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DIFFUSION STRATEGY OF GREEN TECHNOLOGY AND GREEN INDUSTRY IN AFRICA

A Pilot Study of Renewable Energy Technology Market, and Energy Efficiency
Adoption in Cassava and Maize Processing Industry in Kenya and Nigeria
Funded by KEEI through UNIDO

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countries”**

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What the study is about

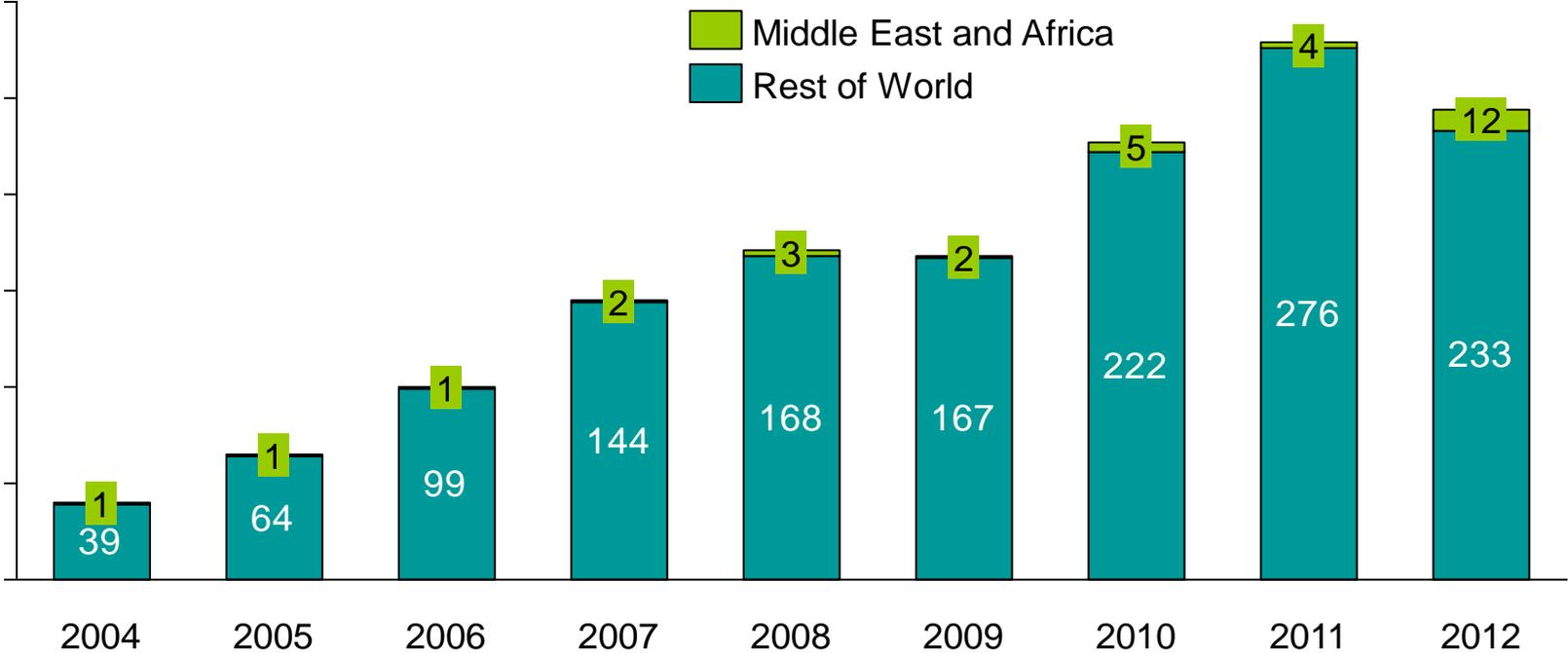
- The **market** for modern **renewable energy technologies** (RET) in Sub-Saharan Africa, and
- The **uptake of energy efficiency** (EE) measures in two agro-industrial sectors (**cassava processing** and **maize milling**) in two African countries (Nigeria and Kenya)

Background of the study

- **Renewable energy** (RE) is spreading across (energy poor) Sub-Saharan Africa (SSA) but few studies have engaged in original data analysis on this.
- Agro-industrial sectors constitute an important part of the economy in SSA, which makes them suited for an analysis of the prospects for green industrial development from an **energy-using** point of view.

