Chapter

Establishing Property Rights and Private Ownership: The Solution to Malinvestment in the Energy Sector in Developing Countries

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Abstract

There are over 800 million people in the world without access to modern forms of energy services, like electricity, cooking gas, and LPG. This has been called energy poverty. Most studies in the field of energy poverty address the issue from an absence of technological or financial resources perspective. They address the problem as energy in itself having an objective inherent value, more or less addressing the symptoms of the problem and not the problem itself. In this chapter, a new paradigm that addresses the problem of energy poverty and malinvestment is introduced. This paradigm, utilizing the theory of economic calculation and the use and exchange value embodied in the subjective value theory, makes a case for the importance of private property rights in the factors or means of production for modern forms or energy such as electricity. The Nigerian energy sector is used as a case study for this.

Keywords: natural energy resources, energy poverty, rural electrification, economic calculation, subjective theory of value, property rights

1. Introduction

According to the International Energy Agency (IEA) there are over 840 million people worldwide without access to electricity [1]. In sub-Saharan Africa (SSA), the electrification rate is 47% while in Nigeria it is about 55, and 39% for those that live in rural communities. Hence there are over 95 million people without access to electricity in Nigeria [2]. Due to the high cost of cost of grid extension to these people, providing electricity, especially to those in remote communities can be prohibitive.

There is also the problem of reliability for those with a connection to the grid. This has led to an increase in the cost of doing business and, according to a 2016 International Monetary Fund (IMF) report was, in part, a factor in the decline on the country's economic growth [3]. Nigerian firms connected to the grid experience about 32.8 outages per month and the average duration for an outage is 8 hours [4]. Power outages have been estimated to cost the Nigerian economy over $7 billion, equivalent to 2.26% of the country's GDP and about 56.9% of its 2015 national budget [5].

In 2015, the United Nations General Assembly adopted a set of 17 goals to bring shared prosperity and peace to the nations of the world by 2030 [6]. These *2030 Agenda for Sustainable Development* goals are generally known as the UN SDGs. While most of the SDGs build off one another, the seventh, which to ensure access to affordable and clean energy and the thirteenth, which is climate action are considered complementary. Today, many governments, multilateral organizations and international NGOs are addressing the problem of energy poverty with climate change mitigation and adaptation policies [7, 8]. A sort of "kill two birds with one stone" is a strategy.

Many studies have shown that the access and utilization of modern forms of energy—electricity—is directly proportional to economic development. In general, people with better access to electricity have better standards of living [9–11]. The development of China and India in the last 3 decades lends credence to this. But these countries increased their electrification rates, through state-owned utility entities which utilized technologies that made them top emitters of greenhouse gases [12]. This is barely the sustainable economic development the UN had in mind.

While all these studies and strategies for addressing the problem of energy poverty in a sustainable manner that does not add to the problem of climate change, are important, they only deal with the symptoms and not the problem.

2. The current paradigm of energy poverty research

The current paradigm is to first ask, why do people in the developing world experience energy poverty? The answer is usually, they have no access to capital, hence; there is a need to transfer capital in the form of foreign aid or innovative financing instruments like green bonds and other thematic bonds, guarantees, pension funds, microfinance investment funds, and other institutional investment to these countries to addresses the problem of energy poverty. **Figure 1** shows the current paradigm of energy poverty research.

A more effective question that attempts to get to the root of the problem was suggested by Swedish economist, Per Bylund:

> *What causes poverty? Nothing. It's the original state, the default and starting point. The real question is, what causes prosperity?*

