Energy and Economic Growth
Applied Research Programme

Policy Brief: Prospects for Energy Efficiency in Iron and Steel Industry in Uganda

September 2022

Iron and steel production is highly energy intensive – and Uganda's demand for iron and steel is growing rapidly. How can energy efficiency help reduce costs, ensure to the sector's positive contribution to economic growth and mitigate greenhouse gas emissions? We provide insights from a participatory research project conducted together with local partners and including energy systems modelling.

Key messages and recommendations

- The Government of Uganda has set out a plan to increase the production of steel from iron ore and the per capita consumption of steel from 13kg to 30kg by 2030. This will result in an increase in energy demand for iron and steel production and the sector's contribution to GHG emissions.
- Our findings show that policies that promote the deployment of energy-efficient technologies could result in a significant decrease in energy demand and greenhouse gas emissions from the sector – while ensuring its positive contribution to economic growth.
- The (Draft) National Energy Policy sets out a plan to promote energy efficiency among high-energy consumers. Once the policy is adopted, efforts must focus on building capacities and developing tangible incentives.
- Updating the Energy Efficiency and Conservation Bill (2010) is also important to enable the establishment of institutions that can support and stimulate efficiency in energy management and ensure synergies between the different policy priorities.
- In the meanwhile, regulators should encourage industries to reduce 'process emissions' by defining specific goals for specific processes based on negotiated agreements with the sector stakeholders and best practices.

Research background and motivation

Production of iron and steel is an energy intensive process which globally accounts for 20% of industrial final energy consumption.[i] In 2020, total direct emissions from the sector were of the order of 2.6 billion tons, representing about 9% of global anthropogenic CO_2 emissions.[ii] Energy use also accounts for up to 40% of the cost of steel production.[iii] In Uganda iron and steel production and consumption is relatively low. Consumption is estimated at 13kg per capita.[iv] Although the installed production capacity is one million tons annually, the reported annual production is half of that (501,700 tons). The sector employs about 5,000 people.[v]

Currently, 30% of the iron and steel produced in Uganda is derived from scrap, while 70% is derived from semi-finished products of iron imported from countries like South Africa.[vi] This means Uganda's current in-country steel production requires much less energy than if it were using iron ore as its raw material and this is reflected in the average energy intensity for the production of iron and steel in the country which, at 1.2 GJ/t, is much lower than the global average of 18 GJ/t. However, this is set to change over the next ten years. According to the National Development Plan 2020-2025 (NDP III), and under the mineral development programme, the Government of Uganda plans to increase the per capita consumption of steel from 13kg (2019) to 30kg per capita by end of 2025. The NDP III also sets out a plan to reduce the sector's dependence on imported raw materials and increase the production of steel from iron ore sourced locally. Although about 500 million tons of iron ore are available in the country, currently only 0.0033% of that is being utilized per year.[vii] Government intervention is further planned to encourage mills to move towards the Direct Reduced Iron-Electric Arc Furnace (DRI-EAF) production route, where mills would use a coal-based Direct Reduction Rotary Kiln to produce iron pellets.

About the study & methodology

This policy brief discusses findings from a scenario-based analysis to explore the future energy demand and associated GHG emissions from the iron and steel sector in Uganda, carried out under the EEG funded project Institutionalization of Energy Efficiency in Uganda.

Oxford Policy Management

UKaid from the British people

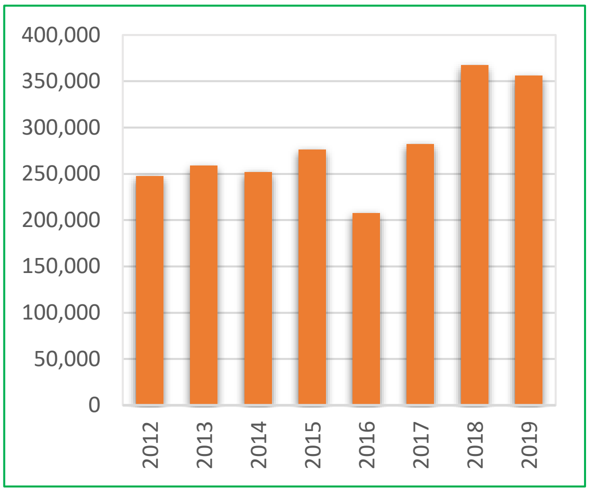

Table 1: Imports of semi processed iron and steel products in Uganda

The study used the Low Emissions Analysis Platform (LEAP) modeling tool. A scenario-based planning framework was used to assess the energy demand of and carbon emissions from the iron and steel industry in Uganda. The team collected data from five iron and steel producing companies and interacted with technical personnel in four of them. The discussions were guided by a data collection template and questionnaire aimed at identifying current practices and technologies applied. Prior to use, the template was discussed with the Ministry of Energy.

