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Models of Growth and Colonial Implications in the Renewable Energy Sector in Africa

Jordan Grimaldi
Pomona

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Undergraduate Research Award

Sophomore Award Winner
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Pomona College

Reflective Essay

The research for my paper, "Models of Growth and Colonial Implications in the Renewable Energy Sector in Africa," was largely sourced from the databases, particularly JSTOR and GreenFILE, that are offered through Claremont Colleges Library. Prior to this project, I had used JSTOR but was unfamiliar with GreenFILE. I discovered GreenFILE by looking through the library's list of databases and under the "By subject" listings I chose Environmental Analysis. It proved to be a very helpful database for my research process, which will undoubtedly continue to serve my future studies as an Environmental Analysis major.

My paper sought to adapt an interdisciplinary approach by addressing several aspects of the renewable energy sector in Africa: (1) the benefits and drawbacks of various models of growth in the context of the renewable energy sector (2) drivers and barriers in the sector and (3) how the history of European colonization influences and contextualizes this issue. These aspects cover several areas of study, including history, policy and politics, economics, renewable energy technology, and climate change. Thus, I chose sources from a variety of different scholarly journals, books, Non-Governmental Organizations (NGO's), and governmental agencies in order to reflect the variety of areas of study that my research questions implied. Furthermore, I strived to keep my sources as current as possible since the renewable energy sector has seen rapid change in the past decade or so. I needed to reflect the most recent trends, policies and technologies. The "Publication Date" constraint on JSTOR made my research process more efficient by filtering out out-of-date sources.

I recognize that a potential bias reflected in many of my sources is that many them support the scaling-up of the renewable energy sector in Africa and do not highlight the drawbacks and consequences that various renewable energy sources, such as nuclear and hydropower, can have.

In using the "Advanced Search" feature for both databases I had to go through a trial-and-error process of selecting which key words would generate relevant sources for my paper. The Advanced Search feature revealed to me what could realistically be the geographic scope of my paper. Before I began my research, I knew Africa has quite a diversity of governmental structures, economies and sociocultural dynamics. Thus, it would make the most sense to focus on a particular region or even country where most of

the drivers and barriers to the scaling-up of the renewable industry would be similar. However, my time spent with the Advanced Search feature quickly revealed to me that there is a significant lack of research focusing on the energy landscape in specific countries or regions in Africa. While my research did reveal a strong focus on South Africa, the sixteen sources I cite in my paper cover a wide range of countries and regions on the continent. I then discovered a need for more parochial research on the renewable energy sectors in Africa on a regional basis. We need to have the sensitivity of local and regional drivers and, political climates etc., so that we may begin to understand how the scaling-up of the renewable energy sector in Africa should best be approached. Additionally, the lack of mention of colonial histories and their implications within the energy sector revealed an issue in the broader field of energy research. Colonialism greatly frames the modern energy issues facing Africa today and the lack of acknowledgement of this context in scholarly research, governmental and NGO reports etc. contribute to exacerbating the inequalities that are imbedded in these issues.

I am grateful for the growth that this research paper afforded me. It began with deciding on a broad topic, narrowing the focus of that topic and has continued, as I am using the skills I gained in current research I am doing for other classes. I originally intended for the topic of my research paper to be leap-frogging within the renewable energy sector in Africa. Eventually, the focus narrowed to models of growth for the scaling-up of the renewable energy sector and how it can be done (in the medium/long-term) in a way that it is for African people and by African people. Before writing this paper, while it countered many of my core environmentalist beliefs, I thought all developing economies should continue to use fossil fuels to foster their growth because I believe that all nations should have the right to self-determination and should not be subject to the will and needs of others. However, my research greatly evolved my opinion into believing that Africa *needs* a renewable economy, not for Europe's needs but for its own. One of the continent's primary goals is improving social and economic development and a renewable economy is the only sustainable way to do so.

Another important lesson I gained from this research paper that helped me grow as a scholar is the realization that at any point new information can arise in the process that significantly alters the direction of the project. I had almost written my entire paper when I

discovered that Africa's greatest energy source was bioenergy and not fossil fuels. Almost all of my sources focused on either the fossil fuel or renewable energy industry, which obscured the issue of biofuels from view. I could not believe that such a glaring issue was left largely unmentioned by practically all of the sources that I had come across thus far. I then had to adjust my paper and argument to reflect this new information that I had discovered. I learned that research can take unexpected twists and turns that may be frustrating but in the end, they made my paper richer and my knowledge deeper.

