

Power to Empower Emerging Africa: Issues and policy options for a new energy-development paradigm (Mohamed VI Polytechnic University, Ben Guerir, March 05 and 06, 2020)

Organizers: Chair Industrial Economics of Emerging Africa, Chair Energy and Prosperity, Chair Climate Economics

The workshop gathered over 50 participants among which 17 speakers from various and diverse backgrounds. Academics, public and private stakeholders, and civil society in the field of energy has shared their views, the challenges and prospect about energy access, and energy transition in the context of emerging and developing Africa. The cross debates were rich, stimulating and open minded. As highlights, discussions pointed out toward potentials provided by innovative local and decentralized technological solutions and business models alike, the design of sustainable financing schemes, all supported by an appropriate institutional and policy framework.

Session 1. Leveraging the development impact of energy: households and firms' channels

A perspective on the growing literature on the impacts of electrification (Jörg Peter, Professor Head, Research Group, "Climate Change in Developing Countries" RWI)

Some points highlighted:

- An overview of the literature perspectives on the impacts of electrification on development variables.
- The question of whether or not to continue to invest in the expansion of national electricity grids was also raised. This question is directly related to the question of whether Africa could make an energy leap (implementation of off-grid without going through on-grid) as was the case in the field of telephony (direct switch to mobile telephony, which avoided major investments in the extension of wireline networks).
- What could explain the differences in effect between Africa and other parts of the world? First of all, let us recall that the results are not very optimistic in Africa than elsewhere (Asia and South America). This would be due to: (i) different starting points: Africa is electrifying at lower levels of development and GDP/capita and (ii) Methodological divide: Experimental studies leads to less optimistic results.
- Instrumental variable (like geography) is good but it may be endogenous (geography predicts development in non-connected areas, geography-land gradient explains access to road, and this is potentially confounding). Working with secondary data, we could not publish (no effect results); while when we invest in experiments, we have to publish it, because we spent money. In any case, all recent reviews agree that impacts of on-grid electrification are (often) much smaller than previously thought (are they measuring the same outcome?) compared to high costs of connection to grid per household.
- The speaker also raised the issue of subscription costs, which remain very high in Africa (on average, between US\$ 1500 and 6600).
- Finally, the speakers put forward the idea of forming common energy markets in order to increase the rate of return on capital in the region, which could boost investment in the energy sector.
- Policy conclusion: Rethink the on-grid/off-grid balance electrification portfolios. Demand patterns in grid connected rural areas can easily be met with off-grid technology.

- Challenge ahead: How to improve energy planning systems (i.e. where should the grid go)? Viable business models for mini grid? What is the role for “high quality” off-grid solar vis-à-vis la chinoiserie? (Grimm and Peters 2016).

Rural electrification and child labour in Nigeria: the role of electricity end-uses (Jeremy Tanguy, Assistant Professor, University of Savoie Mont-Blanc)

Some points highlighted:

- Analysis of the role of rural electrification on child labour in Nigeria. Here, the focus is rather on the final uses of electricity.
- The literature on the impact of electricity on adult employment is quite extensive in contrast to the literature analysing the impact on child labour, which is still quite sparse.
- Electricity, as a source of job creation (opportunities), could lead to a greater likelihood of work for children and adults. On the other hand, electricity, by improving night lighting, could possibly encourage children to attend school.
- Studies have shown that electricity substitutes for firewood outside Africa, which is not the case in Africa because cooking with electricity requires stoves. However, it is conceivable that this substitution could take place through other channels such as household appliances. It is known, for example, that a good proportion of households in rural Africa have recently acquired refrigerators, which could, why not, optimise food preservation and thus reduce the demand for firewood and charcoal for cooking.
- Child domestic labour is not considered in this paper, which could also explain the difference between girls' and boys' work.
- Speakers also suggested using the number of hours worked instead of the binary variable (0 or 1).
- Boys work more than girls, and the older the more they work (5-15 years) and Usually in household farms
- Main utilization: Lighting, TV, fridge, stove
- A proportion of households are considered connected (they pay for it) but do not appear in the results (they don't receive the electricity they paid for).
- An IV approach: Control of household income/economic situation by the estimation of the value of their possessions (houses, farms...).

