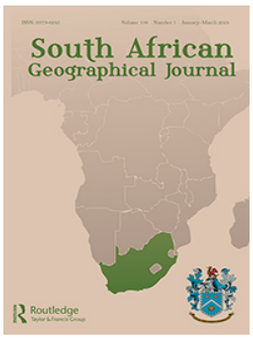

South African Geographical Journal

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rsag20

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To cite this article: Thandiwe Chidzungu & Alex Wafer (2024) Can Social Impact Assessments (SIAs) be a sustainable strategy to address the skills development gap and community sustainability challenges in Just Energy Transition (JET) policy decision-making? Evidence from the South African mining communities of Kriel and Carolina in Mpumalanga, South African Geographical Journal, 106:1, 89-108, DOI: 10.1080/03736245.2023.2214537

To link to this article: https://doi.org/10.1080/03736245.2023.2214537

SOUTH AFRICAN GEOGRAPHICAL JOURNAL
2024, VOL. 106, NO. 1, 89–108
https://doi.org/10.1080/03736245.2023.2214537

Routledge
Taylor & Francis Group

Can Social Impact Assessments (SIAs) be a sustainable strategy to address the skills development gap and community sustainability challenges in Just Energy Transition (JET) policy decision-making? Evidence from the South African mining communities of Kriel and Carolina in Mpumalanga

Thandiwe Chidzungu and Alex Wafer

Department of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg, South Africa

ABSTRACT

South Africa's Just Energy Transition (JET) from coal to renewable energy in response to climate change mitigation policies comes packaged with social costs that these mitigation policies tend to overlook, considering their focus on carbon emission reduction. The paper argues that Social Impact Assessments (SIAs), a component of Environmental Impact Assessments (EIAs) focused on social impact mitigation, can be a long-term approach to closing the social cost gap. Against this backdrop, the paper's arguments were informed by a literature analysis on SIAs and the Just Energy Transition, semi-structured interviews, and surveys with 230 participants, including experts, from Kriel and Carolina in Mpumalanga, South Africa. The findings point to skills development barriers such as poor school attendance, a lack of alignment between existing curriculum design and labour markets, and students' low aptitude for STEM subjects. It also identifies community sustainability issues linked to poor public participation, gender inequalities in land reform and economic participation, and culturally disruptive displacements that will intensify as the energy shift unfolds. The paper submits that SIAs, if incorporated into mainstream energy transition planning, might be a long-term approach to mitigating societal costs and can support socially responsible policies.

ARTICLE HISTORY
Received 4 July 2022
Accepted 11 May 2023

KEYWORDS
Social Impact Assessments; Just Energy Transition; Skills Development; Community Sustainability; South Africa

Introduction

In response to the Paris 2015 Climate Change Agreement, there have been increasing calls for a global energy shift, supported by climate change mitigation policies (Cardoso & Turhan, 2018). South Africa has pledged to transition from coal to the Renewable Energy (RE) sector, supported by such policies as the Renewable Energy Independent Power Procurement Programme (REIPPPP), the Carbon Tax, and the National Climate Change Response White Paper (NWRPCC)

CONTACT Thandiwe Chidzungu 1312738@students.wits.ac.za Department of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg, South Africa

(Burton et al., 2019). Nevertheless, these policies mostly prioritise reducing carbon emissions, resulting in the improvement of the biophysical environment at the expense of the social costs of the energy transition (Glynn et al., 2020). Notably, social costs associated with skills development bottlenecks and community sustainability have been identified as the JET from coal to the RE sector ushers in new job designs (International Labour Organization, 2019; Munnik, 2019; Semelane et al., 2018).

The new job designs in the RE sector will require professionals in Science, Technology, Engineering, and Math (STEM) fields, which are scarce skills in South Africa (Jain & Jain, 2017; Semelane et al., 2018). Furthermore, these jobs are difficult to fill because qualified foreigners who can bridge this skills gap find it difficult to easily obtain legal employment rights in South Africa due to the country's strict work visa regulations (World Bank Group, 2022). These are part of a myriad of issues that would be discussed and that will affect skill development as the JET unfolds. On the other hand, community sustainability issues linked to job losses and the exclusion of communities have also been identified (Munnik, 2019). These two concerns are associated with a lot of social costs, ranging from STEM skills bottlenecks to the loss of income, the temporary nature of jobs in the RE sector during construction, disruption of traditional livelihoods and culture, increased poverty, and the absence of community voices in policy decision-making (Munnik, 2019; Piggot et al., 2019).

These numerous social issues will necessitate a socially sustainable approach to JET policy decision-making, which is currently lacking in energy studies (Glynn et al., 2020; Sovacool et al., 2018). Given the growing concerns about overlooked social costs, can Social Impact Assessments (SIAs) be a sustainable strategy to address the skills development gap and community sustainability challenges in JET policy decision-making?

SIAs are a product, but a weaker component, of EIAs that focus on societal issues and were formalised in 1997 under the requirements of the Environment Conservation Act (ECA) of 1989 (South Africa, 1989; Du Pisani & Sandham, 2006). According to South Africa (1998), the National Environmental Management Act (NEMA), which includes people in its definition of the environment, specifies that SIA is fully incorporated into EIAs (cited in Kruger & Sandham, 2018, p. 2). SIAs' social profiling of communities and collaborations with industry, academia, and regulatory agents (Vanclay, 2003) could afford them the opportunity to facilitate skills need assessments in line with labour market demands that can bridge the skills gap. Additionally, according to Vanclay (1999), SIAs facilitate an understanding of the communities' political systems, advance equity and democratisation, consider the existence of various stakeholder interests, and identify mitigating actions that could improve community sustainability (cited by Vanclay, 2003).

Therefore, to comprehend the potential role SIAs could play in bringing a socially sustainable strategy to JET policy decision-making in the South African context, the paper first recognises some of the challenges in skill development and community sustainability as the energy shift unfolds. This is followed by the methodological considerations. The study's findings on skills development and community sustainability and the role of SIAs, with reference to Kriel and Carolina mining communities in South Africa's Mpumalanga province, which were the research study sites, are presented in the third section. This is followed by a discussion of the findings juxtaposed against SIA's role

in dealing with these social costs as the JET unfolds. A conclusion and suggestions for further research are given at the end.

