Energy Research & Social Science 107 (2024) 103337

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

Navigating the energy transition and industrial decarbonisation: Ghana's latest bid to develop an integrated bauxite-to-aluminium industry

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ARTICLE INFO

Keywords:
Energy transition
Industrial decarbonisation
Green production
Industrial policy
Ghana
Aluminium

ABSTRACT

Research on how countries are positioning and 'greening' their heavy industries in response to the 'global energy transition' has focused on higher-income countries with established heavy industries, rather than lower-income countries with fledgling industries and aspirations to continue expanding them. Our paper responds to this lacuna by examining Ghana's current plans for, and challenges with, developing an integrated bauxite-to-aluminium industry. Adopting a multiscalar political economy approach, and drawing on research methods including documentary analysis and key informant interviews, we argue that Ghana's challenges stem significantly from the mode of its insertion – or subordination – within the global economy. Like other late-developing countries in the global economic periphery, Ghana is struggling to access the latest 'green' technologies or devise a strategy for powering its bauxite-to-aluminium industry because of uncertainties in the 'green' taxonomies of core economies in the Global North. Nationally, meanwhile, tentative plans to feed Ghana's aluminium industry with relatively 'green' hydropower (also Ghana's cheapest electricity source) are provoking pushback because of the trade-offs involved, while other contestations are emerging around expanding bauxite mining into forest reserves. Collectively, these multiscalar challenges may frustrate Ghana's ambitions once more, even though a bauxite-to-aluminium industry could generate significant economic benefits. Ghana's government can overcome some of these issues by consulting meaningfully with domestic stakeholders around the design of an integrated bauxite-to-aluminium industry. However, at an international level, peripheral economies like Ghana need clarity about how particular energy technologies will be classified by core economies moving forwards, and for climate financing and (green) technology transfer pledges to be honoured.

1. Introduction

A growing body of research has started to explore how countries are positioning and 'greening' carbon-intensive heavy industries like aluminium, cement, chemicals, fertiliser and iron & steel production in response to the 'global energy transition' [1–6]. However, to date, the vast majority of this research has drawn on case-study insights from relatively high-income countries in Europe, North America and East-Asia or otherwise major developing countries like China and India. This has left, in the words of [7 p.19], "a large gap in geography-specific research pertaining to industrial decarbonization in the developing world". This is especially-true for sub-Saharan Africa, where the only (partial) exception is South Africa. Some studies have discussed the general challenges that African countries will face in pursuing industrialisation agendas in an era of energy transition and industrial decarbonisation – a tension which [8 p.3] label an "existential dilemma" – while [9] reflect on the implications of these agendas for industrial policy in South Africa specifically. But, as far as we are aware, there are no detailed case-studies of how particular African countries are actually trying to square this circle in relation to specific industries, especially carbon-intensive heavy industries.

Our paper responds to this research lacuna by offering a political economy analysis of Ghana's evolving plans for, and challenges with, developing an integrated aluminium industry (IAI). Facing the ever-worsening conditions of 'late-late development' [10,11], we find that Ghana has long struggled to realise founding President Kwame

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https://doi.org/10.1016/j.erss.2023.103337
Received 3 June 2023; Received in revised form 22 October 2023; Accepted 2 November 2023
Available online 8 December 2023

Nkrumah's vision of developing an IAI, which he proposed in the 1950s. However, these challenges are now being compounded by contemporary energy transition and industrial decarbonisation agendas, as Ghana is struggling to access the latest 'green' technologies or devise a long-term plan for powering its IAI because of ongoing uncertainties in the energy taxonomies of key export markets and financial institutions in the Global North. Meanwhile, at a national level, tentative government plans to feed especially energy-intensive parts of the aluminium industry with relatively 'green' hydropower (also Ghana's cheapest source of electricity) are provoking domestic pushback because of the trade-offs involved. Other domestic contestations are emerging around moves to expand bauxite mining into some of Ghana's last-remaining evergreen forests. Collectively, these issues may frustrate Ghana's ambitions once more, even though an IAI could generate significant economic benefits and support Ghana's structural transformation as demand for aluminium surges globally due to the energy transition.

Our paper proceeds as follows. In the next section, we selectively review literature on the ever-growing challenges that 'late-late' developing countries have faced in trying to pursue industrial policy, and how these are now being exacerbated by contemporary energy transition and industrial decarbonisation agendas. In so doing, we draw particularly on political economy insights from dependency theory, which we argue – echoing the recent work of [10] and others – remains highly relevant for understanding how the nature of the global economic system conditions the policy space for developing countries located in its 'peripheries' to pursue industrialisation. The section then turns to aluminium specifically, outlining the challenges that late-late developers are likely to face when trying to develop – and sustain – globally competitive aluminium industries today. Section 3, meanwhile, describes our research methodology, which combines documentary analysis with key informant interviews. Section 4 then presents our analysis of the Ghanaian case, beginning with an historical account of past efforts to develop an IAI and the different energy solutions that have been considered for powering it as well as the challenges that Ghana has faced in realising these plans as a result of both its insertion within the global economy and domestic political economy dynamics. The section then discusses a contemporary period, starting in 2017, in which Ghana has been undertaking its latest bid to develop an IAI, but while also being forced to contend with global discussions on – and uncertainties around – the energy transition and industrial decarbonisation agendas. A concluding section then summarises our key findings and implications.

2. Literature review

2.1. Heavy industrial policy in an era of late-late development and energy transition

It has long been recognised that industrialisation is a critical driver of long-term productivity growth, employment and – for developing countries – a means of 'catching-up' with high-income countries [12–14].More recently, there has also been growing acknowledgement that industrial policy – as even now recognised by the International Monetary Fund (IMF) [15 p.5] – has played a "preeminent role" in catalysing cases of industrialisation historically [16,17]. However, to date, just a handful of countries in East-Asia have caught up successfully. For dependency theorists – of both earlier [18,19] and newer [10] persuasions – this is because of the inherently uneven and polarising nature of the global economic system, which was imposed by colonialism and serves the interests of countries in the global economic 'core' by extracting surplus from countries in the 'periphery' and making them technologically- and financially-dependent on 'core' countries. Within this context, it is not impossible for countries to catch-up and transition from periphery to core, as countries like South Korea and Taiwan have shown, but it is "unlikely and difficult" and requires concerted state intervention as well as a degree of contingency and favourable domestic political economy dynamics [10]. Indeed, the East-Asian 'developmental states' emerged out of a particular colonial context in which Japan had been relatively open to promoting local industry. They also developed within a specific geopolitical moment where the US, seeking regional allies against China and North Korea, was willing to finance them through initial (and sustained) periods of sizeable balance-of-payment deficits associated with early import substitution industrialisation (ISI) policies [13,14].

Countries in Africa and Latin America, by contrast, tended to experience more exploitative and extractive forms of colonialism [18,19]. In Africa particularly, colonial regimes tended to pursue divide-and-rule approaches that deliberately manipulated and exacerbated ethnic differences and left many post-independence governments with deeply-fragmented societies that had little shared sense of national identity [11,19]. As argued by Kwame Nkrumah himself in his famous 1965 treatise on *Neocolonialism* (published a year before he was overthrown in a coup that was reputedly supported by external forces) African post-independence governments were also often subject to more overt meddling by former colonial powers with stronger "vested interests" in keeping their former colonies "undeveloped" and dependent on foreign capital [20,p.xx]. Collectively, these realities made it much more challenging for 'independent' African states to galvanise their societies around shared projects of economic transformation in the ways that the East-Asian developmental states – governing less fragmented societies and navigating more favourable geopolitical circumstances – were able to. For [10], these insights emphasise the importance of analysing not just global but also domestic political economy dynamics – and, indeed, the interrelations between them – to understand why and how some countries have managed to break free from relations of dependency.

From the 1980s, it became even harder for late-late developing countries to industrialise as many were forced, via donor conditionalities that [13] likened to *Kicking Away the Ladder*, to surrender policy instruments used extensively by South Korea and Taiwan (and other industrialised countries before them). Under the auspices of Structural Adjustment Programmes (SAPs), developing countries were dissuaded from pursuing ISI and were, instead, 'encouraged' to open their economies to cheap imports in ways that undermined what manufacturing industries they had developed. Compounding this, broader processes of liberalisation and globalisation have, since the 1990s, dispersed production capabilities across a fragmented global economy, making it even more difficult for today's late-late developers to build nationally-integrated industries [11]. Now, developing countries face pressures to insert themselves into very specific – and mostly labour-intensive, low-value-added – segments of fiercely-competitive and fast-moving 'global value-chains' that are dominated by multinational 'lead firms' and shaped by shifting consumer preferences in the Global North [11,21].

