Energy demand in Ghana: A disaggregated analysis

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ABSTRACT

This paper presents a comprehensive analysis of energy demand in Ghana by estimating demand functions for key disaggregated energy components including gasoline, diesel, liquefied petroleum gas (LPG), kerosene, biomass, residual fuel oil (RFO) and electricity. Our results show that energy prices, income, urbanization and economic structure are significant demand drivers of the different energy types in Ghana with varying estimated elasticities. Further, there is evidence of high degree of inter-fuel substitution in energy demand in Ghana, particularly from gasoline, diesel and kerosene towards LPG consumption. We recommend, among different policy options, a customization of energy price sub-sidization policies, especially on LPG, to reduce the unintended beneficiary dilemma or spillover effect of current government policy. Other policies such as intensification of energy conservation programs and market entry of independent power trading companies to enhance energy service delivery through competition are also discussed.

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1. Introduction

The role of energy resources in meeting the needs of households, industries, transport and agriculture among others in any economy cannot be overemphasized. Different types of energy sources are required to meet demand for lighting, cooking, electricity generation among many other uses. Demand for energy in Ghana similar to most developing countries exceeds the available supply.

A key challenge to Ghana's energy sector is inadequate access to modern energy services such as liquefied petroleum gas (LPG) and electricity, albeit some marked improvement over the past decade is evident. This has created a relatively high dependence on traditional energy sources such as biomass (mainly charcoal and wood fuel) to meet the energy needs of households. It is estimated that about 76% of Ghanaian households depend on biomass for cooking and heating water [1]

The impact of continual exploitation of forest lands and burning of wood fuel by households and industries on environmental degradation continues to engage decision-makers at the local, national, regional and international levels. Experts argue that the overreliance on biomass as a key energy source by Ghanaian households is among the main drivers of the rapid depletion of Ghana's forest cover which stands at about 2% loss per annum. Thus the incessant depletion of the forest to meet primary energy consumption if not curtailed is likely to derail efforts at ensuring environmental sustainability and inhibit Ghana's attainment of the sustainable development goals.

It is in recognition of the debilitating impact of continued use of primary energy sources such as biomass on climate change that the United Nations has been advocating intensification of programs/policy initiatives that encourages a switch from traditional energy sources to an enhanced access and utilization of modern and efficient sources like LPG [2]. The Government of Ghana therefore launched a National LPG Programme in 1990 to promote LPG use as an alternate energy source to charcoal and firewood. Urban households, public institutions and the informal commercial sector requiring mass catering facilities were targeted through extensive promotional and educational campaigns [3]. The results of these promotional efforts bore some significant fruits with LPG consumption doubling in 1992 and by 2004, total LPG consumption was over 50,000 t per annum which is about ten times more than pre-promotional consumption levels [3]. Promotion of LPG use among rural households was also initiated through the Unified Petroleum Price Fund (UPPF). The idea of this policy was to compensate oil marketing companies that transport petroleum products like LPG to rural and distant locations outside a radius of 200 km from the Tema Oil Refinery[†] to cover transportation cost [3]. Despite these efforts, LPG consumption levels remained low in even urban areas with high demand for wood fuel. Another complementary effort was the completion of the West African Gas Pipeline (WAGP) project in 2006 to enhance gas supply for electricity generation in Ghana.[‡]

Despite these developments, frequent power crises and shortages in LPG supply have almost rolled back most of the gains made in terms of supply for domestic and industrial uses. The high dependence of Ghana on natural gas supply from Nigeria through the WAGP which is erratic, coupled with inadequate gas storage infrastructure (due to low investment) and a crippling refinery are among the reasons for the rampant frequent power outages and LPG shortages respectively in the country. Nonetheless, industry experts are optimistic that the fledgling oil and gas industry will offer sustainable supply of natural gas to boost electricity generation, especially following the completion of the "Ghana gas infrastructure project", to end the looming power crises.

A major concern however, is that solving the energy crises in the country requires not just short term measures but an integrated energy policy design that seeks to tackle both demand and supply side management issues. This is because in an environment where population and urban growth is on the ascendency, meeting the energy needs of the populace will require both increased generation capacity and efficiency in demand. These can be realized only when driving forces behind energy demand are known, critically analyzed and thoroughly understood. Knowledge of such demand drivers will then help in predicting the future demand needs and implementing measures to engender efficiency in the demand.

The goal of this study therefore is to provide a comprehensive analysis of the drivers of disaggregated energy demand in Ghana to offer guidance on energy policy prescriptions towards achieving the overarching aim of becoming an "energy sufficient economy" to propel the engines of economic growth and development. To realize this goal, we consider a comprehensive set of disaggregated energy demand sources – gasoline, diesel, LPG, kerosene, solid biomass, residual fuel oil and electricity. We use the autoregressive distributed lag and partial adjustment models respectively to estimate short and long run disaggregated energy demand determinants. This is important for purposes of policy planning and implementation since the estimated coefficients could inform energy demand management as well as the supply side. Critical policy and sensitive issues such as petroleum price subsidization, urban planning as well as the need for further investment in energy infrastructure could benefit from our results.

The rest of the paper is organized as follows. Section 2 gives a brief overview of energy demand trends in Ghana. A discussion and summary of selected empirical literature on energy demand is presented in Section 3. Section 4 highlights methodological and data issues. The empirical results are analyzed in Section 5. We conclude the paper in Section 6 with a discussion of appropriate policy implications from our results.

2. Energy demand trends in Ghana

The energy sector in Ghana has featured prominently in various government policies including actions to ensure sustainable energy use to reduce the impact on the environment, improve access to modern energy sources such as LPG and making energy products available and affordable for most Ghanaians. Further, Ghana's economy has for the past three decades seen rising incomes with the economy posting positive growth rates since 1984 with a real GDP growth rate reaching an all-time high of 15% in 2011 with a corresponding per capita income growth of 12% in the same year. Structurally, the economy has undergone rapid transformation over the last three decades where agriculture, which hitherto commanded a greater share of total output, has seen its contribution slump over the past few years, losing its position to industry and services. The implication of the sustained economic growth over the years and the changing structure of the economy is that energy demand is likely go up as more firms expand their plant size, households on average are becoming richer and all sectors particularly the emerging petroleum sub-sector's energy requirements surge. As noted by Duku et al. [4], Ghana's energy demand in recent years has increased significantly due to population increase (average growth rate of 2% per annum) and rapid urban growth (average growth of 4% for the period 1980–2013). Unfortunately, this increasing demand for energy is

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[†] TOR is the only oil refinery in Ghana.
[‡] And other West African states such as Togo and Benin.