The skills development gap in South Africa's just energy transition from coal

In South Africa, the shift to the RE sector will disrupt the current skill set, necessitating the development of new skills (Jain & Jain, 2017). This section unpacks issues related to the availability of STEM skills and the roles of educational institutions and industry in the context of JET skills development.

Skills development bottlenecks could be linked to the rapid expansion of the RE sector without adequate planning and the general shortage of expertise in the science and engineering fields, coupled with limited skills transfer to local workers. (International Labour Organization, 2019; Semelane et al., 2018). Responding to such a rapid surge in skill demand can be challenging, given that the minimal time between recognising a need and producing new graduates depends on the course duration, which is usually 2 years or more (International Labour Organization, 2019). In the United States, Haerer and Paratson (2015) found that the fossil fuel sector provided adequate time for the RE sector's skills development, and this required an understanding of the context in which JET will take place, which SIAs could provide (Aucamp & Lombard, 2018).

In COBENEFITS (2022), the Institute for Advanced Sustainability Studies [IASS]/ Institute of Engineering and Technology [IET]/Council for Scientific and Industrial Research [CSIR] depict gender disparities in employment in South Africa's coal sector in favour of men, with female employment estimated at 31% in Eskom and 21% in coal mining, respectively. This points to women's marginalisation, which will extend to the acquisition of new skills in the low-carbon economy. The marginalisation of women in skills development is not only observed in South Africa; in Canada, women and migrants are excluded from the JET reskilling worker compensation schemes, preventing them from obtaining the necessary skills upgrades for the RE sector (Piggot et al., 2019). If included in JET skill development policy decision-making, SIAs could facilitate gender equity considerations as an important component of impact assessment (Vanclay, 2002).

Mpumalanga is anticipated to create solar and wind-related jobs in South Africa (Bulbulia, 2022). This will demand the expertise of electrical, computer, and construction engineers, as well as rooftop solar developers and wind turbine technicians, etc. (Semelane et al., 2018). Notably, most of the technology used is imported, and South Africa lacks the ability to do research and development to ensure that imported technology is localised to promote local skill development in the low-carbon economy (Popp et al., 2011).

Technical Vocational Education and Training (TVET) colleges and industry could be a way to help coal workers retrain for jobs in the RE sector (Semelane et al., 2018; Ward et al., 2020). For example, at the industry level, Eskom's four key contracts relating to the Sere Wind Farm provide technical training in wind energy projects and have allowed local workers engaged by Eskom to take over the maintenance and operation of the Sere Wind Farm (Ward et al., 2020). The support for education, in conjunction with an emerging hub for solar energy, could support local skills development.

Including SIAs in JET skills development policy decisions could ensure that all planned developmental projects and their assessments build the social and human capital of local communities (Vanclay, 2003). Sanz-Hernández et al. (2020) express that while it is imperative to consider skills development needs related to low-carbon technology as the JET unfolds, there is a need to consider community sustainability issues therein (Sanz-Hernández et al., 2020).

Community sustainability issues in South Africa's just energy transition from coal

Mpumalanga is one of the largest sulphur dioxide hotspots in the world, contributing to climate change (Vlanios, 2019). Climate change leads to low precipitation, which results in severe drought, affecting subsistence agriculture and thereby affecting food security (World Bank Group, 2022). Drought is increasing in Africa, the Mediterranean region, North and South America, and Southeast Asia (Koubi, 2019). The increase in global temperatures is also causing more frequent and intense rainfall events in Europe, North America, and Central America (Koubi, 2019). Intense rainfall results in floods, which cause infrastructure destruction, the spread of waterborne diseases, and the loss of economic activities, all of which have an impact on community sustainability.

In line with the need to reduce carbon emissions, hence climate change and its environmental consequences, as well as land, water, and air pollution from coal mining, the move away from coal to RE sources (wind, solar, etc.) brings an improvement to the biophysical environment (Durrenberger, 2015; UK Local Government Association, n.d.). This improvement in environmental sustainability increases agricultural productivity, thereby increasing food security, and this in turn enhances community sustainability.

However, Maia et al. (2011) point out that the use of toxic chemicals such as mercury, lead, and cadmium in the production of some solar PV components and the high water requirements for large-scale installation compromise environmental sustainability. They further posit that solar PV necessitates large stretches of land to install the panels, displacing and disrupting local populations' cultural practises and livelihoods, thereby affecting community sustainability. On the other hand, the seasonal natural variation in wind that affects wind energy viability and requires the use of coal to provide stability to the energy supply also affects environmental sustainability (Maia et al., 2011).

Considering the above impacts, as the JET unfolds, SIAs recognise the interlink between the environmental and social impacts and, hence, could bring the social costs to the fore if given equal standing in EIAs during JET policy decisions (Du Pisani & Sandham, 2006). Furthermore, SIA practitioners have a legitimate mandate that incorporates socio-cultural considerations into the developmental project (Esteves et al., 2012), which could fuel culturally responsible JET policies.

It has also been established that most of the components used for RE in South Africa's JET are imported (Semelane et al., 2018), which has a negative influence on job creation. However, a study by COBENEFITS (2022, p. 4) states that *'the introduction of wind and solar in Mpumalanga, South Africa, will result in the creation of up to 43,000 jobs in solar PV and 28,900 jobs in wind energy by 2030'*. However, these construction jobs are temporary in nature and hence provide temporary income, thereby impacting community sustainability. In the United States, China, and other parts of the world, employment surged following the JET programme (Junjie et al., 2017; Snyman et al., 2020). Studies,

however, show that some of the jobs are not in the same geographical location as the positions in the fossil fuel industry, thereby increasing unemployment in these areas (Burton et al., 2019; Haerer & Paratson, 2015). In China, a 7-year estimate up to 2020 points out that about 2.3 million coal miners affected by JET would require re-employment (Hao, 2019).