Session 2. Policy and regulatory framework

Institutions and geography: A 'two sides of the same coin' story of primary energy use in Sub-Saharan Africa (Nguyen-Van-Phu, Research Director, CNRS, Beta, Université de Strasbourg)

Some points highlighted:

- Focus on the role of geography and institutions on energy consumption in sub-Saharan Africa.
- It is clear from the data that energy consumption is systematically higher on Africa's coasts than in the interior of the continent. Would geography, like the level of development, be an important factor in energy consumption?
- No evidence of an Environmental Kuznets Curve (EKC) in sub-Saharan Africa.
- Analyses show that geography and institutions are determinants of energy consumption. But it is impossible to act on geography (exogenous by definition), so what other economic policy

instruments could be used? One of the proposed answers would be regional integration (between coastal and landlocked countries) which could be a way of escaping its geography.

- The channel through which geography would impact energy consumption is essentially the channel of energy transport costs. Landlocked countries find it more difficult to import energy compared to coastal countries.

Session 3. Policy session

Vijay Modi, Professor, The Earth Institute, Columbia University, Director, Infrastructure Programs, Millennium Villages Project, New York

Some points highlighted:

- Natural gas fuelled most of the increase in electricity supply for the continent on the whole, but fuel shares varied by region and coal dominated in south Africa.
- If we analyse Electricity network losses versus cost recovery ratio for major utilities in selected markets, we find that the weak financial and operational performance of utilities in sub-Saharan Africa hampers affordable financing in the power sector.
- Africa has the lowest voltage compared to other regions of the world.

Faraoun Malik, Director, Themis Energy

Some points highlighted:

- Powering renewable energy for a better future in Africa
- We believe that Sub Saharan Africa represents one of the most compelling cases for energy investments because Africa's economic is growing quickly (GDP, population, urbanization, consumption...).
- Around 600 million people in Africa still have no access to power, representing 48% of the continent's population.
- Themis is Developing and investing in economically and environmentally sustainable power assets for a better life in Africa. The company is leading project developer and investor with an exclusive focus on incremental renewable power generation assets in Sub Saharan Africa. They use renewable resources such as water and sun to generate reliable, affordable and sustainable energy.
- Analysis of Economic and ecological costs in Ivory Coast, Sierra Leone, Madagascar...

Engie Africa, Toward a strong model for Off-grid Solutions

Some points highlighted:

- The company is committed to the low-carbon (or even zero-carbon) energy transition.
- Engie relies on its core businesses (renewable energies, gas, services) to offer competitive and tailor-made solutions (e.g. solar pumping). To achieve this, Engie aims to position itself on the entire value chain (from production to distribution).
- In Africa, Engie's installed generation capacity is over 3 GW and more than 4 million people benefit from access to green electricity via off-grid.

Rebekah Shirley, U. of Berkeley, Director of research Power for All

Some points highlighted:

- Analysis on Africa's Energy Access Workforce
- There are still 650 million people in SSA with no access to electricity. As 80% of the electrified are rural, new distributed renewable energy technologies (DRE) are becoming centred.
- The DRE sector has emerged as a significant employer in emerging market. Although nascent and just beginning to scale, it has already grown a direct workforce (persons working directly for DRE companies) comparative to traditional utility-scale power sectors and is expected to more than double by 2022-2023, according to our early estimates.
- Compared to direct, formal employment, the DRE sector employs twice as many workers through informal jobs and five times as many through productive use jobs, both critical as informal work is the largest source of employment for most SSA countries.
- There are clear skills needed to unlock the DRE sector's potential to scale and create more employment, presenting an opportunity for collaboration between government, academia, training organizations, and industry associations. Managerial skills are in high demand, being identified as most difficult to recruit.

Keynote speaker

Daniel M. Kammen, Professor, Director of RAEL, Chair in Energy, U. of Berkeley

Some points highlighted:

- Carbon crunch: There is a mean budget around 600 gigatons (Gt) of carbon dioxide left to emit before the planet warms dangerously, by more than 1.5 - 2°C. Stretching the budget to 800 Gt buys another 10 years, but at a greater risk of exceeding the temperature limit.
- But we have some progress. For example, Chinese cities move rapidly to 100% electric vehicle taxi and bus fleets.