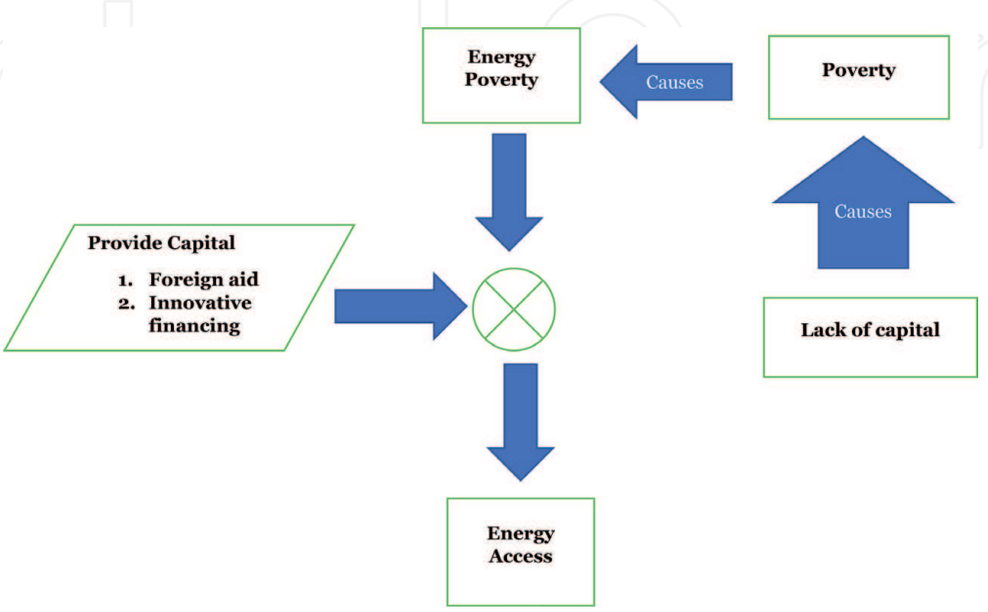

Figure 1.
The current energy poverty research paradigm.

For the sake of our discussion in this chapter, professor Bylund's statement could be rephrased as:

> *What causes energy poverty? Nothing. It's the original state, the default and starting point. No community just out of thin air has the infrastructure that makes electricity available. The real question is, what causes electricity prosperity?*

This should be the real question and it is the question I attempt to answer in this chapter. The answer to this question will lead to a better understanding of the problem of energy poverty.

3. The new paradigm of energy research

Many analysis and studies on energy poverty have addressed it from the position that energy itself has an intrinsic value, an "objective value." One prominent researcher has called it the only universal currency [13]. But in an economy, people use the economic goods, time and labor they own to make ends meet. That is, they take "action" with these goods in the direction they believe will bring them the most satisfaction and prosperity. These economic goods also include the factors or means of production—land, labor and capital. To effectively utilize these goods to make ends meet they need to value the different goods they have, and the ends they want met, eventually creating a scale of value. It is the ends that are at the top on their scale of values, under the conditions and circumstances at the time the decision is made, that they will be inclined to utilize their economic goods to satisfy [14]. All goods or ends on a person's scale of value has a "use-value" which is intrinsic only to that person.

For people to use the means (economic goods) they own in the direction of the ends they want met they must exchange it for the ends they want met. This end could be a consumer or capital good. Hence, the means they own also acquires an exchange value [14]. This exchange value for any commodity e.g. electricity, is derived from the subjective value that is identified from the other commodity or a certain amount of that commodity that one plans to exchange the electricity for or vice versa.

Professor Thomas Taylor explains this thus:

> *... any particular good takes on both a use value and an exchange value. Each of these values reflects the satisfaction that can be expected to come by way of employing the good; the good can be employed either for direct use or as a means of obtaining some other good through outright exchange with another person. The controlling valuation for decision and action is always the greater of the two alternative satisfactions. If the good's use value exceeds its exchange value, the good will be put to direct use or held for eventual direct use, and its exchange value will be forgone. On the other hand, if its exchange value exceeds its use value, the good will be utilized for exchange purposes or held for possible exchange at some time in the future [15].*

In an advanced economy, where specialization and division of labor are the order of the day, people produce goods essentially for exchange, goods acquire an exchange value in addition to the use-value. Because many producers have no plan to utilize the goods they produce but essentially to exchange them for money, the use-value of those products to the producer is zero, but that good has to have an exchange value for the producer to sell it.

Modern forms of energy—like electricity—are an end. And for it to be met it must be up in position on a person's scale of value and must have an exchange value, by which such a person can use to make their decision at that specific time the decision is to be made. Electricity does not have an objective intrinsic value. It has a subjective use and exchange value. For example, a person can decide to make a down payment for a car and not for an electricity bill for this month, and another person may decide to pay for electricity and not buy the car. Both individuals—whom in this case are consumers—have different use-values for electricity.

