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A gasifier in rural Uganda providing basic electricity services.

Truly sustainable bioenergy in East Africa?

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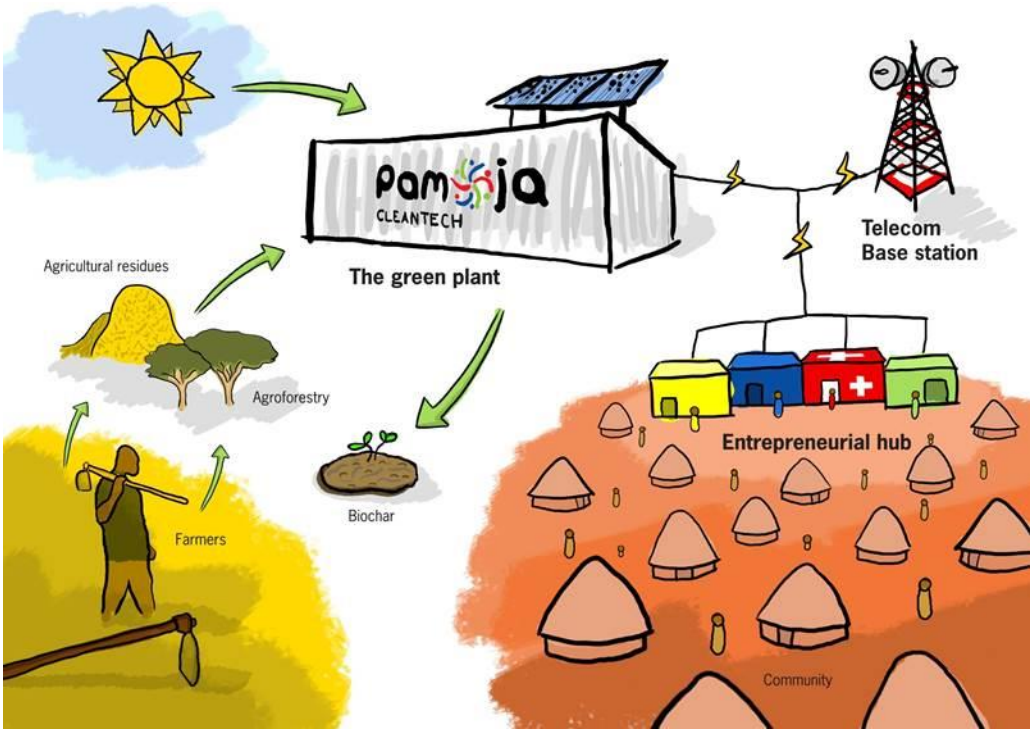
95% of the people in rural areas in East Africa have no access to electricity. At the same time, the telecom industry has been at the forefront of infrastructure development in rural areas and has proven to be a very strong business with positive social impact. Seven in ten Africans have their own cell phone today, network access is essentially universal in several African countries including Kenya. However, the telecom base stations in off-grid rural areas are currently powered by diesel with both high economic and environmental costs.

Particularly bioenergy technologies such as power from small-scale gasification fueled by agricultural residues or wood from sustainable sources exhibit promising potential for expansion. While small-scale photovoltaic systems are able to provide household lighting and electricity for charging cell phones or a radio at an affordable price, gasifier systems produce electricity at scales starting around 10 kw, a scale where photovoltaic systems become costly compared to other alternatives such as diesel-fueled generators. While a 10 kW could provide electricity to around 10 households in the US only, in rural Africa this scale is able to power water pumps, grain mills, minigrids at trading centers, or medium-sized commercial loads powering for instance a telecommunication tower, thereby increasing the standard of living significantly in a whole community and region that previously had no access to electricity.

A widespread application of these bioenergy systems is hampered by several factors including a lack of business models to run the units and the absence of frameworks to measure the potential ecological risks of putting an additional biomass-consuming system into place in an already constraint ecosystem: A growing population using biomass for over 90% of their primary

energy needs and land use change from forests being cut for small scale farming and large monoculture has caused Uganda to lose over 1/3 of its forest cover over the last two decades. Implementing a biomass based electricity system can further contribute to these problems if the biomass fuel supply is not sustainably managed. While per capita wood consumption in sub-Saharan Africa is between 500 to 1,000 kg of dry wood per year, gathered mainly for cooking, a 10 kW gasifier placed in a community and providing basic electricity services would require an equivalent of another 7 kg of dry wood per capita and year. Therefore, for these systems to become truly sustainable, their design needs to consider ecological and social factors on the ground as well as fulfill larger policy goals within a regional context.



A concept to deliver sustainable biomass-based electricity to rural communities in Africa.

Recent entrepreneurial breakthroughs have provided ample examples that renewable sources can boost rural electrification expansion, even in regions where government-led initiatives have a poor track record. Pamoja Cleantech is a young social enterprise driven by an ambition to solve social and environmental problems with entrepreneurial means. Just three years into this venture, Pamoja has already installed three gasifiers in rural communities in Uganda with the first unit poised to be connected to a telecommunication tower by the end of the year. Serving electricity to these towers offers considerable business opportunities for Pamoja due to its replication potential. But more importantly, only the presence of such an ‘anchor load’ that offers reliable long-term business perspectives will mitigate the risk of a bank financing the undertaking and Pamoja installing and maintaining the gasifier in a rural village. Serving both, the single-largest anchor load customer as well as multiple small-scale users providing services for the community is key to this social enterprise model. This game-changing idea enables the telecom industry to make a transition from diesel to a renewable energy solution while expanding electricity access in a rural community at the same time.

An agroforestry plot (lower left) in Uganda next to erosion-affected fields. Adaptation potential abounds.

A focus of Pamoja's work is on understanding the biomass supply chain and identifying sustainable solutions that enhance an ecosystem's resilience rather than contributing to further degradation or competing for fertile land with food production. Identifying a sustainable scale of biomass consumption might well drive the overall scale of a sustainable bioenergy system since each kW installed might require as much as one hectare of accumulated woodlots or hedgerows. Agricultural residues might be a sustainable fuel as long as their extraction rate does not reduce soil fertility or creates indirect land use change by forcing families to gather fuelwood for cooking who previously relied on these agricultural residues. Dedicated fuelwood plantations, hedgerows or agroforestry systems are another option for a sustainable biomass supply chain and can create regional ripple effects by adoption of sustainable agricultural practices; boosting ecosystem health and productivity in a whole region.

Nevertheless, the question remains where setting a path towards increased electricity consumption to improve basic living standards, will lead these communities in the long-term. If we only create new demands that can eventually not be satisfied anymore by the regional ecosystem - be it more biomass for more electricity, or more food for more people - the whole effort will contribute further to unsustainably managed landscapes. If we fail in providing better living standards in rural Africa, urban migration patterns will become disastrous by themselves from an ecological and human well-being perspective. The question what sustainability entails, what lifestyle these landscapes can sustain, what role models we can draw on, what the social consequences of introducing bioenergy to a village are, and if such a thing as sustainable development even exists, is on our minds every day when we work in African communities.

Further readings:

Pamoja website: http://www.pamojacleantech.com/

Modern bioenergy systems – examples in East Africa: A clip on the Gund Institute for Ecological Economics youtube channel: http://www.youtube.com/watch?v=q-sG0guf26M

Buchholz, T.; Da Silva, I.. (2010) Potential of distributed wood-based biopower systems serving basic electricity needs in rural Uganda. Energy for Sustainable Development 14(1) 56-61 http://www.uvm.edu/giee/pubpdfs/Buchholz_2010_Energy_Sustainable_Development.pdf

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