Energy Intensity as determinant factor for Ethiopian Industrial Competitiveness[1]

Abstract

This paper deals with the influence of energy intensity on industrial competitiveness at the level of Africa and Ethiopia in particular. Energy intensity is one of the major factors that can influence the industrial competitiveness of a productive entity and hence the sustainable development of a country. The comparison between the two indicators on these influences highlights the existence of numerous congruities and discrepancies, which could be unfavorable to the development of the Ethiopian manufacturing industry. By and large, economic growth is related to use of energy in terms of its intensity, and energy intensity can depend on either the way the economy is structured or from the effectiveness of the structure – which allows for direct comparison of economies with similar structures. At the industrial level, it determines products or services competitiveness, as the energy they incorporate influence, sometimes in an appreciable measure, their production costs, depending on their energy-intensity. The method used is energy intensity estimation and correlation analysis, and the time span of data is 2010-2015, Growth and Transformation Plan Period (GTP). An economic interpretation of obtained results would lead to the conclusion that could be used as a policy direction that Ethiopian industry sector has to search for more efficient and productive ways to energy consumption. Future policy endeavors without optimal energy efficiency represents a lost opportunity to lock in lower energy consumption for years ahead.

Key words: competitiveness, industry, energy intensity, Ethiopia, GTP

[1]Discussion papers are research materials circulated by their authors for purposes of information and discussion. They have not necessarily undergone formal peer review or editorial treatment.

I. Introduction

Energy is essential input to the development of industrial sector and its competitiveness in modern economies. Industrial sectors in particular are seen as the major consumers of energy resources. The growing demand for energy raises the doubts on whether there would be a secure energy supply in the future, or whether many industries will be able to remain competitive in the global markets. Hence, the sustainability of the current patterns of power usage has gained such prominence in recent years that it seems justified to pay particular attention to the matter (Manuela et al., 2014). Energy intensity represents – along with labor, human and financial capital, technology and innovation potential – another major factor which significantly influences the industrial competitiveness of a productive entity and a country's future economic growth (Russu C.,2012; Vosylius et al., 2013). It is therefore not surprising that many governments have emphasized energy efficiency opportunities during the current economic slowdown, as a way to stimulate their faltering economies.

Most fundamentally, economic development is the pursuit of a better life, and progress towards social-development objectives. Energy is an essential factor for sustainable development and poverty eradication. A country's sustainable development path depends on the rates of economic growth, which in turn is related to use of energy in terms of intensity and price/cost. The researches linked to economic growth and energy consumption are seen as the growing trend in scientific literature. Attempts are made to investigate the casual relationship between economic growth and energy consumption. For instance, Narayan and Smyth (2008) have observed the situation in the G7 countries and concluded"capital formation and energy consumption have had a positive effect on real GDP in the G7 countries".A recent IEA studyalso claims thatif European Union countries were to fully exploit the potential of energy efficiency, GDP would grow by up to 1.1%,[2].

[2]http://www.iea.org/bookshop/475-Capturing_the_Multiple_Benefits_of_Energy_Efficiency

Many energy efficiency studies emphasize the importance of both implementation of efficiency measures and dealing with individual industryproductivity. Other industrial studies also highlight the importance of technology, economies of scale, energy efficiency-oriented policies and firm-level management strategies in energy efficiency improvement within the particular industry. In the Ethiopian context, however, there is a shortage of the detailed studies on energy intensity in the manufacturing sector of the country. A few notable studies performed by researchers include more general investigations at macro-economic level.

Often, energy efficiency is only on the periphery of the debate over climate protection, which instead focuses on issues like CO_2 reduction, increasing renewable energyresources and decreasing fossil fuel consumption. But according to IEA(2014), energy efficiency has long ceased to be a hidden fuel that only relates to energy saving among consumers. On the contrary, energy efficiency leads to macro-economic growth, long-term climate protection and greater energy security.