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Research Project
"Models of Growth and Colonial Implications in the Renewable Energy Sector in Africa"

1. Executive Summary

Rooted largely in colonial histories, Africa is plagued with immense energy poverty and a relative reliance on fossil fuels, especially in Southern Africa. In this paper, Africa is defined as those countries in which there exists a relatively strong democracy and economy. Research has revealed a strong focus on South Africa, in particular. The majority of Sub-Saharan African energy comes from bioenergy (mainly in the residential sector), placing great strain on forest stock and increasing health risks due to poor air quality. Steps must be taken to reduce this dependency and increase diversity of renewable energy options for rural communities. The scaling-up of the renewable energy sector is the only sustainable way to attempt to ensure that the main priorities of social and economic development are met. Africa does not have the same fossil-fuel dependency as many other continents/countries do and, thus, still has the opportunity to skip over a fossil-fuel intensive economy and move towards a renewable economy. Africa has seen recent growth in the renewable energy sector thanks to a variety of domestic and foreign players involved in a variety of models of growth. Foreign involvement in the renewable sector is necessary—at least in the short and medium term—as Africa generally lacks the higher-education infrastructure and competitive, private firms to drive the sector on its own. That being said, any foreign involvement *must* be held accountable in order to ensure that Africa does not become re-colonized by foreign powers. Therefore, Africa's future requires not only a mix of renewable energy sources, but also a mix of domestic and foreign players contributing to a variety of models of growth.

2. The Energy & Sustainability Issue: Energy Poverty

Around 600 million people in Africa (approximately 70 percent of the population) are unconnected to an energy grid and are forced to rely on expensive, unreliable sources of energy to power their lives, most commonly kerosene generators and wood-fired stoves (Amankwah-Amoah 2015). Life without reliable power means little to no opportunity for rapid social and economic growth—students cannot read clearly after daylight hours, businesses cannot function and expand properly, families cannot access certain forms of communication, and so on. Unless this trend is reversed, some projections predict this number could rise to over 700 million by 2030 (Amankwah-Amoah 2015). Energy poverty is an extremely pressing issue in Africa, as 70 percent of the population lives in rural areas, which makes conventional grid expansion difficult and costly (Showers 2011). It is imperative that Africa strives towards a renewable—rather than fossil fuel-intensive—economy to not only minimize the energy gap by providing cheaper and cleaner off-grid solutions, but also to achieve energy independence, provide local employment opportunities, and reduce emissions and exploitive practices. One of the continent's primary goals is improving social and economic development, and having a renewable economy is the only sustainable way to do so.

This memo will look at: the benefits and drawbacks of various models of growth in the context of the renewable energy sector, drivers and barriers in the sector, and how the history of European colonization influences and contextualizes this issue. For all intents and purposes, Africa will be defined as those countries in which there exists a relatively strong democracy and economy and thus have high potential to adopt and expand a renewable energy sector. There is inadequate research on the renewable energy sector in any one country or particular region, but research has revealed a strong focus on South Africa. Thus, a need has been identified for more research on individual countries and regions as geography, governmental structures, and economies vary significantly across the continent, so that every country has different drivers and barriers to its development of renewable energy. The main renewable energy sources looked at are solar, hydropower, and nuclear. This memo is of utmost importance because renewable energy is the only

way to ensure Africa's opportunity for growth in a way that minimizes the acceleration of environmental destruction in the face of climate change.

In facing climate change, Africa is at a critical point. According to the Energy Information Administration (EIA)'s *International Energy Outlook 2017*, non-OECD countries in Africa are expected to experience some of the highest rates of population growth in the world, and energy consumption is expected to increase by 51 percent between 2015-2040. The need for the scaling-up of the renewable energy sector in Africa is magnified by the realities of climate change, as several regions of the continent are extremely vulnerable to its effects—especially when considering existing vulnerabilities, including low levels of infrastructure and poor access to resources. However, while climate change is important in the sense that its effects are disproportionately felt by most of Africa, the continent, as a whole, contributes very little to total global emissions and countries' main priorities are social and economic development, rather than climate change mitigation.