4. Economic calculation, discovery, coordination and incentives

People value the same commodity differently. Even the same person will value a certain commodity differently at different times, hence such a person will allocate their resources differently in other to acquire the commodity the value. In an advanced economy characterized by specialization, division of labor and knowledge, multiple steps of production in producing consumer goods, multiple economic goods that can be used to produce one commodity or an alternative one and different people with different scales of values, of varying degrees of need, competing for scarce resources which have alternatives uses, there has to be a way of deciding what the most efficient use of resources, that they are utilized to satisfy the needs of people with the most intensity before satisfying those of lower intensity. There must be a lowest common denominator by which this objective calculation can be made. This common denominator which is reflected in prices that are derived from the exchange value of the different economic goods under consideration is money. Money is not a measurement of value and prices are not measured in money instead they are amounts of money [16]. Hence to determine the most efficient allocation of resources money prices are the most efficient method for calculation. This is called theory of economic or monetary calculation, introduced by economist Ludwig von Mises in 1920 and expanded later in the 1930s upon by Nobel prize winning economist Friedrich Hayek [16, 17].

Consider two examples:

The first one from economist Leland Yeager:

Consider the issues of providing public transportation in a city.

> *Should it be supplied by busses burning gasoline, by electric streetcars, in some different way, or not at all? The economically efficient answer depends on more than technology and the physical availability of inputs. It depends also on substitutabilities and complementarities among inputs, on alternative uses of those inputs, and on consumers' subjective appraisals of various amounts of the various outputs of those alternative uses, as well as on appraisals of various amounts of various kinds of public and private transportation. The economically efficient answer even to the relatively simply question of local transportation depends, in short, on unimaginably wide ranges of information conveyed, in abbreviated form, by prices [18].*

The second from Mises:

> *The art of engineering can establish how a bridge must be built in order to span a river at a given point and to carry definite loads. But it cannot answer the question*

> *whether or not the construction of such a bridge would withdraw material factors of production and labor from an employment in which they could satisfy needs more urgently felt. It cannot tell whether or not the bridge should be built at all, where it should be built, what capacity for bearing burdens it should have, and which of the many possibilities for its construction should be chosen [16].*

Money prices allow for the calculation which tells us what the most appropriate allocation scarce resources should be. It also allows for the necessary discovery and coordination needed for decision making with respect to the allocation of scarce resources in areas of the economy where they are most needed.

In today's economy, we know that electricity is demanded by different customers but to varying degrees. All these customers value electricity differently. A single person living in a small apartment in Lagos, Nigeria, values electricity differently from a Datacenter in Kaduna, Nigeria. All these entities, the single person and the Datacenter, create their scale of values based on the use value of electricity. Then they decide how much they value the money they have to exchange for electricity. A combination of all these valuations in the market determines what the exchange value of electricity will be, which is reflected in monetary prices.

Now electricity producers can calculate if the use-values of the factors of production they have at their expense through different combinations to produce electricity is less than the electricity exchange value reflected by the monetary price of electricity on the market. If it is, the producer then allocates the scarce resources accordingly to produce electricity. How the producers combine the factors of production at their expense to produce electricity becomes important. The producer may well decide that a diesel generator is cheaper than a solar panel using the monetary price of electricity as a guide. It is important to note that these monetary prices can change and are always changing because people have different use-values for different things at different times. Producers must always be cognizant with the monetary prices to decide the most effective way to allocate resources for electricity production. Profits or losses are a way of ensuring that the producers are making accurate calculations and resource allocations. If producers make a profit then they are allocating scarce resources efficiently, if they make a loss they must stop and change their course of action. If they do not, because they necessarily have limited resources, they will go bankrupt and stop wasting scarce economic resources. And everyone in the economy is better for it.

For all these to be possible, they must be a market in the factors of production—land, labor and capital. For there to be market in the factors of production there must be private ownership in the factors of production. As Mises puts it "... in the absence of market prices for the actors of production, a computation of profit or loss is not feasible" [14]. When computation of profit and loss is not feasible producers are groping in the dark, and this leads to either wastages or shortages of economic resources. Mises points this out:

> *Under a system based upon private ownership in the means of production, the scale of values is the outcome of the actions of every independent member of society. Everyone plays a two-fold part in its establishment first as a consumer, secondly as producer. As consumer, he establishes the valuation of goods ready for consumption. As producer, he guides production-goods into those uses in which they yield the highest product. In this way all goods of higher orders also are graded in the way appropriate to them under the existing conditions of production and the demands of society. The interplay of these two processes ensures that the economic principle is observed in both consumption and production. And, in this way, arises the exactly graded system of prices which enables everyone to frame his demand on economic lines [19].*