Contemporary agendas around energy transition and industrial decarbonisation are now presenting even greater challenges for late-late-developers as they face growing pressures to avoid traditional, carbon-intensive industrialisation pathways. This is leading to further accusations of core economies kicking away the ladder – or, in this case, "the carbon ladder" [22 p.1]. In early climate negotiations, discussions hinged mostly on reducing emissions in the power and transport sectors, as the two biggest emitters. However, attention has increasingly shifted to industry, which generates a quarter of global emissions [7]. Emphasis is now increasingly placed on 'green industrial policy' and 'green industrialisation' [23]. Yet, for developing countries, this will likely entail new forms of dependency on 'green' technologies developed in core economies [24]. These technologies generally come with significant – and, for many developing countries, prohibitively expensive – "green premiums" because they are more costly to procure than traditional technologies and often subject to higher trade barriers [8,p.1], [25]. These technologies become even more unaffordable amidst continued failings by core economies to honour pledges around climate financing and green technology transfer [8].

Additionally, when developing countries have sought to try and develop capacities for producing green technologies through industrial policy, they have often found their paths blocked by core economies who register cases with the World Trade Organisation (WTO) and other multilateral organisations [26]. Even India, a relatively powerful player on the global stage, has experienced this with its *National Solar Mission*, which aimed to develop domestic capacities for manufacturing solar cells and panels via local content requirements (LCRs) that the US claimed were in violation of WTO trade principles [24]. By contrast, the US freely launched its own recent *Inflation Reduction Act* of 2022, which even the EU Parliament described as "a frontal attack on the WTO's international trade order" because of its raft of subsidies and LCRs for green technologies [27]. However, rather than lodge a WTO case, the EU launched a rival *Net-Zero Industry Act* with its own (more WTO-compliant) measures for supporting strategic Net-Zero sectors and decarbonisation technologies. This appears to be fuelling a spiralling trend towards green protectionism in core economies that will further constrain industrialisation efforts for peripheral economies in the Global South [22].

2.2. Aluminium production, emissions and uses

The aluminium industry vividly illustrates many of the realities discussed in the previous sub-section. It is the second-most carbon-intensive industry after steel – accounting for 3.8 % of global emissions – and is one of the hardest to abate because emission-reduction technologies are costly and, in many cases, still under development [7 p.8]. A simplified sketch of the production process is presented in Fig. 1 below. Essentially, mined bauxite is converted via the Bayer Process into alumina, which is then processed into aluminium using Hall–Héroult electrolytic smelting processes. Each of these stages results in significant emissions, albeit in unequal proportions.

The lowest-emitting stage is the initial mining of bauxite, which generally accounts for less than 10 % of total emissions associated with aluminium production. Emissions arise mostly from fuels used by mining and transport vehicles, which is often diesel, and the CO2 vented while extracting and crushing bauxite. Unsurprisingly, emissions-reduction solutions for this stage focus mostly on electrifying mining fleets – or, at least, integrating cleaner fuels like gas – and employing "climate-smart mining practices" that minimise vegetation loss and enhance waste-management practices [29].

The second-most emissions-heavy stage is refining. This accounts for around 15 % of total emissions, mostly via combustion of fossil fuels to provide the steam and heat (of up to 1000 °C) required [29]. Emission-reduction solutions for this stage revolve around utilising alternative – and, in many cases, still-emergent – fuels like bioenergy or (green) hydrogen to produce heat and steam, while running ancillary plant operations on low/zero-carbon electricity.

Finally, smelting is the third and most carbon-intensive stage, as demonstrated visually in Fig. 2 below. Smelting requires vast amounts of electricity and, therefore, the associated emissions – which tend to be 60–80 % of the total – depend significantly on how the electricity is generated [29]. Emissions associated with the use of electricity are known as 'indirect' emissions as they are not released as part of the production process itself nor do they tend to be directly controlled by the smelting entity which tends to only procure electricity rather than produce it. On average globally, around 13 tonnes of CO2 equivalent (CO2e) are generated for every tonne of primary aluminium produced and, of this, indirect emissions from electricity use accounts for about 10.3 tonnes of CO2e [30]. The remainder is comprised of 'direct' emissions released during the smelting process, including around 1.5 tonnes of CO2 and 0.8 tonnes of CO2e in the form of perfluorocarbons [30]. These direct emissions will, eventually, need to be eliminated by using inert rather than carbon anodes, or via carbon capture technologies. However, these technologies are still in their infancy, mostly being developed in the Global North. In the meantime, emission-reduction solutions for smelting hinge similarly on sourcing low/zero carbon electricity [29,30].

Despite the infancy of many emissions-reduction solutions, there are already growing pressures for countries to decarbonise aluminium production, as aluminium will be amongst a first wave of carbon-intensive industries targeted by impending carbon border pricing initiatives. Various core economies – including Japan, the UK, US and Canada – are considering carbon border taxes, partly out of competition with, and in reaction to, each other [34]. However, the most advanced is the EU's Carbon Border Adjustment Mechanism (CBAM), which was first-mooted as part of the 2019 *European Green Deal*. This is set to be introduced – initially on a trial basis – in October 2023 and target so-called 'root' aluminium, cement, fertiliser, chemical and steel industries before extending to others. The specifics are still being finalised, but levies will be imposed from January 2026 on non-EU imports according to assessments of their carbon content – which are likely to be based on increasingly sophisticated and extensive measures of direct and indirect emissions across the production chain – and the extensiveness of emission-control policies in the country of origin [35].

A growing body of literature warns that developing countries will be seriously affected by the CBAM, to a point of raising (in)justice concerns,

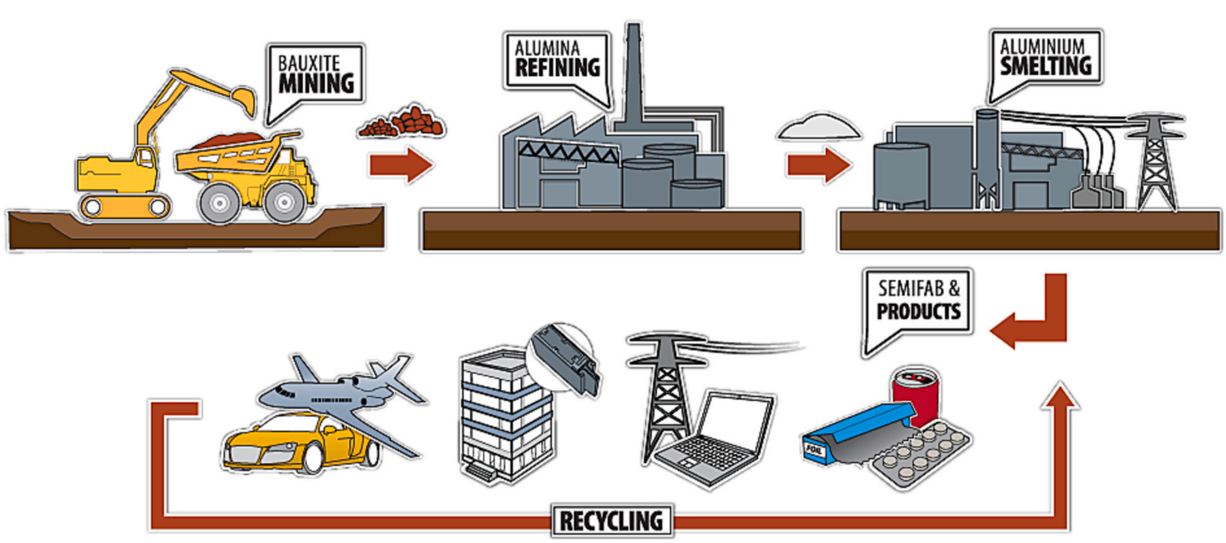
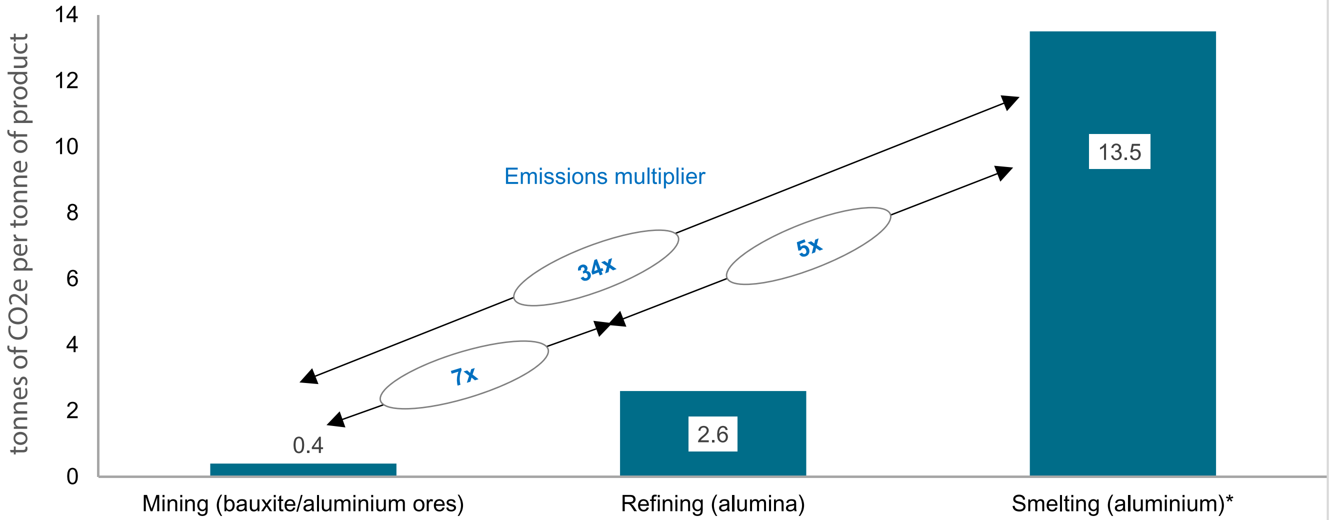