The main objective of this research is to evaluate the perspectives of energy efficiency development in Ethiopian industrial sectorand, in particular, in manufacturing sector, and estimate the intensity of energy consumption during the first five years of Growth and Transformation Plan (GTP-I) which was executed between 2010 and 2015. Ethiopia is one of the few African countries that have formulated and implemented a full-fledged industrial development strategy. The industrial sector offers tremendous opportunity for energy savings, and a significant opportunity to instill the tenets of energy efficiency within facilities that, in turn, employ and influence millions of people. It would be an attractive target sector for government and private investors looking to reach new levels of energy savings through efficiency measures. The sector itself, working constantly to increase shareholder value and reduce expenses, has found energy efficiency investments to be an attractive avenue to achieve those ends. Additionally, as climate change awareness and mitigation strategies increase, energy efficiency will likely be

increasingly prioritized as a critical solution to reduce harmful greenhouse gas emissions.

Ethiopia's economy is chiefly led by agriculture;however, the growth base isbroadening, with increasing contributions to GDP from services and industry. As projections show, by 2025, the share the agriculture sector would be only 29% of the economy, while industry and services would take 32% and 39% respectively. Accounting for about one-third of all end-use energy in Ethiopia, the industrial sector consumes more energy than any other sector. While industrial energy efficiency has increased steadily over the past five years, there are still tremendous opportunities for energy savings, as well as the potential to instill the tenets of energy efficiency in the industrial sector.

The evaluation methodology includes quantitative and qualitative research methods: the analysis of data collected through primary and secondary sources. The necessary information for the evaluation was obtained from the strategic documents, statistical data sources, and interviews with the experts. The methodology is guided by the measurement of energy intensity based on the theoretic energy intensity estimation framework and correlation analysis. It covers the data of energy consumption and output in Ethiopian manufacturing specific sub-sectors, which appear to be high-energy intensive industries, and thesub-sectors during the studyperiod. Similar to the production side, statistics of energy consumption are compiled from industrial survey results andenergy balances equation.The EIA statistics and analysis are also used as data source, as its industrial branch level is far more detailed than in the ESIC database.

II. Energy Intensity: Background

Energy development, interpreted broadly to mean increased provision and use of energy services, is an integral part of enhanced economic development (Toman and Jemelkova, 2003). The development and status of the energy sector is very much related and depends on a country's level of socio-economic development. The linkages of energy, toother economic inputs, and activities clearly change significantly as an economy moves through different stages of growth.Energy use increases as more economic sectors develop and more channels for flow are opened.Economic diversity, as measured by the number of economic sectors using energy and the equitability of flows between them, generally increases (Templet, H. 1999). Generally, developing countries rely more on increasing energy use to increase output while developed countries tend to become more diverse as a means of increasing outputs. Hence, sustainability is enhanced by strategies, which promote diversity and resource use efficiency in economic systems.

One of the most useful ways to measure energy efficiency is to calculate how many units of energy are required to produce a unit of wealth – this is known as energy intensity. Energy intensity changes over time and varies significantly by types of economic activities and across countries. High-energy intensity usually indicates low energy use efficiency to convert energy to Gross Domestic Product (GDP). In theory energy intensity can be measured in a variety of ways, but a useful convention is to divide the total annual energy consumption for a nation, expressed in British Thermal Units (BTUs), by the country's GDP for the same year. This implies, the fewer BTUs per dollar of GDP, the better the score.[3]

Many attempts have been made to investigate the casual relationship between efficiency and greenhouse gas (GHG) emission. Energy efficiency represents about 40% of the GHG emission reduction potential that can be realized at a cost of less

[3] http://www.ecoworld.com

than $70 per metric ton of carbon dioxide equivalent[4]. Usually, it is an extremely attractive upfront investment that pays for itself over time, while providing the added benefits of reducing the cost energy and increasing the energy productivity of the economy. For instance, a new study on the U.S. industry energy-saving potential from 2010 to 2050, statesincreased adoption of energy efficient technologies as well as cogeneration and waste heat recovery systems by U.S. industry will reduce energy use by an additional 4.7 quadrillion BTU/y from business-as-usual scenario. These and other changes, such as energy changes due to fuel switching or to transformation in other sectors, can reduce projected energy use by 27%[5].

Thus, the energy intensityis a determinant of products and services competitiveness since the energy they incorporate influence, sometimes in an appreciable measure, their production cost, depending on their energy-intensity[6]. Lower energy intensity, which usually indicates high-energy efficiency, can promote energy conservation and helps deliver the reduction of GHG emission with minimal costs. The decrease in energy intensity could be achieved by either using less energy to produce the same amount of commodities or by increasing the amount of commodities per energy unit. Energy prices, structural changes, technological advancement, as well as governmental policies are considered to be the main determinants that impact on energy intensity in the manufacturing sector.

