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# An Analysis of the Techno-Economic Dynamics of Energy Infrastructure Investment

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***Abstract –*** This paper analyzes, from a techno-economic perspective, the interaction between societal energy consumption, technological changes, and economic decisions, and how they impact on energy infrastructure investment using a combination of empirical and exploratory research methods. It further analyzes the global investment and cost dynamics of energy infrastructures – with specific emphasis on energy supply and efficiency investment trends - using as its base the 2014 World Energy Investment Outlook report of the International Energy Agency (IEA). It highlights some key drivers of energy demand, consumption, and investment, as well as the specific impacts of energy investment within the sub-Sahara African region. It concludes by highlighting the increasing role of governments in the energy market going into the future.

***Keywords –*** Energy economics, energy investment, energy market, energy outlook, techno-economics.

## 1. INTRODUCTION

Techno-economics is a field that delves into the various aspects of the interaction between technology and economics. Perez [1], [2] argues that technology, together with its supporting institutions, constitutes a techno-economic paradigm. This paradigm has been identified as a key element that represents the *new technological style* which steers engineering and investment decisions towards a more intensive use. Perez further argues that this new technological style induces some practices/principles which serve as a sort of conscious or unconscious paradigm for designing the social tools required to master the new techno-economic potential, as well as steering institutional change.

In essence, a techno-economic paradigm is about the pattern of choices concerning research, development, deployment and promotion of technologies. Therefore, a green techno-economic paradigm would induce an environmental bias in technological preferences of firms and consumers in setting the R&D agenda, and most importantly in policy environment. Freeman [3] argues that society made choices on innovation with environmental implications between the 1970's and 1980's. This resulted in the emergence of bias in favour of environmentally friendly technologies which could be identified in consumption, production, and policy choices in the beginning of the 1990's.

In the following sections, the interaction between energy infrastructures and society's energy consumption – through social practices and socio-technical transitions - is explored, while the global dynamics in energy infrastructure investment is analyzed with specific emphasis on energy efficiency and supply investment trends. The key drivers of energy demand, consumption, and investment are highlighted, as well as the impact of energy investment within the sub-Sahara African region.

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## 2. SOCIETAL ENERGY CONSUMPTION AND ENERGY INFRASTRUCTURES

Energy infrastructures materialize through the services they provide us. Societal energy consumption impacts greatly on energy demand which in turn affects the consumption level and energy infrastructure provisions. Figure 1 shows the historical and projected global energy consumption. This section delves into two main areas, within the social context and structures, which affects and influences energy demand and consumption.

### *2.1 Social Practices and Energy Consumption*

Social practice as a theory, seeks to determine the link between practice and context within social situations [4]. It occurs in the forms of activity and enquiry and most often applied within the context of human development. It involves the production of knowledge, and analysis of both institutional and intervention practices.

Shove and colleagues [5] developed and made some significant contributions to social practice theory in their work on "*The Dynamics of Social Practice: Everyday Life and how it Changes*". This work touches on the fields of consumption and sustainability to which the study of the nature of human behaviour, choices, and actions are important [6]. Shove argues that social practice theory is a response to the ever pressing need to apprehend the nature of social change, while applying that understanding to achieve desired change in behaviour in the areas of sustainability, consumption, and equality, among others [7], [8]. Through that work, they argued and presented the emergent dynamics, transformation and reproduction of social practices, as well as the constituting elements and links that are bound with social practices. Some of the key arguments which are relevant to the understanding of human consumption include:

- Practices are composed of materials, meanings, and competences [5]
- Consumption is just a moment in a social practice centered on achieving other targets [9] – which they described as a result of the pursuit of three key

targets of convenience, comfort, and cleanliness [10].

- Individuals are not independent agents of rationalized choices but rather merely carriers of various social practices [11], [12].

The aforementioned postulations have far reaching important implications on how we conceptualize consumption. Holtz [13] argues that within the context of logic, consumption as an end goal does not make sense because it does not have value in and of itself, but rather occurs within and for the sake of other practices.