Fig. 1. Aluminium production.
Source: [28].



Mining (Bauxite/Aluminium ores): Minor carbon intensity (Emissions arise mostly from fuels used by mining vehicles and CO2 vented while extracting and crushing of bauxite)
Refining (alumina): Moderately carbon intensive (largely from the burning of fuels to produce heat as the Bayer Process takes place at 150-200°C (300-390°F)
Smelting (aluminium)*: Most energy and carbon-intensive phase due to heavy use of electricity from coal, thermal and hydro (up to 15MWh per tonne of aluminium) via the Hall–Héroult process at 940–980°C . Smelting range of 7-20 tonnes of CO2e per tonne of aluminium produced (e.g., 20 tonnes CO2e per tonne of aluminium in Chinese smelters running on coal power and 7 tonnes CO2e per tonne of aluminium for European smelters). Average emissions of 13.5 CO2e per tonne of aluminium is thus calculated using this range [i.e., (7+20)/2 = 13.5]

Fig. 2. Emissions associated with each production stage
Source: Authors tabulations, based on data from [31–33].

as they will struggle to keep ahead of rapidly-evolving regulatory measures and "'go green' at the pace required to remain competitive" [22,p.2,9], [36]. Their ability to plan is also being undermined by the EU's mixed messages, whereby on the one hand it is pressing ahead with CBAM but, on the other, also recently moved – partly in response to geopolitical events in the Global North, including Russia's invasion of Ukraine – to revise its own energy financing taxonomies and temporarily re-designate fossil gas as a 'green' and 'sustainable' solution until 2030 [37,38]. This has left gas with an ambiguous status, frustrating developing countries that are keen to use it as a transition fuel, but who remain unsure about whether – and for how long – it will be considered as such by core markets and financiers [7]. Some scholars have, consequently, called for so-called 'least-developed' countries, at least, to be exempted. However, the EU appears reluctant to consider this, fearing it will lead to further waves of emissions off-shoring and "carbon leakage" [39]. Instead, in the words of the EU's High Representative for Foreign Affairs, the EU is emphasising the "new opportunities for cooperation that these policies can present" [39]. These appear to include an initiative to promote 'climate clubs' as a carrot alongside the stick of CBAM that developing countries sharing the EU's climate aspirations can join and, in so doing, receive assistance to invest in decarbonisation solutions and fill gaps left by carbon-intensive producers [25]. This initiative is, though, at a very early stage, with little tangible information about it. Developing countries may also be sceptical about its ultimately ameliorative potential given experiences with climate financing and technology transfer to date.

Beyond public regulatory measures, pressure to decarbonise aluminium production is also emanating from the private-sector, as major companies – and, particularly, multinational 'lead firms' – are seeking to get ahead of intra-governmental regulations rather than follow them by introducing their own carbon pricing measures [40]. Facing growing pressures from shareholders and consumers, and seeing opportunities to boost their own competitive advantage, multinational corporations are increasingly seeking to 'green' the value-chains that they lead. Automotive lead firms like Audi, BMW and Tesla have started to map their supply chains and the emissions associated with each link, looking for ways to slash their carbon footprints [30]. They have also been pressuring the Aluminium Stewardship Initiative, the leading private aluminium certification scheme, to go further and faster in auditing mining companies, refineries and smelters and spreading 'green' standards throughout the industry. Trading platforms that facilitate aluminium trading are also introducing carbon 'passport' systems to allow buyers to assess the carbon footprint of different offerings. These include the London Metal Exchange, which is beginning its passport system with the aluminium industry [34].

Taken together, these developments paint a daunting picture of the challenges that today's late-late developers will face when trying to build – and sustain – globally-competitive aluminium industries. However, there will be "sizeable opportunities" for developing countries that can overcome these challenges [34 p.2], including and especially those in Africa [41,42]. This is because global demand for aluminium is expected to surge over the coming decades. This will be driven significantly by the energy transition itself, since aluminium is used in everything from solar panels and wind turbines to electricity cables and batteries, giving the aluminium industry a somewhat paradoxical status as being both a major constraint to, but also a vital enabler of, a Net-Zero future.

Accelerating shifts to electric vehicles will also ramp-up demand as carmakers seek ever-lighter chassis to compensate for heavier e-batteries, while similar dynamics will unfold in the aerospace industry. This will be in addition to the numerous more traditional requirements for aluminium across the packaging, construction and electronics industries, amongst others, which have long-established aluminium as the second-most used metal in the world [30]. Indeed, looking forwards, the World Bank [29 p.74] warns that "demand may be so high that it could bring pressure on the aluminium industry's capacity to meet demand", which explains why both the US and EU recently designated bauxite as a 'critical mineral'. Yet, these developments also lead the World Bank to identify a potentially lucrative 'window of opportunity' for developing countries with significant reserves of bauxite (or other critical minerals) to service this demand, especially given ongoing EU and US drives to reduce their reliance on Chinese imports and slash emissions by shortening their supply-chains. These opportunities will be especially lucrative for countries that can move beyond primary bauxite exports to shift into higher-value-added parts of the aluminium value-chain. We now turn to Ghana, a country that has long struggled to do exactly that.

3. Methodology

Our analysis of the Ghanaian case is informed by various data sources and research methods. For more historical developments, we analyse primary documentary sources including government reports and newspaper articles as well as secondary academic literature. Primary sources include a handbook produced in 1955 outlining Nkrumah's vision for an IAI that we discovered during our research and which, to the best of our knowledge, has never been cited in academic literature.[1] Our analysis of contemporary dynamics, meanwhile, draws on over 50 semi-structured interviews with stakeholders in Ghana's energy sector and/or its aluminium industry. In the energy sector, we interviewed government officials from the Ministry of Energy, Ghana National Petroleum Corporation, Ghana National Gas Company and Volta River Authority, amongst other agencies. In the aluminium industry, we interviewed officials representing the Ghana Integrated Aluminium Development Corporation and Volta Aluminium Company as well as private-sector players operating downstream in Ghana's aluminium value-chain. Additionally, we interviewed journalists, consultants and researchers who were deemed to have specialist knowledge of Ghana's energy sector and/or its aluminium industry, as well as civil-society actors who have been involved in debates around – and sometimes protests against – the government's plans for an IAI. Interviewees were selected by purposive and snowball sampling. Most interviews were conducted during a two-month period of fieldwork through July and August 2022. However, one of the authors has a longstanding research interest in Ghana's IAI and has been conducting related periods of fieldwork since 2018. In all cases, we ensure the anonymity of our participants by only listing their institutional positions when referencing interview data in the analysis that follows.

4. Analysing Ghana's IAI

4.1. Nkrumah's (unrealised) vision (1950–2007)

Ghana has long attempted to develop an IAI as a pillar of industrialisation and take advantage of its bauxite reserves, which are currently estimated at 900 million tonnes (Mt) and are the largest in Africa after Guinea. These efforts began in the 1950s under founding president Kwame Nkrumah, who envisioned an IAI as part of his Volta River Project (VRP). The key elements of the VRP are presented in Fig. 3 below. Essentially, Nkrumah's vision was to construct a dam on Ghana's Volta River in the Akosombo gorge to provide dedicated electricity to a newly-built smelter run by the Volta Aluminium Company (VALCO) in a new industrial city of Tema. The smelter, in turn, would be backlinked to a refinery that would process Ghana's bauxite deposits, which were estimated to have a lifespan of at least 200 years and significant employment- and income-generating potential [43].