The temporary nature of jobs, combined with the anticipated job losses in the coal industry and the fact that some of the jobs are not in situ, will be disastrous in countries like South Africa. Considering that coal miners support at least three dependants in Mpumalanga, which is earmarked as a Renewable Energy Zone (REZ) in South Africa (Burton et al., 2019; Munnik, 2019), this will increase poverty, putting pressure on the government's social grants, which came under immense pressure at the advent of COVID-19 in 2020, where they stood at 1535 614 in 2020 and increased to 1 591 184 in 2021 (SASSA, 2019/2020; SASSA, 2021/2022). All these issues will impact community sustainability.

Aucamp and Lombard (2018) found that due to power struggles and resource shortages associated with poverty, affected groups are prevented from fully engaging in decision-making, which has a direct impact on the impact assessment process. The exclusion of impacted communities from JET decision-making in South Africa and in countries like China and Kenya has been identified as an impediment to JET

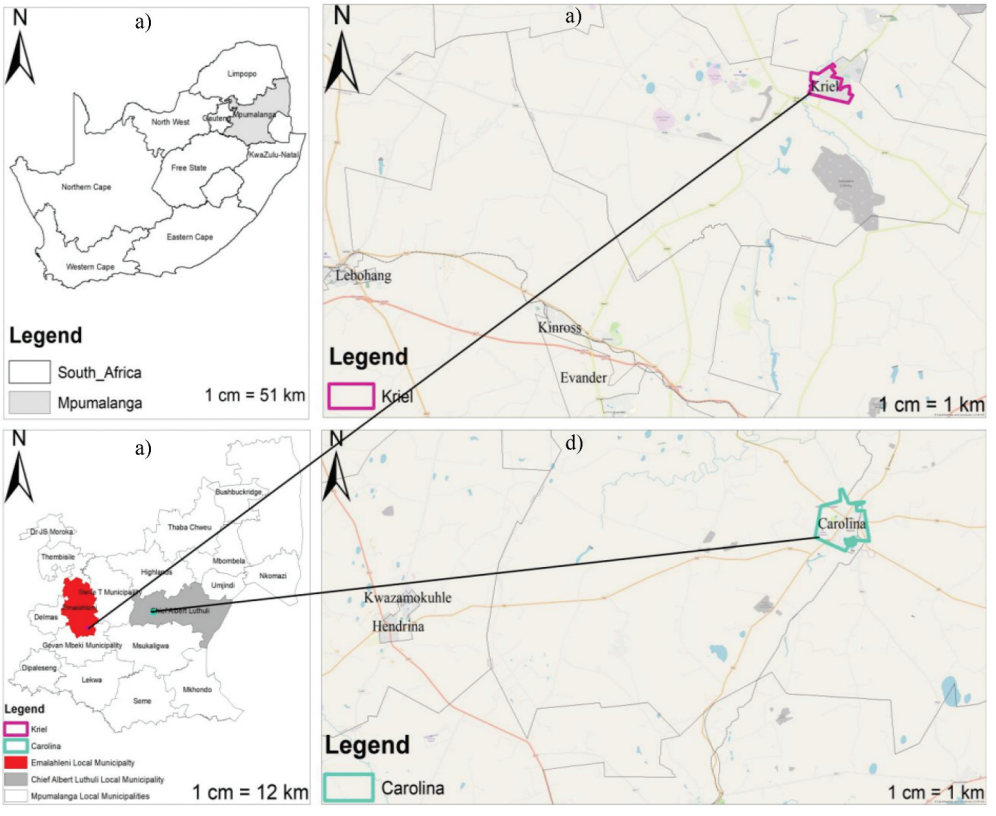

Figure 1. The location of Carolina and Kriel towns in Mpumalanga, South Africa. Source: Selahle (2022)

decision-making (Casey, 2020; Lingxuan et al., 2012; National Planning Commission, 2019). In South Africa, this is exacerbated by the fact that the state is more aligned with the interests of industry than its citizens (National Planning Commission, 2019). SIAs could identify interested and affected people and coordinate the participation of stakeholders (Vanclay, 2003), hence promoting social dialogue and, in turn, socially oriented policies. Sarto (2018) posits that social dialogue is crucial for supporting workers and communities to manage the transition in a just manner.

Methodological considerations

Study area

This study is based on the authors' in-depth qualitative research on the JET from coal to renewable energy in South Africa's coal industry from 2020 to 2022. Two coal mining communities, Kriel and Carolina, in the Mpumalanga province of South Africa, were identified as study sites for the research. This was due to their high environmental footprints emanating from coal mining and their poor socioeconomic conditions: poor educational attainment impacting skills development; high unemployment; hence poverty impacting community sustainability (Chidzungu, 2019; Kriel Social and Labour Plan (SLP), 2014–2018). Figure 1 shows the location of the two study sites within the Emalahleni and Chief Albert Luthuli local municipalities in Mpumalanga, South Africa.

Materials

Two software programmes were used to process, visualise, and analyse the data. These included Microsoft Excel for the graphic presentations of the collected primary and secondary data and ArcGIS 10.5 for the creation of the map.

Methods

Sampling

The community participants came from the field visits to the two locations between August 2020 and October 2021, as well as from their attendance at community forums and conferences on coal mining in Mpumalanga. They were sampled using systematic, random, and convenient sampling as deemed fit. Community members and mine employees residing in the two study areas made up the community groups. The expert participants came from the existing networks in academia and the coal mining sector, alongside virtual platforms like webinars on JET and conferences on the RE sector attended by the authors, as well as LinkedIn profiles of RE and coal mining experts. The experts were sampled using purposive and snowball sampling techniques. We conducted in-person and online semi-structured interviews with 30 community members and 20 experts, as well as questionnaire surveys with 140 community members and 40 experts.