Energy use tends to be taken for granted, and it is unclear how and to what degree members of the public make direct trade-offs between, for example, personal comfort and national imperatives such as security of supply. Issues and decisions on security of supply are better done within the political sphere as political decisions. Embedded practices, which impacts on rise in energy demand, is one of the contributing factors to the increased demand for more energy supply infrastructures [14]. In relation to the elements of practices, energy infrastructure also makes up a part of the materiality element for most practices. Power stations, pylons, transmission and distribution network, *etc*. help provide the energy needed for ovens for cooking, or computers for policy-making *etc*. Thus, changes to energy infrastructure can influence practices, and vice versa.

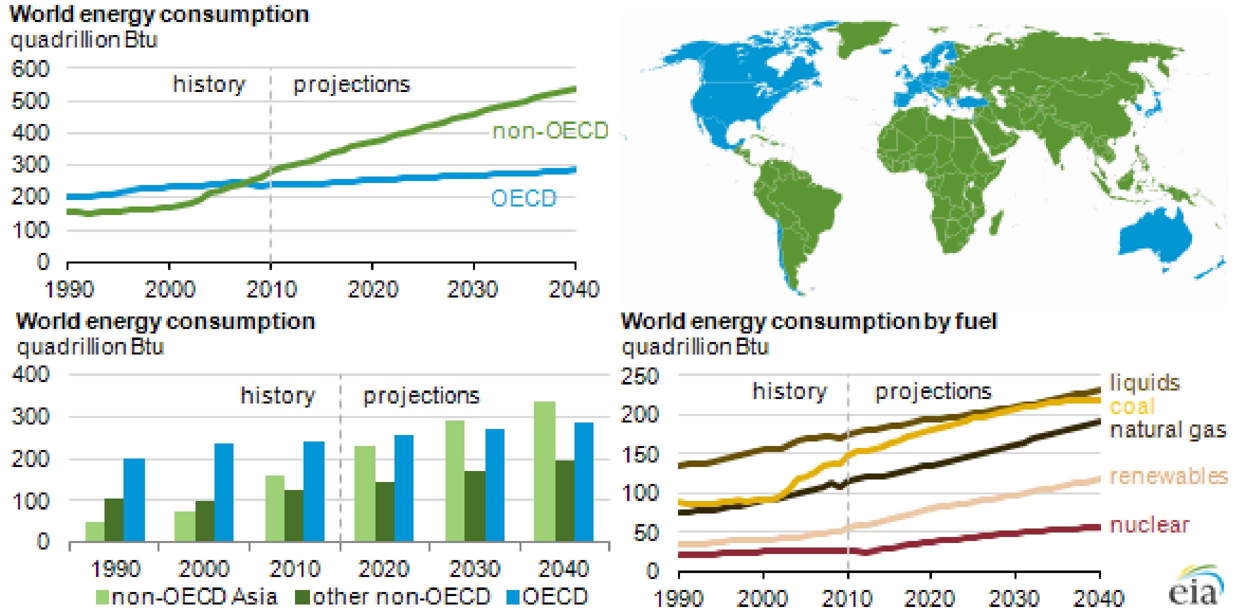


**Fig. 1. Source: U.S. Energy Information Administration, International Energy Outlook 2013.**

## 2.2 *Socio-Technical Transitions and Energy Demand*

Socio-technical transitions are joint transformation of coupled technological and social systems that enables society to realize benefits from technological innovation [15]. These transitions can occur via various pathways, but often require widespread learning and behavioural change [16].

Geels [17] argues that there are three sectors that are responsible for high energy consumption which are critical in the consideration of socio-technical transitions:

- Housing and energy
- Food and drink
- Mobility

Geels highlighted that when we consider mobility, one notices that there are several infrastructures that are interconnected in order to ensure smooth and easy mobility [18], [19]. The use of cars will require more elements to get the car function such as: fuel infrastructure; lifestyles and markets which shape and shows how we have embedded cars in our lifestyles; how we have organized our cities, how we take our children to school, how we do our shopping, how we move to work [20]. All of these show how we have a whole lifestyle organized around cars. Geels further argues that industry structure – and therefore massive economic interests - also plays a role in the car industry (as the car industry is still one of the biggest industries); maintenance networks (when ones car breaks down), regulations, road infrastructure, and cultural dimensions are the things we should think of when we talk about socio-technical systems [21].

