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Comparative Assessment of Modern Bioenergy Potential in Thailand & Kenya

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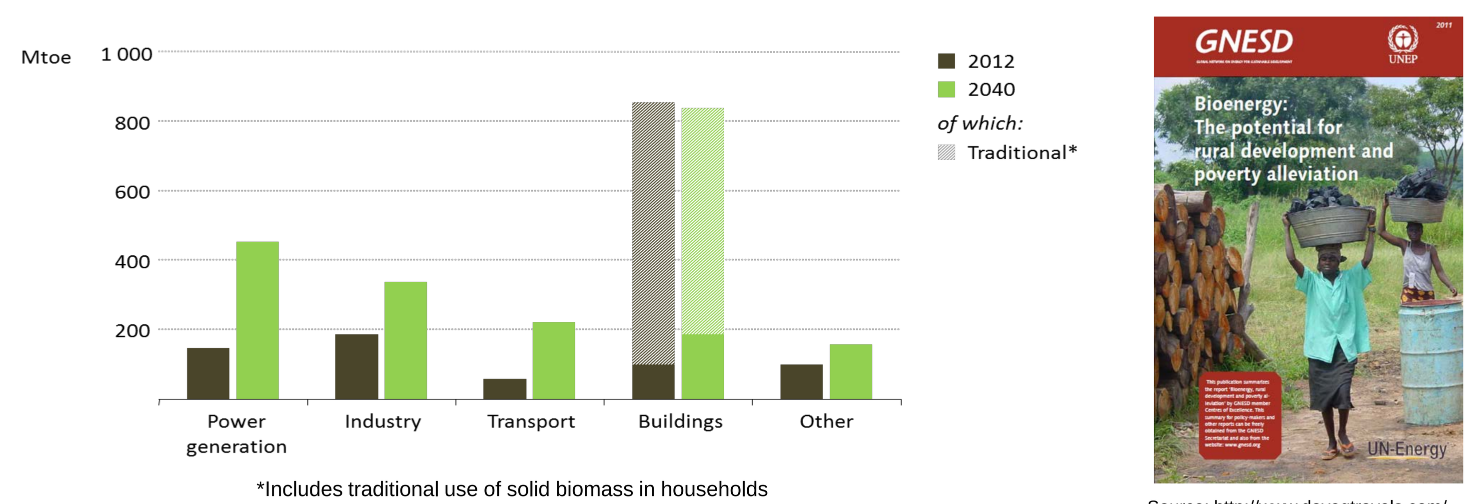
Introduction:

Globally, 2.7 billion people rely on traditional biomass for their basic household energy needs (Fig. 1). This is especially the case in South Saharan Africa (SSA) and developing Asia. This paper is a comparative study on Thailand and Kenya (both are GNESD member centre countries).



Source: IEA World Energy Outlook, 2014

Source: http://www.davegtravels.com/

Fig. 1. Global bioenergy use globally (current & future)

Key drivers for the increased modern bioenergy interests in Thailand and Kenya include's:

❖ diversification of energy resources;
❖ reducing national energy imports;
❖ rural income generation; and
❖ reduction in greenhouse gas (GHG) emissions.

Both Thailand and Kenya are agricultural economies. Thailand is a major exporter of food such as rice, sugar, corn and palm oil, globally. Kenya on the other hand exports tea, coffee and horticultural produce. Debate on the use of food sources for energy generation is still on-going. The utilization therefore of agricultural residue (instead of food materials) for energy generation is a preferred option as it avoids food (in)security issues and other environmental and GHG concerns.

Objective:

The objective of this study was to understand the role that sustainably extracted agricultural residues could play in achieving national demand for electricity in both Thailand and Kenya.

Method:

Using methods developed by FAO and IEA, this paper estimated per annum residue amounts from Thailand and Kenya's agricultural production. This study applied sustainable extraction of agricultural residues factor for the two countries. Additionally, it estimated the corresponding bioelectricity amount that could be produced.

Results and Discussions:

There appear to be more agricultural production and hence residue generation in Thailand compared to Kenya (Tables 1 & 2).

Source	Food (tonnes/ year)	(RPR)	Residue (dry tonnes/ year)	Residue. 20% (dry tonnes/ year)	Bioelectricity potential TWh (GJ x 0.28 x efficiency x 10E-6)	
					Low	High
Maize	4.45E+06	1.5	5.68E+06	1.14E+06	0.7	2.0
Rice	3.16E+07	1.5	4.03E+07	8.06E+06	5.3	14.0
Sorghum	5.40E+04	2.6	1.20E+05	2.41E+04	0.02	0.05
Sugarcane	6.88E+07	0.3	5.16E+06	1.03E+06	0.6	1.6
Coconut	1.30E+06	0.6	7.01E+05	1.40E+05	0.06	0.2
Coffee	4.90E+04	2.1	8.74E+04	1.75E+04	0.01	0.03
Total				**1.04E+07**	**6.67**	**17.8**

Table 1. Estimated bioelectricity potential rom agricultural residues in Thailand

Due to competing utilization of agricultural residues for animal fodder, bedding, soil nutrient replenishment and other energy applications, only 20% of available residues (sustainable extraction) would be considered for bioelectricity generation in both Thailand and Kenya. In practice however, ddapho-climatic studies would be required to determine the exact extent to which agricultural residues should be extracted from each soil type as this is geographic and soil/location specific.

