_j}{P_j}, \qquad (3)$$

where $E_j = \sum_{i=1}^{n} p_{ij} x_{ij}$ denotes total expenditure in j on goods from all sources $i = 1,...,n$. Note that import demand in j of goods from i is decreasing in its price p_{ij} and increasing in total expenditure E_j as we would expect.

Country i's export supply of the good in question is assumed to be a function of the price received on the world market, given by the following expression:

$$Q_i = \sum_{j \neq i}^{n} x_{ij} = k_i \overline{p}_i^{\grave{o}}, \tag{4}$$

where $\grave{o}$ denotes the elasticity of supply and k_i is a constant. Similarly, demand in j of the composite good defined in is assumed to be a constant elasticity function of the domestic price index . Expenditure in j is therefore given by the following expression:

$$E_j = c_j P_j^{\eta+1}, \tag{5}$$

where η is the elasticity of demand and c_j is a constant. Note that, for simplicity, we assume the same elasticities of supply and demand for all countries.

2.2 Equilibrium

We solve for the global market equilibrium by equating the sum of all import demands for goods produced in i with total export supply from i. That is:

$$\sum_{j=1}^{n} x_{ij} = \sum_{j=1}^{n} \alpha_{ij}^{\sigma} \left(\frac{p_{ij}}{P_j} \right)^{-\sigma} \frac{E_j}{P_j} = k_i \overline{p}_i^{\grave{o}} = Q_i, \ \forall \ i. \tag{6}$$

Substituting E_j for and P_j for , bearing in mind that $p_{ij} = \overline{p}_i (1 + t_{ij})$, leaves us with a system of n equation in n unknowns. Solving for the individual prices $\overline{p}_i$ we can use equation , , and to solve for changes in aggregate prices, bilateral trade flows, production and consumption, resulting from a change in tariffs.

2.3 Welfare effects

Once we have solved for changes in prices and quantities resulting from the policy change, we can easily calculate the impact on government revenue. In addition, we can calculate welfare impacts on producers and consumers based on the concepts of producer and consumer surplus. The total welfare effect of the change in tariffs is defined as the sum of changes to government revenue, producer and consumer surplus.

Producer surplus (PS), also known as quasi-rent, is defined as revenue less total variable costs or, alternatively, profits plus total fixed costs. It can be illustrated as the geometric area under the export supply curve and above the price line in a standard supply diagram. Loosely speaking, it represents the benefit that producers accrue from staying in business. The change in PS following a policy change, which is equal to the change in profits, is approximated through the following expression:

$$\Delta PS_i = r_i^0 \hat{p}_i + \frac{1}{2} r_i^0 \hat{p}_i \hat{x}_i = \left(r_i^0 \hat{p}_i \right) \left(1 + \frac{\grave{o} \hat{p}_i}{2} \right) \tag{7}$$

where r_i^0 denotes export revenue in i prior to the policy change and a "hat" (^) symbolizes a proportional change. The two terms in the right-hand side of the top equation represent a rectangular and triangular area, respectively, in the supply diagram implying that is based on a linear approximation of the export supply function. Such approximations are relatively accurate when the price changes resulting from a tariff removal are small.

The concept of consumer surplus (CS) is more problematic from a theoretical perspective than that of producer surplus. In a demand diagram it can be illustrated as the area below the price line and above the demand curve. A change in CS is interpreted as a monetary measure of utility change although this interpretation is only valid under certain restrictive conditions.

Consumption of the composite good defined by equation depends on the price index . A change to this price index can be written as follows:

$$\hat{P}_j = \frac{dP_j}{P_j} = \sum_{i=1}^{n} \mathsf{q}_{ij} \hat{p}_{ij}, \tag{8}$$

where θ_{ij} is the expenditure share in j on goods from i. The proportional change in the domestic price in j of a good from i, caused by a change in the tariff, depends on the size of the tariff change as well as the resulting change in the export price:

$$\frac{dp_{ij}}{p_{ij}} = \hat{p}_{ij} = \frac{\overline{p}_i^1 \left(1+t_{ij}^1\right)}{\overline{p}_i^0 \left(1+t_{ij}^0\right)} - 1 = \left(1+\hat{p}_i\right) \frac{\left(1+t_{ij}^1\right)}{\left(1+t_{ij}^0\right)} - 1. \tag{9}$$

This makes it possible to approximate the change in CS through the following expression:

$$\Delta CS_j = \left(\sum_{i=1}^{n} r_{ij}^0 (1+t_{ij}^0) \right) \left(\frac{\mathsf{h} \hat{P}_j^2 \cdot sign(\hat{P}_j)}{2} - \hat{P}_j \right) \tag{10}$$

where $r_{ij}^0(1+t_{ij}^0)$ represents initial expenditure in j on imports from i. The $sign(\hat{P}_j)$ term is necessary because the elasticity of demand is negative, $n<0$. Again, the linear approximation is appropriate for small changes.

As mentioned above, the total domestic welfare change in country j, resulting from a change in tariffs, is defined as:

$$\Delta W_j = \Delta GR_j + \Delta CS_j + \Delta PS_j.$$

It is measured in the same unit as the trade flows (that is, in US dollars).[20]

3. Trade flows, tariffs and non-tariff barriers

This section starts out by describing global trade in the eight EST products considered in this report, including the top importers and exporters. Next, we summarize the EAC's imports and exports of these products and, finally, we describe the tariff and non-tariff barriers facing imports into the EAC. Our data on trade flows and tariff rates are sourced from the World Integrated Trade Solution (WITS) website maintained by the World Bank and the Integrated Data Base (IDB) maintained by the World Trade Organization (WTO).[21]

20 The elasticities that we use to calculate the various effects are the same for all countries and are given by *n* = -1.25 (demand), Ò = 1.5 (supply) and σ =5 (substitution). These are standard values in the applied literature (see e.g. Stern, 1976, Goldstein and Khan, 1985, Reinert and Roland-Holst, 1992, Feenstra *et al.*, 2012).

21 From WITS one has access to the United Nations (UN) Comtrade database, the World Trade Organization (WTO) Integrated Data Base (IDB), the UNCTAD Trade Analysis Information System (TRAINS) and other resources.

3.1 Trade in ESTs

Table 1 lists the eight products, classified according to the 6 digit Harmonized System (HS6), constituting the 5 ESTs included in the analysis. Figure 1 illustrates the global import value of the product with HS6 code 854140 (photosensitive, including photovoltaic cells), which we shall refer to simply as "solar cells", from 1996-2016. It is by far the most traded of the eight EST products. Figure 2 shows that the second most traded of the eight products (850231-Electric generating sets; wind-powered), has a trade value that is around one tenth of that of solar cells. This product constitute one out of two products included in the EST we shall refer to as "wind turbines".

Table 2 lists the world's top 10 importers and exporters of these five ESTs combined, where the numbers represent the 2014-16 averages in million US dollars. As can be seen, EU27, China, US, Japan and Korea are top exporters as well as importers of these products and so are the individual EU member states of Germany and UK. Two small economies, Denmark and Singapore, are among the top 10 exporters of these goods combined. Specifically, Denmark is a major exporter of wind turbines whereas Singapore is a major exporter of Solar cells.

Table 3 summarizes the EAC members' total imports of the five ESTs for the years 2014-2016. Note that data for Kenya are not available. The most imported product by the EAC countries is 730820 (iron or steel; structures and parts thereof, towers and lattice masts), followed by 854140 (solar cells), whereas imports for the rest products are close to zero. Finally Table 4 compares the total EAC imports of the five ESTs with the imports coming from other EAC countries. It can be seen that intra EAC import share is very low for almost all countries and products.

3.2 EAC tariffs on ESTs

Table 5 summarizes the average applied MFN tariffs on the five ESTs by the five EAC countries.[22] The most protected industry, on average, is 730820 (iron or steel; structures and parts thereof, towers and lattice masts) and the countries with the highest tariffs, on average, are Burundi, Kenya, Tanzania and Uganda. According to these figures, there is some variation from year–to-year in the applied MFN tariffs for several of the countries and therefore we need to make a decision as to which tariffs we use in the simulations. Table 6 lists the initial applied MFN tariffs for each EAC member country and each of the eight EST products that we use in the simulations. These are just the tariffs from Table 5 for the most recent year for each country and product. All scenarios are based on trade flows from 2015, which is the most recent year with complete information. Similarly, Table 7 shows the tariffs that each EAC country imposes on imports from other EAC members. It can be seen that intra-EAC preferential import tariffs are zero. These figures, which also refer to the most recent year in the 2014-2016 period, are the initial preferential EAC tariffs that we use in the simulations.[23]

3.3 Non-tariff barriers

Table summarizes the non-tariff barriers (NTBs) to imports of the different ESTs into EAC that we use in the simulations. The NTB numbers, which are based on Egger et al. (2015), represent ad valorem tariff equivalents (AVEs) of the NTBs, i.e. the equivalent tariff that would reduce trade to the same extent as the NTBs (see also Berden and Francois, 2015). We also list the average EAC MFN tariffs on each product for comparison. Clearly, NTBs are more important than tariffs, which are non-zero only for the first product. That being said, the NTB

22 We do not include South Sudan which only joined the EAC in 2016.
23 The EAC countries do not report any preferential tariffs for other than their EAC partners.

figures are subject to substantial uncertainty. However, rather than going into a discussion of the methodology behind these NTB AVE estimates we refer to the studies mentioned above.

3.4 Scenarios

We consider three scenarios. In the first scenario we assume that the EAC countries remove their tariffs on imports from all sources of the eight EST products listed in Table 1. In the second scenario, we assume that, in addition to the tariff removal, the EAC countries are able to remove their non-tariff barriers (NTBs) as well, on imports from all sources. Finally, in the third scenario we assume that the tariff and NTB removal applies only to EAC imports from other EAC countries. This way we are able to assess the relative importance of tariffs versus NTBs on trade flows and welfare in addition to the value of pursuing further regional economic integration within the EAC framework versus a broader free trade agenda. Note that all scenarios refer to a unilateral trade liberalization by the EAC countries. That is, we assume that third country tariffs (and NTBs) on export from EAC countries remain unchanged in all three scenarios.