In line with Geels arguments, one sees that changes in social structures are highly influenced by the technology in use. This is also applicable in the case of energy infrastructures. The provision of certain energy supply infrastructures (say electricity or natural gas) has some impact and influence on people's practices (such as cooking with gas stoves, or home heating using power from electricity). This influence on people's practices (such as cooking) further impacts on the social structures (particularly when such practices become predominant), thus, leading to some sort of pressure on decisions on energy infrastructure provision and technologies that supports and promotes those practices. Thus, the new energy infrastructure provision leads to a situation where there is a shift in technology used to achieve those practices from *niche* to *mainstream* within the fabrics of the existing regime of social structures.

## 3. METHODOLOGY

The use of quantitative research methods that seeks to confirm hypotheses about phenomena – with specific emphasis on documentary literature research tools - is used. Quantitative method uses instruments of a more rigid style in eliciting and categorizing response to questions, and uses highly structured methods such as surveys, structured observations, or questionnaires. Most quantitative researches use more closed ended question formats and numerical data formats obtained by assigning numerical values to responses. They have a fairly stable study design from beginning to end, with minimal influence of participant's responses on the study design and structure. The study design used in quantitative research is subject to statistical conditions and assumptions [22]. This paper explores analytical objectives, with focus on quantifying variations, predicting causal relationships, and describing characteristics of the techno-economics of energy infrastructure investment [23].

Quantitative data was collected with the aid of existing documentary literatures using documentary literature research tools. A document is a written text, produced by individuals and groups in the course of their everyday practices, and are geared exclusively for their immediate practical needs [24]. They are written based on particular assumptions and with a clear purpose. In documentary study, there are two types of documents used:

- *Primary documents* - this refers to eye-witness accounts produced by people who experienced the event or behaviour under study.
- *Secondary documents* – this refers to documentary accounts produced by people who were not eye-witnesses of the event or behaviour under study, but who rather received eye-witness account to compile the documents or have read eye-witness accounts.

Quantitative data from primary and secondary sources already in published literatures and official statistics were used for analysis In order to understand the global dynamics in energy investment; the key drivers of global energy demand and consumption; as well as the underpinning factors influencing energy investment in the sub-Sahara Africa region.

## 4. DYNAMICS AND TRENDS IN GLOBAL ENERGY INVESTMENT

The EIA, in the 2012 Annual Energy Outlook [22] report argues that global electricity use will increase by 29% from 2012 to 2040. The EIA further argues that to meet the demand, new capital investments in electricity generation, transmission, and distribution is needed. There is also need for new capital investments for energy efficiency improvement, as well as reducing greenhouse gas emissions. This section, explores the investment trends in energy supply and energy efficiency measures.

### *4.1 Energy Supply and Efficiency Investment Trends.*

The International Energy Agency (IEA) - an institution which epitomizes the economics of energy infrastructure investments - in her 2014 World Energy Investment Outlook Special Report [23] argues along the following line

> *Investments made today determine the future. What links today and the future are the energy investments we make today. The level of investment is what determines energy demand, supply, security, climate change, among others interconnected factors.*
>
> *The capital cost in the past 10 years to produce one unit of energy has doubled. Energy is becoming very expensive. The cheap energy hubs are becoming less available in the future*[24]*. This will require higher energy prices to incentivize those investments as capital cost has also doubled and will keep rising going into the future.*

In the last ten years, the investment surge to meet the rising energy demand, mainly in Asia and developing countries, has led to a greater search for better exploration and production technologies [30]. The shale revolution and investment in the United States and the renewables revolution in Europe are concrete examples [27]. In the past 10 years in Europe, half of the total investment in electricity infrastructure came from renewable energies, which is an important concrete outcome. In the United States today, shale gas production is about 250bcm (billion cubic meters). The IEA argues that it is a result of the right policies and investment framework (which supports economic investment in new energy infrastructure provisions) rather than pure econometric and cost-benefit calculations [35]. The IEA further argues that the investment in renewables in Europe is about three times higher than the investment in shale gas production in the Unites States, thus, implying that the increased investments in new energy infrastructure provision is a result of successes and returns on previous investments already made.