Data acquisition

A qualitative research design, alongside quantitative techniques, was used to collect primary and secondary data. A total of 48 research papers, reports, and policy documents on SIAs in large-scale development projects were consulted for secondary data, along with literature reviews on community sustainability and skill development in the context of JET in South Africa and other countries. The use of the questionnaires provided primary, quantitative, and qualitative data, while the semi-structured interviews allowed for open-ended responses and validated the quantitative, closed responses from the questionnaires. The questionnaires also allowed for the reverse coding of questions, which allowed for checking if respondents were giving consistent answers, increasing reliability. Community sustainability challenges, skills development, and the possibility of SIAs as a sustainable strategy in the JET were among the themes discussed in the data collection instruments. An ethics clearance certificate to do the research was obtained from the Witwatersrand University Ethics Department before the data collection commenced. Participants were informed about their rights to anonymity, confidentiality, and consent before data collection could begin, and relevant permission letters were obtained from relevant authorities.

Data analysis

Conceptual data analysis was used for analysing qualitative data from interviews. All the data was considered, then taken apart and reconstructed into more meaningful categories that spoke to the research questions. The analysis of the quantitative data from the survey questionnaires involved checking, editing, assembling, coding, and transforming.

Results

The study findings, in line with recent studies done in JET, suggest that the energy shift results in social costs that are not yet fully addressed in JET policies and scholarship (Sovacool et al., 2018; World Bank Group, 2022). The section presents the findings on the social costs of the skills development gap and community sustainability, and the role of SIA in JET policy decision-making in this regard in the Carolina and Kriel mining communities.

The skills development gap in Kriel and Carolina mining communities and the role of Social Impact Assessments

Understanding the labour market and the age, gender, race, skills, and educational profile of the workers and communities is a crucial aspect of JET skill development policy decision-making.

According to study participants, the transition to a low-carbon economy will lead to new job designs that call for a revamping of some of the current skills in the coal sector. As the JET progresses, they predict that this will affect three different age groups of coal miners. Workers over sixty will find it challenging to retrain and be included in the RE industry due to age limitations and the technologically complex requirements of the sector. The hardest hit will be those over forty who are firmly rooted in these areas because they have made significant investments and honed their expertise in the coal

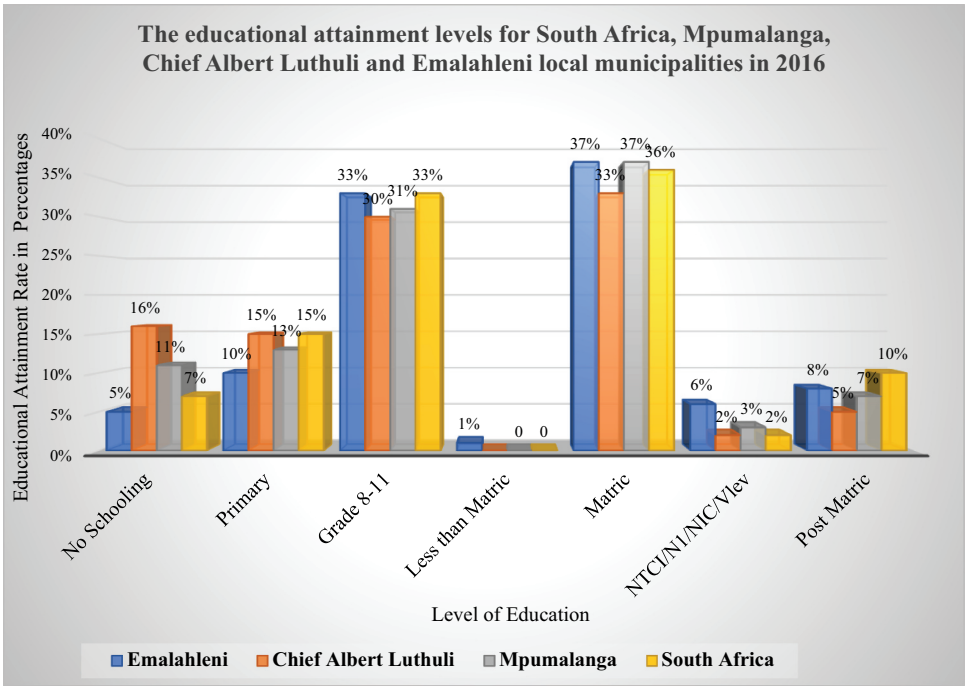

Figure 2. The educational attainment levels for South Africa, Mpumalanga, Chief Albert Luthuli and Emalahleni local municipalities in 2016. Source: Adapted from the Community Survey (2016)

industry. Younger people under the age of forty who have portable skills, that is, job skills and abilities that can be applied in several contexts and are based on networking, entrepreneurship, and other aspects (Milazzo, 2012), will be less affected. These young people are the most sought-after for new skill upgrades or reskilling.

Apart from the age groupings, some of the participants argued that they are contract workers who will not be given the opportunity to retrain by the parent firm once their contract ends. Women raised related issues, pointing out that they will be excluded from skill upgrades in the RE sector as non-coal mining employees. According to one participant:

> *As women, we find it difficult to get employed by the mines because, as diesel mechanics, we can only work under certain conditions in terms of the machinery that is compatible and appropriate. Mines do not want to incur additional expenses as these machines are expensive, and if they are found without them by safety officers, they are fined. So how would we be considered for reskilling in renewable energy if we were not employed by these mines (Community interviewee C1, 2021)?*

The study participants and the reviewed literature posit that SIAs are critical for understanding the impacted communities' population, education, skill sets, age, and gender considerations, which mainstream JET policy could overlook.

Furthermore, findings of a desktop study conducted in Emalahleni and Chief Albert Luthuli local municipalities, which house Kriel and Carolina communities, show that five percent of the population in Emalahleni had no formal schooling, and this figure was higher in Chief Albert Luthuli local municipality, standing at

Table 1. The race distribution of Kriel Power Station employees' skill sets in 2014.

Positions	Africans	People of Colour	Indians	Whites
Senior management	5	0	0	1
Professionally qualified and experienced specialist and mid-management	27	0	0	24
Technical and academically qualified workers in junior management	172	0	3	75
Semi-skilled and discretionary decision-making	61	2	1	17
Unskilled and defined decision-making	483	1	0	8
Non-permanent employees	1	0	0	4

Source: Adapted from the Kriel Social and Labour Plan (2014–2018)

16 percent. Those with less than a matric were 1% in Emalahleni and 0% in the other three levels of governance. Matriculation rates for both local municipalities were also low, not even reaching a 50% pass rate. Those with degrees or higher were less than 10% for both municipalities, as shown by the data in Figure 2. There were few differences in matriculation attainment at the local, provincial, and national levels, demonstrating a country-wide low matriculation pass rate (Community Survey, 2016).