3. Energy & Sustainability Context: Chronology of Energy Sector and Colonial Legacies

There is a long history of Europe using Africa as an energy source, from which stemmed a long history of exploitation with little economic benefit to the African nations. Electricity first arrived on the African continent with colonial administrators and private entities using energy infrastructure developed by Europeans with commercial interests, rather than the social development interests of Africans themselves (Showers 2011). This largely explains the prominence of energy poverty in rural areas today. Looking at the chronology of Africa's energy sector reveals how foreign involvement—both in the past and present—is complicated, as European entities are largely responsible for the growth of its fossil fuel industry, but *also* for its development of renewable energy products and accessibility.

Electrification in Africa began in the 1880s and 1890s, with small-scale, isolated generators fueling various industries and lighting cities. The generators were mostly powered by steam turbines fueled by gas in North Africa, wood in East and Central Africa, and coal in Southern Africa. Additionally, diesel engines fueled by imported oil were also very prominent in West Africa (Showers 2011). In the early twentieth century, isolated generators transitioned into more expansive grid systems via thermal plants (powered primarily by fossil fuels, as wood became less economical) provided by a mix of colonial governments, African governments, and private foreign companies. Coal was the first fossil fuel to be exploited on a large scale dating back to the 1880s, mainly in Southern Africa where 91 percent of Africa's coal reserves are located (Iwayemi 1992). Throughout the latter half of the twentieth century, private foreign companies explored for East Africa's large potential oil reserves, but efforts were slowed by volatile political climates and turned primarily to West Africa, which is where most of the continent's oil exports come from today. However, Africa is not nearly as dependent on fossil fuels as the United States (Figure 1), and, thus, the continent still has the opportunity to skip through a fossil-fuel intensive economy and instead towards a renewable one.

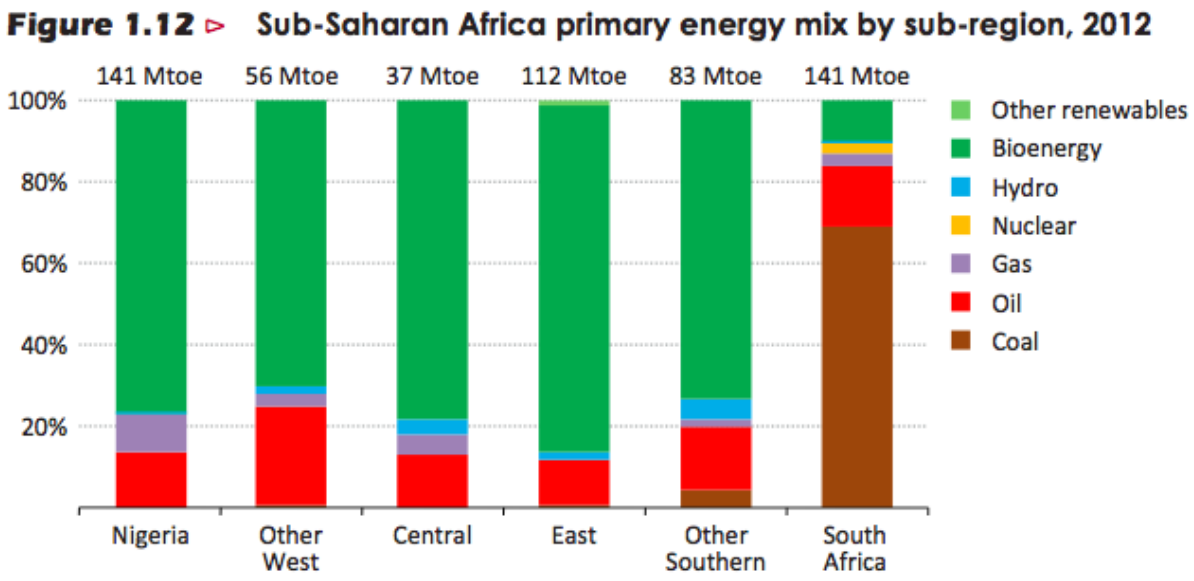

Figure 1: Courtesy of USEIA (African Energy Outlook 2014)

Hydropower entered the energy mix on a larger scale in the late nineteenth century, when colonial governments made a push for hydroelectricity after realizing that African rivers held one-half of the world's hydropower potential (Showers 2011). The 1930s saw a resurgence in hydropower due to the demand for mineral exploitation caused by post-WWI rearmament, and, then again, in the 1950s-1970s, as newly independent African nations became enthusiastic about hydroelectricity (Showers 2011). Hydropower development has since slowed due to strong opposition on environmental and social grounds, coupled with extreme droughts and financial crises in the 1990s (Kibonde 2017).