However, Nkrumah struggled to realise his VRP vision. In his treatise on *Neocolonialism*, Nkrumah wrote of the challenges that many newly-independent African countries faced when trying to "bargain successfully with powerful foreign companies" that often "control[led] financial empires worth more than the state's total revenue" [20 p.26]. Certainly, these challenges were apparent in Nkrumah's own attempts to secure investment for an aluminium smelter, as a combination of Nkrumah's "eagerness to see the project become a reality" – so he could start delivering the poverty-reducing, job-creating industrialisation that he saw as the solution to Ghana's pressing developmental challenges – coupled with competition from other African countries, who were all scrambling for foreign investment in similar industries, led Nkrumah to "accept a deal that was sub-optimal, to say the least" [44 p.87].

Here, the US multinationals Kaiser Aluminium and Reynolds, which became joint owners of the VALCO smelter, signed an agreement with Ghana's Volta River Authority (VRA) – which was created to oversee the VRP and remains Ghana's primary electricity generation company – to receive electricity from Akosomobo at a long-term preferential price of just 0.6265 cents/kWh [45]. This price might have made economic sense for Ghana if Nkrumah had been able to deliver a refinery solution but, in 1966, he was overthrown in a coup before the middle-chain could be developed. In the absence of a refinery solution, bauxite was exported in raw form to places like Scotland, Jamaica and Canada for refining, before being imported back into Ghana to take advantage of VALCO's ultra-cheap power from Akosombo. Aluminium output was then either (mostly) re-exported or provided to local downstream players. This arrangement severely limited Ghana's ability to fully exploit its bauxite resources for inclusive growth and development [46].

It was also a lasting arrangement, as Nkrumah's overthrow was followed by decades of economic stagnation and political instability, within which a series of short-lived governments punctuated by military coups failed to progress Nkrumah's vision [44]. Enjoying vastly subsidised electricity and numerous other incentives including duty-free imports and exports, VALCO's multinational owners faced little pressure to push ahead with developing a refinery themselves. A relatively more stable and coherent administration led by former flight lieutenant Jerry John Rawlings, who came to power in 1979 via a coup, managed to push through a slight increment in VALCO's electricity tariff – from 0.6265 to 1.1 US cents/kWh – but the overall economics of the agreement remained such that there was no incentive for VALCO's owners to pursue a refinery solution. There was also little enthusiasm for such an endeavour from International Financial Institutions (IFIs), who were then advancing their SAP agenda and trying to steer developing countries away from ISI [45–47].

In the early-2000s, VALCO experienced significant changes to its ownership and power arrangements. In 2002, Kaiser Aluminium, VALCO's parent company, filed for bankruptcy in the US, causing VALCO to be closed until President John Agyekum Kufuor announced in December 2003 that it would pass into government ownership. That same year, the original power contract between VRA and VALCO – which, in four decades, had seen multiple largely unsuccessful attempts to renegotiate it – was formally terminated, in large part because of donor pressure to make VALCO pay 'realistic electricity tariffs' and enhance cost recovery under the remit of privatising Ghana's energy sector [48]. VALCO's tariff increased to 2.7 US cents/kWh, but this was still a significant consumption subsidy, since it cost VRA about 6.5 US cents/kWh to generate power from its combined hydro and thermal sources, while Ghanaians paid about 8 US cents/kWh. As it was, though, VALCO's increased tariff was somewhat redundant, as the plant suffered regular operational shutdowns between 2004 and 2007 due to escalating waves of power rationing. In 2007, Ghana entered a particularly deep electricity crisis, prompting VALCO's management to explore the idea of building a 1200 MW coal-fired power plant to re-ignite the IAI initiative. However, these plans stalled following the election of a new government in 2008 which, as the following section elaborates, entered office with its own vision for revitalising – and powering – Ghana's aluminium industry.

[1] We have scanned and uploaded a publicly-accessible version of the handbook, which can be accessed here: https://www.dropbox.com/s/uwjmd7l95hoavrh/The%20Volta%20River%20Project%20Handbook%201955.pdf?dl=0.

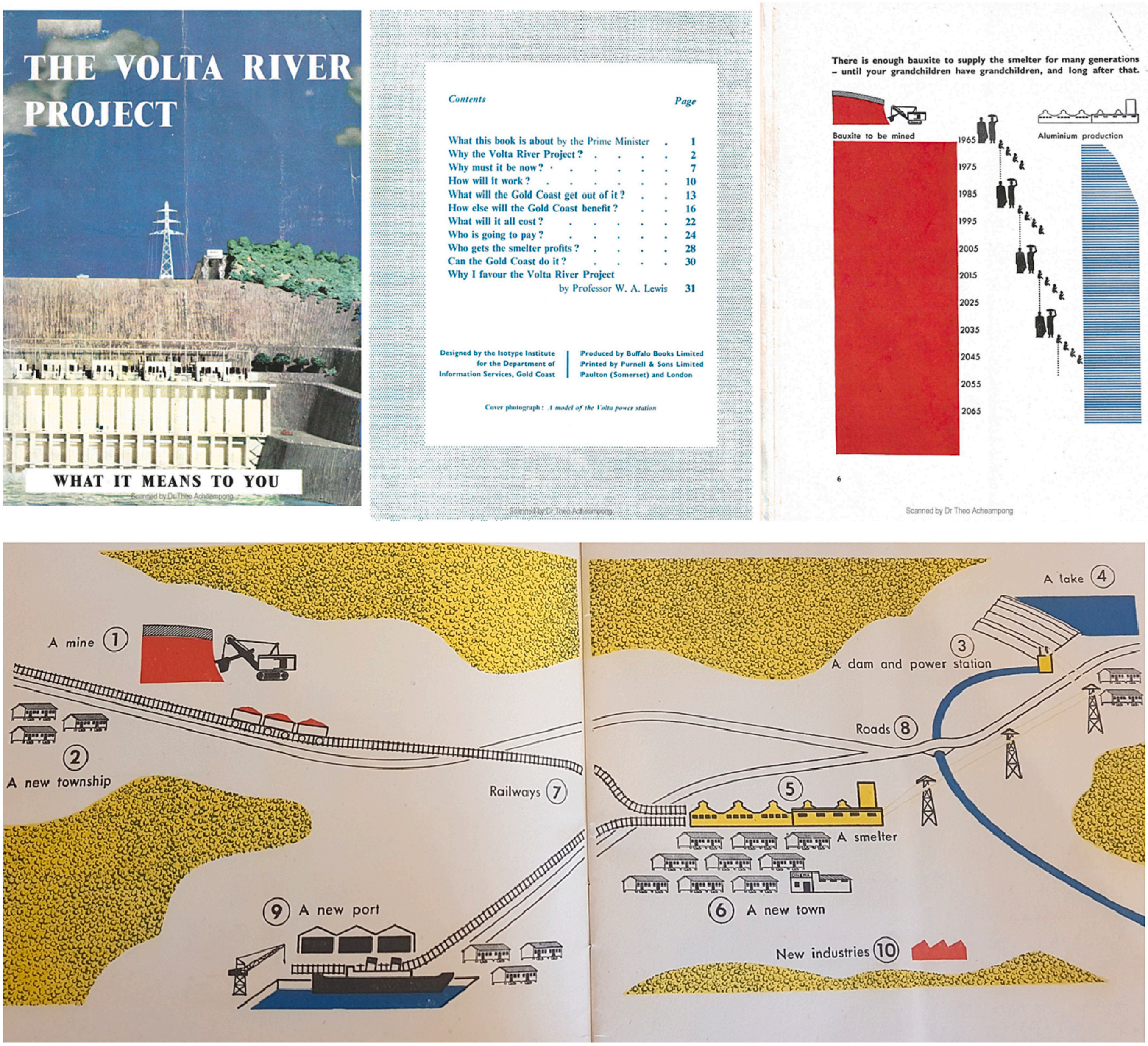


Fig. 3. Snippets from the VRP Handbook (1955).
Source: [43].