The results of the interviews qualitatively back up Figure 2's statistics, suggesting that young people in the study areas drop out of school before matriculation, as shown by the high percentages of people with grade 11 going down. Participants also pointed out that most of the dropouts leave school to go to work in the mines as part of the unskilled labour force. Furthermore, participants expressed that most students have a low aptitude for STEM subjects, especially female students. They contended that SIA reports could bring to light contextual issues regarding pre-existing skills and educational dynamics that policymakers should be aware of as part of reskilling policy guidelines imposed on new businesses.

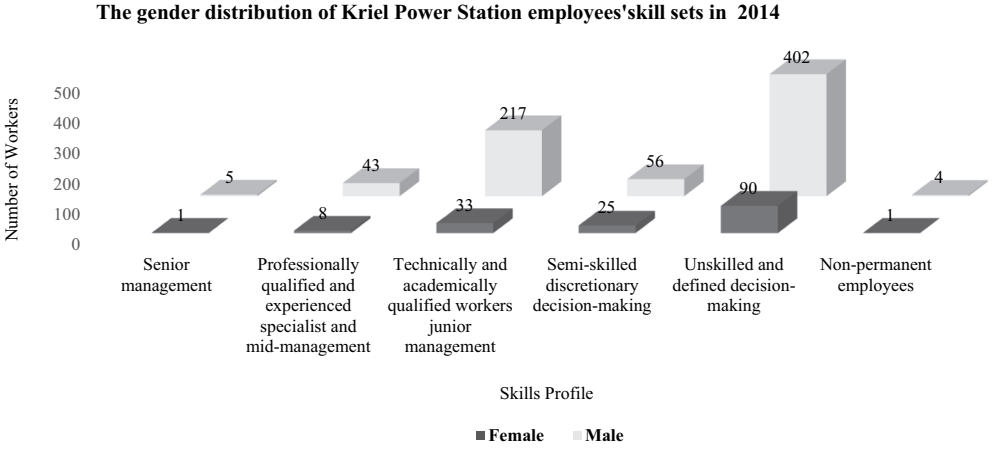

Figure 3. The gender distribution of Kriel Power Station employees' skill sets in 2014. Source: Adapted from the Kriel Social and Labour Plan (2014–2018)

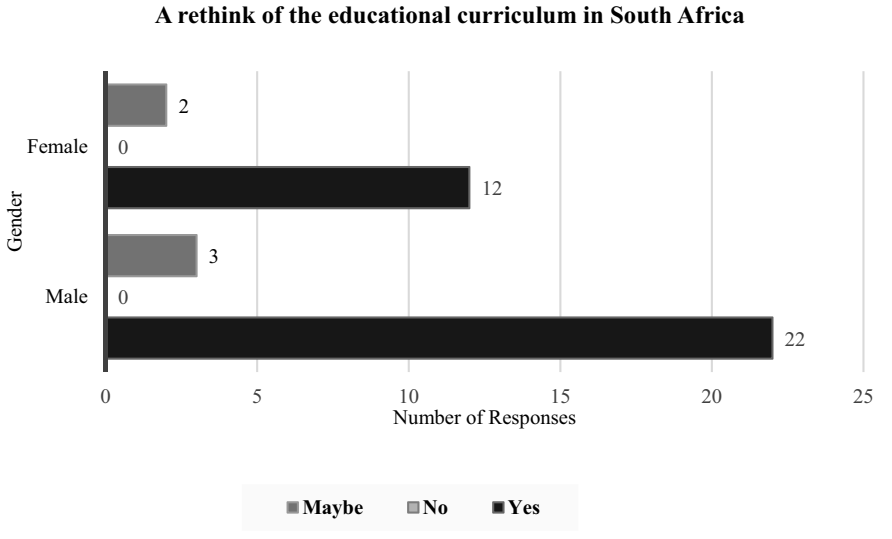

Figure 4. A rethink of the educational curriculum in South Africa. Source: Authors' Own, 2022

Some participants condemned the educational system, positing that the university model is more theory-oriented and does not equip students for technical roles. According to the Kriel Social and Labour Plan (2014–2018), the Kriel Power Station in the Kriel community committed to allocating 5% of the leviable amount on technical skills development, including artisans, internships, learnerships, apprenticeships, bursaries, and literacy and numeracy skills for employees and community members. Electricians, fitters, boilermakers, diesel mechanics, and riggers were trained between 2014 and 2018 (Kriel Social and Labour Plan, 2014–2018). However, upskilling is required, as some of the skills are transferable and others will require complete retraining. Race distribution inequalities in the skills status quo in Kriel were also identified, See Table 1.

From Table 1, a high number of whites were in mid-management compared to Indians and people of colour, who were not represented at all. Africans were also less represented, considering that whites come from a minority group compared to them. Indians were found at the junior management level, and more Africans were in the unskilled group with defined decision-making. Gender considerations were also brought to the fore. See Figure 3.

More males were at the senior management level, had technical skills, and were more qualified compared to females. These disparities reflect a gender gap in skill development and employment that will encroach on the RE sector. Given the general low levels of skill, a poll to find out whether South Africa should rethink its curriculum was conducted with 39 experts. 34 responded 'yes', supporting the need for a rethink, while 5 said 'may be' and none said 'no'. As seen in Figure 4, of the five, 3 were men and 2 were women, and of the thirty-four, 12 were female and 22 were male, exhibiting gender imbalances even in public participation surveys.