We comment on the outcomes from each of the three scenarios below. However, before we present the results it is worth commenting on the expected impacts of the tariff removals. As Table 3 and 4 show, most of the EAC countries do not import much of these products. Moreover, as Table 6-7 shows, the EAC countries currently do not impose MFN tariffs on seven out of the eight EST products so a complete tariff removal will not have a large effect on trade. However, according to Table 8, there are considerable NTBs to trade in these products so a removal of the NTBs will of course have a larger effect on trade flows and welfare than a removal of tariffs. Regarding the expected qualitative changes, basic economic reasoning suggests that unilateral tariff elimination by the EAC countries will reduce EAC import demand for goods produced within the EAC. On the other hand, EAC import demand for goods produced in third countries is expected to increase. The reason is that the EAC import price of goods produced in third countries will generally fall more than the import price of goods produced within the EAC, because the initial tariff, at least in one case, is higher in the former case than in the latter. In the third scenario where NTBs on intra EAC imports are eliminated we would expect to see additional intra EAC trade (trade diversion) whereas in the second scenario where NTBs on EAC imports from all countries are eliminated the effect would be more trade in general (trade creation).

4. Results

In this section we report the results from the simulations of the three scenarios. In each of the tables summarizing the simulation results, we report changes for each of the eight EST products and each of the five EAC countries. In addition, we report simulated changes for the major exporting countries: China, EU28, Japan, Korea, the United States and the rest of the world (a country grouping that we label ROW).

4.1 Scenario 1: Unilateral removal of tariffs by the EAC countries

Table 9 shows the simulated effects on output resulting from a tariff removal by the EAC countries. The changes are low, as expected, and in line with the qualitative predictions above. Table 10 summarizes the net welfare effects resulting from scenario 1. As can be seen from Table 6, tariffs exist only for the EST 730820 (iron or steel; structures and parts thereof, towers and lattice masts). Therefore, the simulated output and net welfare effects for the remaining products will be zero. That being said, exports decline for Burundi and Kenya, and increase slightly for the remaining countries. As discussed above, the explanation for this pattern of

change is that the tariff elimination makes exports from EAC's non-preferential trade partners relatively cheaper, whereas exports from EAC countries become relatively more expensive.

Table 10 summarizes the net welfare effects resulting from scenario 1. None of the welfare impacts from the removal of EAC tariff on EST imports are above 1.5 million $US. Clearly, the net welfare effects are modest. Most of the EAC countries experience welfare gains as a result of the tariff removal, except for Burundi and Kenya, whose net welfare remain unchanged (Burundi) or decrease slightly (Kenya). The reason for the Kenyan welfare reduction is that, according to the official UN trade statistics, the country does not import any of the five ESTs. Therefore, the price reduction caused by the removal of tariffs will not benefit consumers in Kenya. Kenyan producers, on the other hand, will suffer from the increased competition with third countries.

Among the EAC trade partners, China experiences the largest welfare gains, whereas the United States experiences the largest welfare losses when the EAC countries remove their tariffs. The reason is that producers in China experience higher import demand, while consumers in the United States experience a loss due to the resulting increase in prices. In general, third countries that are net importers such as the United States are adversely affected in scenario 1, whereas net exporters such as China are better off.

4.2 Scenario 2: Unilateral removal of tariffs and NTBs by the EAC countries

Scenario 2 is the most comprehensive of the three liberalization scenarios and, as mentioned above, we would expect that it leads to increased EAC imports from all sources. Results summarized in Table 11 are supportive of this hypothesis. The table shows the simulated effects on output resulting from a complete unilateral trade liberalization (elimination of tariffs and NTBs on imports from all sources) by the EAC countries, where changes larger than 5 % are written in boldface type. In comparison with scenario 1, where only the EAC import tariffs were removed, there are two major differences (see Table 9). First, there are more non-zero effects in scenario 2. Secondly, the fall in production of 730820 by Burundi and Kenya is smaller than in scenario 1. The reason for the former difference is that the EAC countries do not impose any tariffs on seven of the eight selected EST products, whereas there are NTBs to imports for all eight products, cf. Table 8. The reason for the latter difference is that the removal of NTBs increases EAC demand for imports from all sources. Although the price of 730820 from non-EAC third countries falls more than the price of imports from EAC countries, so that there is substitution towards imports from EAC's non-PTA partners, the lower trade costs on imports from all sources will tend to increase imports from all sources.

Table 12 summarizes the net welfare effects resulting from scenario 2. Clearly, there are no significant welfare effects on the majority of the products, except for 730820. In four out of five cases the EAC countries gain from trade liberalization, meaning that the loss of tariff revenue is outweighed by an increase in consumer and producer surplus. Only in Kenya, where there are no imports, and where exports mainly go to other EAC countries, is there a reduction in aggregate welfare.

For the non-EAC countries there is no effect on tariff revenue, since we do not change the tariffs that these countries apply to imports. Producers in these countries generally experience welfare gains due to the higher import demand by the EAC countries, whereas consumers experience a loss due to the resulting increase in prices (tariffs and NTBs remain constant in non-EAC countries in all three scenarios). Countries that are net importers of the five ESTs are therefore adversely affected in scenario 2, whereas net exporters are better off. By comparing the figures in Table 12 with the corresponding figures in Table 12, we see that the welfare effects are much higher in scenario 2 than in scenario 1. The EAC country with the largest

net welfare impact is Tanzania, with an estimated welfare gain of approximately 11.8 million $US, as compared with 1.4 million $US in scenario 1. The liberalization of trade does not bring about any significant welfare gains to the remaining EAC countries.

Table 13 decomposes the welfare effects from liberalizing trade in 730820 on consumers, producers and taxpayers. As can be seen, it is mainly the EAC consumers that are better off with the lower domestic prices. Producers in non-EAC countries benefit from the increased demand and resulting higher world-market prices, whereas consumers in non-EAC countries are left slightly worse off.

4.3 Scenario 3: Unilateral removal of tariffs and NTBs on imports from other EAC countries

In the third scenario we assume that the EAC countries eliminate all NTBs on imports from other EAC countries.[24] Thus, whereas scenario 1 and 2 represent a broad free trade agenda by the EAC countries, scenario 3 represents a situation where the EAC countries pursue a deeper level of economic integration within the EAC trade bloc. Table 14 contains the simulated output effects resulting from scenario 3. Compared to Table 44, which contained the output effects from scenario 2, where the EAC tariffs and NTBs on imports from all sources were eliminated, there are two obvious differences. First, as anticipated, the simulated effects on EAC output are larger than in scenario 2. For example, the effects on Tanzania's and Uganda's outputs of the second EST are three times as high in scenario 3, than in scenario 2. Moreover, Burundi's and Kenya's output of 730820 turns positive in scenario 3, from -9.9 and -6.3 %, respectively, to 18.5 and 17.7 %, respectively. Secondly, the effects on non-EAC countries' output are all either zero or negative, but close to zero. These effects are what we would expect to find. The removal of all NTBs on intra-EAC trade has a large impact on relative prices. For this reason, EAC imports from other EAC countries become much cheaper, relative to imports sourced from a non-EAC country. On the other hand, since the EAC trade bloc represents a relatively small market for ESTs, the reorientation of trade flows amongst the EAC countries does not have a large impact on the major producers of ESTs.

Moving on to Table 15, which contains the welfare effects associated with scenario 3, we see that the elimination of NTBs on intra-EAC imports has very small effects on welfare. The reason is simply that the EAC countries' export of these five ESTs is very low and, consequently, consumers and producers are only affected marginally by the policy.

4.4 Further analysis of NTB trade costs and their impacts

As the literature on economic integration stresses, it is not possible to remove all costs related to NTBs. Deep provisions in an regional trade agreement (RTA) will reduce NTB costs, but will not eliminate the entire cost of complying with regulation in import countries (see e.g. Berden *et al.,* 2009, van Tongeren *et al.,* 2018). The part of the NTB cost that can be realistically removed is called "actionable", and the size of this part is up for considerable debate. In this section we therefore look further into the importance of NTBs in the scenarios discussed above. In particular, we analyze how the assumed size of the NTB reductions affects the results from scenario 2, by considering an alternative scenario in which the ASEAN countries only manage to remove half of their NTBs. That is, in this final scenario, to which we refer as 2a, we make the assumption that only half of the NTBs are "actionable" or, equivalently, that the size of the NTBs are half as large as in Table 8.

Table 16 summarizes the welfare impacts from scenario 2a. As can be seen by comparing with Table 12, scenario 2a leads to welfare impacts that are approximately half as large as

24 Recall, there are no tariffs on inta-EAC trade in the 8 selected ESTs, cf. table 7.

in scenario 2, which is not surprising in light of the fact that tariffs are comparatively low. Similarly, although we do not show this explicitly, if we assume that the NTBs are twice as large as in in Table 8, a complete removal would lead to welfare changes that are approximately twice as large as those in Table 12.

5. Discussion

In the previous section we discussed and compared the results of our simulations. This section discusses factors influencing the choice of action by the EAC countries, the comparative effects of a global Environmental Goods Agreement (EGA), where all countries agree to remove trade barriers on EST goods and, finally, the likely impact on greenhouse gas (GHG) emissions.

As we saw, scenario 2, in which the EAC countries eliminated all tariffs and NTBs on imports from all sources, results in the largest net welfare gains for the EAC countries. Scenario 3, in which the EAC countries eliminated NTBs on intra-EAC trade, leads to the smallest welfare gains for the EAC countries, whereas scenario 1, in which tariffs - but not NTBs - were removed on EAC imports from all sources, leads to the second largest welfare gains for the EAC as a whole. Therefore, from the standpoint of the EAC countries, the best option, in a net welfare sense, is to follow a broad liberalization agenda as in scenario 1 and 2, rather than pursuing a deeper level of regional integration as in scenario 3. Of course, there may be political and other reasons why the EAC countries might choose scenario 3, for example, over scenario 2, although net welfare gains are lower. This is the likely outcome, if the EAC governments care more about producer welfare than consumer welfare, or if producers are more organized and, therefore, better able to influence policy makers. Another reason why EAC countries might opt for deeper integration within the EAC area (scenario 3) rather than a broad trade liberalization agenda (scenario 1 and 2) is that the former results in a lower level of tariff revenue loss. Therefore, if government revenue is difficult to obtain from other sources, or if the revenue goes to a small and influential elite, then scenario 3 will be preferable to scenario 2. Finally, there might be dynamic aspects that we are not able to capture with our simple static framework. If there are external economies of scale, for example, the significantly larger output effects from scenario 3 might bring about long-run welfare effects that are higher than those from scenario 2, due to potentially higher exports within and outside of the EAC region, over time.