4.2. Hopes of a gas-fired revival (2007–2017)

In late-2007, Ghana discovered commercially-viable offshore oil and gas reserves, prompting an incoming government led by President John Atta Mills and his National Democratic Congress (NDC) party to identify gas as the energy solution that would finally deliver on Nkrumah's vision for an IAI while also supporting a broader industrialisation agenda targeting new industries like iron, steel and fertilisers [49]. Domestic gas, it was hoped, would provide cheap baseload power directly to VALCO and other industry players at comparable levels to Akosombo, while also – critically – offering a more reliable power source since it would not suffer from the climatic variations that were increasingly undermining Ghana's hydropower. Additionally, gas was seen as a cheaper and more reliable solution than then-expensive and still-intermittent renewable technologies like solar and wind, while it was also framed – at a time when the energy transition agenda was yet to bite – as an indisputably "clean" energy solution relative to the imported fuel oils that accounted for a large share of Ghana's electricity mix (and which Ghana's gas was slated to gradually replace) [50 p.151].

However, efforts to develop Ghana's gas resources were undermined by missed deadlines, cost overruns and institutional turf wars [49,51]. In 2010, the government created a new agency called Ghana National Gas Company (GNGC), assigning it responsibility for developing gas infrastructure including an onshore processing plant. This institutional fix was partly in response to demands from China – which agreed to finance the infrastructure, but demanded that the projects be managed by a new state entity responsible solely for the gas sector – though China's demands also aligned with the government's own patronage and factional motivations, whereby the creation of a new agency yielded lucrative positions to distribute and other rent-generating opportunities [52]. Responsibilities for the gas sector were, consequently, taken from Ghana's then relatively well-capitalised and capacitated national oil company, the Ghana National Petroleum Corporation (GNPC), which had worked closely with upstream joint venture partners including Tullow Oil to complete Ghana's 'Jubilee' oil export project in a record time of three-and-a-half years – delivering first oil in late-2010 – and had already begun to invest in developing midstream gas infrastructure as well [53].

In contrast to GNPC, GNGC demonstrated "limited capacity to manage large-scale infrastructural projects" and became subsumed both by internal jostling amongst its political appointees around procurement and external turf wars with GNPC [52 p.111]. There were also ongoing uncertainties with China over funding arrangements. The result was a series of project delays and cost overruns, beginning with the processing plant and associated pipelines to transport gas from the Jubilee fields. Initially slated to "coincide with first oil", the plant was delayed by three years, only coming online in 2014 [54 p.322]. In the meantime, the government had to continue importing expensive heavy fuel oils to keep thermal plants running and stave-off an increasingly severe power crisis. This became so costly for VRA that, once Ghana's gas was finally integrated into the power sector, VRA was so indebted that it was unable to actually pay GNPC – the gas aggregator – for any of it [54].

Since gas from Ghana's Jubilee fields was of an 'associated' nature —it comes from a well that contains and produces crude oil— the delays in completing the processing plant also meant that oil production had to be reduced to avoid destabilising the field, resulting in lower-than-planned export revenues and further damaging effects to public finances [54]. Similar delays beset the infrastructure required for transporting gas from Ghana's 'Sankofa' field, which was discovered two years after Jubilee in 2009. To secure investment for field development, the government committed to purchasing Sankofa gas from ENI on generous 'take or pay' terms. This resulted in annual charges of hundreds of millions of dollars for gas that Ghana was unable to fully utilise when the field became operational in 2018 without associated infrastructure [54].

Far from being a solution to the energy sector's issues, then, in many senses the botched efforts to integrate Ghana's gas into the power mix caused additional problems. VALCO continued to face periodic shutdowns, including a two-year-long suspension between 2008 and 2010. Even when there was sufficient power to operate, VALCO could run only one of five potlines at just 17 % capacity [55]. By 2016, Ghana's energy sector was in deep financial crisis and the implications were spilling well beyond. Various state agencies had accumulated significant arrears and were unable to meet basic obligations [56]. This forced the government to work with the World Bank and other donors to devise an Energy Sector Recovery Programme (ESRP). Reflecting the World Bank's influence, the ESRP document openly questioned whether VALCO's subsidy arrangements "should continue" [57 p.16]. Other government documents, meanwhile, started expressing noticeably more caution about the viability of an IAI, labelling the initiative "high-risk" because of the need for significant capital investment that the government was unable to afford and for low gas prices that the sector was unlikely to provide in the near-to-medium term [58 p.2]. These developments form the backdrop to Ghana's latest aluminium drive under a newly-elected National Patriotic Party (NPP) government since 2017 – as covered in the next section – whereby the country has also been confronting the realities of the global energy transition.

4.3. Ghana's latest IAI drive (2017-date): going for green?

Upon entering office, the NPP identified bauxite and iron ore as two key minerals that, if developed under an integrated model, could drive Ghana's industrial development and resuscitate its economy. To that end, two new state entities responsible for each value-chain were created – namely, the Ghana Integrated Aluminium Development Corporation (GIADEC) and Ghana Integrated Iron and Steel Development Corporation (GIISDEC).[2] GIADEC is mandated with developing the IAI and has been configured as a holding company for all the state's investments and interests across the bauxite-to-aluminium value-chain.[3] These include full ownership of VALCO and the Ghana Bauxite Company as well as mining rights to Ghana's bauxite reserves. In addition, GIADEC will hold a minimum 30 % stake in any new mine, refinery or smelter.[4] Offering an important indicator of the government's commitment to realising an IAI, GIADEC's leadership has been composed of respected technocrats. This represents a notable departure from Ghana's broader public-sector norm, whereby the senior positions of state agencies – at both executive and board level – are often filled with overtly political rather than technical appointees due to the clientelist demands of Ghanaian politics [44,59].

GIADEC has developed an IAI Masterplan which envisages four mining concessions, two refineries and two smelters for fuelling exports and domestic industry (Fig. 4). On the mining front, Ghana's long-running Awaso mine will be expanded, while three new sites (two in Nyinahin-Mpasaaso and one in Kyebi) will be developed. Collectively, the four mines will produce 20Mt of bauxite annually. Half of this is slated to be exported in primary form – in part to satisfy the conditions of a US$2 billion resource-backed loan that the government struck with Chinese firm Sinohydro in 2018 to finance infrastructure projects outside the aluminium value-chain [60] – while the other half will feed the new refineries, each with an alumina output of 2Mt annually. In late-2021, GIADEC selected Rocksure International as a strategic partner to build one of the new bauxite mines and an associated refinery, while it is currently searching for partners to deliver other work packages.

Finally, GIADEC envisages a new 500,000 ton per annum smelter to supplement VALCO's existing one. VALCO is also slated for expansion and modernisation, with GIADEC seeking strategic investors to retrofit its plant, replace potlines that have fallen into disrepair, install modern energy efficiency technologies and increase capacity to 300,000 tons annually.[5] VALCO's existing smelter has a nameplate capacity of 200,000 tons per annum, but it is currently doing 30 % of this. In the meantime, GIADEC has been working with VALCO to reduce its operational costs and financing obligations while the government has also made a modest cash injection to support VALCO's operations, all of which allowed VALCO to return to profitability in 2022 and provide what GIADEC hopes will be a springboard for securing strategic partner investment by the end of 2023.[6]

Ghana's government, GIADEC and industry players are all increasingly aware of global discussions around the energy transition, industrial decarbonisation and 'green' manufacturing. Indeed, in late-2022 the Ghanaian government published a *National Energy Transition Policy Framework* that was developed by a National Energy Transition

[2] The creation of these two entities was partly motivated by a desire to recreate institutional arrangements that pertained in the 1970s and early-1980s, prior to Ghana's SAP reforms, whereby the Aluminium Industries Commission (AIC) and the Integrated Iron and Steel Commission (IISC) had responsibility for promoting the development of industries around Ghana's bauxite and iron ore minerals respectively.

[3] As per Section 2 of Act 976, GIADEC's mandated functions are to: (a) undertake the preparatory work for the promotion and development of the integrated aluminium industry; (b) collaborate with investors for the development of the integrated aluminium industry; (c) make recommendations to the Minister on the nature and scope of State participation in the development of the integrated aluminium industry; (d) ensure the development and implementation of a local content policy in the integrated aluminium industry; and (e) ensure the participation of Ghanaians in technical and managerial functions of the integrated aluminium industry.

[4] See: https://www.giadec.com/who-we-are/company-profile/.

[5] See: http://www.valcotema.com/index.php/integrated-aluminium-project.

[6] ibid.