Therefore, the improtance of this topic depends not only on in the necessity of cost savings in the sector, but also in the need to deal with the growing prices of energy resources casued by their scarcity, which ultimately impacts the market strucutre and competitiveness of the sector.

[4]Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve

[5]U.S. Department of Energy. Annual Energy Outlook 2010, "Energy Prices by Sector and Source, United States, Reference Case: U.S. industry energy-saving potential, 2010–2050

[6]Krugman, P., Obstfeld, M. *International Competitiveness:* Theory and Policy, 8th edition, Addison Wesley, 2008

III. Situation analysis of Ethiopian Industry Sector

The industrial sector has long been considered the main engine of economic growth andstructural transformation (Prebisch and Singer, 1950). Many studies show that increased industrial energy efficiency is one of the most important routes to sustainable development, particularlycountries that have shown a renewed interest and started to transform into climate resilient green economy, like Ethiopia.

Ethiopia's Growth and Transformation Plan (GTP) is the first of a five-year plan to propel the country toward a climate resilient middle-income status by 2025. The GTP places special emphasis on agriculture and rural development, industry, infrastructure, social and human development, as well as democratization and good governance.This five-year economic plan has achieved high double-digit growth rates through government-led infrastructure expansion, commercial agriculture andthereby the industrial sector continued its stride with about 20% growth rate in the past GTP years.That will mean a significant shift towards industrialization.

The energy intensity of the Ethiopia industrial sub-sectors, registered as average throughout the GTP period and shown in Table 1, provides a conclusive picture of the country's positionin terms of energy intensity among selected countries in Africa and Europe. However, there are opportunities for energy savings through application of more advanced technologies and policies in a variety of commercial and industrial end uses.

Table 1: Energy Intensity - Total Primary Energy Consumption per Dollar of GDP
(Btu per Year 2015 U.S. Dollars (Market Exchange Rates))

	2010/11	2011/12	2012/13	2013/14	2014/15
Ethiopia	7364.75	7850.34	7127.95	6815.22	7180.61
Kenya	9561.98	8816.62	8960.12	9553.04	9310.80
Zambia	15401.11	13794.35	13929.58	13961.66	13896.48
Egypt	25809.25	27422.05	26665.19	25839.39	26716.14
Germany	4656.236	4717.25	4657.52	4773.27	4456.50

Source: EIA (2015), author analysis

A more efficient use of the energy has been the goal of GTP over the past five years. While specific efforts have had different degrees of success, the trend is clear: the

Ethiopian economy has steadily improved its ability to produce more with less energy compared with some other African countries such as Zambia. Yet, this improvement has emerged unevenly and incomplete within the economy, consequently, net efficiency gains are falling short of their full potential. According to energy intensity ratio estimation, three sub-sectors of manufacturing sector appear to be high-energy intensive industries, i.e. the sub-sector of cement, steel as well as textile.

A closer look at sub-sectorial (cement, steel and textile) exposure in these high energy-intensive industries, classified based on Ethiopian Standard Industrial Classification (ESIC), provided in the table below confirms that there are strong positive correlation between Saving Potential (SP% GDP) and final energy consumption.

Table 2: Energy Saving Potential: 2012/13

High Energy-Intensive	Annual energy saving potential (MWh)	Values in Birr
Cement Factory	15,432.20	58,444,970.00
Steel Factory	773.00	426,740.80
Textile Factory	5,211.90	3,988,592.45

Source: EEP (2013), author analysis

As can be seen in Table 2, during the year 2012/13, Ethiopia could reduce itsenergy consumption from these factories by 25% relative to the business as usual by only deploying capacitor banks in its industries. As a result, Ethiopia could save 21.5 GWh of end-use energy. This potential exists,but significant barriers impede the deployment of energy-efficient practices and technology, for instance information barriers, market failure, and lack of performance indicators and benchmarks has been mentioned by interviewees. Efficient waste management technologies are not widespread in these sub-sectors in most Ethiopian industries, in addition the use of modern technological equipment, computer-aided production planning and management systems and process automation technologies does not prevail much.