Session 4. Harnessing Africa energy resource potential for sustainable development

Utilities 2.0: Unlocking Africa's Integrated Energy Future (Rebekah Shirley, U. of Berkeley, Director of research Power for All)

Some points highlighted:

- SSA Utility challenges: Reliability, Cost, Recovery. Consumption in SSA is low, a cost recovery challenge for utilities. Reliability as proxied by the duration and frequency of outages, is low. Losses affect recovery of infrastructure costs, limit customer consumption and affect ability to attract investment.
- Energy landscape in Africa is evolving. Of course, 40% of SSA countries have official rural electrification targets and a third have decentralized renewable energy targets or plan, 4.11 million quality-certified solar lanterns, multilight and solar home systems were sold in SSA from January to June 2019, 773,000 off-grids solar appliances were sold between January and June 2019, and there are 1,500 mini-grid installed across Africa, plus 4,000 mini-grids planned.
- The research challenge and opportunities are : identifying successful business techniques and strategies that will improve profitability and attract investment and improving policies and the broader business environment that affect decentralized technologies, identifying opportunities to combine mini-grids and distributed storage, with main grid extensions and/or

solar home systems to develop new business models that leverage combinations of these technologies, assessment of social/community/economy impact of integration...

- We assume that by leveraging the strengths of both centralized and decentralized systems and advances in digitization, profitable, affordable and accelerated universal electricity access is possible for Sub Saharan Africa.

Natural resources and energy transition (Mouez Fodha, Professor, Paris Sorbonne School of Economics)

Some points highlighted:

- Referring to the energy transition, the speaker raised the hypothesis of the finiteness of mineral resources, because for him, this requires intensive investment in those mineral resources, which are finite. Like fossil resources, the mineral resources underlying the energy transition are finite. Hence the need for recycling.

- Renewable source of energy (RE) are more dispersed than non-renewable ones (NRE)

- The scarcity of minerals could limit the development of RE (obstacle to the energy transition). But minerals can be recycled, while fossil resources cannot.

- When a unit of NR resource is used as fuel to produce energy through combustion, the resource is definitely lost. When a unit of mineral resources (NR) is embedded in the infrastructure used to produce energy from R sources, it supplies a flow of energy services over an interval of time, but at the end of the life cycle of the equipment, it adds to the stock of secondary mineral resources that can be recycled.

- The previous literature doesn't take into account the dependency of renewable energies on exhaustible mineral resources and the role of recycling.

- We find that without recycling technology, resource extraction is carried out at the same rate, the difference between the two resources is explained by the initial "known" quantities of the stock. But when the resources embedded in infrastructure can be recycled, the development of RE should be brought forward in time. Generally, the higher the recycling rate, the earlier the extraction of mineral resources must take place.

Stochastic Petro-politics: the dynamics of institutions in resource-dependent economies (Fabien Prieur, Professor, University of Montpellier)

Some points highlighted:

- Resource-dependence is often invoked to explain the bad economic and institutional outcomes of resource-rich countries (Ploeg, 2011).

- Most of the literature deals with the link between the level of resource windfalls and the quality of institutions. While no contribution on the interplay between resource windfalls volatility and institutional change.

- The main question is: Is the volatility good or bad for the quality of institutions? Theoretically, uncertainty makes the legislative state more liberal in the long run. In the empirical side, the analysis shows negative link between the volatility of the rents and liberalization.

- Other proposition is that diversification could address the volatility (Qatar case...).

Session 5. New technological and business models

Intermittent renewable electricity generation with smart grids (Prudence Dato, Researcher, University of Basel, Competence Center for Research in Energy, Society and Transition)

Some points highlighted:

- Smart-grids can generate rebound effects
- Energy storage opportunity leads to more grid electricity purchase
- Smart meters can lead to more grid electricity purchase and less welfare for households
- Curtailment measures aimed at avoiding congestion can lead to more grid electricity purchase

Prepaid electricity and in-home displays: an alternative for the most vulnerable households in Colombia (Juan Miguel Gallego Acevedo, Associate Professor, Universidad del Rosario, Bogota)

Some points highlighted:

- The main motivation is that many vulnerable households face difficulties to pay their bills. Electricity prepayment programs have been used in more than 17 countries.
- We exploit the implementation that EPM has been carrying out of a prepaid electricity program since 2015 to date. We focus our analysis on the period of time between January 2010 and December 2017, due to data constraints, to (i) analyse the causal impact of being part of the program on dwelling's energy consumption behaviour and (ii) assess the potential benefits that vulnerable households can have adopting the prepaid scheme.

- Prepaid electricity and in-home displays: an alternative for the most vulnerable households in Colombia (Maria Eugenia Sanin, U. Evry, Université Paris-Saclay)

Some points highlighted:

- $\frac{2}{3}$ of variability in individual percentile access in energy and water are explained by country effect
- Estimates of income elasticities per percentile per service (affordability) stable across the quintiles
- In Latin America, 99% of countries with piped water have improved water, 93% of countries with improved water have piped water and 99% of ones with sewerage have it improved