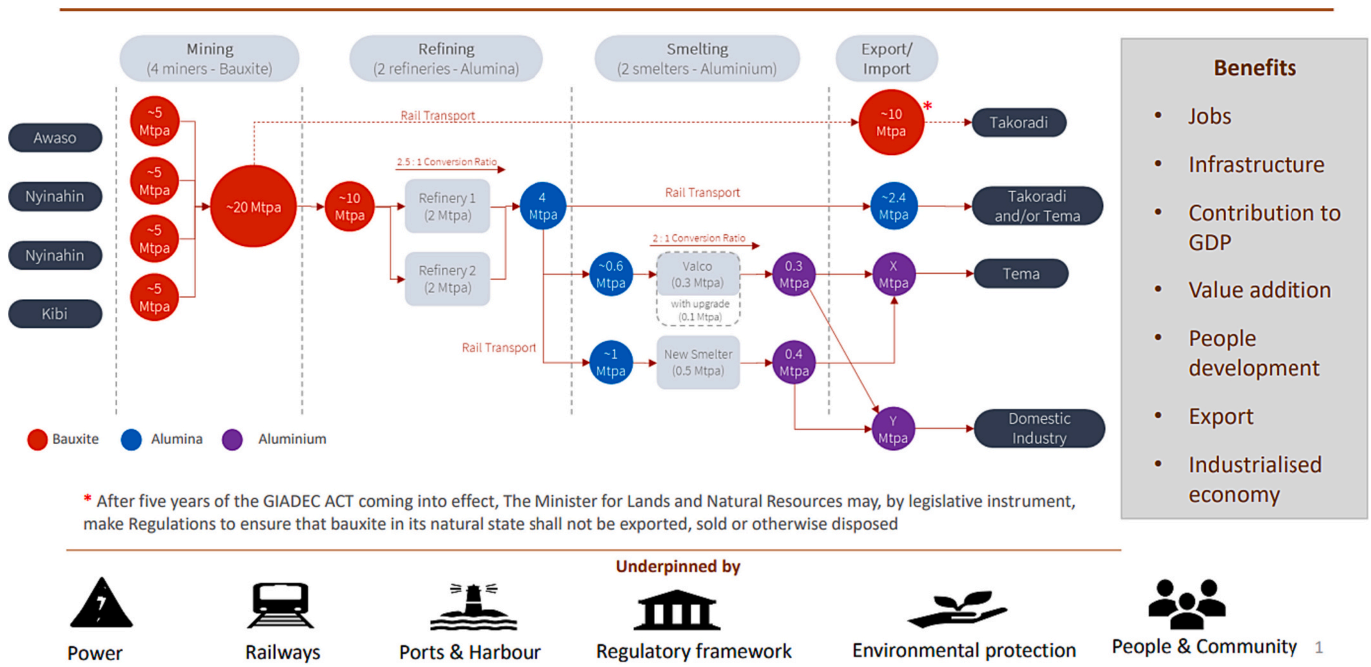


Fig. 4. Ghana's IAI Masterplan.
Source: [61].

Committee following country-wide consultations [62]. Amongst other things, the Framework formalises a targeted Net-Zero date of 2070 and maps out an optimal energy mix for achieving that, which is presented visually in Fig. 5. Key points to note here are that natural gas is slated to retain a predominant role within Ghana's energy mix up until the mid-2050s, at which point nuclear power is predicted to take over as the main source of electricity. Renewables, by contrast, are predicted to play a comparatively minor role throughout, both in terms of installed capacity and (even more so) actual generation output.

According to the Framework, gas has been identified as Ghana's primary 'transition fuel' over the near-to-medium term because it can provide the baseload power that Ghana requires for its industrialisation, as opposed to "intermittent" renewables which are deemed to require costly storage solutions to make them viable on a large scale [62 p.7]. Additionally, and more instrumentally, the Framework identifies the oil and gas sector as a major source of revenues for the state. It also points out that Ghana has sizeable gas resources that, if suitably managed and developed, could last well into the 2050s, which Ghana consequently should not be expected to abandon given pressing developmental challenges and energy access needs (we would also add, echoing other researchers, that the oil and gas sector has become a lucrative source of rents for political elites across the spectrum, which further explains the reluctance to abandon it) [49,53,63]. For all these reasons, Ghana's government has gone to great lengths to frame natural gas as the

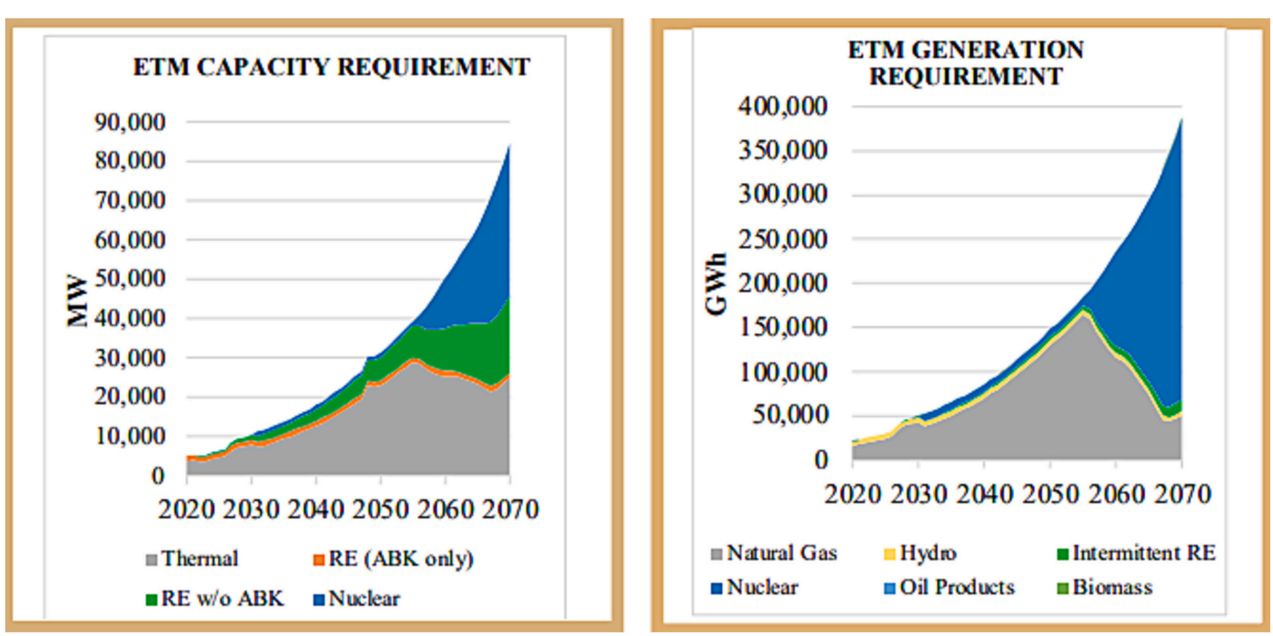


Fig. 5. Ghana's projected energy transition mix (ETM) up to 2070.
Source: [62].

country's – and, indeed, Africa's – 'just' transition fuel.[7] Interestingly, several government officials even drew on dependency-style arguments to make this case to us in interviews. One Ministry of Energy official, for example, explained that "we've spent decades building our own capacities to manage our oil and gas resources, so why would we now want to go and make ourselves dependent on new renewable technologies?"[8] A GIADEC official concurred, asking rhetorically "why is it only now, when we're finally reaching a point where we can profit from our own resources, that the West says oil and gas is no longer allowed?... They're suppressing our ability to develop in an economically-viable way."[9]

However, while the government is clear about a primary role for gas in Ghana's overall energy mix, there is significant uncertainty about the energy solutions that will be adopted across different parts of the aluminium chain, which government recognises may require specific power arrangements to avoid jeopardising its export potential. These uncertainties are greatest in terms of smelting, which is the most energy intensive stage and requires cheap baseload power (which, globally, has historically come from coal, hydro or thermal). Technological improvements have seen the electricity consumption of aluminium smelting reduce globally [64]. However, even for leading producers like Norway and China – who have registered some of the most impressive efficiency advances – smelting remains a vastly energy-intensive process, whereby even the "world's most efficient" smelter, operated by the Norwegian corporation Hydro, requires 12,300 kWh/t of aluminium produced. This means that electricity cost is a fundamental factor in smelting economics, representing about 33 % of the cost of aluminium ingots. The extant literature suggests that, to remain globally competitive, the cost of electricity must be a maximum of 5 US$ cents per kWh. This price point is especially critical for countries like Ghana, whose smelters – at least currently – are stuck with relatively old Soderberg technologies dating from the 1960s, rather than newer pre-baked anode ones. Consequently, they have significantly higher energy consumption profiles than the 14,000kWh/t average of modern smelters, reaching as high as 16,000–17,000 kWh/t [34,48].