South Africa has been producing nuclear energy since 1984, when it built its first of two reactors using French technology (Abdenur and Kassier 2014). The transition from apartheid to democracy, beginning in the 1990s, dismantled the nuclear industry, but, in 2014, President Zuma announced his commitment to its revitalization and even issued a supply contract of around $94 million for six more reactors (with Russia and China building them) (Abdenur and Kassier 2014). In fact, Adriana E. Abdenur and Conrad Kassier in their paper, "Nuclear Energy and the BRICS," argue that BRICS (an acronym for Brazil, Russia, India, China, and South Africa, which are all in similar stages of newly advanced economic development) states will play a vital role in reshaping the geopolitics of nuclear energy.

The "newest" of the three main renewable energy sources—solar—has also seen significant growth in Africa in recent years. Ever-improving solar technologies have caused a shift in the way people have considered the power of the sun in Africa, from a hindrance to a power source (Amankwah-Amoah 2015). Much of this growth has been made possible by foreign resources.

However, despite these recent improvements and developments in the renewable energy sector, the majority of African nations remain largely dependent on bioenergy. Bioenergy is essentially energy in liquid, solid, or gaseous form derived from living organisms, most commonly fuelwood and ethanol. This dependency on bioenergy, surprisingly, is left unmentioned by most scholars and agencies when talking about energy consumption in Africa. Bioenergy use is contributing to serious consequences, such as deforestation and 600,000 premature deaths from household pollution from

wood-burning stoves (EIA 2014). Bioenergy in Africa is most dominant in the residential sector in the form of fuelwood for wood-burning stoves for cooking and heating. Nearly 730 million Africans rely on solid biomass for cooking (EIA 2014). Furthermore, the Africa Energy Outlook predicts a 40 percent rise in demand for bioenergy by 2040, which will significantly exacerbate preexisting strains on forestry stock. Colonial legacies of initial electrification infrastructure have indirectly contributed to this unsustainable dependence on bioenergy in the ways they neglected to expand energy access to rural areas where the majority of Africans live. However, solar cook stove technology is improving and provides a potential solution for heating and cooking in rural residences, in that it will decrease strain on forest stocks and decrease GHG emissions, thereby, also improving air quality and health.

4. Current Challenge: Barriers to Renewable Energy Sector Growth

First and foremost, a major barrier faced by the renewable energy sector in Africa is the vast amounts of money and political power going towards the fossil fuel industries. In Tanzania, powerful gas lobbies are successfully blocking the expansion of hydropower projects (Ahlborg and Linus 2014). Carl Death asserts in his book, *The Green State in Africa*, that politicians in South Africa, who have backed their careers on fossil fuels, effectively make any meaningful transformation of South Africa's high-carbon development strategy in the medium term almost impossible. He describes what he calls the Minerals-energy Complex (MEC), in which mining, electricity, and manufacturing companies are closely connected to state elites. Again, this complex has roots in early European colonization, and flourished during interwar and post-World War II, as state corporations heading dirty industries exerted serious political power over South Africa, fusing together the state and the market.

Second, a serious lack of government power and/or initiative is a barrier. Many African governments have passed taxes and policies that have made the electrification of rural areas by solar power costly, according to Joseph Amankwah-Amoah in his book, *Solar Energy in Sub-Saharan Africa.* Additionally, many African countries experience major hindrances to effective or ethical governance, including corruption, inadequate regulatory and legal frameworks, weak institutions and poor transparency and accountability (EIA 2014). As a result, businesses have cited poor governance as a deterrent to invest in the continent (EIA 2014).

Third, extreme poverty and development of human capital are huge barriers. In 2010, 49 percent of Africa's total population lived in absolute poverty, which is defined as living on $1.25 or less per day (EIA 2014). Even as solar prices continue to drop, up-front costs of access and installation make it inaccessible to many. Furthermore, a 2015 report by the Africa-America Institute found that only 6 percent of young Africans are enrolled in higher education. Higher education development is crucial to ensuring renewable energy growth in the long-term, as domestic companies and individuals can play an increasingly larger role in the sector.

