Diagnosis of Determinants for Electricity Access in Ethiopian

Ephrem Hassen[1]

Ministry of Water & Energy of the Democratic Republic of Ethiopia;

International Energy Policy Program (IEPP), Technology Management, Economics & Policy Program (TEMEP), Seoul National University, Seoul, Korea,

1. Overview

Ethiopia is a developing country where 83% of the people reside in rural settlements (CSA, 2012). According to Population Reference Bureau of United States, the global population growth is greater and will continue upwards in developing countries up to 2050 (Population Reference bureau, 2013). For countries like Ethiopia, this trend signals that exit from poverty would require significant effort. The government has focused on poverty elimination as strategic issue for the country.

National programs which include PASDEP, GTP and global initiatives like Millennium development Goals, Global Green Growth program, are directed towards improving the wellbeing of the society. These efforts are contributing to the growth of the economy though still there is huge potential which has to be exploited in different facets of the socio-economy.

The Country is among a few emerging economies since 2004 and performing more than 7% economic growth throughout (IMF, 2013). According to IMF, the Growth and Transformation Plan (GTP) of the country is part of an ambitious Long term development strategy designed to halt poverty and ensure macro-economic stability simultaneously by 2025 and its implementation began in 2011 (International Monetary fund, 2012). The government has a vision of transforming the economy of the country to middle income level. Sustained Supply of Energy, especially electricity is one of the major aspects to support such an ambitious plan. For this purpose, the government has allocated significant amount of financial investment and the generation capacity is planned to be raised to 10,000MW from the current level of 2150MW within the transformation plan period. But this financial resource has to be productive and loss has to be minimized as much as possible. This needs identification of how the current pattern of electricity use looks like.

The aim of this study is to factor the change in the aggregate electricity demand into, changes in economic activity (activity effect), change in technological efficiency of electricity use at sector level (efficiency effect), and change in economic structure (Structure effect). This study tries to give clue about the source of the

[1] Corresponding Author, e-mail: ephrem@temep.snu.ac.kr

increase in power demand. This will help to check whether the demand is attributed to the real need in the economy or due to other reasons. Therefore, diagnosis of sectorial electricity utilization is vital for studying the real cause for the increase in electricity utilization. Based on the outcome further analysis to remedy unnecessary wastage of electricity would be relatively simpler.

The study hypothesizes that the increase in the aggregate electricity intensity in Ethiopia is due to the greater activity level shift in the major economic sectors.

2. Methods

Scholars have conducted studies for decomposing the gross national energy or electricity use into subcomponents in a national economy using standard industrial classification over certain period of time. According to B.W. Ang and F.Q. Zhang, the need to decompose energy use has stemmed from the 1970s energy crisis which alerted practitioners to introduce detailed analysis of current demand and its trend in the future in the economic sectors, mainly industry (B.W.Ang F. , 2000). The approach is still in use for studying the relationship between Green House Gas emission & energy use in the industrial sector.

There are various potential methods for decomposing energy use in the national economy, main sector or subsectors within a country and also between countries (SZÉP, 2013). According to Blok, decomposition analysis was initially designed for factoring economic growth in to price & Volume (Blok, 2007). This idea is supported by other scholars who applied this method. He mentioned that this approach is applicable for energy decomposition analysis too. Block states that decomposition helps us to know how energy use can be factored into volume, Structure, and energy efficiency or specific energy use.

This study has taken 2001 as a base year (0) and 2010 as end year (t). Based on these considerations, electricity consumption in 2007 and the base year 2001 can be put in the following was:

$$E^t = Q^t\Sigma(EI^t_iS^t_i) \quad and \quad E^0 = Q^t\Sigma(EI^0_iS^0_i) \qquad (2^2)$$

The contribution of the change of each sub-component will be given as shown below:

Activity Change contribution:

$$Q^{effect} = (Q^t - Q^0\ \Sigma(EI^0_iS^0_i)$$

Intensity Change Contribution:

$$Ieffect = (Q^0)\ \Sigma(EI^t_i - EI^0_i)S^0_i$$

[2] This number is used just for the sake of recalling the location of the equation. This equation is borrowed as they are presented in the works of (Blok, 2007) and (Bhattacharyya, 2011).