> *Monetary calculation is the guiding star of action under the social system of division of labor. It is the compass of the man barking upon production. He calculates in order to distinguish the remunerative lines of production from the unprofitable ones, those of which the sovereign consumers are likely to approve from those of which they are likely to disapprove. Every single step of entrepreneurial activities is subject to scrutiny by monetary calculation. The premeditation of planned action becomes commercial pre-calculation of expected costs and expected proceeds. The retrospective establishment of the outcome of past action becomes accounting of profit and loss [14].*

Deploying renewable energy technologies such as distributed solar photovoltaics (PV) panels and wind turbines have been proposed as solutions to the problem of energy poverty in many developing countries, especially those who live in rural communities. These communities are usually identified as underserved or unserved [20]. The use of solar PV technologies has increased over the last two decades. This is, in part, due to the decrease in the cost renewable energy technologies and creative financial structures that enable them to become affordable [7, 8, 20, 21]. This way, developing countries can have access to electricity and keep down the likelihood of contributing to climate change. In one fell swoop, we can meet the UN SDG 7 and 13 [6]. But as we will see it is not that simple. Looking at the problem in terms of technology or a lack thereof does not get to the crux of it. North Korea has a nuclear weapons program but still has most of its people living in poverty, with 1 in 5 of its population not having access to clean water or adequate sanitation [22]. The old Soviet Union was the first country to put a man in space but millions of its people were dying of hunger, and the nation was replete with the wastages and shortages of different goods because of the lack of private ownership in the means or factors of production [23]. Without the private ownership in the means of production, in this case, land and fossil fuels, malinvestments in the energy sector will occur, causing wastage and shortages, which will neither achieve the goals of SDG 7 nor 13.

This is because those who live in the rural communities in the developing countries that are usually targets of renewable energy-based electrification projects do not have secured property rights in the land they live on. Therefore, they cannot effectively place a value on the land and its potential use for development of electrification projects with respect to the opportunity cost of the other things on their scales of values. This makes deriving monetary prices for electricity difficult.

Governments in these countries, through their electricity regulatory agencies or state-owned energy utilities (gas and electricity) institute price controls on electricity, which defeats the calculation, discovery, coordination and incentive process of the price mechanism, leading to either shortages in the production of electricity or wastages through overproduction of electricity. A 2016 World Bank report showed that most utilities of 39 countries in sub-Saharan Africa are almost always insolvent [24].

The study goes on to say:

> *Of the 39 countries studied, only the Seychelles and Uganda were fully recovering their operational and capital costs. In only 19 countries did the cash collected by utilities cover operational costs; just 4 of these countries were also covering half or more of capital costs, based on new replacement values of current assets. Such large funding gaps prevent power sectors from delivering reliable electricity to existing customers, let alone expand supply to new consumers at an optimal pace [24].*

Twenty-one out of 48 sub-Saharan countries have no private participation in their electricity sectors. They still have state-owned vertically integrated utilities. Most of the others have different degrees of private ownership and participation in the distribution, transmission and generation electricity [25].

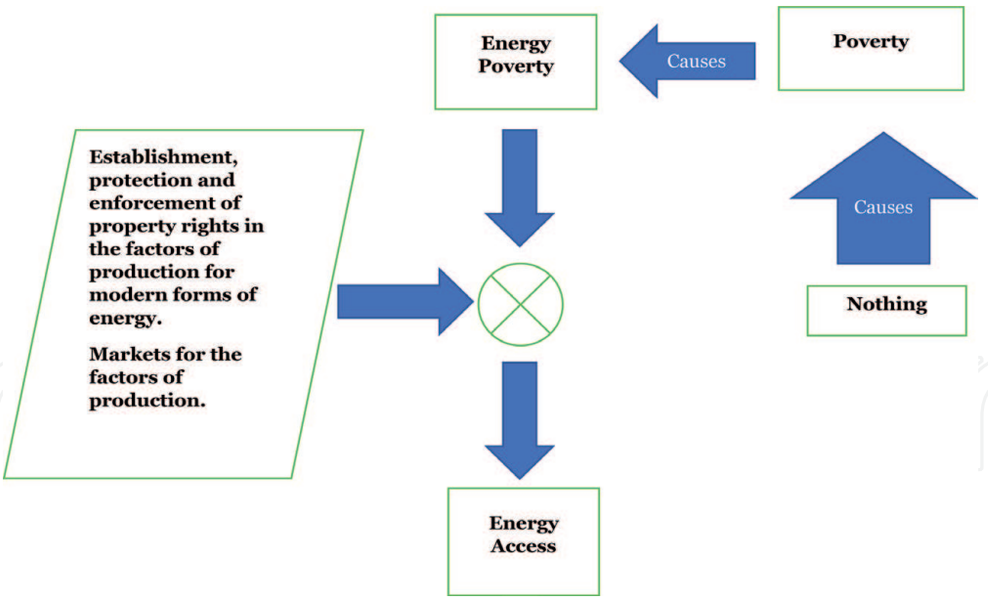

Figure 2.
The new energy poverty research paradigm.