Source	Food (tonnes/ year)	(RPR)	Residue (dry tonnes/ year)	Residue. 20% (dry tonnes/ year)	Bioelectricity potential TWh (GJ x 0.28 x efficiency x 10E-6)	
					Low	High
Maize	3.22E+06	1.5	4.11E+06	8.22E+05	0.6	1.6
Millet	5.39E+04	3.0	1.37E+05	2.75E+05	0.02	0.05
Rice	8.00E+04	1.5	1.02E+05	2.04E+04	0.01	0.04
Sorghum	1.64E+05	2.62	3.65E+05	7.31E+04	0.05	0.14
Wheat	5.12E+05	1.2	5.22E+05	1.04E+05	0.07	0.18
Barley	6.42E+04	1.7	9.28E+04	1.86E+04	0.02	0.04
Sugar cane bagasse	5.71E+06	0.3	4.28E+05	8.56E+04	0.05	0.13
Total				**1.16E+06**	**0.8**	**2.15**

Table 2. Estimated bioelectricity potential rom agricultural residues in Kenya

Our findings show that 10.4 million bone dry tonnes (bdt)/year of residues are potentially available for bioelectricity generation in Thailand whiles for Kenya this is approximately a tenth of Thailand's residues and amounts to 1.2 million bdt/year. Using the range of conversion efficiencies for biogasifiers that are currently available on the market for bioelectricity estimations, these sustainably extracted residues have the potential to generate between 6.7-18 TWh for Thailand (Table 1).

Results and Discussions (contd.):

For Kenya however, the residues could provide between 0.8 - 2.2 TWh/year (Table 2). These are significantly smaller compared to Thailand.

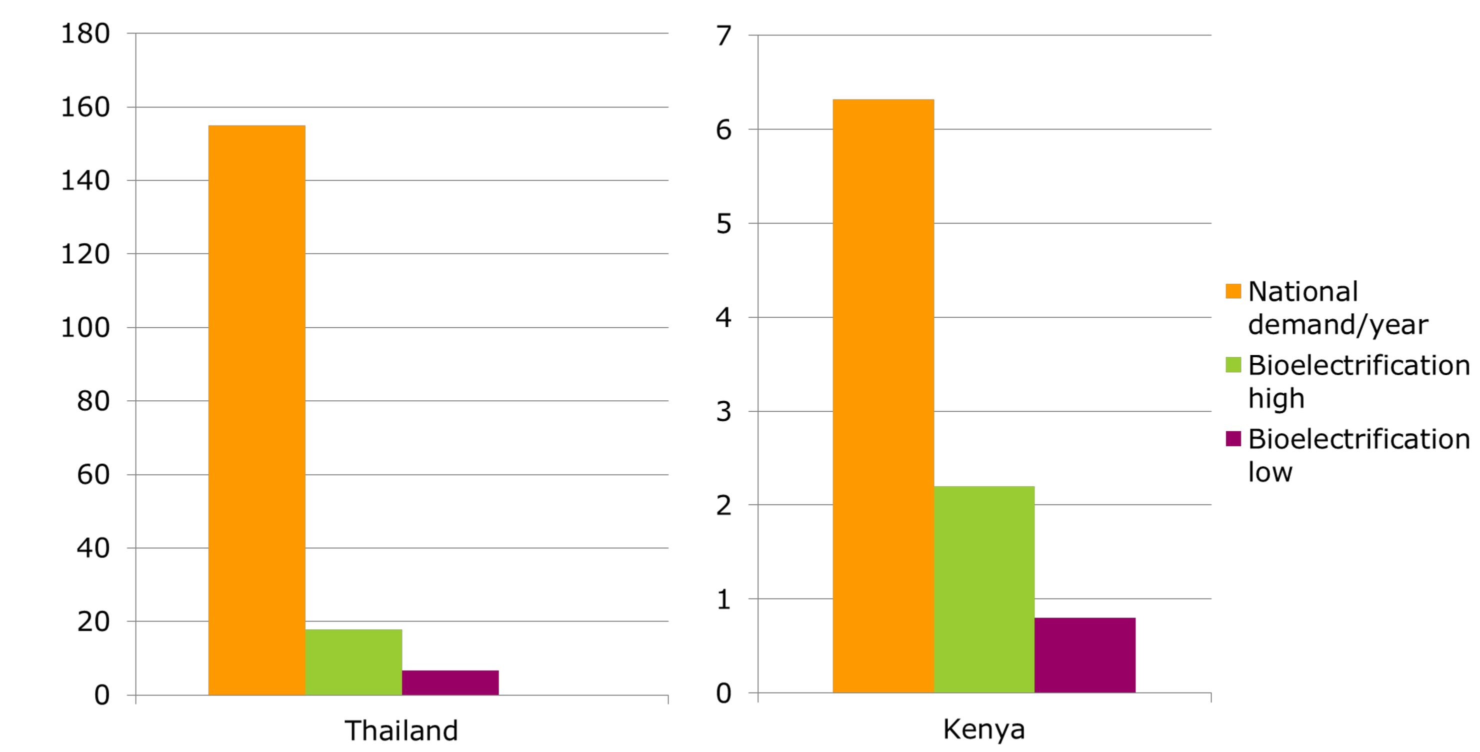


Fig. 2. Bioelectrification from residues in relation to national energy demand per year (year 2012)

However, the amount of bioelectricity generation from Kenya's residues could potentially satisfy the country's electricity demand to a far greater extent compared to Thailand. For example, up to a third of Kenya's electricity demand of 6.32 TWh/year can be met from agricultural residues alone (Fig. 2).

Whereas, bioelectrification from sustainably derived residues in Thailand, would only satisfy up to 11% of the country's 155 TWh electricity demand per year.

Conclusion:

❖ Bioelectrification from agricultural residues presents an opportunity in the food-energy nexus and help address issues pertaining to food (in)security and modern energy provision especially to rural communities in Asia and Africa.

❖ Bioelectrification from residues hold good potential for both Thailand and Kenya, however it seems to have greater potential impact in Kenya compared to Thailand.

❖ Wider uptake in bioelectrification would require additional investments in research, demonstration and deployment.

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