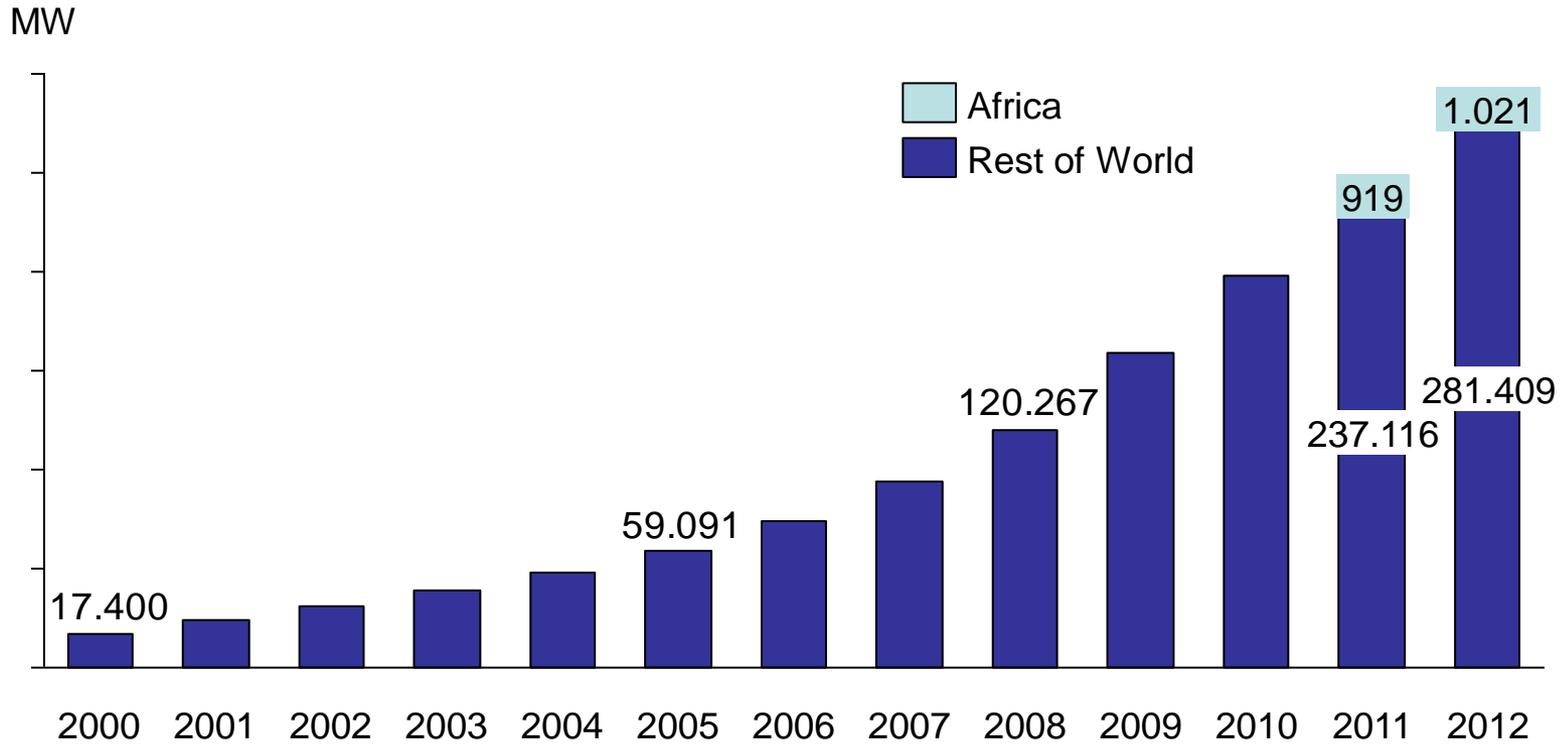
Global Trends in Renewable Energy Investments (2012)