Another issue is whether the EAC countries are better off with a global Environmental Goods Agreement (EGA), where all countries agree to remove trade barriers on EST goods. On the one hand, a global EGA will increase demand for EAC EST exports more than a unilateral removal of trade barriers by the EAC countries. In such a situation, producers would better off than in scenario 2. On the other hand, EAC consumers might, in some cases, be worse off than in scenario 2, due to an increase in prices resulting from the higher demand. Whether the net effect is positive or negative depends on the trade patterns of the EAC countries. We also simulated the effects of a global EGA, where we assumed that all tariffs and NTBs were removed on each of the eight EST products Results indicate that welfare in the EAC region would increase less (by around 6 million $US) than in scenario 2. The simulated global net welfare gain from a global EGA, on the other hand, is two orders of magnitude higher than in scenario 2. Therefore, from a global perspective, there are good reasons to pursue a broad EGA similar to that which is currently being negotiated under the auspices of the WTO.

A final issue is the extent to which a liberalization of trade in ESTs would result in lower greenhouse gas (GHG) emissions. In general, there are several ways in which a lowering of trade barriers can affect the environment. Grossman and Krueger (1991), in their influential study, argue that the environmental effects of trade liberalization can be grouped into three

categories. First, more trade tends to expand the scale of economic activity. Second, it may alter the *composition* of economic activity. Third, it can cause a change in the *techniques* of production. Whereas the first effect, also known as the "rebound effect", tends to increase the amount of GHG emissions, the third effect tends to reduce it. The composition effect on GHG emissions and pollution in general is variable, as it depends on the characteristics of the expanding and contracting sectors following the trade liberalization.

Wan et al. (2018) note that an elimination of trade barriers on ESTs does not necessarily reduce GHG emissions. Essential inputs for the production of ESTs are usually toxic and environmentally hazardous materials. For example, silicon tetrachloride ($SiCl^4$) is one of the byproducts of solar panel production, which is a toxic substance. Similarly, the efficiency of wind turbines is dependent on rare metals, such as neodymium (Nd), whose production generates toxic acids and heavy metals that cause water and air pollution problems. The authors conclude that countries do not necessarily benefit from free trade agreements without them being accompanied by environmental policies to control for negative externalities.

Regarding the impact on GHG emissions from potential trade liberalization by the EAC countries, most likely its magnitude would be modest. Although we do not calculate this impact ourselves, we can compare with the estimated impacts from other studies, to get an idea of the size of the effect. European Commission (2016), for example, analyzes a scenario in which the G-17 negotiating parties of the EGA agree on a full liberalization of trade in ESTs on the Asia-Pacific Economic Cooperation (APEC) list.[25] According to their simulations, the cumulative impact by 2030 is a reduction of 9.93 billion tonnes of carbon dioxide equivalents, as compared with the baseline scenario. This corresponds to the total carbon dioxide emissions produced by Cyprus in 2013. The main reasons why the impact is relatively small are a) tariff barriers are already low; b) a trade liberalization only causes a fall in the price of manufactured components, whereas installation costs, which can be substantial, remain unaffected; c) the "rebound effect" leads to additional greenhouse-gas emissions; and d) some of the ESTs, such as turbines, can also be used for fossil fuel-based energy production. However, the European Commission (2016) report also presents several case studies in which a trade liberalization in ESTs has positive environmental effects that are not captured by the macro simulation mentioned above.

6. Conclusion

None of the EAC countries are among the world's top importers or exporters of ESTs. Therefore, the welfare gains associated with a liberalization of trade in ESTs in the EAC countries would be modest. We quantify the effects on output and welfare from three different scenarios involving a liberalization of EAC trade in five selected ESTs. These scenarios differ with respect to the types of trade barriers considered and the scope of the concessions. In the first scenario, the EAC countries remove all tariffs on imports of ESTs from all sources. Our simulations indicate that the trade and welfare impacts associated with this scenario are relatively modest, given that the EAC countries currently impose no import tariffs on seven of the eight selected EST products. In the second scenario, the EAC countries eliminate all tariffs as well as non-tariff barriers (NTBs) on EST imports from all sources. Implementing the trade liberalization measures associated with this scenario results in somewhat larger impacts, due to the magnitude of NTBs relative to EAC tariffs on ESTs. However, as we point out, the size of the impacts depend crucially on the size of the "actionable" part of the NTBs. In our final scenario, the EAC countries eliminate all non-tariff barriers, but only on imports of ESTs from other EAC countries (intra-EAC tariffs are zero on all eight EST products). Thus, whereas scenario 1 and 2 represent a broad free trade agenda by the EAC countries, scenario

25 See ANNEX I in European Commission (2016).

3 represents a situation where the EAC countries pursue a deeper level of regional economic integration within the EAC trade bloc. The main difference between the results from scenarios 2 and 3 is that scenario 3 leads to higher EAC production of ESTs, whereas the welfare impact is higher in scenario 2 than in scenario 3.

Our findings are generally in line with the literature. Egger et al. (2015), for example, find that a hypothetical preferential trade agreement between the European Union and the United States leads to substantially higher welfare gains when NTBs are eliminated, compared to a removal of tariffs only. Similarly, Mevel and Karingi (2012) conclude that a removal of tariff barriers alone, in connection with the newly agreed Continental Free Trade Area (CFTA), will not lead to a doubling of intra-African trade, which is the goal of the African Union. This goal can only be achieved if NTBs are reduced as well. However, as mentioned above, the size of the NTBs in general, and the size of the "actionable" part of the NTBs in particular, is subject to considerable debate. Therefore, the impact estimates presented in this report must be considered as informed guesses, rather than hard facts. Similar reservations apply to the choice of model and specific parameter values. We have tried to be as clear and open about these choices as possible, such that others can replicate our findings and further discuss the plausibility of the results on an informed basis.

Tables

Table 1. List of eight products constituting five Environmentally Sound Technologies (ESTs) considered

HS6 code	Product description
Biomass boilers	
840410	Boilers; auxiliary plant, for use with boilers of heading no. 8402 or 8403 (e.g. economisers, super-heaters, soot removers, gas recoverers)
840290	Boilers; parts of steam or other vapour generating boilers
Solar	
841919	Heaters; instantaneous or storage water heaters, non-electric, other than instantaneous gas water heaters
854140	Electrical apparatus; photosensitive, including photovoltaic cells, whether or not assembled in modules or made up into panels, light-emitting diodes (LED)
Wind	
730820	Iron or steel; structures and parts thereof, towers and lattice masts
850231	Electric generating sets; wind-powered, (excluding those with spark-ignition or compression-ignition internal combustion piston engines)
Hydro (small scale)	
841012	Turbines; hydraulic turbines and water wheels, of a power exceeding 1000kW but not exceeding 10000kW
841011	Turbines; hydraulic turbines and water wheels, of a power not exceeding 1000kW

Source: UN Comtrade (2018)

Table 2. Top ten importers and exporters of the fiveselected ESTs. (Trade figures in mio USD, 2014-2016 averages)

Importing country	Import value	Exporting country	Export value
EU27	1685.7	China	2713.9
China	1281.8	EU27	2110.5
United States	1249.9	Germany	741.6
Japan	855.9	Korea, Rep.	623.7
Hong Kong, China	606.4	Japan	590.3
Germany	468.5	Denmark	540.6
Korea, Rep.	371.7	Malaysia	536.7
United Kingdom	330.7	Philippines	360.6
Mexico	279.9	Singapore	284.7
India	257.8	United States	272.7

Source: WITS (2018)

Table 3. EAC imports from the world 2014-2016 (mio. US dollars)

	730820	840290	840410	841011	841012	841919	850231	854140	Total
Burundi	1.5	0.3	0.0			0.0	0.0	0.4	2.2
2014	2.3	0.6	0.0			0.0	0.0	0.3	3.3
2015	1.6	0.1	0.0			0.1	0.0	0.5	2.2
2016	0.6	0.1				0.0	0.0	0.4	1.2
Kenya									
2014									
2015									
2016									
Rwanda	6.9	0.3	0.4	0.1	0.1	0.8	0.0	8.8	17.5
2014	7.9	0.6	1.3	0.0	0.1	1.0	0.0	10.7	21.7
2015	10.4	0.1	0.0	0.3		0.9	0.0	5.0	16.8
2016	2.3	0.3	0.0	0.0		0.3	0.0	10.7	13.7
Tanzania	30.5	1.1	0.0	0.5	2.0	2.1	0.4	13.3	50.0
2014	29.8	0.7	0.1	0.8	5.0	1.5	0.8	13.6	52.2
2015	47.3	0.6	0.0	0.7	0.0	1.1	0.4	12.5	62.6
2016	14.4	1.9	0.0	0.1	1.0	3.9	0.1	13.8	35.2
Uganda	13.4	0.2	0.1	0.0	1.6	0.8	0.0	20.8	36.8
2014	33.7	0.2	0.0	0.0		0.6	0.1	17.0	51.7
2015	5.8	0.2	0.1	0.0		0.8	0.0	23.4	30.2
2016	0.6	0.2	0.0	0.0	1.6	0.9	0.0	21.9	25.3
Total	52.2	1.9	0.6	0.7	3.7	3.7	0.5	43.3	106.5

Source: WITS (2018), Authors' own calculations. Note: Numbers in bold in rows with country names are averages over the years

Table 4. Intra and total EAC imports (2014-2016 averages)

	730820	840290	840410	841011	841012	841919	850231	854140	Total
Intra EAC imports (mio. $US)									
Burundi	0.4	0.0	0.0			0.0	0.0	0.0	0.4
Kenya									
Rwanda	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5
Tanzania	0.2	0.1	0.0	0.0	0.2	0.0	0.0	0.4	0.9
Uganda	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4
Total	1.0	0.2	0.0	0.0	0.2	0.1	0.0	0.8	2.2
Total EAC imports (mio. $US)									
Burundi	1.5	0.3	0.0			0.0	0.0	0.4	2.2
Kenya									0.0
Rwanda	6.9	0.3	0.4	0.1	0.1	0.8	0.0	8.8	17.5
Tanzania	30.5	1.1	0.0	0.5	2.0	2.1	0.4	13.3	50.0
Uganda	13.4	0.2	0.1	0.0	1.6	0.8	0.0	20.8	36.8
Total	52.2	1.9	0.6	0.7	3.7	3.7	0.5	43.3	106.5
Intra EAC imports as a share of total imports									
Burundi	0.26	0.06	0.00			0.01	0.00	0.03	0.19
Kenya									
Rwanda	0.05	0.08	0.08	0.00	0.00	0.00	0.00	0.01	0.03
Tanzania	0.01	0.09	0.00	0.00	0.09	0.02	0.00	0.03	0.02
Uganda	0.00	0.15	0.00	0.00	0.00	0.06	0.00	0.01	0.01
Average	0.02	0.09	0.06	0.00	0.05	0.02	0.00	0.02	0.02