5. Analysis: Models of Growth

The aforementioned barriers, in addition to some other factors, are hindering Africa from reaching its tremendous potential for renewable energy production. African rivers have, by far, the greatest untapped potential out of anywhere else in the world at 91 percent of total technical potential (Nature Conservancy 2014). Ghana and Sub-Saharan countries, in general, have optimal conditions for solar power with sunshine duration of 1,800 hours to 3,000 hours per annum (EIA 2014), and yet, Africa's solar PV energy industry, like so many of its industries, is arguably underserved, underexploited, or underutilized with potential for growth (Amankwah-Amoah 2015).

Unfortunately, the same tremendous potential can also be said of Africa's nonrenewable resources, such as coal, oil, and precious metals.

The "answer" to the future of Africa's renewable energy economy will not rest on one single renewable energy source, but, instead, some mix of various sources. Thus, when discussing the scaling-up of renewable energies, it is also crucial to position their costs (economic, social and environmental) alongside their benefits (see table below).

Type of renewable energy	**Benefits (+)**	**Costs (-)**
Solar	a cheaper and healthier alternative to kerosene generators and wood-fired stoves, potential local job creation, zero emissions, (Amankwah-Amoah 2015)	often high up-front costs that are not accessible by many poor/rural communities and the rare metals necessary to construct panels
Hydropower	Generally low-carbon source of energy, largest global source of affordable renewable energy (Kibdonde 2017) hydropower reservoirs can be used for other uses (i.e. recreation, water storage) (Nature Conservancy 2014)	Habitat fragmentation caused by dams and general disruption of aquatic ecosystems, displacement of communities due to inundation, reservoir-induced seismicity (Nature Conservancy 2014)
Nuclear	Cost of electricity produced is relatively cheap, almost carbon free on the whole life-cycle, plants requires much less land use than solar farms (Abdenur and Kassier 2014)	Radioactive waste, very high up-front construction costs, uranium mining (& health/safety of uranium miners)

Below is a discussion of the strengths and weaknesses of several models of growth for the scaling-up of the renewable energy sector.

NGO and Aid Agency Model

NGOs and Aid Agencies, such as the World Bank, United Nations, and Global Environment Facility, are largely responsible for the substantial growth seen in the renewable energy sector—especially in regard to solar (Amankwah-Amoah 2015). However, Amankwah-Amoah warns that there is a real need to shift away from donor-led projects, and, instead, towards commercial and productive investments, which give Africa's viable private sector firms the opportunity to thrive. It is also worth mentioning here that the presence of NGOs engaged in renewable, energy-related work, however, is uneven across Africa, as found by a study conducted in 2014 by Maclean et. al. The study found that NGOs are more likely to be located in more democratic countries with large populations and less access to electricity, instead of location based on pure need (Figure 2). The study also found that some NGOs in Kenya were actually working to inform new energy policy by partnering with the government. Thus, we see that often times, the various players involved in the renewable sector form partnerships with entities outside of their own sector (i.e. NGO + government) in order to more effectively scale-up renewable energy production and distribution.

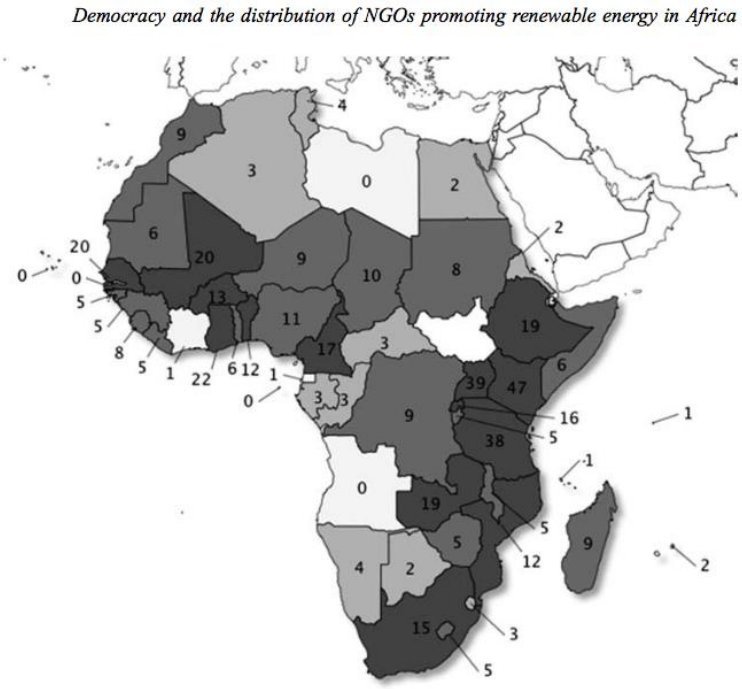

Figure 1. Number of DG-NGOs per country.