USD bn

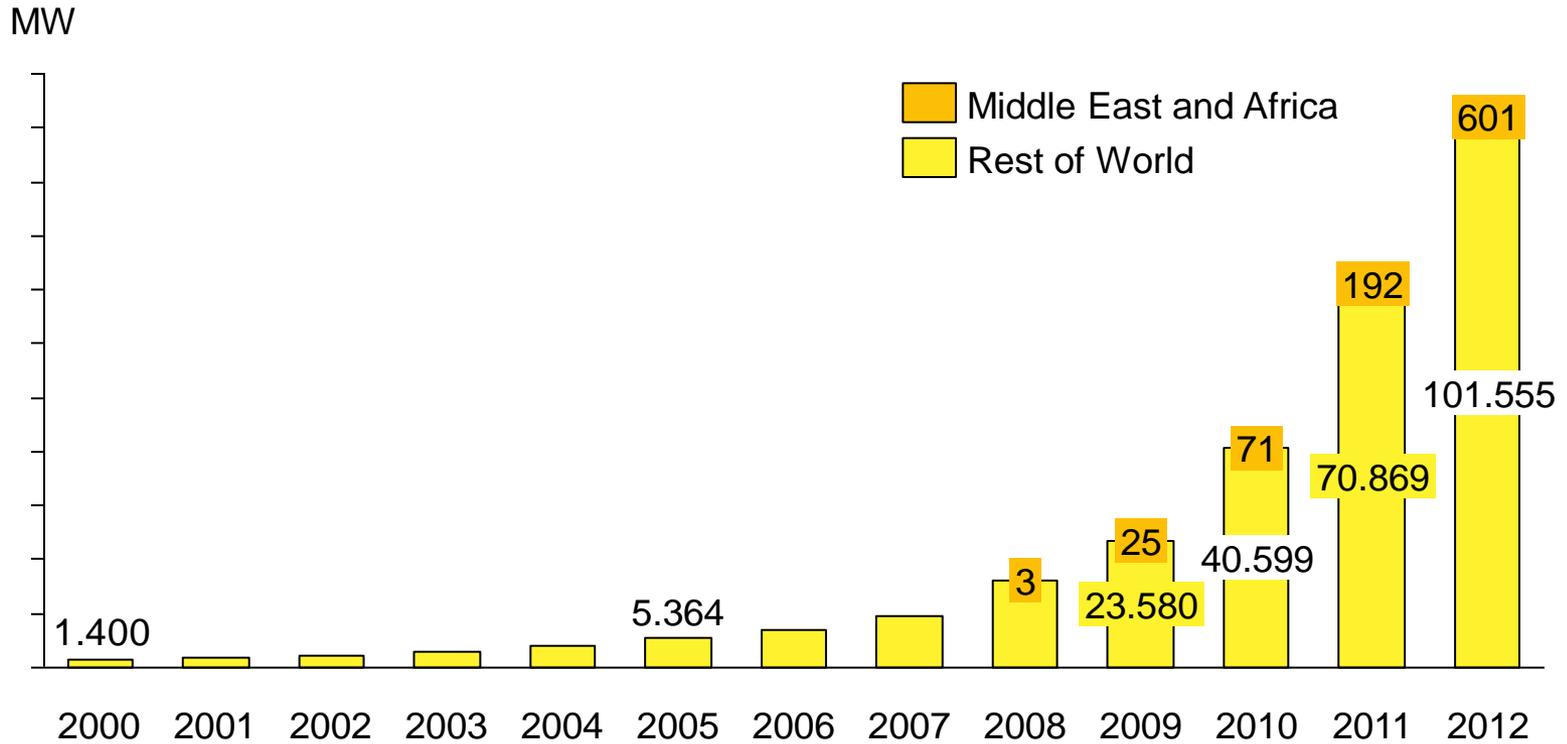


Source: UNEP Global Trends in Renewable Energy Investments (2013).