Findings state that through SIAs' multistakeholder collaborations with industry and educational institutions, they could facilitate skills needs assessment in line with educational institutions and labour market demands, hence guiding curriculum

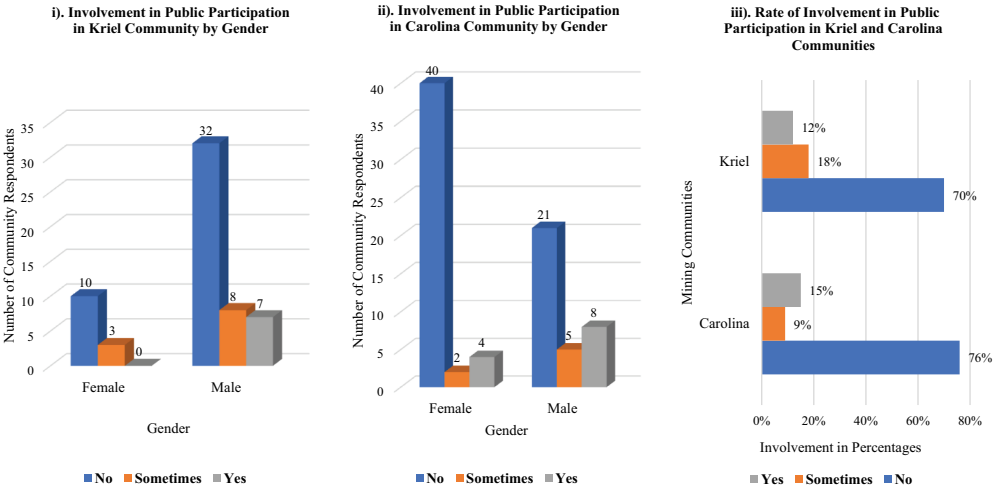

Figure 5. The involvement of communities in public participation during energy projects in Carolina and Kriel. Source: Authors' Own, 2021

implementation suitable for the low-carbon economy, during JET skills development policy decision-making.

Community sustainability issues in Kriel and Carolina mining communities and the role of Social Impact Assessments

At the heart of community sustainability are the impacts on the biophysical and social environment that the JET brings. The study found that JET will bring an improvement to the biophysical environment through carbon emission reduction, which will in turn impact the social environment positively. In addition, JET will bring cost-effective electricity options through the RE sources. However, it also comes with adverse social costs for community sustainability.

On the other hand, the participants highlighted a lack of public participation in developmental projects during interviews, and this was backed up by the survey that was conducted. See Figure 5.

An average of 73% of the participants said they were not involved in public participation, with only a small percentage saying they were actively or sometimes involved. Males have been more involved in, or have sometimes participated in, public participation in both areas than females. This impacts effective social dialogue during decision-making. One participant argued that:

> *SIAs can facilitate the enactment of community-centred policies that will compel the RE industry to involve communities in decision-making using a bottom-up approach and move away from government and industry-centred approaches (E. interviewee 7, 2020).*

Some female participants raised issues of lack of water and land rights linked to unmanaged land reform policies that will continue to impact their participation in agriculture even as the JET unfolds if they are not consulted to raise these concerns. The reviewed literature states that SIAs consider contextual issues in the project

Figure 6. Solar panels on arable land in Kriel. Source: Fieldwork Material, 2022

environment that a project did not cause but that can affect it; hence, they could bring land reform issues to the fore in JET decision-making.

Other participants predicted wanton job losses, transient jobs, and population migration to other locations in search of alternative sources of income as the JET progresses. Participants argued that SIA can influence policies that will ensure continuity of life in JET-impacted areas. Others pointed to reduced investments in Social Labour Plans (SLPs) initiatives and the suspension of mining-related services like water supply. Findings state that SIAs teams could align the JET projects with Local Economic Development (LED), Integrated Development Plans (IDP), and SLPs and integrate them with community needs to influence government policy.

Participants from Kriel and Carolina communities expressed concerns about the potential relocation of their traditional homes and gravesites to make space for large-scale renewable energy infrastructure, which they fear may disturb their cultural heritage and occupy arable land. See Figure 6, which provides a snapshot of what a fully-fledged solar PV erection could look like.

The study and the reviewed literature found that SIAs do away with the world of command and control, facilitating open engagement with communities, promoting cultural considerations, and facilitating an Impact Benefit Agreement (IBA) between the developer and impacted stakeholders if such relocations are undertaken.

The findings also demonstrate the vast value chain of mining, which, among many others, includes transportation, brickmaking, and the informal sector. See Figure 7.