Source: WITS (2018), Authors' own calculations

Table 5. Average applied MFN ad-valorem duties, 2013-2016 (percent)

	730820	840290	840410	841011	841012	841919	850231	854140	Average
Burundi	9.0	0.0	0.0	0.0		0.0	0.0	0.0	1.6
2013	0.0	0.0	0.0			0.0	0.0	0.0	0.0
2014	10.0	0.0		0.0		0.0	0.0	0.0	1.7
2015	10.0	0.0	0.0			0.0		0.0	2.0
2016	25.0	0.0	0.0			0.0		0.0	5.0
Kenya	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
2013	10.0	0.0	0.0	0.0		0.0	0.0	0.0	1.4
2014	10.0	0.0	0.0	0.0		0.0	0.0	0.0	1.4
2016	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Rwanda	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
2013	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
2014	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
2015	10.0	0.0	0.0	0.0		0.0	0.0	0.0	1.4
2016	10.0	0.0	0.0	0.0		0.0	0.0	0.0	1.4
Tanzania	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
2013	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
2014	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
2015	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
2016	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Uganda	9.0	0.0	0.0	0.0		0.0	0.0	0.0	1.3
2013	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
2014	10.0	0.0	0.0	0.0		0.0	0.0	0.0	1.4
2015	10.0	0.0	0.0	0.0		0.0	0.0	0.0	1.4
2016	25.0	0.0	0.0	0.0		0.0	0.0	0.0	3.6
Average	92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3

Source: WITS. Note: Numbers in bold in rows with country names are averages over the years

Table 6. Initial applied MFN ad valorem tariffs for the EAC countries used in the simulations (percent)

	730820	840290	840410	841011	841012	841919	850231	854140	Average
Burundi	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Kenya	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Rwanda	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Tanzania	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Uganda	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6
Average	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3

Source: WITS (2018).

Table 7. Initial applied preferential ad valorem tariffs on intra EAC imports used in the simulations (percent)

	730820	840290	840410	841011	841012	841919	850231	854140	Average
Burundi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rwanda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tanzania	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uganda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: WTO IDB.

Table 8. Initial NTB tariff ad valorem equivalents (AVEs) used in the simulations

HS6 code	GTAP sector	GTAP sector description	NTB AVE (%)	Avg. EAC MFN tariff (%)
730820	37	Metal products	16.7	19.0
840290	37	Metal products	16.7	0.0
840410	37	Metal products	16.7	0.0
841011	41	Machinery and equipment nec	6.2	0.0
841012	41	Machinery and equipment nec	6.2	0.0
841919	41	Machinery and equipment nec	6.2	0.0
850231	41	Machinery and equipment nec	6.2	0.0
854140	40	Electronic equipment	1.8	0.0

Source: Egger et al. (2015), Authors' own calculations.

Table 9.. Simulated output effects from scenario 1: Unilateral elimination of tariffs by the EAC countries on imports from all sources (percent changes)

	730820	840290	840410	841011	841012	841919	850231	854140
Burundi	-17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	-12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rwanda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tanzania	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uganda	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
China	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EU	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Japan	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea, Rep.	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United States	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROW	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' own calculations

Table 10. Simulated net welfare effects from scenario 1: Unilateral removal of tariffs by the EAC countries (in mio. $US)

	730820	840290	840410	841011	841012	841919	850231	854140	Total
Burundi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Rwanda	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Tanzania	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Uganda	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Subtotal	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
China	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
EU	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea, Rep.	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
United States	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
Row	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Total	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8

Source: Authors' own calculations

Table 11. Simulated output effects from scenario 2: Unilateral elimination of tariffs and NTBs by the EAC countries on imports from all sources (percent changes)

	730820	840290	840410	841011	841012	841919	850231	854140
Burundi	-9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	-6.3	4.3	0.0	0.0	0.0	1.7	1.8	0.5
Rwanda	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.5
Tanzania	0.2	5.4	0.0	0.0	0.0	0.0	0.0	0.5
Uganda	0.2	5.4	0.0	0.0	0.0	1.8	0.0	0.1
China	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EU	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Japan	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Korea, Rep.	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United States	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROW	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' own calculations

Table 12. Simulated net welfare effects from scenario 2: Unilateral removal of tariffs and NTBs by the EAC countries (in mio. $US)

	730820	840290	840410	841011	841012	841919	850231	854140	Total
Burundi	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Kenya	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Rwanda	2.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	2.2
Tanzania	11.4	0.1	0.0	0.0	0.0	0.1	0.0	0.2	11.8
Uganda	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.8
Subtotal	15.2	0.1	0.0	0.0	0.0	0.2	0.0	0.7	16.1
China	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2
EU	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea, Rep.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
United States	-0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8
Row	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Total	15.4	0.1	0.0	0.0	0.0	0.2	0.0	0.8	16.4

Source: Authors' own calculations

Table 13. Decomposed welfare effects from scenario 2: Unilateral removal of tariffs and NTBs by the EAC countries (in mio. $US). HS 730820

HS 730820	Producer Surplus	Consumer Surplus	Tariff Revenue	Net welfare effect
Burundi	0.0	0.8	-0.4	0.4
Kenya	-0.1	0.0	0.0	-0.1
Rwanda	0.0	3.1	-1.0	2.1
Tanzania	0.0	23.2	-11.8	11.4
Uganda	0.0	2.8	-1.4	1.4
Subtotal	-0.1	29.9	-14.6	15.2
China	1.1	0.0	0.0	1.1
EU	0.7	-0.9	0.0	-0.2
Japan	0.0	0.0	0.0	0.0
Korea, Rep.	0.3	0.0	0.0	0.3
United States	0.1	-0.9	0.0	-0.8
Row	6.1	-6.3	0.0	-0.2
Total	8.3	21.7	-14.6	15.4

Source: Authors' own calculations

Table 14. Simulated output effects from scenario 3: Unilateral elimination of tariffs and NTBs by the EAC countries on imports from other EAC countries (percent changes)

	730820	840290	840410	841011	841012	841919	850231	854140
Burundi	18.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	17.7	16.0	0.0	0.0	0.0	6.4	7.0	2.0
Rwanda	0.0	0.0	0.0	0.0	0.0	7.0	0.0	2.0
Tanzania	0.0	17.5	0.0	0.0	0.0	0.0	0.0	1.8
Uganda	0.0	17.5	0.0	0.0	0.0	7.1	0.0	0.2
China	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EU	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0
Japan	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Korea, Rep.	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
United States	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Row	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' own calculations

Table 15. Simulated net welfare effects from scenario 3: Unilateral removal of tariffs and NTBs by the EAC countries. Elimination of NTBs only applies to intra EAC trade (in mio $US)

	730820	840290	840410	841011	841012	841919	850231	854140	Total
Burundi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kenya	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Rwanda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tanzania	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uganda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
China	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea, Rep.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United States	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Row	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2

Source: Authors' own calculations

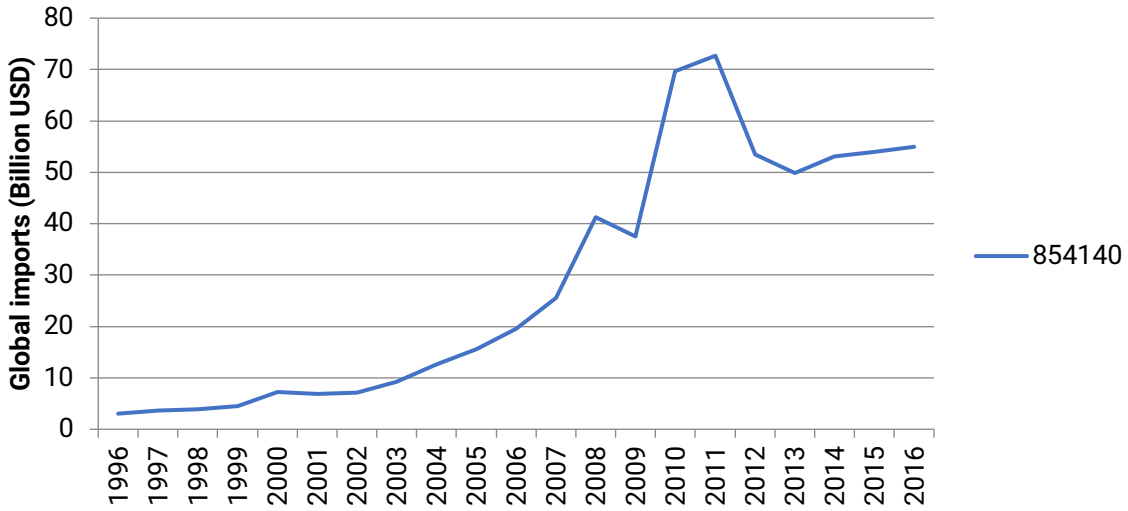
Table 16. Simulated net welfare effects from scenario 2a: Unilateral removal of tariffs and NTBs by the EAC countries on imports from all sources (mio. $US). NTBs half as large as in the standard case

	730820	840290	840410	841011	841012	841919	850231	854140	Total
Burundi	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Kenya	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Rwanda	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Tanzania	6.4	0.1	0.0	0.0	0.0	0.0	0.0	0.1	6.6
Uganda	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0
Subtotal	8.3	0.1	0.0	0.0	0.0	0.1	0.0	0.4	8.9
China	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0
EU	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Japan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Korea, Rep.	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
United States	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7
Row	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Total	8.4	0.1	0.0	0.0	0.0	0.1	0.0	0.4	9.1