Investment decisions are becoming more and more difficult due to the rising levels of uncertainty in forms of changing role of geopolitical alliances in forming energy deals, geopolitical trends that impact on energy production, fluctuations in energy prices and trade dynamics, issues of poor governance and political instability, threats to infrastructural facilities, as well as other environmental concerns. Considering possible threats to successful investment in new energy infrastructures, the IEA argues that aside from the rising capital investment cost, other major factors include geo-political concerns [30] which highlights the issue of energy security as the stubborn part of the decision making process. There seem to be a big disconnect between the climate change cause and the necessary investment decisions taken today. There are growing public pressures on energy related issues in different parts of the world such as removal of subsidies on fossil fuel [31], building of carbon capture and storage facility [32], and building nuclear power plants, which affect investment decisions. Techno-economists have noticed these changes and threats, and as such, have started considering them in their cost/benefit calculations and investment decision processes. The growing public pressures are now becoming part of the public and investment agenda, and as such, are being considered by policy makers and not only by investors and economists.

The 2014 global energy system infrastructure investment budget, stood at $1.6 trillion [23]. This is what went into building power plants, transmission lines, distribution lines, oil fields, gas fields, and other energy infrastructures [33]. This has more than doubled in the past 10 years. However, it has slowed down in the past 3 years owing partly to the reduction in investment in developing countries outside China, as well as reduced cost of renewable energy (such as solar energy). By Source, about $1 trillion went to fossil fuels (oil, gas, and coal production, as well as coal, gas, and oil fired power plants) while the rest ($0.6 trillion) went to renewables, nuclear transmission and distribution. The IEA further argues that in the last 10 years, global renewables investment increased by 5 times. About 60% of electricity investment came from renewables during the same period. However, in the past 3 years, we have noticed a slowdown, and even a decline in investment cost. The cost of renewables is becoming cheaper and more economical, particularly solar energy. Another contributing factor is the diversion of subsidy funds into massive investment in renewables by many countries which has led to an overall fall in required cost for renewable investment, thus, making it more viable [34].

Looking into the future, how much money will we need to keep the lights on, to drive the kind of cars we use, among others, in the next 20 years? The IEA argues that *we* will need $40 trillion for our energy systems between now and 2035. This means we need about $2 trillion annually. About 40% of this investment will be required to meet the incremental demand growth in energy demand (oil, gas, coal, electricity) while about 60% will be required to compensate the declining oil and gas fields, as well as many power plants retiring, particularly in the western world in order to replace them [38]. This means we need 60% of the investment to maintain current energy infrastructures, and 40% to add new energy infrastructures.

In the oil industry, about 80% of all oil investments are made to compensate for the existing declining oil fields [38]. Oil investment today has not much to do with increasing oil demand; however, it has a lot more to do with the declining oil fields. The aforementioned $40 trillion investment would be much higher if we do not invest in energy efficiency measures. Energy efficiency measure helps to reduce the increasing demand for new energy infrastructure. The IEA argues that about $8 trillion will be required in the next 20 years in energy efficiency investment measures. Today, about $150 billion is what is invested in energy efficiency improvement measures.

In terms of ownership, which gives an idea in terms of financing, the IEA report shows that about half of the power plants in the world belong to state owned companies. More than 3/4$^{th}$ of the global oil and gas reserves are owned by state or state owned corporations. This has a lot of implications as the investment decisions would not be based only on the commercial considerations of such investment, but may also be based on implementation of the national energy priorities and strategies of the concerned states [44]. The role of states will be much more pronounced in global energy decisions in the years to come. This indicates that energy infrastructure investment decisions may not be based on economic processes and indices alone. Policy makers and governments are, and will continue to be, very important players in the decision making process.

In the beginning of the 2000's, about one-third of the global electrical power markets were ruled by the market principles. Today, it has reduced to about 10%. Most of the markets today are regulated markets, and in the future, more decisions will not be made under the market rules as it will be more regulated. Electricity transmission and distribution, renewables and nuclear power, as well as fossil fuels in the emerging economies are highly regulated. Only a small part of the fossil fuel market in the Organization for Economic Cooperation and Development (OECD) countries are in the competitive market i.e. not regulated. These are clear pointers that economic processes alone in decision making for new energy infrastructures is gradually phasing out. Decisions will be more and more influenced by politicians and policy makers in the near future.