In almost all cases, government agencies have controls on the prices of electricity, which is almost always not cost reflective [20, 24, 25]. The lack of private ownership in the factors of production for electricity is the major reason why many SSA countries still experience energy poverty, especially in the form of electricity. Hence, how energy poverty research is conducted needs to change. **Figure 2** shows what the new paradigm of energy poverty research should be.

5. Energy poverty in Nigeria and sub-Saharan Africa

To solve malinvestments in the energy sector and the problem of energy poverty there must be a private ownership of the factors of production—land, labor and capital—used to make modern forms of energy services available. When this not the case, appropriate use-values and exchange values cannot be arrived at, because you can only effectively value what you own, to decide if it is worth it to exchange for what you want or not. Hence, there is no market for the factors of production used to make electricity. When there is no market, there are no market prices. Without market prices or attempting to fix a market prices, like SSA governments do, will always lead to a wastage or shortage of electricity production.

The major factors of production for electricity under consideration are land and its tributaries, such as mineral and natural energy resources like oil, natural gas, iron ore, etc. If any of these factors of production cannot be privately owned, you cannot have an efficient allocation of resources to provide electricity in the quality and quantity demanded.

It does not matter if a country is resource rich, as long as private ownership does not exist in those resources and there are no market prices for the resources it will be wasted at the expense of the entire economy. Let us consider the example of Nigeria's energy sector.

Nigeria has enough natural gas and oil resources to solve its energy problem. It is the largest oil producer in Africa and the fourth largest exporter of liquified natural gas (LNG) [26]. Oil and natural gas are factors of production in the production of electricity. The land needed to build the infrastructure (capital goods), such as pipeline, generating plants, transmission and distribution lines, which will enable

converting oil and natural gas to electricity is a factor of production. In Nigeria private property rights in land is shaky and non-existent in natural resources [27–29]. Hence, the economic/monetary calculation is difficult, leading to a lack of market prices in electricity, which results in a shortage of every consumer good—such as, electricity and petrol—that oil and natural gas is used to produce. Nigerians are consistently faced with extensive petrol shortages and chronic electricity outages [20, 26, 30].

6. Brief overview of the Nigerian power sector

In 2005, the Nigerian Electric Power Sector Reform Act (EPSRA) became law. This required a breakup of the state-owned vertically integrated electricity and for the allowance of the private sector into the business of producing and distributing the commodity—electricity [30, 31]. By 2013, the unbundling and eventual sale of the state-owned utility's—Power Holding Company of Nigeria (PHCN)—assets was complete. This led to 11 distribution companies (DISCOs), with exclusive rights to geographic service territories, six generating companies (GENCOs) and one transmission company, which is called the Transmission Company of Nigeria (TCN) [30]. The GENCOs where completely sold off to private investors, the government retained a 40% stake in the 11 DISCOs and 100% government ownership was maintained for TCN. A Bulk trader, the Nigerian Bulk Electricity Trading (NBET), was created to buy electricity from the GENCOs (both the original ones and the newer Independent Power Plants (IPPs)) and then sell to the DISCOs. The DISCOs could only buy from NBET and not directly from the GENCOs/IPPs. Finally, a regulator was created. This is the Nigerian Electricity Regulatory Commission (NERC) [30–33]. Refer to **Figure 3** for a graphical representation of the Nigerian electricity sector.

The sector is still replete with government intervention and ownership. The DISCOs continuously experience capacity and insolvency issues [30]. With all the risks of electricity theft, old infrastructure and vandalism NERC still does not allow the DISCOs charge cost effective tariffs [30, 34]. The problems of the Nigerian energy sector, like that of many other developing countries, are many and well documented in the old paradigm of energy poverty research [4, 20, 24, 30, 32–36]. But as we can see there has been little to no amelioration in the last 3 decades.