Source: Authors' own calculations

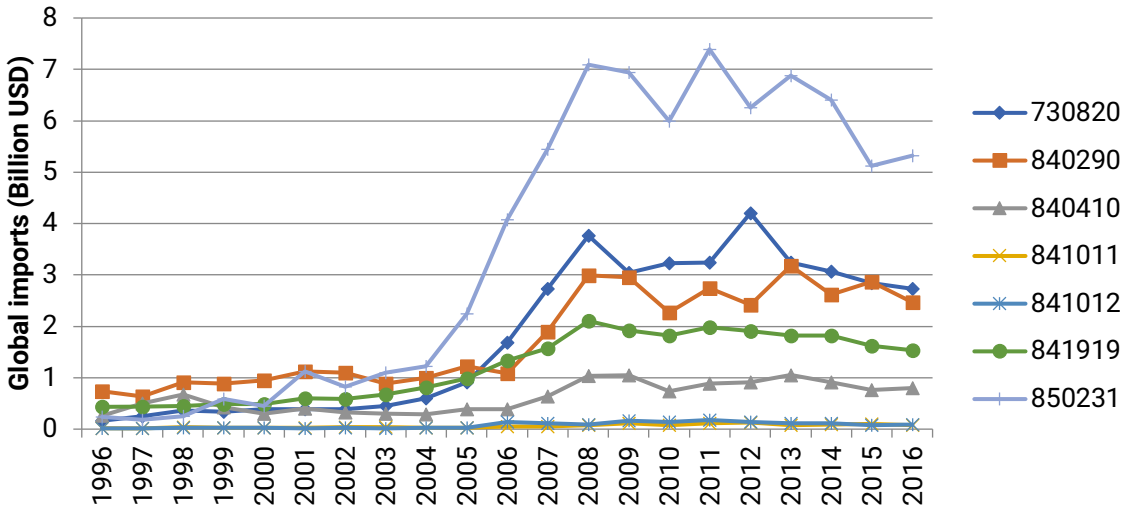
Figures

Figure 1. Global trade in the most traded of the selected EST products



Source: WITS (2018)

Figure 2. Global trade in the remaining 7 of the selected EST products



Source: WITS (2018)

References

African Development Bank Group (2014). Poor technological capability undermining Africa's growth potential. Available at: https://www.afdb.org/en/news-and-events/poor-technological-capability-undermining-africas-growth-potential-13684/ [Accessed at 27 November, 2018]

African Review. (2017). *Gigawatt Global: Solar street lights illuminate Bujumbura,* Burundi. Available at: http://www.africanreview.com/energy-a-power/renewables/solar-street-lights-illuminate-bujumbura-burundi. [Accessed at 31 August, 2018]
African Union. *African Union-Continental Free Trade Area.* Available at: https://au.int/en/ti/cfta/about [Accessed at 30 November, 2018]

African Union (2018a). *Protocol to the Abuja Treaty relating to the Free Movement of Persons, Right of Residence and Right of Establishment, adopted 29 January 2018.* Available at : https://www.tralac.org/documents/resources/african-union/1965-protocol-to-the-abuja-treaty-free-movement-of-persons-right-of-residence-and-establishment-adopted-29-january-2018/file.html [Accessed at 30 November, 2018]

African Union (2018b). *List of African Countries that signed the Establishment of the African Continental Free Trade Area (AfCFTA) at the 10th Extraordinary Session of the Assembly on the Launch of AfCFTA.* Available at: https://au.int/en/pressreleases/20180321/list-african-countries-signed-establishment-african-continental-free-trade [Accessed at 30 November, 2018].

African Union (2018c). *Summary of the key decisions and declarations of the 31st African Union Summit, 6 July 2018.*Available at:
https://au.int/en/pressreleases/20180706/summary-key-decisions-and-declarations-31st-african-union-summit [Accessed at 30 November, 2018]

AHK (2013). *Target Market Study Kenya Solar PV and Wind Power.* Delegation of the German Industry and Commerce in Kenya. German Chambers of Commerce Abroad.

Alternative Energy (2018). Solar Roof Tiles. Available at: http://www.altenergy.org/renewables/solar/DIY/solar-roof-tiles.html. [Accessed at 31 August, 2018]

Alshenqeeti, Hamza. "Interviewing as a Data Collection Method: A Critical Review." English Linguistics Research 3.1 (2014): 39.

Armington, P. S. (1969). *A theory of demand for products distinguished by place of production. Staff Papers,* 16, 159-178.

Armstrong S., and Nicoll E., (2016). Alternative energy in East Africa: The case for solar power. Available at: https://www.marsdd.com/news-and-insights/east-africa-solar-power-innovations/. [Accessed at 31 August, 2018]

Baltzer, K., and Jensen, M. F. (2015). *Final Report Study of the Impacts of Green Trade Liberalisation on Least Developed Countries*, (November).

Beghin, J. (2006). Non-Tariff Barrier. Ames, Iowa: Center for Agricultural and Rural Development, Iowa State University.

Berden, K. and Francois, J. (2015). *Quantifying Non-Tariff Measures for TTIP. Paper No. 12 in the CEPS-CTR project 'TTIP in the Balance'and CEPS Special Report No. 116/July 2015.*

Berden, K. G., Francois, J., Thelle, M. M., Wymenga, M. P. and Tamminen, M. S. 2009. Non tariff measures in EU-US trade and investment–An economic analysis. *Report Number OJ 2007/S 180. ECORYS Nederland BV.*

Bucher, H., Drake-Brockman, J., Kasterine, A., and M. Sugathan (2014). *Trade in Environmental Goods and Services: Opportunities and Challenges.* International Trade Centre Technical Paper, Geneva.

Calabrese, L., and Mendez-Parra, M., (2016) *What are the causes of non-tariff barriers in the East Africa Community,* Briefing Paper, ODI. Available at: https://www.odi.org/publications/10643-what-are-causes-non-tariff-barriers-east-african-community. [Accessed at 31 August, 2018].

Cattaneo, Nicolette (2017). *Trade in Services Negotiations: A Southern African Perspective.* International Centre for Trade and Sustainable Development. Available at: https://www.ictsd.org/themes/development-and-ldcs/research/trade-in-services-negotiations-a-southern-african-perspective [Accessed at 30 November, 2018]

Chepkoech, A., (2016). *New scorecard report shows EAC yet to fully implement common market protocols.* Available at: https://www.nation.co.ke/news/EAC-common-market-protocols/1056-3435654-8272gs/index.html. [Accessed at 31 August, 2018]

COMESA (1998). *COMESA Protocol on the Free Movement of Persons, Labour, Services, Right of Establishment and Residence.* Common Market for Eastern and Southern Africa Secretariat. Available at: http://www.visafree.ccpau.org/wp-content/uploads/2017/10/COMESA-Protocol-on-Free-Movement-of-Persons.pdf [Available at 30 November, 2018].

COMESA (2018). *COMESA Customs Union.* Common Market for Eastern and Southern Africa Secretariat. Available at: https://www.comesa.int/comesa-customs-union/ [Accessed at 30 November, 2018]

Cosbey, A. (2014). *The Green Goods Agreement: Neither green nor good?* International Institute for Sustainable Development Commentary, February. Available from: http://www.iisd.org/sites/default/files/pdf/2014/commentary_green_goods.pdf. [Accessed at 31 August, 2018]

Danish Energy Management and Esbensen (2017). *Renewable Energy market Landscape Study, covering 15 countries in Southern and Eastern Africa.* Available at: https://www.ndf.fi/sites/ndf.fi/files/news_attach/volume_i_market_landscape_study_eep-sea_report.pdf. [Accessed at 31 August, 2018]

EABC (2005). *A Study on Non-Tariff Barriers (NTBs) and Development of a Business Climate Index in the East Africa Region.* East African Business Council. March. 64.

EABC (2018). Non- Tariff Barriers. East African Business Council. Available at: http://eabc-online.com/index.php?/policy/category/non-tarriff-barrier. [Accessed at 31 August, 2018]

EAC. *East African Community.* Available at: https://www.eac.int/ [Accessed at 30 November 2018]

EAC (2006a). *The East African Community Competition Act.* East Africa Community.

EAC (2006b). *EAC protocol on environment and natural resource management.* East Africa Community.

EAC (2006c) *EAC Private Sector Development Strategy, 2006*. East Africa Community. Available at: https://www.eac.int/investment/75-sector/investment-promotion-private-sector-development. [Accessed at 31 August, 2018].

EAC (2009). *The EAC regional strategy on scaling up access to modern energy services.* East Africa Community.

EAC (2010). *EAC Climate Change Policy.* East Africa Community.

EAC (2011) *The EAC Climate Change Masterplan.* East Africa Community.

EAC (2012). *Special edition: Deepening Kenya's Integration in the East African Community East Africa Community.* Edition 6. June 2012.

EAC (2014). *The Regional Scoping Study to identify Potential areas of Intervention*, EAC Secretariat on Renewable Energy and Efficiency. East Africa Community.

EAC (2015). *EAC Trade and Investment Report 2015.* East Africa Community. Available at: http://eabc-online.com/index.php?/highlights/view/eac-trade-and-investment-report-2015. [Accessed at 31 August, 2018]

EAC (2016a) *East African Community Facts and Figures report.* East African Community Secretariat. Available at: https://d3n8a8pro7vhmx.cloudfront.net/eatradehub/pages/3248/attachments/original/1493280329/eac_facts_figures_2016_0.pdf?1493280329. [Accessed at 31 August, 2018].

EAC (2016b). *EAC Common Market Scorecard 2016.* East Africa Community.

EAC (2016c). *East African Community Vision 2050.* East African Community Secretariat. Available at: http://www.africa-platform.org/sites/default/files/resources/eac_vision_2050_february_2016.pdf. [Accessed at 31 August, 2018].

EAC (2017a). *Gender, Community Development and Civil Society.* East Africa Community. Available at: https://www.eac.int/gender. [Accessed at 31 August, 2018].

EAC (2017b). *The East African Community Elimination of Non-Tariff Barriers Act, 2017.* East Africa Community.

EAC (2018a). *About the EAC Partner States.* Available at: https://www.eac.int/eac-partner-states. [Accessed at 31 August, 2018].