Data was collected on installed production capacity, annual energy consumption and production, sources of energy and percentage contribution to total demand, type of technologies applied in the production, the status of energy management, and any implemented energy saving measures. The modelling exercise followed three scenarios: Firstly business-as-usual (BAU), where current technologies and practices are assumed to continue as they are while annual production increases. Secondly, best practice with current technologies (BPT), i.e. localized energy efficiency options derived from retrofits, process monitoring, control and optimization. Thirdly, best available technologies (BAT), i.e. a scenario where facilities are assumed to gradually replace existing technologies with the best available and most efficient technologies. Fourthly, a combined scenario was used where it is assumed that iron and steel firms adopt energy-efficient practices and gradually replace existing technologies with the best available efficient technologies (BPT+BAT).

Results and discussion

Energy demand and energy saving potentials: According to Uganda Bureau of Statistics in 2018 about 446,230 tons of steel products were produced, thus the overall energy demand for the sector is 533.492 thousand GJ. Electricity from the main grid contributed 55.5% of total energy demand while heavy furnace oil, diesel and LPG contributed the rest (45.5%). The scrap-based mills consumed 90% of the total energy demand, while finishing mills consumed 10%.

In the **baseline scenario (BAU)**, energy demand in the iron and steel industry is projected to increase from 0.5 million GJ in 2018 to 97.8 million GJ by the end of 2040. This sharp increase is largely because of the projected change in the production mix noted above – specifically, plans to revamp and enhance the production capacity of DRI-EAF mills to produce steel from iron ore (the production of steel from iron ore is more energy-intensive compared to producing steel from scrap).

In the **BPT scenario** for the iron and steel industry, the total energy demand by the end of 2040 is projected to be 79.9 million GJ. The trends in the BAP scenario can be realised by adopting and implementing energy-efficient practices, which will result in savings of up to 17.9 million GJ as compared to the business-as-usual/baseline scenario.

In the **BAT scenario**, the projected energy demand is 66.1 million GJ, which is the result of gradually phasing out all old, inefficient technology and replacing it with the best available technologies in the iron and steel industry outlined above.

In the **combined scenario (BPT+BAT)** the projected energy demand by the end of 2040 is 59.1 million GJ, which is the result of adopting both the best available energy-efficient practices and the best available energy-efficient technologies. (saving up to 38.7 GJ compared to baseline scenario).

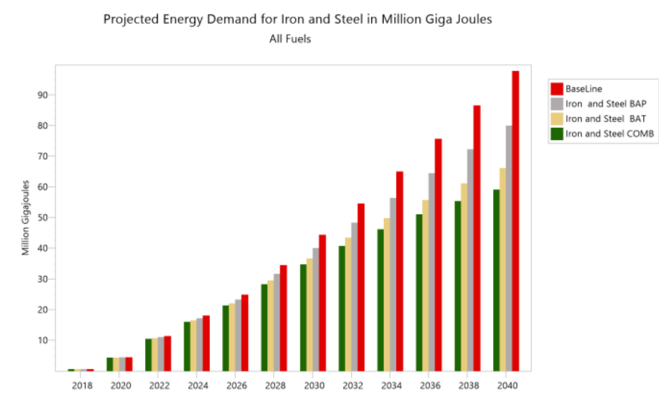

Figure 1: Projected energy demand for baseline, BAP, BAT and COMB Scenarios

Greenhouse gas emission:

Projected GHG emissions: In the baseline scenario, GHG emissions from the sector are projected to increase from 17,500 metric tons of carbon dioxide equivalent (tCO2eq) in 2018 to 6,116,900 tCO2eq in 2040. The anticipated increase in the use of fossil fuels (coal) – as required in DRI-EAF mills – will largely account for this massive increase in emissions. However, under the BAP scenario, emissions are expected to be 5,157,000 tCO2eq in 2040. The iron and steel industry can achieve this by adopting energy-efficient practices using energy management systems that are in accordance with ISO 50001. In the BAT scenario, the GHG emissions for the sector are expected to reach a maximum of 4,544,500 tCO2eq in 2040. Achieving such a reduction would need policy provision that requires firms to invest in natural gas-based DRI-EAFs mills, which are reported to be more efficient than coal-based DRI-EAFs. In the combined scenario, the GHG emissions for the sector are anticipated to be 4,461,600 tCO2eq in 2040. This can be achieved by adopting both energy-efficient practices and BAT.

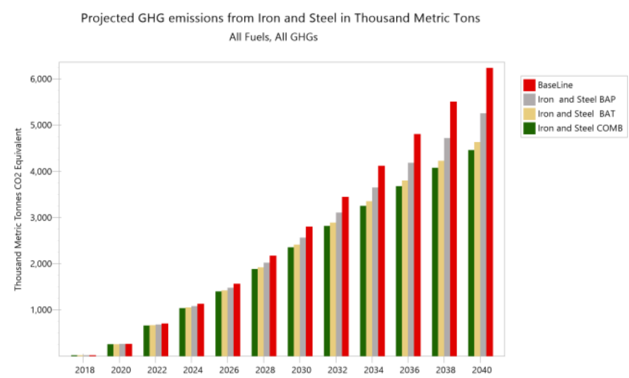

Figure 2: Projected GHG emission from iron and steel industries for the baseline, BAP, BAT, COMB scenarios

Policy implications

On average and when compared with the global average, the specific energy intensity for production of iron and steel in Uganda is low. However, for several structural and economic reasons including urbanisation, construction and industrialisation, demand for iron and steel is growing. Furthermore, the Government has laid out plans to increase production and reduce dependency on import by building capacity for production of steel from iron ore. Our findings and other similar analysis elsewhere show that investing in energy efficient technologies could result in significant reduction in energy demand as well as carbon emissions. Hence, plans to increase the productivity of the sector must also include energy efficiency strategies. To ensure success, a careful consideration must be given to: reducing the sector GHG emissions, enhancing energy saving opportunities, and contributing towards a healthy iron and steel sector that can positively contribute sustainable economic growth.