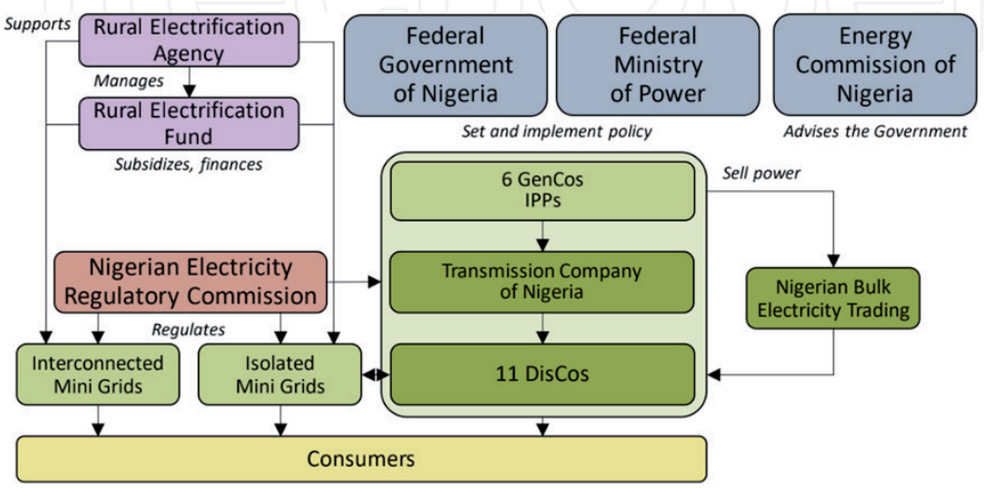

Figure 3.
Overview of the Nigerian electricity sector [32].

The reason why these problems have proven protracted is simple: no private property in electricity factors of production, hence no market prices, hence no economic calculation, hence wastage or shortages, exacerbating energy malinvestment and energy poverty. When in an economy there is very little private ownership in any sector, consumer goods from that sector do not get produced in the quantity or quality they are demanded. This is the new paradigm of energy poverty research introduced here.

7. Private ownership in the factors of production for electricity—land and natural energy resources

In this section we will look at how lack of private property in two important factors of production for the electricity—land and natural energy resources—has caused energy poverty in Nigeria.

All land in Nigeria, apart from those vested in the federal government and its agencies is under the control of the state governors. The lands are held in "trust and administered for the use and common benefit of all Nigerians..." in urban areas by the state governors and in rural areas they are managed by the local governments [27]. Nigerians can only get access to the land through a certificate of occupancy (C of O), which is valid for 99 years, given by the state governor or on the governor's behalf. The state governor is also responsible for land use decisions. For example, if somewhere is to be used as a residential, commercial or industrial area. Hence, land can also be taken from anyone with a C of O if the government decides the land should be used for something else. Private property rights to land in Nigeria is shaky at best [28]. There have been numerous violent forced evictions of people by the government from lands that have been in their families for decades, because a governor decided to designate that piece of land for development. Sometimes these governors completely ignore court injunctions attempting to stop them from carrying out their violent decimations of affected communities [28, 37, 38].

If private property to land in Nigeria is on shaky foundations, private property to natural energy resources is nonexistent. All natural resources within the geographic domain of Nigeria are owned by the federal government.

> *...the entire property in and control of all minerals, mineral oils and natural gas in under or upon any land in Nigeria or in, under or upon the territorial waters and the Exclusive Economic Zone of Nigeria shall vest in the Government of the Federation and shall be managed in such manner as may be prescribed by the National Assembly [29].*

Therefore, even if a person had a C of O to a piece of land and oil was discovered on that land, immediately the government can expropriate that land from such a person. Public ownership of natural energy resources has wreaked havoc on the country, bringing about poverty, environmental degradation and mismanagement of windfall profits. This is because when there is no private ownership, hence no market prices in natural energy resource and the mechanism for economic calculation, coordination, discovery and incentives breaks down, leading to shortages or wastages. This has been the case of the Nigerian energy sector.