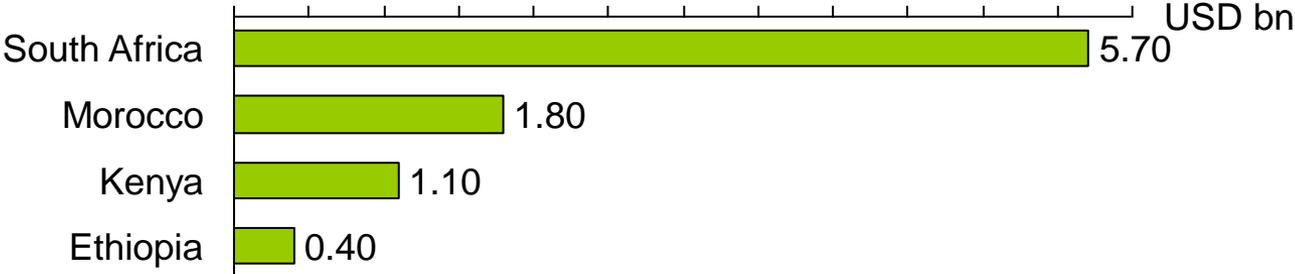
Trends in Wind Installed Capacity



Trends in Solar Installed Capacity



Investments in Renewable Energy in Africa (2012)



Note: omits countries with less than USD 0.1 bn investment.
Source: UNEP Global Trends in Renewable Energy Investments (2013).

Key research questions

1. What are the **trends in renewable energy technology deployment** and **investment** across various world regions, and how does investment in SSA compare with these global trends?
2. What are the **product offerings** and **market prospects** for RET (solar, wind, biomass, hydro) in Nigeria and Kenya?
3. What factors **shape** the diffusion of RET in Nigeria and Kenya?
4. What are the **factors behind the choice and adoption** of EE and RETs in agro-industrial sectors? What factors are preventing companies from investing more in EE and RET?
5. Is there a need for **technical cooperation** in RET and EE? If so, what form should this take?

The research approach

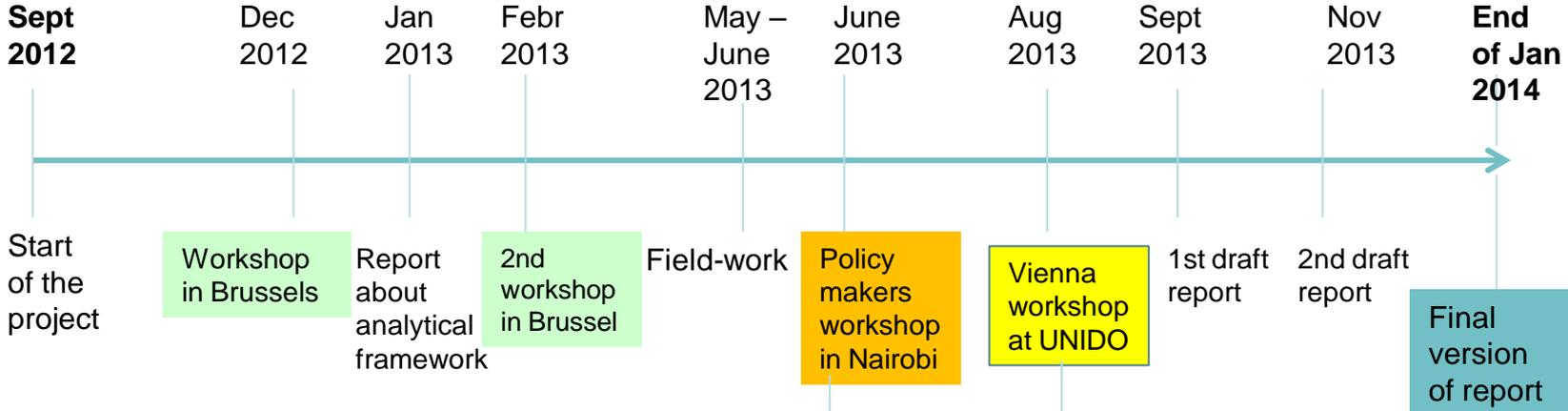
- The research questions are assessed through two specially designed **questionnaires**, **interviews** with companies and experts and **desk research**
- The project draws on the literature on diffusion and adoption of new technologies, the literature on innovation systems and the literature about global value chains.
- **Local** and **global** aspects of value chains and innovation are being brought into the analysis, helping us to understand the indigenous and foreign sources of knowledge and technology, the need for financial assistance, technology transfer and technical cooperation.