Figure 2: Courtesy of Maclean et. al. (2014)

Government/State Model

Even though the Paris Agreement places no responsibility on South Africa to reduce emissions as an Annex I party, the South African government has engaged in several promotional, renewable-energy policies. South Africa is used here as an example of the governmental model of growth because it is one of the continent's leading industrial countries in terms of climate change and energy-related policies (Odeku and Edson 2010). That being said, we must also note that the country lacks an umbrella statute for renewable energy policy, but does make references to renewable energy policy in numerous documents (Lüdemann 2012). For instance, the government introduced a renewable portfolio standard target of 20 per cent by 2025 (Figure 3). Additionally, governmental agencies created feed-in tariffs, which guaranteed affordable prices for renewable energy technologies for a certain period of time. This was eventually replaced by a procurement plan in 2011 that determined prices of construction of renewable energy facilities and production of energy by a competitive bidding procedure (Lüdemann 2012). These policies effectively provide market stability in the long-term, which is key in attracting investors and developers (Lüdemann 2012).

Figure 1. Note that the technical and financial viability of these options is continually being re-assessed. (Source: Eskom Annual Report 2008)

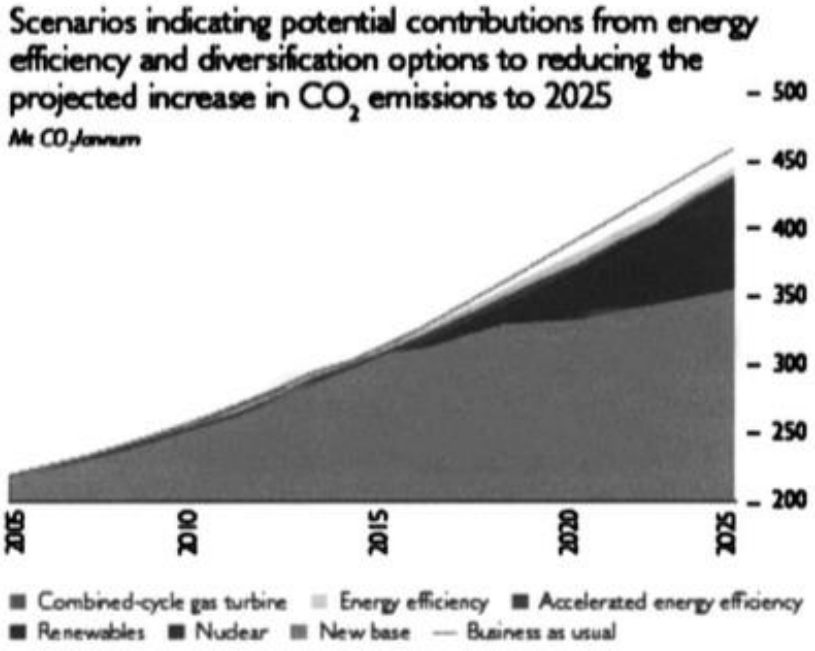

Figure 3: Courtesy of Odeku and Edson (2010)

Emerging-Market Multinational Model
Thanks to Chinese companies such as JA Solar, solar technology has become cheaper and more efficient than ever before (Amankwah-Amoah 2015). Their specialization and experience in operating in emerging markets has enabled them to play a great role in providing communities in Africa with access to solar products for development (Amankwah-Amoah 2015). Again, however, this discourages any opportunity for African solar firms to become competitive in the national and global markets.

Pay-as-you-go Model
Fourth, there is the pay-as-you-go model, in which individuals in isolated areas can rent or lease solar PV systems. In Kenya, through a company called Eight18, individuals can buy the solar technology for $10 and pay $1 a week, rather than the $2 for connection to a kerosene generator that is less reliable and less healthy for users. However, this can create a dependency on the firm, and consumers can potentially end up paying more than market value (Amankwah-Amoah 2015).