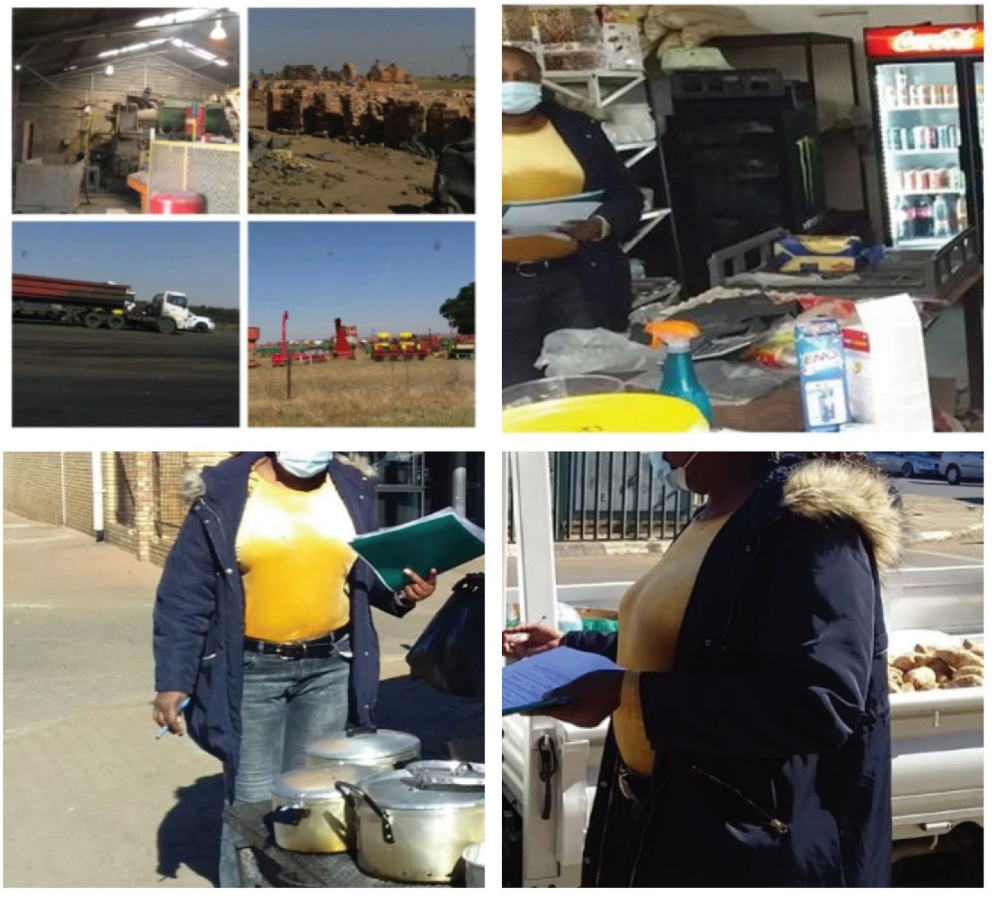

Figure 7. Small formal and informal industries in Carolina. Source: Authors' Own, 2021

Overall, the expert participants during the interviews expressed that SIAs could be a sustainable strategy for addressing the social costs of the JET. This was confirmed by the survey results of the 39 experts who responded to the question. See Figure 8.

Considering the above findings, we submit that SIAs could fuel procedural, rectificatory, and distributive justice. Procedural justice will ensure that all impacted players, especially impacted communities and workers, have a role in contributing to JET policy decision-making. Distributive Justice will ensure that there is an equitable distribution of community benefits and skills acquisition across class, race, and gender. Rectificatory Justice will ensure the correction of the previous injustices within the coal sector before they encroach on the low-carbon economy.

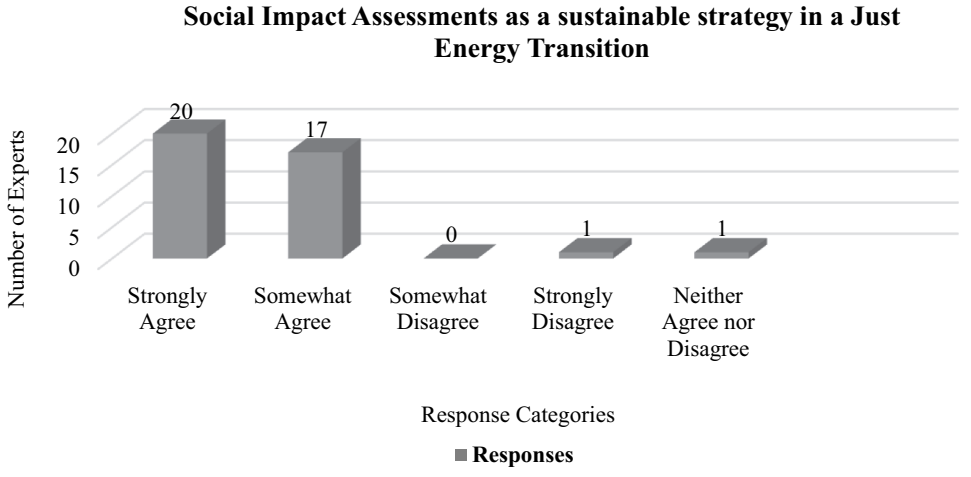

Figure 8. Social Impact Assessments as a sustainable strategy in a Just Energy Transition . Source: Online Surveys, 2021

Making sense of the role of SIAs in the skills development gap and community sustainability in the Carolina and Kriel mining communities

This section discusses the role of SIAs with reference to the findings on the skills development needs and community sustainability status quo in the study areas as the JET unfolds.

SIAs' role in bridging the skills development gap

Our findings reflect a failing educational system from primary to tertiary levels, with high pre-matric dropout rates, low performance, low aptitude, and a lack of interest in STEM courses among students, particularly among girls. Findings of the study as well as reviews of the literature depict that SIA teams work with regulatory agencies, industry, grassroots organisations, communities, and academia and can therefore influence educational policies (Vanclay, 2003). These policies could pave the way for dropout adult literacy learnerships tailored to the demands of the RE sector.

We argue that as part of skills development gap mitigation strategies, SIAs can support the use of Conditional Cash Transfers (CCTs) to encourage female high school and college students to continue their education and pursue STEM subjects. CCTs have pre-determined criteria aimed at enhancing specific outcomes like school attendance (Samson et al., 2010). Financial incentives are used in Guyana to encourage the private sector to focus on building green TVET skills (International Labour Organization, 2022), which could be ideal to support the local skills development efforts in TVET colleges in the study areas and country-wide.

The Kriel Power Station's skill development programmes include learnerships for both coal workers and community residents (Kriel Social and Labour Plan, 2014–2018). However, some of the skills will need upgrades suitable for the RE sector. Participants criticised the current curriculum, saying that it is theory-focused and does not give

students training in practical skills, hence a different vocational approach to training is needed. SIAs, through the contribution of the mining and energy industries, can facilitate skill development and capacity building in the impacted communities and advise on appropriate institutional arrangements for all parties (Aucamp & Lombard, 2018; Vanclay, 2003).

The study found that women are excluded from skill upgrades in the RE sector as non-coal mining employees. Given SIAs' grassroots level engagement, where women are concentrated, we believe that efforts to form a task force led by women to investigate RE industry skills training for women could be facilitated. Such action plans can feed into SDG 5: By 2030, '*achieve gender equality and empower all women and girls*' (United Nations, 2015, p. 21).

The study's findings reveal that different age groups are impacted differently and hence need age-specific skill development interventions. SIAs apply age considerations in their evaluations and could bring this to the fore in JET skill development policy decisions (Vanclay, 2002). SIAs can press for the development of youth-focused innovation centres and research institutes as part of age policy considerations. This could aid in achieving SDG 8, clause 8.6, which calls for '*substantially reducing the number of young people who are not in school, not in employment, or training by 2020*'. (United Nations, 2015, pp. 19–20).