The research team

- The research teams involves development specialists, innovation researchers and policy experts from Africa and Europe and is led by UNU-MERIT



Time line



Key findings

- The RET sectors are young: Most of the solar technology suppliers and almost all bioenergy and wind turbine companies which were examined in Kenya have been established after 2000.
- **Solar** and **biomass** are the biggest RET markets with solar PV being based on foreign technology and biomass mostly based on domestic T and knowhow
- The majority of the suppliers are **not** experiencing growth (82% in Nigeria and 71% in Kenya) but they are **very positive about futures sales** (64% and 56% are expecting significant growth)
- We did not observe energy leapfrogging and do not consider this a realistic option for SSA
- There are many constraints to diffusion (a “web of constraints”)

Barriers

- **Lack of technical knowledge** and **financial sourcing** come out as important barriers
- RET suppliers also state that there is a **strong need to improve the business climate** in Kenya which affects availability of financial sources, especially from international financial institutions
- To deal with these obstacles, RET suppliers offer specific services to reduce shortcomings. The reason for **bundling the technology supply with advice on finance or provision of financing solutions** is to overcome financing challenges and mobilize financial resources.
- High import tariffs on RET components were mentioned as a barrier to adoption by 15% of the RET suppliers

Origin of suppliers, reasons for adoption and the importance of finance

- Most foreign energy technologies come from **China** (68% in Nigeria and 44% in Kenya)
- **India** is an important exporter too.
- Of the European countries, Germany is the most important exporter of RET for the countries of Nigeria and Kenya
- In Nigeria the **main reasons for adoption are**: unreliable power supply and volatile exchange rate. In Kenya, **ver** is the most often stated reason for adoption
- **Funds** appear a necessary condition for most sales
- 86% of investments in EE in Nigeria is self-financed, against 44% in Kenya

The adopters

- The most important adopters of RET are government and not-for-profit organisations (schools, hospitals community centres)
- **Modern RET uptake by industry is slow** (main energy need is for heat and for this wood products and FF are used).
- There is **potentially big market for biogas and biobricks** for the reason that FF are expensive and energy costs being a significant cost item for many agro-industrial sectors
- **Few companies have adopted sophisticated energy efficiency measures.** Reasons for this are: High costs of adoption, problems of technical capability and associated fears, risk perceptions. (Energy losses in the manufacturing sector are considerable : between 10-40 percent according to KAM-Center for Energy Efficiency & Conservation).
- Many of the potential adopters want to **see the technology in operation**: demonstration effect, possibility to have a conversation with trustworthy user.

Foreign vs domestic knowledge

- Roughly one quarter of RET are fully based on **foreign components**, 30% involve domestic technology to a small degree and another 30% involve domestic technology to a larger degree. The local content of bioenergy technology is much higher
- 17% of RET suppliers state that the level of domestic components has increased within the last 5 years while for the coming five years in the future 24% state that they **expect an increase in domestic component sourcing**
- The majority of RET suppliers provide technical support for clients in form of training and installation of RET, while the technical support is mostly offered by local experts . This holds true similarly for solar and bioenergy technology suppliers. Respondents expect that foreign experts will be completely replaced by local ones within the next 5-10 years' time.

- **China is an important supplier of RET**

Why?

- Chinese companies can supply products of any desired quality at a price matching the quality
- There is a great deal of trading between Africa and China with African traders/entrepreneurs going to China
- China has a presence (with great visibility) in Africa
- The Chinese government encourages exports into Africa and has exchange programmes
- Kenyan business has representatives in China
- High level contacts exist between China and African countries (trade and cooperation visits)
- ...