Migration Development Model
Fifth, there is the migration development or sustainability entrepreneurship model in which diasporic Africans, who have acquired great human capital, come back to the African continent to drive its green economies (Patterson 2011). This is key, as higher education infrastructures are severely lacking in many African countries (Africa-America Institute 2015). However, this model would realistically occur only according to the altruism of individuals because it would be difficult

for African nations to provide incentives for them to return their expertise to the continent (Patterson 2011).

Avon Model

Lastly, the Avon Model, named after the "Avon Ladies" who sold cosmetics door-to-door in the US in the late nineteenth century, is an attractive business model that is currently being replicated as the "Solar Sisters" in East Africa. Solar Sisters sell and distribute solar products, such as solar lamps. The organization empowers women in energy poor areas by providing them with the economic opportunity to start their own social enterprises (Amankwah-Amoah 2015). Hiring locals allows producers to be more in touch with local needs. However, this model provides only a limited, small-scale solution.

6. Recommendations: Accountability of Foreign Players and African Agency

As demonstrated above, the future of Africa's environment, economy, and society will depend on the scaling-up of the renewable energy industry. The future will require not only a mix of renewable energy sources, but also a mix of models of growth within the industry, which all have their respective benefits and drawbacks. The question of who should play what roles and how in the renewable energy sector becomes increasingly complicated when we consider foreign players (especially former colonial powers) and their involvement in shaping Africa's energy landscape. To what extent is foreign influence and intervention in Africa's renewable energy sector a form of re-colonization? Will sustainability and environmental priorities be sacrificed for economic opportunity within the context of foreign involvement in Africa's energy sector?

Climate change awareness has been a major pillar of European Union (EU) policy since 2009, but somewhat recent issues regarding energy security have made it turn towards Africa to alleviate this insecurity, resulting in a clear dilemma. At least in the short and medium-term, a "green energy Africa," rather than a "hydrocarbon based Africa," will certainly worsen the EU's energy security prospects (Hadfield 2013). Arguments for fossil fuel development are compounded by strong economic incentives presented by the EU, which pressures developing nations in Africa to exploit its natural resources to create a lucrative export industry. The immediate economic incentives of fossil fuels are especially appealing, as such nations are trying hard to alleviate pressing social ills, such as extreme poverty. The EU is important here because its member states are primarily responsible for the proliferation of the fossil fuel economy in Africa and, thus, its policies must be heavily analyzed for their implications. Thus, Africa must push back on EU plots to increase its fossil fuel production because Africa does not have energy insecurity—the EU does (Ahlborg and Linus 2014). It is clear that heavily fossil fuel-dependent economies can have tremendous environmental, economic, and social consequences, (Amankwah-Amoah 2015), so it is crucial to avoid re-colonization ploys and strive for energy independence.

Collaboration between African governments and firms with those from foreign nations is needed in the short and medium-term, as much of Africa currently lacks the human capital and infrastructure to drive the renewable energy industry on its own. In the long-term, the plan must be to gradually move away from foreign involvement, so that African firms have the opportunity to establish themselves as serious competitors in the greater global renewable energy industry and achieve a sense of independence in general. It is thus the responsibility of any foreign players to:

- actively allow their technologies and knowledge to diffuse into the local landscape;
- attempt to promote education and training to technicians for renewable energies; and
- enhance capacity through research and development.

African governments can do their part by passing more legislation that incentivizes the construction and use of renewable energy (as we have seen South Africa do) and holding foreign players accountable for the responsibilities listed above. If such players are not held accountable, Africa faces the risk of re-colonization by European powers and a growing dependence on fossil fuels.

In consideration of the major dependence on bioenergy in the residential sector and its subsequent consequences, I recommend that African governments enact policies that reduce the cost of, and increase access to, solar cook stoves. Foreign firms and NGOs/Aid Agencies may also play a part in the scaling-up of solar alternatives to cooking and heating.

In consideration of the benefits and drawbacks, I recommend that a *combination* of foreign NGOs/Aid Agencies, along with multinational companies, be utilized to support African governments and private firms in the *short and medium-term* to drive its renewable energy sector, starting with decentralized and eventually national grid solutions. In the *long-term*, I recommend that African governments and private firms be the main players in driving the renewable energy sector to be supplemented by a mostly laissez-faire combination of NGOs/Aid Agencies and private foreign companies.