The economic growth throughout the mentioned lapse of time also brought increase weight on the manufacturing industry's structure (13%). This suggests that energy will be of increasing relevance to these companies' cost structures and operating models in the years ahead.

There is no doubt that the Ethiopian industry sector is key to the country'sambitiousgrowth plan. However, costs pertaining to industrialization are the biggest factor that keeps Ethiopia's growth under-check. Otherwise, the abundant resources make the country ideal place for being a manufacturing hub/power houseand earn revenues than it does by exporting the raw material at a lower price.

Capturing the full potential over the next GTP-II would decrease the end-use energy consumption. Hence, big gains await these companies if they raise their energy productivity.

IV. Conclusion

Taking into consideration the growth of Ethiopia's economy dependency on energy resources, the paper provides an analysis of the relationships between energy intensity as determinat factor of the industrial competitiveness. The findings have revealed that the trends of energy intensity variation in Ethiopian industry sectors as a whole and despite significant progress towards industrialization, Ethiopia still has unsustainable consumption patterns of energy, as evidenced by high energy-intensive industries competitiveness. Future industrial plant, constructed without optimal energy efficiency represents a lost opportunity to lock in lower energy consumption for years ahead. The experience of the developed economies in the other region holds valuable lessons for Ethiopia, and economies in transition in Africa in this regard.

There are also effects on the trade balance, not only when the energy is imported (fossile fuel), but also when it stems from the country's own resources, because thesurplus energy could be exported and achieve high prices on the sub-regionalpower pools.

The firms face strong incentives to respond to energy price changes by practicinginnovative ways of energy management with a view to increasing their profits (lowering overhead costs). This could gravitate to restructuring towards lower energy intensity and a higher value-addition. The energy intensity of Ethiopian GDP, although improving, continues to be several times higher than that of the developed countries. It is very obvious that big gains await Ethiopia if the country raisesits energy productivity.

In view of the current situation explained above, Ethiopian industrial sector, especially the high-energy intensive manufacturing industries, has to search for more efficient and productive ways of energy consumption. A key challenge for many firms infact is lack of accurate and flexiable performance indicators information and benchmarks.

To broaden the scope of this study, further research should therefore concentrate on a deeper analysis across the country and sector-specifics are advised. Nevertheless,the data available suggest that the energy intensities of Ethiopian industry sectors are more or less similar to those of comparable sectors in Africa. As such, there are unlikely to be significant adverse competitiveness impacts in terms of lost market share to competitors as a result of higher energy prices.

References

A. Markandya, S. Pedroso-Galinato, and D. Streimikiene, "Energy intensity in transition economies: Is there convergence towards the EU average?" Energy Economics, vol. 28, no. 1, pp.121–145, 2006.

A. Balezentis, T. Balezentis, and D. Streimikiene, "The energy intensity in Lithuania during 1995–2009: A LMDI approach," Energy Policy, vol. 39, pp. 7322–7334, 2011.

Corneliu R. " Economic Insights – Trends and Challenges" Vol.LXIV (2012)

Ethiopian Electric Power Corporation (EEPCo) Database and strategic documents

EIA Database (online) www.eia.gov

International Energy Agency Database (Online)www.iea.org

Energy Outlook 2010 -USA, "Energy Prices by Sector and Source, United States, Reference Case: U.S. industry energy-saving potential, 2010–2050

Hartono, D., Irawan T., &Achsani, N.A. (2011). An analysis of energy intensity in Indonesian manufacturing. International Research Journal of Finance and Economics, 62, 77–84.

J. E. Payne, "Survey of the international evidence on the causal relationship between energy consumption and growth," Journal of Economic Studies, vol. 37, no. 1, pp. 53–95, 2010.

J. Vasauskaite and D. Streimikiene, "Energy efficiency development in Lithuanian furniture industry," Journal of Advanced Management Science, vol. 4, no. 1, 2015.

Krugman, P., Obstfeld, M. International Competitiveness: Theory and Policy, 8th edition, Addison Wesley, 2008

Narayan, P. K., & Smyth, R. (2008). Energy consumption and real GDP in G7 countries: new evidence from panel cointegration with structural breaks, Energy Economics, 30, 2331–2341. http://dx.doi.org/10.1016/j.eneco.2007.10.006

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