A clear interest from policy makers but no simple recipes

- African governments are interested in renewable energy (RE) and energy efficiency (EE)
- They are **looking for guidance to support RE and EE**
- There are no simple recipes for creating a more enabling environment for RE because policy is a PROCESS requiring
 - Capacities for policy making and coordination
 - Mechanisms for implementation and enforcement
 - Policy learning (to adapt policies to new circumstances)
 - An ability to avoid falling prey to special interests, to hypes and short-termism

Implications for technical cooperation

- Technical cooperation projects should focus on areas in which there is an **(economic) demand** for the outcomes of cooperation and **a capacity** for cooperation.
- It appears worthwhile to interact with knowledgeable **knowledge brokers**
- There is a need for foreign T to be more adapted to African needs and a need to upgrade African T (Technical cooperation should be based more on this insight.)
- In Africa there is a need for low-cost, low-maintenance solutions
- For complex RE technologies, the **operation contract** is a better model than a sales contract model.

Technical cooperation models

- 1) Development aid model
- 2) Development finance institution model
- 3) South-South model
- 4) Intra-Africa model
- 5) Going out models
- 6) Enterprises' initiative model

About the TC models

- 1) **Development aid model:** Projects last only a few years, NGOs lacking technical competence resulting in inappropriate solutions, need for local champion (knowledge broker).
- 2) **Development finance institution (DFI) model:** Offering finance to firms and state agencies, several IPP are associated with DFI; projects can take long to attain financial closure, crowding out of local and foreign private investors, neglect of small-medium scale projects, DFI tend to finance projects with technologies from their countries
- 3) **South-South model:** This consists of organisations from (mostly) BRICS countries trading/cooperating with African countries.
- 4) **Intra-Africa model:** Consultancy expert services from Africans to Africans

TC models cont.

5) **Going out models:**

- **GO model of China** consists of state support to (state-owned) enterprises in the form of financial resources, customisation of packages, absence of rules, continuity, presence and visibility in Africa, focus is on commodities and infrastructure;
- **GO model of NL** consists of offering co-financing, risk mitigation instruments trade missions, plus technical and business advice to private sector endeavours into Africa; **Chambers of commerce are playing the crucial role of organizing Dutch entrepreneurs in various sectors (water, energy)**. Brokering services are provided by the NL-Africa Business council and commercial attachees in destination countries.

6) **Enterprises' initiative model:** Business clubs set up by banks offering seminars and workshops, opportunities for networking, and organised tours to important trade goods markets (which differ from government driven trade tours in allowing a greater participation from small business) (thus far only one trip to D and NL has been organised by the Barclay Kenya Business Club)

Our evaluation of the “technology cooperation” models is that

- **All models have a role to play** but all suffer from weaknesses
- The “going out” economic models involve ample opportunities for technology transfer and adoption especially in key sectors that have potential in transforming SSA economies but opportunities for real technical cooperation are missed.
- Firms from countries such as the Netherlands and Korea could focus on **a more complementary exchange of technology and knowhow**
- Trade missions offers opportunities for learning about possible projects of technical cooperation leading to the identification of a range of technologies that are suited to SSA contexts. However, SSA countries are yet to put in place a clear strategy through which they can tap these emerging models.

Conclusions about TC cont.

- Development aid grants **distort markets** and **create non-sustainable dependencies** of financial support. A more viable approach with potential for sustainable progress is by fostering and enabling interactions between African firms and foreign firms holding technology expertise relevant to African firms.
- The technology transfers from cooperation do little to improve weaknesses of the eco-innovation system
- Development aid and DFI supported technical cooperation should **target areas of economic production where they have higher chances of making a (lasting) impact**, thanks to a functional organisational framework, ability to self-evaluate needs and identify own solutions.
- Technology transfer and diffusion efforts and supportive policies should adopt **a more pragmatic approach**, with the actors themselves determining the details of cooperation. Direct contact between (knowledgeable) actors helps to achieve this.

It is also proposed that TC focusses more on

- **Mutual learning and adaptation.** Three ways to do this are: 1) through training and education, 2) by adapting foreign technologies, and 3) by improving African solutions **Intermediaries** and **direct contacts** are a way to identify opportunities for TC
- **Capacity building at the level of government.** Low-carbon development paths require “**analytical and institutional capacities** [...] to analyse and interpret the data, to organise and participate in meaningful stakeholder involvement, and to translate background information into (policy) action” (van Tilburg et al. 2011, p. 30). (Such capacities can only partially be provided by international experts: “if the role of the international experts in the strategy process is too large, this could lead to low legitimacy of the LCDS and lack of ownership”).