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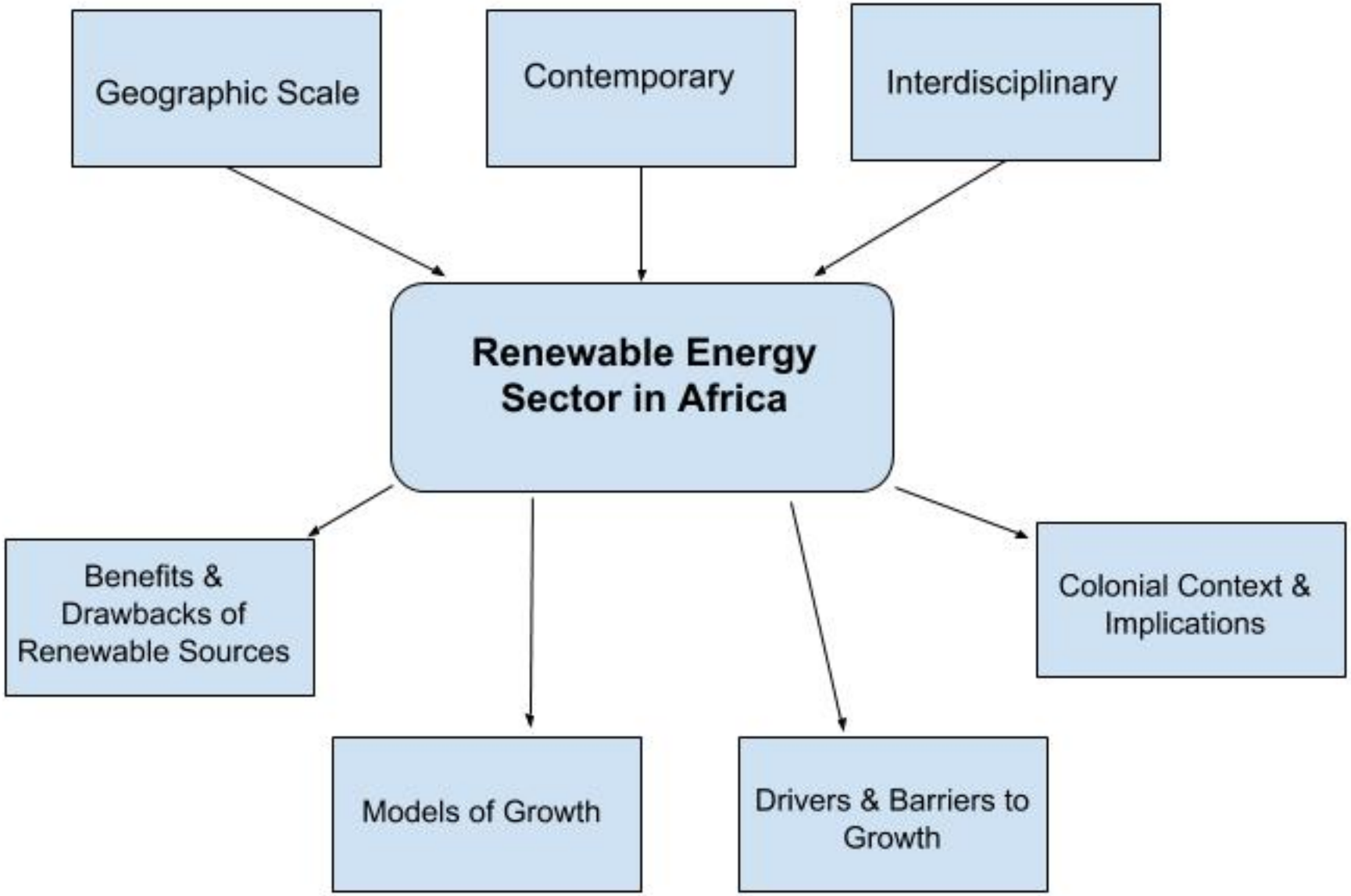
Concept Map


Geographic Scale
Contemporary
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Renewable Energy Sector in Africa
Benefits & Drawbacks of Renewable Sources
Models of Growth
Drivers & Barriers to Growth
Colonial Context & Implications