The government does not only own and control the exploitation of all natural energy resources, it also controls the prices of the consumer products produced from these resources:

> *The Minister may by order published in the Federal Gazette fix the prices at which petroleum products or any particular class or classes thereof may be sold in Nigeria or in any particular part or parts thereof [29].*

The Nigerian government benefits from its large natural energy resources reserves by licensing and forming joint ventures with International Oil Companies (IOCs) and Local Oil Companies (LOCs). These companies exploit the resources with reckless abandon leaving environmental degradation in their wake leaving many of their host communities unlivable. Over 2 million barrels of oil were spilled between 1976 and 1996 [39]. Since the IOCs and LOCs do not own the natural energy resources, they are mostly interested in the short term profits of exploiting the resources, having no incentive to preserve the long term capital value of the resources as a private owner would, they flare natural gas, a useful byproduct of the oil drilling process, further polluting the environment [40, 41]. This has led to violent conflicts between the IOCs/LOCs and the communities. The Niger Delta, where most of Nigeria's natural energy reserves are found is one of the least developed and poorest regions of the country [41, 42].

Max Siollun, a historian, in his book, *Oil, Politics and Violence: Nigeria's Military Coup Culture (1966–1976),* presented the quintessential example of how the Nigerian government has tried to manage the countries natural energy resources for the betterment of its economy but instead has repeatedly failed wreaking havoc on the economy:

> *The influx of petrodollars into government coffers also amplified both the Nigerian government and people's developmental ambition.... The (Federal Military Government) FMG proved ineffective at managing the wealth, and was unable to use it to significantly increase Nigerians' living standards. Although the oil boom created a tiny coterie of powerful economic oligarchs and patronage system amongst senior military officers, their families and their civilian associates, living conditions for the rest of the population either remained stagnant or deteriorated. This created the paradox of a rich country with poor people. Gowon (the Head of State) described the problem as "want in the midst of plenty" and observed that Nigeria's problem was not lack of money, but how to effectively spend its sudden new found wealth.*
>
> *Civil perceptions that Nigeria was "rich" also made the population impatient for the oil boom wealth to trickle down to the society at large. In an attempt to distribute federal wealth to workers, the FMG in January 1975 decided to award public sector employees massive pay rises exceeding 100%...*
>
> *The increased spending power of public sector workers led traders to increase their prices, fueling inflation and wiping out the economic benefits the pay rises were intended to create. Private sector workers then went on strike to demand pay rises for themselves [43].*

A lot has been written about the resource curse, first introduced by economist Richard Auty and popularized by economists Sachs and Warner [44, 45]. The resource curse theory is an attempt to explain why some countries with abundant natural resources are usually worse off economically or have the least level of economic development, compared to prosperous countries with little or no natural resources [45]. What many of these studies fail to take into consideration is that in places where private property in land and natural resources exist, are secured and can be easily exchanged from one party to another, the resource curse was never an issue.

For example, let us look at the difference between the issue of oil drilling in the Arctic National Wildlife Refuge (ANWR) and the Audubon Society's Paul J. Rainey wildlife sanctuary (PRWS) in Louisiana—both places in the United States. The ANWR is owned by the government while PRWS is owned by a private organization—the Audubon Society. Policy analyst Fred Smith described the situation thus:

> *Both of these areas are valued by environmentalists. Both also sit above oil deposits. In the case of ANWR, we have witnessed political gridlock. To put it very simply: the environmentalists want it preserved, and the oil companies want to drill. ANWR is a political football in the Congressional debates over environmental and energy policy. Rainey is different. This refuge is owned privately by the Audubon Society, rather than by the federal government. At this site, Audubon has the ability to exclude all visitors and activities that could damage the refuge or threaten the animals that live and breed there. Audubon could have prevented all oil development at Rainey. They chose not to do so. Preventing oil development would have required foregoing the economic benefits of that development-economic benefits that could fund other environmental efforts. As a private owner, Audubon had an incentive to reconcile the very same interests that are in conflict in the case of ANWR. Audubon developed an oil extraction plan that would allow drilling but also protect Rainey's ecological values. They did so by making accommodations: no drilling during the breeding season; a smaller oil platform; spill prevention and containment plans to prevent contamination, and the like. Oil production has been occurring under these conditions at Rainey for over twenty years with little problem. Because of Audubon's private ownership, it was possible to integrate the human economic and ecologic concerns. Private ownership encouraged people to work toward this type of win-win solution. Politics too often encourages conflict and a zero-sum game. Where politics has been dominant-as in the case of ANWR---conflict, not accommodation, has been the rule [46].*