Table 1 shows the world average annual investment in energy supply infrastructures and energy efficiency measures.

**Table 1. World average annual investment in energy supply and efficiency.**

| | World Average annual investments | | | | | Cumulative investments | |
|---|---|---|---|---|---|---|---|
| | Historical | New Policies Scenario | | | | NPS | 450 |
| | 2000-13 | 2014-20 | 2021-25 | 2026-30 | 2031-35 | 2014-35 | 2014-35 |
| **Energy Supply** *(billion, year-2012 US dollars)* | | | | | | | |
| **Total** | **1 230** | **1 772** | **1 759** | **1 830** | **1 963** | **40 165** | **39 387** |
| **Oil** | **427** | **637** | **608** | **613** | **621** | **13 671** | **11 062** |
| Upstream | 320 | 510 | 509 | 513 | 520 | 11 284 | 9 014 |
| Transport | 54 | 50 | 42 | 39 | 46 | 986 | 902 |
| Refining | 52 | 77 | 57 | 61 | 55 | 1 401 | 1 146 |
| **Gas** | **252** | **357** | **388** | **414** | **453** | **8 771** | **7 457** |
| Upstream | 152 | 230 | 272 | 297 | 337 | 6 138 | 5 135 |
| Transport | 100 | 127 | 116 | 116 | 116 | 2 633 | 2 322 |
| **Coal** | **61** | **54** | **40** | **42** | **50** | **1 034** | **690** |
| Mining | 31 | 32 | 29 | 32 | 40 | 736 | 508 |
| Transport | 30 | 21 | 10 | 10 | 9 | 298 | 181 |
| **Power** | **479** | **713** | **712** | **746** | **818** | **16 370** | **19 258** |
| Fossil fuels | 106 | 120 | 117 | 117 | 125 | 2 635 | 2 877 |
| *Of which: Coal* | 55 | 68 | 66 | 71 | 74 | 1 528 | 1 918 |
| *Gas* | 46 | 49 | 49 | 43 | 49 | 1 054 | 930 |
| Nuclear | 8 | 46 | 56 | 51 | 41 | 1 061 | 1 722 |
| Renewables | 153 | 241 | 234 | 274 | 326 | 5 857 | 8 809 |
| *Of which: Bio energy* | 17 | 22 | 23 | 34 | 39 | 639 | 892 |
| *Hydro* | 52 | 71 | 65 | 69 | 68 | 1 507 | 2 097 |
| *Wind* | 43 | 76 | 81 | 97 | 113 | 1 989 | 3 027 |
| *Solar PV* | 37 | 60 | 49 | 51 | 71 | 1 276 | 1 724 |
| Transmission | 48 | 84 | 80 | 78 | 82 | 1 787 | 1 586 |
| Distribution | 164 | 222 | 227 | 226 | 242 | 5 030 | 4 265 |
| **Biofuels** | **10** | **11** | **11** | **15** | **22** | **320** | **920** |
| **Energy Efficiency** *(billion, year-2012 US dollars)* | | | | | | | |
| **Total** | | **212** | **334** | **436** | **533** | **8 002** | **13 531** |
| **Industry** | | **21** | **31** | **40** | **48** | **739** | **1 371** |
| Energy intensive | | 8 | 11 | 15 | 19 | 284 | 529 |
| Non-energy intensive | | 13 | 19 | 25 | 29 | 455 | 842 |
| **Transport** | | **115** | **193** | **276** | **356** | **4 928** | **8 120** |
| Road | | 109 | 179 | 250 | 317 | 4 496 | 7 267 |
| Aviation, navigation and rail | | 6 | 14 | 26 | 39 | 432 | 854 |
| **Buildings** | | **77** | **110** | **120** | **129** | **2 334** | **4 040** |

*Source: IEA World Energy Investment Outlook* © 2014 OECD/IEA

## 5. KEY DRIVERS OF GLOBAL ENERGY DEMAND, CONSUMPTION, AND INVESTMENT.

This section explores five major drivers of global energy demand and consumption which in turn impacts on the level of investment required for the provision of the required energy infrastructures.