EAC (2018b). *Customs Union. East Africa Community.* Available at https://www.eac.int/customs-union. [Accessed at 31 August, 2018]

EAC (2018c). *Trade. East Africa Community.* Available at https://www.eac.int/trade. [Accessed at 31 August, 2018]

EAC (2018d). *Multilateral Environmental Agreements.* Available at: https://www.eac.int/index.php?option=com_content&view=article&id=141:eac-defence&catid=146:press-releases&Itemid=194. [Accessed at 31 August, 2018]

EAC (2018e). *Protocol on Environment and Natural Resource Management.* East Africa Community Available at https://www.eac.int/environment/natural-resources-management/protocol-on-environment-and-natural-resource-management. [Accessed at 31 August, 2018]

EACREEE (2017). *Our objectives and mandate.* East African Centre for Renewable Energy and Energy Efficiency. Available at: http://www.eacreee.org/content/objectives-and-mandate. [Accessed at 31 August, 2018]

EAC Secretariat (2004). *The protocol on the establishment on the EAC customs Union.* Arusha, Tanzania: EAC. East Africa Community Secretariat.

East African Business Week (2018a). *Burundi signs African Continental Free Trade Area Agreement.* Available at: https://www.busiweek.com/burundi-signs-african-continental-free trade-area-agreement/ [Accessed at 30 November, 2018]

East African Business Week (2018b). *Africa's Protocol on Free Movement of People under spotlight at East African Community meeting.* Available at: https://www.busiweek.com/africas-protocol-on-free-movement-of-people-under-spotlight-at-east-african-community-meeting/ [Accessed at 30 November, 2018]

Ebrary (2018). Trade barriers. Available at https://ebrary.net/1579/economics/trade_barriers-. [Accessed at 31 August, 2018]

EC (2016), *Trade Sustainability Impact Assessment on the Environmental Goods Agreement Executive Summary.* European Commission. Available at: http://trade.ec.europa.eu/doclib/docs/2016/june/tradoc_154619.pdf. [Accessed at 31 August, 2018]

EC (2018a). *European Strategy for Plastics in a Circular Economy. European Commission.* Available at https://eur-lex.europa.eu/resource.html?uri=cellar:2df5d1d2-fac7-11e7-b8f5-01aa75ed71a1.0001.02/DOC_1&format=PDF. [Accessed at 31 August, 2018]

EC (2018b). *East African Community. European Commission.* Available at: http://ec.europa.eu/trade/policy/countries-and-regions/regions/eac/ [Accessed at 30 November, 2018]

EC (2018c). *Overview of Economic Partnership Agreements-Updated* November 2018. European Commission. Available at: http://trade.ec.europa.eu/doclib/docs/2009/september/tradoc_144912.pdf [Accessed at 30 November, 2018]

EC Trade HelpDesk (2018). *Everything But Arms.* Available at: http://trade.ec.europa.eu/tradehelp/everything-arms [Accessed at 30 November, 2018]

Econlib, (2013). *Barriers to trade.* Available at: http://www.econlib.org/library/Topics/HighSchool/BarrierstoTrade.html. [Accessed at 31 August, 2018]

Egger, P., Francois, J., Manchin, M. and Nelson, D. (2015). *Non-tariff barriers, integration and the transatlantic economy.* Economic Policy, 30, 539-584.

ENERGIA, ESMAP and UN Women (2018). *Policy Brief on the Interlinkages between Energy and Gender Equality.* Available at https://sustainabledevelopment.un.org/content/documents/17489PB12.pdf. [Accessed at 31 August, 2018]

ERC (2017). *Licensed solar pv traders database.* Enery Regulatory Commission, Nairobi, Kenya.

Ernst & Young (2017). *Solar PV Jobs & Value Added in Europe.* SolarPower Euro. Available at : https://www.ey.com/Publication/vwLUAssets/EY-solar-pv-jobs-and-value-added-in-europe/$FILE/EY-solar-pv-jobs-and-value-added-in-europe.pdf [Accessed at 30 November, 2018]

EU and EAC (2014). Economic Partnership Agreement between the East African Community Partner States of the One Part, and the European Union and its Member States of the Other Part. European Union and East African Community. Available at : http://trade.ec.europa.eu/doclib/docs/2015/october/tradoc_153845.compressed.pdf [Accessed at 30 November, 2018]

EUEI (2011). *Energy Strategy and Action Plan for Burundi.* European Union Energy Intiative, November 2011.

Fatihiya, A. M., Kenneth, M. B., and Amini, E. K. (2015). *Household awareness and knowledge on improved cookstoves: A case of Kilimanjaro region, Tanzania.* International Journal of Physical and Social Sciences, 5(1), 457.

FAO (2015). Global guidelines for the restoration of degraded forests and landscapes in drylands: building resilience and benefiting livelihoods. Forestry Paper No. 175. Rome, Food and Agriculture Organization of the United Nations.

Feenstra, R. C., Luck, P., Obstefeld, M. and Russ, K. N. (2012). *In search of the Armington elasticity.* Review of Economics and Statistics.

Fernandes, D. (2014). *Study on the liberalization and regulatory frameworks of construction services in the SADC Region.* Draft Report undertaken for SADC Secretariat, Equinoccio and IBF Consulting. https://extranet.sadc.int/files/9314/3271/9523/Final_Report_SADC_Construction_Study_2014.pdf

Francois, J. and Hall, H. K. (2009). *Global simulation analysis of industry-level trade policy: The GSIM model.* Institute for International and Development Economics.

Francois, J. F. and Hall, H. K. (1997). *Partial equilibrium modeling. Applied methods for trade policy analysis. A handbook.* Cambridge University Press.

Futurewatch Report (2016) *Energy Sector Insights Kenya.* Cape Town, South Africa [available on: https://www.businessfinland.fi/globalassets/julkaisut/energy_sector_insights_kenya_2017.pdf]

Goldstein, M. and Khan, M. S. (1985). *Chapter 20, Income and price effects in foreign trade.* In: Jones, R. W. and Kenen, P. B. (eds.) Handbook of International Economics. Elsevier.
Gordon, Emma (2018). The Politics of Renewable Energy in East Africa. Oxford Institute for Energy Studies, Oxford, United Kingdom.

Grossman, G. M. and Krueger, A. B. (1991). *Environmental impacts of a North American free trade agreement.* National Bureau of Economic Research.

Hangi, M. A. (2010). *The Non-Tariff Barriers in Trading within the East African Community.* Research Paper (Geneva: CUTS Geneva Resource Centre). Available at: http://www. cuts-grc. org. [Accessed at 31 August, 2018].

Hankins, M., (2009). *Market potentials for German solar energy companies in East Africa.*, Presentation at HannoverMesse, 22 April 2009.

Hansen, U. E. (2018). *The insertion of local actors in the global value chains for solar PV and wind turbines in Kenya* (IREK Working Paper No. 2). Copenhagen/Nairobi/Eldoret: AAU, ACTS and MU.

Hansen, U. E., Pedersen, M. B., and Nygaard, I. (2014). *Review of Solar PV market development in East Africa.* UNEP Risø Centre, Technical University of Denmark: Kongens Lyngby, Denmark.

Hook, A. (2014). *Mutual Recognition Agreements in Professional Services and CEFTA Services Integration.* World Bank Report. Available at: http://cefta.int/wp-content/uploads/2016/05/WB-MUTUAL-RECOGNITION-AGREEMENTS-IN-PROFESSIONAL-SERVICES-CEFTA_final.pdf [Accessed at 30 November 2018]

ICTSD Bridges (2018). *African Leaders Launch Continental Free Trade Area.* Bridges, 22 March 2018. International Centre for Trade and Sustainable Development. Available at: https://www.ictsd.org/bridges-news/bridges/news/african-leaders-launch-continental-free-trade-area [Accessed at 30 November 2018]

Ikiara, M. (2009). *Trade in Environmental Goods & Services.* Solar Energy in Kenya. WTO Workshop, Geneva, Switzerland, Sept. 23–25, 2009. Available at: https://www.wto.org/english/tratop_e/envir_e/wksp_goods_sept09_e/ikiara_e.pdf. [Accessed at 31 August, 2018]

Investopedia (2018) *Business to Business.* Available at: https://www.investopedia.com/terms/b/btob.asp. [Accessed at 31 August, 2018]

IRENA (2015). *Africa Power Sector: Planning and Prospects for Renewable Energy.* Synthesis Report. International Renewable Energy Agency. Available at: https://www.irena.org/documentdownloads/Publications/IRENA_Africa_Power_Sector_synethesis_2015.pdf. [Accessed at 31 August, 2018]

IRENA (2016). *Renewable Energy and Jobs. Annual Review 2016,* Abu Dhabi. International Renewable Energy Agency. Available at http://www.irena.org/publications/2016/May/Renewable-Energy-and-Jobs--Annual-Review-2016. [Accessed at 31 August, 2018]

IRENA (2017). *Renewable Energy and Jobs. Annual Review 2017,* Abu Dhabi. International Renewable Energy Agency. Available at https://www.irena.org/documentdownloads/publications/irena_re_jobs_annual_review_2017.pdf . [Accessed at 31 August, 2018].

IRENA (2018). *Renewable Energy and Jobs. Annual Review 2018,* Abu Dhabi. International Renewable Energy Agency. Available at https://irena.org/-/media/Files/IRENA/Agency/Publication/2018/May/IRENA_RE_Jobs_Annual_Review_2018.pdf [Accessed at 23 November, 2018)

ITC (2018). *A business guide to the African Continental Free Trade Area Agreement.* International Trade Centre. Available at: http://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/AfCFTA%20Business%20Guide_final_Low-res.pdf [Accessed at 30 November, 2018]

ITC and COMESA Business Council (2016). *Services in COMESA – An Industry Perspective: Integrating the Voice of Business in Policy. International Trade Centre.* Available at: http://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/Services_in_COMESA_300316_ITC%20version%20low-res.pdf [Accessed at 30 November, 2018].

Ivanova, M., Baste, I., Lee, B., Belliethathan, S., and Gelil, I. A. (2012) *Global Responses. Global Environmental Outlook 5.* Nairobi, United Nations Environment Programme.

Jäger-Waldau, A. (2017). *PV Status Report 2017*, Joint Research Centre (JRC), European Union, Luxembourg. Available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108105/kjna28817enn.pdf . [Accessed at 31 August, 2018].

Karekezi, S., and Kithyoma, W. (2003). *Renewable Energy in Africa: Prospects and Limits.* prepared for: The Workshop for African Energy Experts on Operationalizing the NEPAD Energy Initiative. 2-4 June 2003.