The study recommends portable skills training for the elderly and people between the ages of 40 and 65. We contend that SIAs' collaborative platforms, which may include investors, banks, and agricultural extension workers, may, for example, help small-scale farmers obtain financial support and transferable skills through business incubators. South Africa's RE sector can glean lessons from the Green Exchange in the United States, which offers portable skills through business incubators designed exclusively for green start-ups (International Labour Organization, 2016).

SIAs' role in community sustainability

The findings reveal that the biophysical impacts of fossil fuel burning, climate change, and JET have subsequent social costs and opportunities that impact community sustainability. It points to improvements in environmental health, hence food security, and community health, as well as the provision of cheaper forms of energy that transitioning away from coal to a low-carbon economy could contribute to. Sarto (2018) gives the example of India, where JET provides a cheaper off-grid solar and battery solution and more effective access to electricity for off-grid communities. SIAs bring to light the interlink between the biophysical and social costs of the JET and their equal importance, which should be considered in JET policy decision-making.

Findings further point to transient positions, job losses, and the reduced viability of businesses along the coal value chain. Burton et al. (2019) argue that job losses for coal workers pose risks to livelihoods, which will worsen as the JET unfolds. This will increase poverty, putting a strain on social protection that has been increasing since COVID-19 in Mpumalanga (SASSA, 2021–2022). SIAs could recommend the use of Unconditional Cash Transfers (UCTs), which can include social pensions, child support payments, and disability grants (Samson et al., 2010). Non-cash contributions in the form of psychosocial support can also be provided to the impacted workers and communities, given the stress

imposed by the loss of livelihoods. Aucamp and Lombard (2018) substantiate this mitigation role of SIAs, expressing that social protection is one of the key values of SIAs.

The findings indicate a lack of public participation that may lead to human rights violations and, hence, affect the acceptance of JET and its viability. SIAs could promote open communication between stakeholders, consider human rights, and uphold the principles of Free Prior Informed Consent (FPIC) during JET decision-making (Esteves et al., 2012). Participants further identified cultural disruption linked to community displacements to make way for the erection of RE facilities. In line with Vanclay (2002), the study argues that SIAs could provide cultural context to policy decisions and develop an understanding of local community values, particularly how they relate to the planned intervention. As demonstrated by the reviewed literature, RE jobs may not be in the same geographic area as coal jobs (Burton et al., 2019), resulting in migration from the impacted areas. SIAs, as part of policy advocacy, could recommend tax incentives for businesses to invest in these areas to ensure community stability and sustainability.

Participants identified a lack of land and water rights, emanating from an unmanaged land reform process, which will affect women's livelihoods in agriculture. In line with Saunders (2003), we contend that SIA teams collaborate with government oversight bodies and grassroots groups that represent women, which can enable them to mobilise for the enforcement of laws like the Extension of Security of Tenure Act, which accords women the same land rights as men, and potentially influence JET policy decisions in this regard. Reidar (2018) confirms this mitigation role that SIAs can play in policy enforcement in land reform, expressing that SIAs consider '*contextual issues*', which are risks in the project environment that become associated with the project and could impact community sustainability but are overlooked in policy.

Conclusion

Our analysis identified a biophysical bias in JET policies in response to climate change mitigation, overlooking the social costs for impacted workers and communities. As demonstrated by the findings and the reviewed literature, SIAs consider the biophysical and social environments in unison, which could balance out JET policy decision-making. Findings from the study show a skills development gap and community sustainability issues as the JET unfolds, linked to changes in job design and coal mine closures. The study findings posit that the South African curriculum design lacks a strong STEM foundation and favours theory over practice, limiting the development of technical abilities within JET skill development. Furthermore, a high proportion of pre-matriculating dropouts, poor school attendance, a pro-male gender bias, and poor aptitude in STEM courses in schools and colleges were identified as barriers to skills development in the two study areas and in South Africa in general. The SIAs teams, through their collaborative engagements with educational institutions, communities, legislators, and industry, could help facilitate the design of vocational educational policies aligned with the RE sector's labour market expectations that could span the skills gap. Furthermore, the inclusion of gender and the marginalised in all SIA assessments can lead to local action plans, such as CCTs, that could encourage the study of STEM subjects in vocational institutions, particularly among female students and school dropouts. Community sustainability issues, such as poor public participation processes, loss of traditional livelihoods, job losses in the coal sector and related businesses, age group-distinct job

loss impacts, the temporary nature of jobs in the construction stage, cultural disruptions, and an unmanaged land reform process as the JET unfolds, were identified. As demonstrated by the findings and reviewed literature, SIAs could help mitigate such impacts through promoting active citizen participation, leveraging indigenous and technocratic knowledge on potential economic activities, and bringing cultural and age concerns to the attention of policymakers. Moreover, SIAs could facilitate the management of contextual issues such as land reform that affect women who do not have access to land and water rights by advocating for the enforcement of the Extension of Security of Tenure Act. In light of these findings, we submit that SIAs could be a sustainable strategy to help address the skills development gaps and community sustainability issues in JET policy decision-making, and we submit that SIAs as part of impact mitigation should recommend:

- The use of CCTs to promote school attendance and the study of STEM subjects.
- Funding support and a rethink of the educational curriculum design that is aligned to labour market demands in the RE sector.
- Interprovincial worker transfer programmes to support the retraining of workers in the RE sector.
- Gender, race, and age responsive JET skills development policies.
- Community-led public participation and cultural considerations in JET impact assessments.
- The use of UCTs, business incubators, and non-cash contributory social protection such as psychosocial support for livelihood losses and emotional stress thereof.
- Reinvestment initiatives based on existing economic potential.
- A rethink and enforcement of land reform policies.

Acknowledgments

We express our gratitude to the participants from Carolina and Kriel in Mpumalanga, South Africa, and the experts who took part in the study.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Thandiwe Chidzungu http://orcid.org/0000-0001-6643-4707
Alex Wafer http://orcid.org/0000-0002-5059-1852

Research in the future

Future studies on integrating SIAs into mainstream policies in the context of a JET should pique the interest of SIAs scholars, policymakers, and energy experts.

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