### *5.1 Energy for Residential and Commercial Centres*

The residential and commercial sector depends largely on supply of electricity for lighting, cooking, heating, and other applications. Energy use in this sector for heating is of particular importance since it is a matter of national priority in the temperate region [41]. In many developing countries, this sector significantly relies on traditional biomass. Reliance on traditional biomass in this sector is a serious national energy security issue due to its side effects on environment, health, and development.

Energy-use pattern in this sector differs between industrialized and developing countries. Countries with lower income typically have high proportion of residential and commercial energy use. In essence, whether one looks at it from a developed or developing economy perspective, provision of energy for residential and commercial use is a matter of national priority for most governments. This represents a major driver of energy demand, consumption and investment.

### *5.2 Energy for Industry*

Energy use in industrial applications is mainly in the form of heat and electricity. This varies between countries. In most developed countries, energy use in the industrial sector accounts for about 15% of total energy use. The industrial sector accounts for over 25% of energy use in about 60 countries with a population of 4.5 billion people. In about 12 countries (including Brazil, China, and Ukraine) with a population of about 1.7 billion, the energy use in the industrial sector accounts for over 40%. Emerging and developing economies are dominated by a few industries relying on distinct energy systems which are critical for energy security in those societies.

In many economies, provision of energy infrastructures served as a major driver of industrialization. Absence of planning for future provisions of energy infrastructures has led to de-industrialization at some point in the history of some economies (as is the case of Nigeria). However, it should be noted that growth in industrial use of energy cannot be considered pressing or permanent as is the case of residential and transport sectors. Industrial growth of energy use may be reversed. Industrial energy intensity is an important factor that can make the industrial sector relatively vulnerable to price volatility and other energy supply disruptions.

### *5.3 Energy for Transport*

Transportation is an essential element which is crucial for every aspect of modern society. Transportation has helped and shaped the way we address varying issues such as; food production, personal mobility, availability of goods and services, trade, military security, and so on. Over 20% of energy use in many developed countries accounts for transport. Inasmuch as there is a rapid growth in energy use in developing countries (including India and China), energy use in developing countries for transportation is less than 15%. In least developed countries, transport account for less than 10% of their energy use. There is a competition for the same energy resources used for both modern transport systems and other applications such as construction, agriculture, and other machinery. The increased need for (land, sea, and air) transportation infrastructure poses a huge pressure on the need for more energy supply provisions.

### *5.4 Energy for Water*

A very important factor for consideration in the water-energy mix concerns energy required for treating and supplying water. This involves electricity requirements for pumps used in the extraction (from ground and surface sources), collection, transportation, and distribution of water. The amount of energy required depends on the distance to (or depth of) the water source. The conversion of various water types – saline, fresh, brackish, and waste water – into water that is fit for specific use requires electricity, heat, and other processes involved in desalination of water which can be very expensive and energy intensive. There are other energy requirements associated with end-use application of water - mostly in households - for water heating, cloth washing, *etc*.

Growing population, improved standards of living, and scarcer freshwater supplies in the proximity of population centres will contribute to the rising demand for energy for the water sector looking ahead. The implication is that water might need to be pumped from greater depth, undergo additional treatment, and transported over long distances. A shift from the traditional surface/flood irrigation method to pumped method puts further pressure on energy requirement for water.

### *5.5 Energy Cost*

Different technologies pose different advantages and constraints, particularly associated investment, maintenance, and operational cost. The potential to refine an existing technology and its consequent potential for further cost reduction is determined by the technical maturity of that particular technology. Despite very good energy yield prospects, there are also operational and technological parameters that limit the potential for cost reduction. A good example is the high associated cost for offshore installation and maintenance of wind turbines as compared to onshore systems due to installation conditions and transportation routes. This necessarily results in additional costs which can scarcely be optimized through technical refinement.

## 6. IMPACT OF ENERGY INVESTMENT IN SUB-SAHARA AFRICA.

The sub-Sahara Africa energy sector is a huge and growing sector. Sub-Sahara Africa is expected to account for about 20% of the global population by 2040, meaning that the energy choices that will be made in the region today will also have global consequences. This section highlights some of the vital areas where the impact of energy investment will be felt.