Interviews with government officials across the Ministry of Energy, GIADEC and VALCO suggested that a solution in which smelting activities would be powered directly by Akosombo's hydropower is widely seen as the ideal solution. This is because hydro is both Ghana's cheapest and 'greenest' (though certainly not entirely green) energy source and would allow the country to compete favourably in international markets that will increasingly be regulated by carbon border taxes like the EU's CBAM. The generation cost of Akosombo's hydro equates to about 3 US cents per kWh based on publicly available tariff data sourced from the Public Utilities Regulatory Commission. For comparisons sake, Ghana's current high voltage 'composite special load tariff', which utilises a mix of hydropower and gas, is priced at 8 cents per kWh. A dedicated electricity supply from Akosombo would, therefore, bring Ghana below the 5 US$ cents per kWh competitiveness threshold, though our calculations – which are presented visually in Fig. 6 below – suggest that this would still need to be coupled with significant improvements to VALCO's smelting efficiency to ensure that Ghana's aluminium production comes within overall international cost competitiveness benchmarks. Using the composite special tariff that blends hydropower and gas, by contrast, would render Ghana's smelting costs uncompetitive, at least without significant subsidisation.

However, while recognising that dedicating Akosombo's hydropower to smelting operations would in many senses be the ideal solution, interviewees suggested there is significant debate and uncertainty within government about whether to pursue this in reality, as it would come with a number of trade-offs and risks. For one, if VALCO and a new smelter were to operate at levels of production envisaged by GIADEC, this would remove almost the entirety of Akosombo's output from Ghana's broader electricity mix when currently this plays a key role in bringing down overall electricity prices in a country where electricity costs have become a deeply politicised – and almost overriding – electoral issue [65–67]. Secondly, VRA – the custodian of Akosombo and a powerful and relatively autonomous actor within the Ghanaian state, depicted by [68 p.1] as a "state within a state" – is itself deeply sceptical of, and concerned by, the proposal to dedicate the dam's output almost entirely to aluminium smelting. Akosombo provides the cheapest form of power within VRA's own generation portfolio and allows it to offer competitively priced power to so-called 'bulk consumers' of electricity – both in Ghana and regionally – who offtake directly from it under special license. These bulk supply arrangements have become increasingly important to VRA's financial sustainability since the 2010s, when it faced escalating financial challenges due to the botched attempts to integrate Ghana's gas into the electricity sector discussed previously. Consequently, there would be renewed questions about VRA's fiscal viability if it were to lose the ability to offer such arrangements competitively. Thirdly, there are important questions about the future reliability of Ghana's hydropower in a context of climate change and unreliable patterns of rainfall, which could lead to costly suspensions in smelting operations. Even GIADEC officials – the strongest advocates of using hydropower for aluminium smelting – recognised these risks, citing the example of China where some hydro-powered smelters have recently been forced to suspend their operations due to erratic rainfall.[10]

Given these potential risks and trade-offs, there are voices within government calling for gas to power smelting operations. Already, a decision has been made for upstream mining and refining operations to be gas-powered since, together, these activities would represent a comparatively small proportion of emissions that would not (at least in the near-term) appear to threaten Ghana's access to international aluminium markets.[11] However, actors within Ghana's gas assemblages are pushing for gas power solutions to be extended to smelting operations as well. These voices appear to be emboldened by recent global developments, including, notably, the EU's decision to re-classify gas as a 'sustainable' energy source within its own taxonomies. This was exemplified by one GNGC official who remarked that "this Ukraine thing has shown just how hypocritical this whole Western transition agenda is. How can they try to stop us using our gas now? The EU's announcement that gas is a green fuel means we can now comfortably use our own gas."[12]

However, progressing with using gas for smelting (and, indeed, for mining and refining) would come with its own trade-offs and risks. As the CEO of a private Ghanaian aluminium products manufacturer remarked, "you saw how quickly the EU decided that gas was green. Just as quickly, they're going to change their minds again and we'll be locked out of Europe… People seem to be forgetting that it was only a temporary decision [up until 2030]"[13] It is, indeed, uncertain how gas will be treated after 2030, and there are risks that Ghana could face hefty penalties under CBAM if it opts to power smelting with gas. Other interviewees, meanwhile, felt that it may, to a significant extent, be irrelevant whether Ghana's aluminium is classified as 'green' or not by the CBAM and other public regulatory measures, as "the private sector is trying to get ahead of the regulatory curve… You can see the big multinationals like Coca Cola are racing to be the first to show they've got an entirely green value-chain, so I worry they're not going to be interested

7 See: https://www.ghanabusinessnews.com/2022/11/23/energy-transition-is-good-for-africa-but-should-be-gradual-minister/.

8 Interview, Ministry of Energy official, 26/08/2022.

9 Interview, GIADEC official, 01/09/2022.

10 See: https://www.reuters.com/article/china-aluminium-idUSL4N36N1M4; and https://www.fastmarkets.com/insights/yunnan-aluminium-producers-ordered-to-cut-output-amid-power-rationing.

11 See: https://www.myjoyonline.com/ghana-gas-company-to-site-a-distribution-gas-plant-at-adupri-in-atwima-mponua/.

12 Interview, GNPC official, 18/08/2022.

13 Interview, owner of aluminium manufacturing company, 31/08/2022.

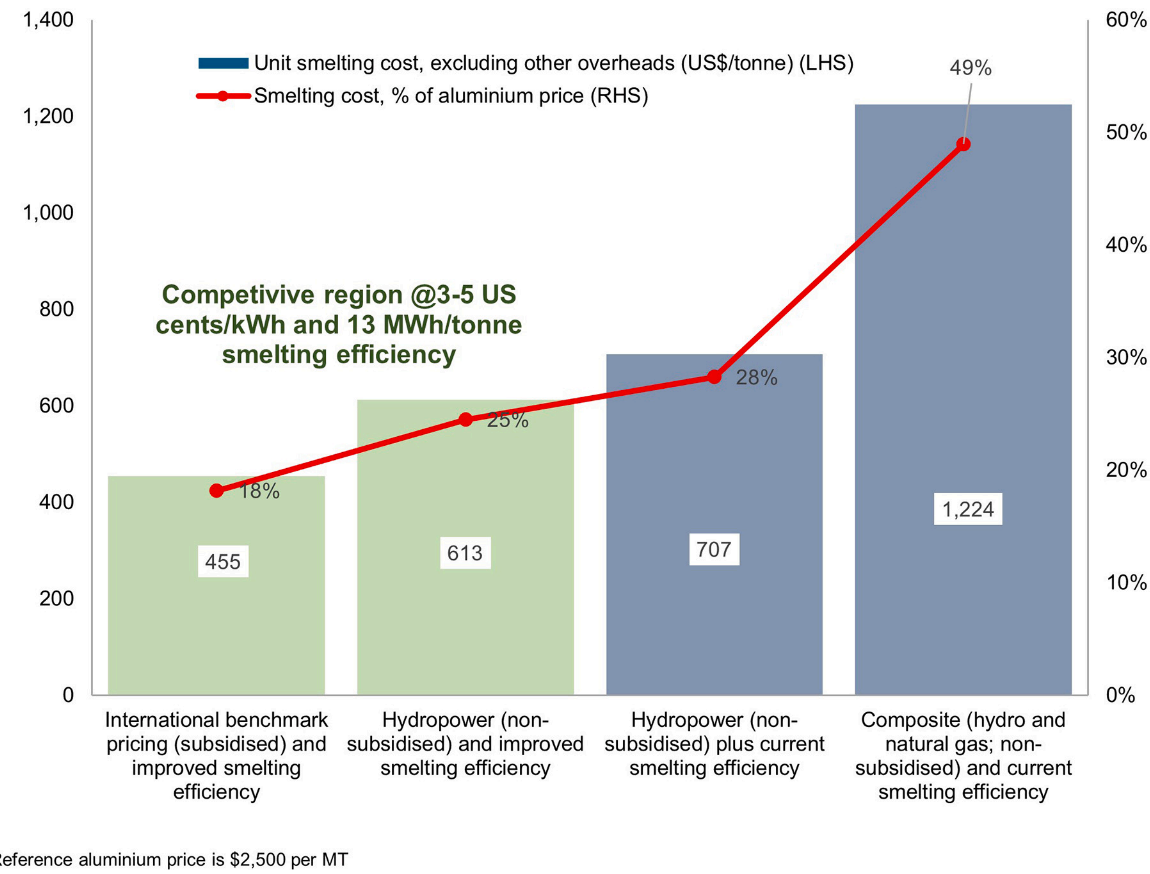


Fig. 6. Cost comparatives of different fuel choices and smelting efficiencies.
Authors' construct. These four scenarios, starting from the left hand side as they are presented in the figure, are based on the following assumptions: **(1) International benchmark pricing (subsidised) + improved smelting efficiency**: The cost of power is procured at 3.5 US cents per kWh while VALCO's smelting efficiency increases to 13,000 kWh per tonne in line with international benchmarks. **(2) Hydropower (non-subsidised) + improved smelting efficiency**: Hydropower from the Akosombo dam is dedicated to smelting operations as originally envisioned in the 1960s IAI plan. The cost of hydro equates to 4.7 US cents per kWh and VALCO's smelting efficiency increases to 13,000 kWh per tonne in line with international benchmarks. **(3) Hydropower (non-subsidised) + current smelting efficiency**: The cost of hydro equates to 4.7 US cents per kWh while VALCO smelting efficiency is assumed to be 15,000 kWh per tonne. **(4) Composite (non-subsidised hydro and natural gas) + current smelting efficiency**: The current composite special load tariff – high voltage of 8 cents per kWh is used together with an assumed 15,000 kWh per tonne current VALCO smelting efficiency.