Why would an organization like the Audubon Society allow oil development on the PRWS which is "home for deer, armadillo, muskrat, otter, mink and more than 50,000 snow geese... also is the site of a number of oil and gas wells, and provides grazing land for private cattle herds" [47]. This is because the PRWS is private property, the natural energy resources in the land, is a factor of production and can be sold on the market. With these market prices, Audubon can effectively calculate economically what the cost and benefits of allowing oil development on the PRWS would be to them. This would include what allowing this could do to its reputation, since Audubon is a natural conservancy organization. Audubon can decide subjectively what the use-value of that PRWS is, and since there is a market for the natural energy resource, it can achieve an exchange value. Audubon discovered that the exchange value was more than the use-value to them, and this presented a platform for them to decide. Audubon and the oil company were both better off as a result of the transaction. Audubon, throughout the lifetime of the contract with the oil company made over $20 million in royalty checks. The oil company, as long as they met the Audubon's conditions, like ensuring the environmental integrity of the PRWS ecosystem, could exploit the natural energy resource [47, 48].

This is only possible when natural energy resources are private owned. Nigeria's natural energy resources cannot lead to economic development until private property in the resources themselves exist.

8. The mini grid industry in Nigeria: a possibility for moving forward

While in Nigeria land ownership in urban areas is largely contested due to the higher value on them, in the rural communities this is not always the case. The laws that govern land use in the country are largely ignored in those places. Okafor et al. stated that while "the land use Act provides that 'all lands in rural areas, be under the control and management of the Local Government, within the area of jurisdiction of which the land [is] situated,' which implies that there will be no more open market transaction, yet this is still in practice in the area." [28].

Around 2013 entrepreneurs went into rural communities to develop and deploy small power systems in these communities providing them electricity. These rural communities are usually off grid. In these cases, the community members were able to place a use-value on the land they had at their disposal and compare it with the exchange value of electricity. In many cases the developers were allowed to install their solar + diesel or storage systems in the communities [20, 32].

What is important to note is the tariffs the mini grid electricity companies charged the community members. Their tariffs were between $0.38 and $0.51. This is more than the tariff the DISCOs charge on the main grid, which is usually between $0.064 and $0.080 for the Eko Distribution Company [30, 49]. It may seem like the off-grid rural community members are paying more, but this is not the case. In some of these communities they utilize small petrol generators to provide for their electricity needs. For many of them to refill their generators, they have to travel many kilometers to the nearest gas station, they also have to operate and maintain their generators. These add to costs that are either the same or higher than the tariffs offered by the mini grid electricity companies. Hence making what may look like a high tariff to third parties, a perfect price, they are willing to pay, and the mini grid company is willing to accept for electricity.

In 2016 the Nigerian government, through NERC released a regulatory framework for the development of renewable energy based mini grids [50]. This was done to help the nation accelerate its electrification plans. Nigeria plans to achieve universal energy access by 2030 [4]. The policy was also instituted to regulate the mini grids that had started springing up in different off-grid communities before 2016. It was also meant to guide the new mini grid industry that has been estimated to be $8 billion-dollar industry annually [51].

Mini grids below the size of 100 kW do not need to apply for a permit, those below the size of 1 MW need to apply for a permit and those above 1 MW are treated as IPPs and must get a license. The mini grid companies are also able to determine the tariffs they charge the community members. Hence, they are free to negotiate with the community to determine what price they are willing to pay and if this price can economically justify deploying and operating a mini grid electrification asset in the community [32]. Since the policy was passed, the Rural Electrification Agency (REA), the government agency responsible for providing technical and financial assistances to rural electrification project has become very involved in the industry [32, 51]. Many rural communities are now receiving government oversight, the danger of this is that property rights in land and other factors of production like solar panels and batteries, can become contested soon, leading to government expropriation of the land in these communities, in the name of using them for the development of electricity projects, and if this happens the rural communities will not achieve the energy access, they will become worse off and as evidence shows, will probably become like the impoverished Niger Delta communities.

9. Conclusion

To achieve universal electrification or the UN SDG 7 by 2030 in Nigeria or other developing countries, there needs to be a paradigm shift in how energy poverty and malinvestment in the energy sector research is conducted. In this chapter a new paradigm that takes into consideration the importance of private ownership of the factors or means of production for modern forms of energy services like electricity and the use and exchange values of these factors or means founded on the theory of economic calculation and the subjective theory of value is introduced. More studies on the applications of the economic theory of calculation and the subjective theory of value in energy development in developed and developing countries are needed and important. It is my hope that this chapter serves as a catalyst for this research.

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