Karugia, J., Wanjiku, J., Nzuma, J., Gbegbelegbe, S., Macharia, E., Massawe, S., and Kaitibie, S. (2009). *The impact of non-tariff barriers on maize and beef trade in East Africa.* Washington DC: IFPRI.

Kaushik, s. (2016). *The World Bank: Picture Trade; Types of tariffs explained.* Available at: http://blogs.worldbank.org/trade/picture-trade-types-tariffs-explainedkaushik. [Accessed at 31 August, 2018]

Kenya (2004). *The Energy Policy.* Available at: https://www.renewableenergy.go.ke/downloads/policy-docs/sessional_paper_4_on_energy_2004.pdf. [Accessed at 31 August, 2018].

Kenya (2006). *The Energy Act.* Available at: https://eregulations.invest.go.ke/media/energy%20act.pdf.

Kenya (2010). *The Constitution of the Republic of Kenya,* 2010.

Kenya (2013a). *National Climate Change Action Plan.* Available at: http://www.kccap.info/. [Accessed at 31 August, 2018].

Kenya (2013b). *VAT Act.* Available at: https://www.taxkenya.com/wp-content/uploads/2017/05/Value-Added-Tax-2013.pdf. [Accessed at 31 August, 2018].

Kenya (2014). *Draft National Energy Policy. Ministry of Energy and Petroleum.* Available at: http://www.eisourcebook.org/cms/January%202016/Kenya%20Draft%20National%20Energy%20Policy%202014.pdf. [Accessed at 31 August, 2018]

Kenya (2016). *SE4ALL: Kenya Action Agenda. Ministry of Energy and Petroleum.* Available at: https://www.seforall.org/sites/default/files/Kenya_AA_EN_Released.pdf. [Accessed at 31

August, 2018]KCIC (2018) *Kenya Solar PV market assessment.* Kenya Climate Innovation Centre. Available at: https://kenyacic.org/sites/default/files/publications/KCIC%20Solar%20Survey-3.pdf. [Accessed at 31 August, 2018]

Kenya Climate Innovation Centre (n.d) Kenya Solar PV Market Assessment. Nairobi, Kenya. [accessed on: https://www.kenyacic.org/sites/default/files/publications/KCIC%20Solar%20Survey-3.pdf]

Kung'U, A. (2017) *Analysis of the Push Towards Allowing the Free Movement of Lawyers and Enabling Cross-Border Legal Practice in the East-African Community.* Available at: https://www.academia.edu/34255048/ANALYSIS_OF_THE_PUSH_TOWARDS_ALLOWING_THE_FREE_MOVEMENT_OF_LAWYERS_AND_ENABLING_CROSS-BORDER_LEGAL_PRACTICE_IN_THE_EAST_AFRICAN_COMMUNITY [Accessed on 30 November, 2018]

Lema, R., Hanlin, R., Hansen, U.E., and Nzila, C. (2018). *Renewable electrification and local capability formation: Linkages and interactive learning.* Energy Policy, Vol. 117, 01.06.2018, p. 326-339.

MEA (2005). *Ecosystems and Human Well-being: Synthesis.* Millennium Ecosystem Assessment. Island Press, Washington, DC

Mevel, S. and Karingi, S. (2012) *Deepening regional integration in Africa: A computable general equilibrium assessment of the establishment of a continental free trade area followed by a continental customs union.* Proceedings of the African Economic Conference, 2012.

Muchunku, C. (2013). *Solar PV Market in Kenya: Status and Opportunities.* Kenya Renewable Energy Association (KEREA). BSW-Solar Special Exhibit Rural Electrification. Intersolar 2013, Munich, Germany.

Murphy, J. T. (2001). *Making the energy transition in rural East Africa: Is leapfrogging an alternative?* Technological Forecasting and Social Change, 68(2), 173-193.

Mutai, H. K. 2015). *Assessing the implementation of the East African Community Common Market: A preliminary scoping study.* Stellenbosch: tralac.

Oiro, R., Owino, B., and Mendez-Parra, M. (2017). *Non-tariff barriers and 'complaints' in the East African Community's reporting process.* Policy briefing, ODI. Available at: https://www.odi.org/sites/odi.org.uk/files/resource-documents/11409.pdf. [Accessed at 31 August, 2018].

Okumu, L., and Nyankori, J. C. (2010). *Non-tariff barriers in EAC customs union: implications for trade between Uganda and other EAC countries.* Research Series no. 75, Economic Policy Research Centre. Available at: https://ageconsearch.umn.edu/bitstream/113621/2/series75.pdf. [Accessed at 31 August, 2018].

Okute, A., M., (2017). *Non-Tariff Barriers to Trade in East Africa Community: a Case of Exporters in Kenya.* Available at: http://erepo.usiu.ac.ke/bitstream/handle/11732/3265/ANYAL%20MICHAEL%20OKUTE%20MBA%202017.pdf?sequence=1&isAllowed=y. [Accessed at 31 August, 2018].

Ondraczek, J., (2013). *The sun rises in the east (of Africa): a comparison of the development and status of solar energy markets in Kenya and Tanzania.* Energy Policy, 56, pp.407–417.

RECP (2015a). *Higher Education for Renewable Energy Country Mapping. Uganda.* Africa-EU Renewable Energy Cooperation Program. Available at: http://www.euei-pdf.org/sites/default/files/field_publication_file/RECP_Higher_Education_Country_Mapping_Uganda_May2015.pdf. [Accessed at 31 August, 2018]

RECP (2015b). *Rwanda: Renewable Energy Potential.* Africa-EU Renewable Energy Cooperation Program. Available at: https://www.africa-eu-renewables.org/market-information/rwanda/renewable-energy-potential/. [Accessed at 31 August, 2018]

REN 21 (2016). *Global status report.* Renewable energy policy network for the 21st century.

REN21, 2018. R*enewables 2018 Global Status Report, Paris: REN21* Secretariat. http://www.ren21.net/wp-content/uploads/2018/06/17-8652_GSR2018_FullReport_web_final_.pdf

Reith, S., and Boltz, M. (2011) *The East African Community, KAS International Reports.* Available at: http://www.kas.de/wf/doc/kas_28725-544-2-30.pdf?110908154737. [Accessed at 31 August, 2018].

Reinert, K. A. and Roland-Holst, D. W. (1992). *Disaggregated Armington Elasticities for the Mining and Manufacturing Sectors of the United States.* Journal of Policy Modeling, 14. Rwanda (2015). Energy Policy. Ministry of Infrastructure. Available at: http://www.mininfra.gov.rw/fileadmin/user_upload/new_tender/Energy_Policy.pdf. [Accessed at 31 August, 2018].

Rwanda (2016). *Rural Electrification Strategy. Ministry of Infrastructure.* Available at:http://www.mininfra.gov.rw/fileadmin/user_upload/aircraft/Rural_Electrification_Strategy.pdf. [Accessed at 31 August, 2018].Uganda (2015). Sustainable Energy for All Action Agenda. Ministry of Energy and Mineral Development.

SADC. *Southern African Development Community: Towards a Common Future.* Southern African Development Community. Available at: https://www.sadc.int [Accessed at 30 November, 2018]

SADC (2005). *Protocol on the Facilitation and Movement of Persons 2005. Southern African Development Community.* Available at: https://www.sadc.int/about-sadc/overview/sa-protocols/ [Accessed at 30 November, 2018]

Sankar, U. (2008). *Environmentally Sound Technologies for Sustainable Development of China and India.* E Social Sciences.

Shinyekwa, I. M. (2015). *Has the East African Community Regional Trade Agreement Created or Diverted Trade? A Gravity Model Analysis.* Journal of Sustainable Development, 8(9), 129.

Sichilima, M., Gikonyo, A. (2017). *Opening opportunities: Kenya's electronic single window connects East Africa to global value chains. IFC smart lessons brief.* Washington, D.C.: World Bank Group, Available at: http://www.tfafacility.org/sites/default/files/case-studies/2017_-_kenya_knesw_wto.pdf. [Accessed at 31 August, 2018].

Stanton, D. (2016). *Trade facilitation iitiatives are sweeping through East Africa.* Trade Mark East Africa.

Stern, R. M. (1976). *Price elasticities in international trade: An annotated bibliography,* Springer.

Sumner, D. A., (2001). *Tariff and non-tariff barriers to trade.*

Tanzania (1998). *The Constitution of the United Republic of Tanzania,* 1998.

Tanzania (2008). *Electricity Act.* Available at: https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/ppp_testdumb/documents/Tanzania_10-2008.pdf. [Accessed at 31 August, 2018]

Tanzania (2010). *The Public Private Partnership Act.* Available at: https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/Tanzania_PPP%20Act_EN.pdf. [Accessed at 31 August, 2018]

Tanzania (2015). *Energy policy.* Available at: http://africaoilgasreport.com/wp-content/uploads/2017/10/Tanzania-National-Energy-Policy_December-2015-1.pdf . [Accessed at 31 August, 2018]

The Citizen (2016). *Remove hurdles to trade, TZ urged.* Available at: http://www.thecitizen.co.tz/magazine/businessweek/-/1843772/3304328/-/1h1xuc/-/index.html. [Accessed at 31 August, 2018]

The East African (2016a). *Kenya president urges Tanzania, Burundi to effect work permit fees waiver.* Available at: http://www.theeastafrican.co.ke/news/effect-work-permit-fees-waiver/2558-3412424-c6wse1/index.html. [Accessed at 31 August, 2018].

The East African (2016b). *Dar Cuts work permit for East Africans to $500.* Available at: http://www.theeastafrican.co.ke/news/2558-3440722-bwyibaz/index.html. [Accessed at 31 August, 2018].