### *6.1 Energy Poverty/Energy Access*

There is still a huge spotlight on energy poverty crisis in sub-Sahara Africa. The IEA in her 2014 Africa Energy Outlook special report argues that more than 620 million people (about two-third of the population) in sub-Sahara Africa live without electricity. Only one country in the region – South Africa – consumes as much electricity as London. The IEA report also highlights that an average person in the developed world consumes more electricity than 16 people in sub-Sahara Africa. Nearly 750 million people in sub-Sahara Africa still rely on hazardous inefficient forms of cooking using wood, charcoal, and agricultural residues as fuel, and polluting cooking stoves causing huge numbers of premature deaths each year. Today, the use of these traditional fuels easily outweighs all the other fuels combined. Simply put, the energy sector in sub-Sahara Africa has not yet been able to meet the needs and aspirations of its people. More can, and should, be done to tackle this because, more importantly, the benefits far outweigh the cost, which means it makes economic sense.

The primary purpose of our energy systems is to enable economic growth and better quality of life. Having access to energy brings with it better multiple benefits for various sectors of the economy: healthcare, education, manufacturing, *etc*.

### *6.2 Regional Energy Cooperation*

A major challenge of the sub-Sahara Africa energy sector is the unevenly distributed and underdeveloped energy resources. To address this, there is an urgent need for regional energy cooperation. Investment in this sector will further strengthen the need for this cooperation to happen. The region is already home to major energy players including Nigeria, South Africa and Angola, who are also being joined by emerging players such as Mozambique and Tanzania. These countries have the opportunity to reap the dividends of their natural resources; however, there is a need to reinvest these dividends locally to yield yet greater gains in terms of a more effective energy sector, and in terms of a more broad based economic growth.

There is need to also build upon existing channels of regional cooperation which can bring about mutual benefits, and perhaps more importantly, efforts must be put into ensuring high standards of governance both within and beyond the energy sector. Transparency and accountability are critical to building credibility and public trust. A long term development model for the region needs to be one where the energy sector becomes a driver.

### *6.3 Localizing Technologies and Driving Down Cost*

Sub-Sahara Africa is endowed with abundant renewable energy resources which are expected to be harnessed increasingly [42]. By 2040, renewables is expected to account for nearly 45% of electricity generation in the region varying from large dams to mini and off-grid solutions in remote areas. The IEA argues that the recent geometric economic growth experienced in the region has led to a corresponding growth in energy demand by about 80%; however, the per capita energy consumption remains very low. The report further highlights that by 2040, nearly 1-billion people are expected to have access to electricity; however, due to rapid population growth, about half of that number will still not have access to electricity [43]. Increasing access to reliable modern energy can turbo-charge the economic growth in sub-Sahara Africa, enabling a major push towards its more self-sustaining model towards economic growth.

Investments already made in renewables in developed countries already have some impact on the cost of renewables as it is now becoming more accessible. However, localizing the production of those technologies will further drive down the costs.

### *6.4 Reshaping Energy Markets*

Investment in the sub-Sahara Africa energy sector will help in reshaping the energy market in the region. Governments in the region will see the need to be more proactive in taking action that can help provide a strong boost to the regional economy, and put it on a much faster path to a modern integrated energy system for all. The implementation of these actions will require high level political commitment to energy sector reform, and policy makers need to focus on building capacity within the energy sector, strengthen policy and regulatory frameworks so that more functioning energy markets emerge, opening up the market to new players and new sources of finance, and – where it is not the case - moving towards prices that reflects market fundamentals.

## 7. CONCLUSION

The role of government in the energy market is on the rise. Shaping the energy market will be more and more government decisions and investors are getting worried about the regulatory risks and uncertainties attached to that. We see investments today going towards the high capital cost areas – deep water, energy efficiency, *etc*. – which makes the task of financing a bigger challenge. However, national governments still matter as they will shape the energy supply-demand landscape. Governments will play a key role in addressing supply security issues, in creating appropriate regulatory and market frameworks and in encouraging technology development and deployment. The regulatory and structural reforms in the energy sector which governments promote will have a major impact on supply prospects. These reforms which started with the privatization of state owned enterprises and the opening up of the energy sector to private capital are also favouring the removal of trade and investment barriers and encourage the development of new supply projects. By endorsing such endeavor, national governments play an active role in the provision of security that the new geometry of the global energy scene is imposing on producer and consumer countries.

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