Structural Level Contribution:

$$S^{effect} = (Q^0)\ \Sigma(S^t_i - S^0_i)\ EI^0_i$$

The change in aggregate electricity consumption is the sum of all three effects and the residual as presented below:

$$\Delta E = Q^{effect} + I^{effect} + S^{effect} + R^{effect},$$ where ΔE, Q^{effect},, I^{effect}, S^{effect}, ^{and} + R^{effect} represent change in aggregate electricity use, effect of activity (GDP), effect of sectorial electricity intensity, effect of Structure of the economic sector, and the residual from the analysis. The sectors considered in this study are Industrial, Services, and Residential

3. Result

Based on the analysis result, the activity effect played dominant role in the overall increase in the electricity consumption in Ethiopia during the two five year strategic planning periods (See Annex). Structure and intensity effects dropped in second planning periods depicting their negative role in electricity consumption. .Given data issues the Ethiopian electricity consumption can be said that it was increasing due to increasing overall economic activities in industrial and services sectors. But though the role of household's in the GDP is not recorded as in the manner for the Industrial or services sectors, the energy significant amount of electricity is consumed by the households and the size increases through time..

4. Implications

Electricity use in Ethiopia is mainly affected by the size of business in the major economic sectors rather than shift in the nature of business activities within each sector. At sector level, the industrial activity contributes more than the Service sector. To identify the subsectors where most of the power is used in the industrial sector, further detailed analysis using two or more sublevels will be necessary.

As electricity needs heavy investment and relatively longer establishment period, the right sector and relevant information on those demand centers can be used for capacity planning and fuel mix. This might contribute for cost effective expansion of power generation establishments.

The demand in the industrial sector will lead to the growth of other electricity demanding sectors like transport, trade, and communication. Hence while planning for electricity expansion the multiplier effect of the demand of the sector in question has to be taken into consideration.

It is clear that decomposing the electricity use does not lead to comprehensive planning. But it helps to identify the major areas of focus and mainly to narrow down the focus of problem solution in development effort. Sensitive and critical demand centers might need special awareness by all stakeholders to avoid misunderstanding during execution of plans. In this study, the government might need to scrutinize the type & nature of industries and their pattern of growth.

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ANNEX

The GDP and Electricity Consumption at National and Sectorial Level (2001 -2010)

Year	Gross value added at Factor cost(US $)	Total Electricity Use (Million Kwh)	Agriculture value added (US$)	Agriculture (Mkwh)	Industry Value added (US$)	Industry (Mkwh)	Service value added (US$)	Services (Mkwh)	Household value added (US$)	Household (Mkwh)
2010	27.867.538.154	3.22697	13.304.319.399	0	3.984.901.342	1.22269	10.578.317.412	0.81339	0	1.19089
2009	30.139.430.148	3.10352	15.308.045.304	0	3.240.377.303	1.18794	11.591.007.541	0.73748	0	1.1781
2008	24.841.457.203	2.90102	10.902.360.298	0	3.224.773.041	1.13965	10.714.323.863	0.73205	0	1.02932
2007	18.167.388.096	2.74158	8.400.350.208	0	2.411.056.478	0.97783	7.355.981.410	0.70344	0	1.06031
2006	14.047.318.727	2.36843	6.731.016.548	0	1.779.378.449	0.98883	5.536.923.730	0.5839	0	0.7957
2005	11.327.956.334	2.036	5.289.122.906	0	1.468.508.880	0.7932	4.570.324.548	0.5211	0	0.7217
2004	9.186.647.411	1.7144	4.059.183.474	0	1.290.965.794	0.7158	3.836.498.143	0.4017	0	0.5969
2003	7.947.025.039	1.6868	3.329.902.322	0	1.117.173.970	0.6882	3.499.948.747	0.4017	0	0.5969
2002	7.230.348.454	1.6064	3.145.953.068	0	1.004.518.760	0.6357	3.079.876.626	0.3912	0	0.5795
2001	7.573.288.504	1.4001	3.610.099.935	0	986.230.221	0.5421	2.976.958.348	0.3391	0	0.5189

Table-2: Results of Decomposition Analysis

Sectors	2001 - 2005						2006 - 2010					
	Activity (Million kwh)	Structural (M kwh)	Intensity (M kwh)	Total Change explained (M kwh)	Actual (M kwh)	Residual (M kwh)	Activity (M kwh)	Structural (M kwh)	Intensity (M kwh)	Total Change explained(M kwh)	Actual (M kwh)	Residual (M kwh)
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	na	0.000	0.000	0.000
Industry	0.028	-0.001	-0.001	0.026	0.636	0.610	1.470	-0.372	-0.665	0.434	0.234	-0.200
Services	0.018	0.000	0.004	0.022	0.018	(0.004)	0.056	0.035	0.130	0.221	0.755	0.534
Household	na	na	na	na	0.028		na	na	na	na	na	na
Total national	**0.046**	**-0.001**	**0.003**	**0.048**	**0.682**	**0.606**	**1.526**	**-0.336**	**-0.534**	**0.655**	**0.989**	**0.334**