The East African (2018a). *EAC partner states sabotaging spirit of Common Market.* Available at: https://www.theeastafrican.co.ke/business/EAC-partner-states-sabotaging-spirit-of-Common-Market/2560-4798356-rwbx0az/index.html [Accessed at 30 November, 2018]

The East African (2018b). *Engineers seek fairplay in major projects in EAC.* Available at: https://www.theeastafrican.co.ke/business/Engineers-seek-fairplay-in-major-projects-in-EAC/2560-4845700-cn5cx5/index.html [Accessed at 30 November, 2018]

The East African (2018c). *Tunisia becomes Comesa's 20th member state.* Available at: https://www.theeastafrican.co.ke/business/Tunisia-joins-Comesa/2560-4671666-kkdpx6/index.html [Accessed at 30 November, 2018]

The New Times (2018). *Regional engineers seek bigger share of major EAC projects.* Available at: https://www.newtimes.co.rw/news/regional-engineers-seek-bigger-share-major-eac-projects [Accessed at 30 November, 2018]

The Pan-African Citizens Network. *Popular Version of the COMESA Free Movement Treaties.* Available at: http://www.visafree.ccpau.org/wp-content/uploads/2018/02/Simplified-Visa-Protocol.pdf [Accessed at 30 November, 2018]

Tigabu, A. (2016). *A Desk Assessment on the Overviews of Current Solar and Wind Energy.* Projects in Kenya. IREK Report.

TMEA (2016). *Making sense of EAC's vision 2050.* Trademnark East Africa. Available at https://www.trademarkea.com/news/making-sense-of-eacs-vision-2050/. [Accessed at 31 August, 2018].

TMEA (2017). *Customs agents making business at the Sirare border point impossible.* Trademnark East Africa. Available at https://www.trademarkea.com/news/customs-agents-making-business-at-the-sirare-border-post-impossible/. [Accessed at 31 August, 2018].

TRALAC (2018). *African Continental Free Trade Area (AfCFTA) Legal Texts and Policy Documents.* Available at: https://www.tralac.org/resources/by-region/cfta.html [Accessed at 30 November, 2018)

Uganda (2015). *National Climate Change Policy 2015.* Available at: http://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf. [Accessed at 31 August, 2018]

Uganda (2013). *Rural Electrification Strategy and Plan 2013-2022*. Available at: http://www.rea.or.ug/resources/strategy%20and%20plan%202013-2022.pdf. [Accessed at 31 August, 2018].

UNCED (1992) *Agenda 21.* United Nations Conference on Environment and Development.

UNCTAD (2018a). *East African Community Regional Integration: Trade and Gender Implications.* United Nations Conference on Trade and Development. Available at http://unctad.org/en/PublicationsLibrary/ditc2017d2_en.pdf. [Accessed at 31 August, 2018].

UNCTAD (2018b). *Handbook on Duty-Free Quota-Free Market Access and Rules of Origin for Least-Developed Countries.* United Nations Conference on Trade and Development. Available at: https://unctad.org/en/PublicationsLibrary/aldc2018d5part2_en.pdf [Accessed at 30 November, 2018]

UNCTAD (2017). *Handbook on India's Duty Free Tariff Preference Scheme for LDCs.* United Nations Conference on Trade and Development. Available at: https://unctad.org/en/PublicationsLibrary/itcdtsbmisc77_en.pdf [Accessed at 30 November, 2018]

UNDP (2012). *Investment opportunities in renewable energy - Burundi. United Nations Development Program.* Available at: http://www.bi.undp.org/content/dam/burundi/docs/publications/Investment%20opportunities%20in%20renewable%20energy%20Burundi.pdf. [Accessed at 31 August, 2018].

UNDP (2018). *Gender Inequality Index (GII).* United Nations Development Programme. Available at http://hdr.undp.org/en/content/gender-inequality-index-gii. [Accessed at 31 August, 2018].

UNECA (2018). *EAC-Macroeconomic policy convergence.* United Nations Economic Commission for Africa. Available at: https://www.uneca.org/oria/pages/eac-macroeconomic-policy-convergence. [Accessed at 31 August, 2018].

UNECA (2016a). *EAC Trade and Market Integration.* United Nations Economic Commission for Africa. Available at: https://www.uneca.org/oria/pages/eac-trade-and-market-integration. [Accessed at 31 August, 2018].

UNECA (2016b). *COMESA - Common Market for Eastern and Southern Africa.* United Nations Economic Commission for Africa. Available at: https://www.uneca.org/oria/pages/comesa-common-market-eastern-and-southern-Africa [Accessed at 30 November, 2018].

UNECA (2014a). *COMESA - Free Movement of Persons.* United Nations Economic Commission for Africa. Available at: https://www.uneca.org/pages/comesa-free-movement-persons [Accessed at 30 November, 2018].

UNECA (2014b). *Energy Access and Security in Eastern Africa: Status and Enhancement Pathways.* United Nations Economic Commission for Africa.. Addis Ababa, Ethiopia.

UNECA. *African Continental Free Trade Area - Questions & Answers.* United Nations Economic Commission for Africa. Available at: https://www.uneca.org/publications/african-continental-free-trade-area-questions-answers [Accessed at 30 November, 2018]

UNEP (2011) *Towards a green economy: Pathways to Sustainable Development and Poverty Eradication.* United Nations Environment Programme. Available at: https://www.unenvironment.org/resources/report/pathways-sustainable-development-and-poverty-eradication [Accessed at 03 December, 2018]

UNEP (2014). *South-South trade in renewable energy: a trade flow analysis of selected environmental goods, 104.* United Nations Environment Programme. Available at http://www.greengrowthknowledge.org/resource/south-south-trade-renewable-energy-trade-flow-analysis-selected-environmental-goods?utm_source=GGKP+Knowledge+Update,+Issue+2014-5&utm_campaign=GGKP+Knowledge+Update,+Issue+2014-4&utm_medium=email. [Accessed at 31 August, 2018].

UNEP, (2017a) *Energy Profile – Burundi.* United Nations Environment Programme. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/20486/Energy_profile_Burundi.pdf?sequence=1&isAllowed=y. [Accessed at 31 August, 2018].

UNEP, (2017b) *Energy Profile – Kenya.* United Nations Environment Programme. Available at: http://wedocs.unep.org/bitstream/handle/20.500.11822/20506/Energy_profile_Kenya.pdf?sequence=1&isAllowed=y. [Accessed at 31 August, 2018].

UNEP (2017c) *Energy Profile – Rwanda.* United Nations Environment Programme. Available at: http://wedocs.unep.org/bitstream/handle/20.500.11822/20519/Energy_profile_Rwanda.pdf?sequence=1&isAllowed=y. [Accessed at 31 August, 2018].

UNEP (2017d) *Energy Profile – Tanzania.* United Nations Environment Programme. Available at:http://wedocs.unep.org/bitstream/handle/20.500.11822/20594/Energy_profile_Tanzania.pdf?sequence=1&isAllowed=y. [Accessed at 31 August, 2018].

UNEP (2017e) *Energy Profile – Uganda.* United Nations Environment Programme. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/20591/Energy_profile_Uganda.pdf?sequence=1&isAllowed=y. [Accessed at 31 August, 2018].

UNEP (2018) *About green economy.* United Nations Environment Programme. Available at: https://www.unenvironment.org/explore-topics/green-economy/about-green-economy. [Accessed at 31 August, 2018].

UNFCCC (1992). *United Nations Framework Convention on Climate Change.* Available at: https://unfccc.int/resource/docs/convkp/conveng.pdf. [Accessed at 31 August, 2018].

UNFCCC (1998). *Kyoto Protocol to the United Nations Framework Convention on Climate Change.* Available at: https://unfccc.int/sites/default/files/kpeng.pdf. [Accessed at 31 August, 2018].

UNFCCC (2011). *Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010.* United Nations Framework Convention on Climate Change. Available at: https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf. [Accessed at 31 August, 2018].

UNIDO & ICSHP (2014). *The World Small Hydropower Development Report 2016.* United Nations Industrial Development Organization, Vienna, and International Center on Small Hydro Power, Hangzhou.

Van Tongeren, F., Flaig, D. and Greenville, J. (2018). *Market Opening, Growth and Employment.* OECD Publishing.

Vossenaar, R. (2014). *Identifying Products with Climate and Development Benefits for an Environmental Goods Agreement.* Issue Paper No. 19, ICTSD.Available at https://www.ictsd.org/sites/default/files/research/Identifying Products with Climate and Development Benefits for an Environmental Goods Agreement.pdf. [Accessed at 31 August, 2018].

Vossenaar, R.(2010). *Climate-related Single-use Environmental Goods, ICTSD Issue Paper No. 13,* International Centre for Trade and Sustainable Development, Geneva, Switzerland.

Wan, R., Nakada, M. and Takarada, Y. (2018). *Trade liberalization in environmental goods.* Resource and Energy Economics, 51, 44-66.

Wawa, A. I. (2012). T*he challenges of promoting and adopting biogas technology as alternative energy source in semi-arid areas of Tanzania: The case of Kongwa and Bahi districts of Dodoma region.* Doctoral dissertation, The Open University Of Tanzania.

World Bank (2018a). *Ease of Doing Business: Distance to Frontier.* Available at: http://www.doingbusiness.org/reports/~/media/WBG/DoingBusiness/Documents/Profiles/Regional/DB2018/EAC.pdf. [Accessed at 31 August, 2018].

WTO (1994) *General Agreement on Tariffs and Trade (GATT).* Available at: https://www.wto.org/english/docs_e/legal_e/06-gatt_e.htm. [Accessed at 31 August, 2018].

WTO (2001) DOHA WTO MINISTERIAL 2001: *Ministerial Declaration,* WT/MIN(01)/DEC/1. World Trade Organization. Available at: https://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm. [Accessed at 31 August, 2018].

WTO (2006). *Trade Policy Review on EAC.* World Trade Organization.

World Trade Organization Secretariat and UN Environment (2018) *Making trade work for the environment, prosperity and resilience.* WTO, Geneva, Switzerland.

Zhang, Z. X. (2013) *'Trade in Environmental Goods, with Focus on Climate-Friendly Goods and Technologies',* in Van Calster, G. and Prévost, M. D. (eds) Research Handbook on Environment, Health and the WTO. London: Edward Elgar Publishing, pp. 673–699.

Databases

- UN Comtrade (2018). *International Trade Statistics Database*. Available at: https://comtrade.un.org/. [Accessed at 31 August, 2018].
- IRENA (2018). *Solar energy data.* International Renewable Energy Agency.
- WITS (2018). *World Integrated Trade Solutions World Bank Database.* Available at: https://wits.worldbank.org/. [Accessed at 31 August, 2018].
- World Bank (2018b). *World Bank data base.* Available at https://data.worldbank.org/. [Accessed at 31 August, 2018].
- World Bank (2018c). *Sustainable Energy 4 All (SE4ALL) Database.* Available at: https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS [Accessed at 30 November, 2018]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