in our aluminium if we go down the gas route."[14] Government officials themselves acknowledged these concerns, but generally did so while explaining that they do not see Europe or the US as high potential markets for aluminium exports, instead seeing more potential for China and regional markets via the African Continental Free Trade Area (AfCFTA). However, private sector players expressed concerns about this attitude, as exemplified by an Association of Ghana Industries representative: "sure, AfCFTA will bring some good opportunities, but we shouldn't only be thinking about Africa… This is also a question of justice. Why should Africans be limited to trading only with each other?"[15]

Finally, and more imminently, another potentially major obstacle in using gas to power smelting operations would be the level of subsidisation required to make aluminium production competitive, given prevailing prices of gas in Ghana discussed previously. Subsidies in and of themselves are not necessarily an issue, as core economies including Australia, France and the US have all effectively utilised them to support their heavy industries [7]. This reality was observed by an official in the Vice-President's Office, who called it "deeply hypocritical that those same countries are now telling us not to use them."[16] However, the current pricing of Ghanaian gas does appear to raise serious questions about whether the level of subsidisation would be worth it, or whether the associated costs would serve to cancel out many of the potential gains. More practically, there are also questions about whether such subsidies would be feasible within Ghana's current political economy, given the state of its economy and the fact that the government is currently implementing a strict IMF assistance programme that, if anything, is seeking to remove subsidies from Ghana's energy sector rather than add in new ones [69].

4.4. Broader green contestations and trade-offs around Ghana's IAI

Beyond uncertainties about energy solutions, other emerging 'green' contestations are stymying the development of Ghana's IAI. This is because many of Ghana's untapped bauxite reserves lie in protected forest reserves, meaning that expansion of the industry will necessarily involve encroachment into – and potential degradation of – green spaces. These include Atewa Forest Reserve, which is one of Ghana's two remaining major upland evergreen forests and, amongst other things, contains over 70 endangered or vulnerable plant and animal species –

[14] ibid.
[15] Interview, Association of Ghana Industries representative, 27/08/2022.
[16] Interview, senior official in Vice President's office, 25/08/2022.

which collectively make it a globally-significant biodiversity reserve – while it is also the source of three rivers that provide drinking water to millions of Ghanaians [70].

For these reasons, an array of national and international civil-society organisations, environmental activists and celebrities including Leonardo di Caprio have opposed government's plans, filed lawsuits in Ghanaian courts, launched petitions and pressured multinational corporations – including lead automotive firms like BMW – to commit to not purchasing Atewa-linked aluminium.[17] On the other side of the debate, the government and many Ghanaian companies that use aluminium – who currently face limited and inconsistent local supply or high and fluctuating importation costs – have emphasised the wide-ranging benefits of an IAI. The government has framed its own arguments partly in relation to the energy transition agenda itself, asserting in its Energy Transition Framework that Ghana has "critical (green) minerals" including bauxite that it is "determined to extract" so Ghana can become a lucrative "hub" for manufacturing renewable energy technologies, electric vehicles and batteries [62 p.1]. In so doing – and demonstrating the inherent contradictions of 'green extractivism', whereby certain environmentally-detrimental practices are justified on the basis of solving others [71] – the government argues that Ghana can become a leading regional and global player in the fight against climate change.

Our intention is not to weigh in decisively on this particular debate, other than to emphasise that any decisions to expand bauxite mining into reserves like Atewa must be guided by a clear and transparent assessment of the costs and benefits and meaningful stakeholder consultation. Recently – and, arguably, also belatedly – the government committed to this, declaring in local media that a comprehensive environmental impact assessment is being undertaken with Ghana's Environmental Protection Agency and researchers at Kwame Nkrumah University of Science and Technology. This will inform a Biodiversity Action Plan based on "world class responsible mining standards".[18] It is important, then, not to pre-empt or forestall that process. What we would emphasise, though, is that just as the potential environmental costs of an IAI are significant and require serious discussion, so do the potential economic gains. These have often been underplayed in public debates so far. For example, A Rocha Ghana, a local NGO that has led resistance to the government's plans, still refers to its 2016 report on *The Economics of the Atewa Forest Range* which found that Ghana would generate more economic benefits by turning Atewa Forest into a national park and promoting ecotourism. However, the calculations appear to be based not only on assumptions that almost the entirety of Atewa reserve would be lost to mining activities, but that all bauxite would be exported cheaply in its primary form – as has been done in Ghana historically – rather than being fed into an IAI which would retain much of the value of Ghana's natural resources domestically.

Amongst other benefits, an IAI *could* generate significant employment for Ghana's rapidly growing population, ease its chronic trade imbalances and foreign exchange issues, provide cheaper manufactured inputs to companies in various economic sectors, and generate significant demand for ancillary services along the bauxite-aluminium value-chain [41]. None of these potential gains should be dismissed when debating the merits of an IAI. Development is an inherently messy process that rarely – if ever – offers the economic, social and environmental 'triple-wins' sought by mainstream development actors [72]. Instead, development entails difficult tradeoffs with environmental and other considerations. The challenge for the Ghanaian government, therefore, is to work with other stakeholders to identify an inevitably messy middle-ground.

5. Conclusion

This paper set out to examine Ghana's evolving plans for, and challenges with, developing an IAI, using a political economy approach. We have found that Ghana's latest efforts to develop an IAI are encountering new uncertainties and contestations, both nationally and transnationally. These are associated significantly with the unfolding global energy transition agenda and shifts towards 'green' manufacturing, but are also very much related to – and, indeed, giving new faces to – long-standing challenges that Ghana has faced as a peripheral economy navigating the conditions of late(late) development within a deeply uneven and polarising global economy. Collectively, these multiscalar political economy challenges are threatening to frustrate Ghana's ambitions once more, even though finally delivering on Nkrumah's founding vision could generate significant value for Ghana and help to propel its industrialisation as demand for aluminium surges globally due to the energy transition.

In terms of recommendations, the Ghanaian government can overcome some of these issues by engaging in more meaningful dialogue with domestic stakeholders around the benefits and costs of an IAI and being frank about the trade-offs involved. However, to a significant degree, a national discussion about benefits and costs is only possible if, at an international level, there is greater clarity from core economies in the Global North about how they will classify particular types of energy – and, particularly, natural gas – moving forwards. These countries must also go much further in honouring their pledges around climate financing and green technology transfer. Facing the conditions of late-late development, countries like Ghana have long faced a deeply unfavourable environment in which to conduct industrial policy. However, emerging uncertainties and inequities associated with the energy transition are only adding to their challenges, undermining their ability to plan coherently and forcing them to make risky bets on the future.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Theophilus Acheampong reports a relationship with Ghana Volta Aluminium Company that includes: consulting or advisory.

Data availability

Data will be made available on request.

Acknowledgements

This work was supported by a British Academy Postdoctoral Fellowship held by Matthew Tyce [PF20\100105].

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[17] According to letters published online by A Rocha Ghana, a Ghanaian NGO that has led resistance to the government's plans to mine in Atewa, some multinational corporations – including packaging company Tetra Pak and homeware manufacturer Schüco – have committed outright to not using any aluminium Atewa-linked bauxite, while BMW has stated it "will not accept aluminium in its supply chains that originates from the Atewa Forest" if mining practices are not "in line with the Convention on Biological Diversity, the UNFCCC Paris Agreement on Climate Change and Ghana's voluntary national contributions to towards the UN Sustainable Development Goals." See: https://www.change.org/p/atewa-forest-for-national-park-not-mining-saveatewa-petitioning-president-nakufoaddo-of-ghana/u/28519143.

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