The Uganda National Energy Policy (2002) sets out a plan to promote the efficient utilisation of energy resources. As part of this commitment, the Ministry of Energy drafted the National Energy Efficiency Strategy (2010–2020) for all sectors, including industry. The document paved the way for drafting the Energy Efficiency and Conservation Bill (2010). The Bill provides the statutory basis for the promulgation of rules and regulations to promote energy efficiency. It defines the rationale for pursuing energy efficiency and lays out an overall strategy to achieve them. Updating and adopting the Bill is a critical next step. The presence of an enabling statutory basis is important for establishing energy efficiency institutions.

The (Draft) National Energy Policy (2021) also sets a policy agenda to promote energy efficiency across all sectors. Some of the associated strategies include promoting the implementation of Energy Management Systems and regulating energy usage among high energy-consuming industries. Currently in draft format, the policy needs to be adopted and operationalised. Doing so would pave the way for developing other policy instruments (administrative mechanisms and market-based incentives) to promote iron/steel firms' compliance and deployment of efficient technologies.

In the meanwhile, policymakers can encourage industries to reduce 'process emissions' by defining specific and standards for specific sectors, based on negotiated agreements and best practice as benchmark targets. For example, within the iron and steel sector as the government of Uganda plans to increase demand and production from iron ore. Alongside this, policymakers should promote and incentivize the use of DRI_EAF mills which are more energy efficient compared to BF_BOF mills; and natural gas based DRI_EAF which are much more energy efficient as compared to coal based DRI_EAF.

Furthermore, efforts to mitigate climate change and reduce global GHG emissions must include energy efficiency strategies. In this regard, embedding (industrial) energy efficiency in national climate policies and strategies could unlock innovative partnerships and financing mechanisms toward integrated solutions designed to address the challenges of energy, climate and development.

In this regard, research projects like this one create opportunities on multiple fronts. On the one hand, the collaborative process enables stakeholders from the industrial sector and public institutions to come together and identify opportunities and barriers. On the other hand, the knowledge produced and the analysis that comes out of such exercises provides the input policymakers need to take the necessary steps to create an enabling environment. One such example comes from our own research experience. As part of our ongoing engagement with public institutions in Uganda and following sharing of our findings, the Ministry of Finance, Planning and Economic Development has included the iron and steel industry in its Sustainable Public Procurement National Action Plan in 2021, with the objective of using the Government's buying power to influence best practices in the sector.

This shift in policy is a significant step towards incentivising industries to improve efficiency. To augment this, and as a next step, policymakers will need to define specific goals for specific processes or sectors to reduce 'process emissions' and encourage a more targeted approach. However, such policy measures must be developed not to prescribe specific actions but to promote the use of energy management processes. This would allow industries to have some discretion in dealing with technical suitability and cost-effectiveness matters.

[i] IEA (2020), Iron and Steel Technology Roadmap, IEA, Paris https://www.iea.org/reports/iron-and-steel-technology roadmap.
[ii] IEA, Iron and Steel Technology Roadmap, October 2020 (Iron and Steel Technology Roadmap - Towards more sustainable steelmaking (windows.net)
[iii] The State-of-the-Art Clean Technologies (SOACT) for Steelmaking Handbook, 2nd Edition, Asia Pacific Partnership for Clean Development and Climate, 2010, (Introduction (jisf.or.jp) –p10
[iv] National Planning Authority (NPA), 2020, National Development Plan III (2020/21-2024/25)
[v] Ministry of Works and Transport (MWT) 2018 Market and Value Chain survey report
[vi] National Planning Authority (NPA) 2018 Developing the Iron and Steel industry in uganda – harnessing the low hanging fruits
[vii] Baguma. Z. M. Atwoki, (2015). Iron and Steel industry development in Uganda. Ministry of Energy & Mineral Development- Department of Geological Surveys & Mines. Entebbe, Uganda

About the author:

Edson Twinomujuni a Senior Technical Officer in the department of energy at Uganda Cleaner Production Centre. He is a registered member of Energy Efficiency Association of Uganda.

The brief was prepared in collaboration and with input from the project team: Meron Tesfamichael (University College London), Mbeo Ogeya (Stockholm Environmental Institute), and Yacob Mulugetta (University College London).

The brief provides insights drawn from the *Institutionalisation of Energy Efficiency in Uganda* (IEE Uganda) research project. IEE Uganda is supported by UK Aid from the UK government under the Applied Research Programme on Energy and Economic Growth (EEG), managed by Oxford Policy Management..