

EVI-SICEE-CASE STUDY REPORT-01

Women- and Youth-Led Clean Energy Enterprises in South Africa: Challenges & Enablers Affecting Scaling

JUNE 2026

Ann Numi ¹, Rebecca Hanlin ²

African Centre for Technology Studies (ACTS), Nairobi, Kenya¹

University of Johannesburg, South Africa²

Design and layout by Peter Ongalo



Authors

Ann Numi,
Research fellow
Science, Technology & Innovation, Knowledge and Society program
African Centre for Technology Studies (ACTS), Nairobi, Kenya

Prof. Rebecca Hanlin
Professor of Innovation and Sustainable Development
SARChI-Trilateral Research Chair in Transformative Innovation (TRCTI)
University of Johannesburg, Johannesburg, South Africa



SARChI
TRANSFORMATIVE
INNOVATION, 4IR
AND SUSTAINABLE
DEVELOPMENT



Table of Contents

1. Background.....	4
2. The status of youth and women-led CEEs in South Africa.....	5
3. Methodology.....	6
3.1 Research design.....	6
3.2 Case study selection.....	6
3.3 Data collection.....	7
3.4 Data analysis.....	7
3.5 Ethical considerations.....	7
3.6 Study limitations.....	7
4. Case studies of successful enterprises.....	7
Case study 1: Amahlathi Eco-Tech (AET Africa).....	8
Case study 2: Kusini Water.....	9
Case study 3: Kaeane renewable energy developers.....	11
Case study 4: Tshilidzi Tshawe Cooperative.....	12
5. Systemic challenges affecting women and youth-led clean energy enterprises.....	13
6. Recommendations.....	14
7. Conclusion.....	15
References.....	16

1. Background

Africa's transition to clean energy can only be rapid, equitable, and attractive to investors if women and youth are recognized not just as consumers of clean energy, but as key contributors, employees, innovators, and leaders shaping the sector (ECA, 2026). SMEs whether formally registered or informal, are central to economic growth and employment creation in South Africa. Despite this growing potential, women and youth entrepreneurs continue to encounter structural barriers that constrain their participation and ability to scale clean energy innovations. In response to these challenges, the African Centre for Technology Studies (ACTS) in partnership with the University of Johannesburg (UJ) and other partners^[1], with funding from the International Development Research Centre (IDRC), is implementing the Evidence for Informing Optimization and Scaling of Youth and Women-Led Clean Energy Enterprises and Business Models (EVI-SICEE) project that supports women- and youth-led or -owned small and medium enterprises (SMEs) to generate evidence for scaling up transformative clean energy enterprises in South Africa. This research brief focuses specifically on findings from the project's work in South Africa, led by UJ. It explores the experiences of selected youth- and women-led enterprises operating in the solar and biogas sectors. Through key informant interviews, the study examined how clean energy enterprises are navigating innovation, financing, market access, institutional support, and policy environments. By generating actionable insights and evidence-based recommendations, the study contributes to advancing gender equality, youth empowerment, and inclusive participation within South Africa's evolving energy transition.

In South Africa, approximately 78% of electricity is produced from coal-fired power stations, many of which were constructed during the 1960s and 1970s under apartheid. Since 2007, South Africa has experienced recurring load shedding (scheduled electricity outages), driven by ageing coal-based infrastructure, underinvestment in maintenance, generation shortfalls, and governance challenges within the electricity sector (IEA, 2024). Renewable sources now contribute approximately 12% (see Fig.1) of national electricity generation and an increasing share of installed generation capacity, reflecting the country's commitment to diversifying its energy mix, improving energy security, and supporting a low-carbon transition (IEA, 2024). South Africa's commitments under international frameworks such as the Paris Agreement and the outcomes of COP26, together with national policy initiatives including the Integrated Resource Plan (IRP 2019) and the Just Energy Transition Investment Plan (JET-IP), have accelerated efforts to expand renewable and low-carbon energy deployment (DMRE, 2019). These initiatives seek to diversify the country's energy mix through the increased use of clean energy sources, including solar, wind, hydropower, bioenergy, gas and nuclear power. Expanding clean energy capacity is expected to reduce dependence on fossil fuels, strengthen energy security, enhance system resilience, and contribute to South Africa's climate mitigation commitments (IRENA, 2024; IEA, 2024). Given growing energy demand associated with population growth, urbanisation, and infrastructure development, South Africa must strategically plan its energy transition to ensure a reliable, affordable, and sustainable energy supply between 2020 and 2050. However, ongoing policy and regulatory improvements are strengthening the sector. The effectiveness of clean energy deployment is hindered by weaknesses in the policy framework. Anekwe et al. (2024) highlights that South Africa's approach to integrating clean energy into its energy mix is often fragmented and lacks sufficient institutional and financial support. This limits the pace of clean energy expansion and highlights the need for a more coordinated and robust policy environment to drive sustainable energy development.

[1] Other partners in the EVI-SICEE project include;

Academic Partners: Makerere University Business School (Uganda), Mzuzu University (Malawi) and KCA University (Kenya)

Innovation, Incubation and Business Partners: Kenya Climate Innovation Centre (KCIC), GAMOS East Africa, MECs (Modern Energy Cooking Services)

Civil Society Partners: African Youth Initiative on Climate Change (AYICC)

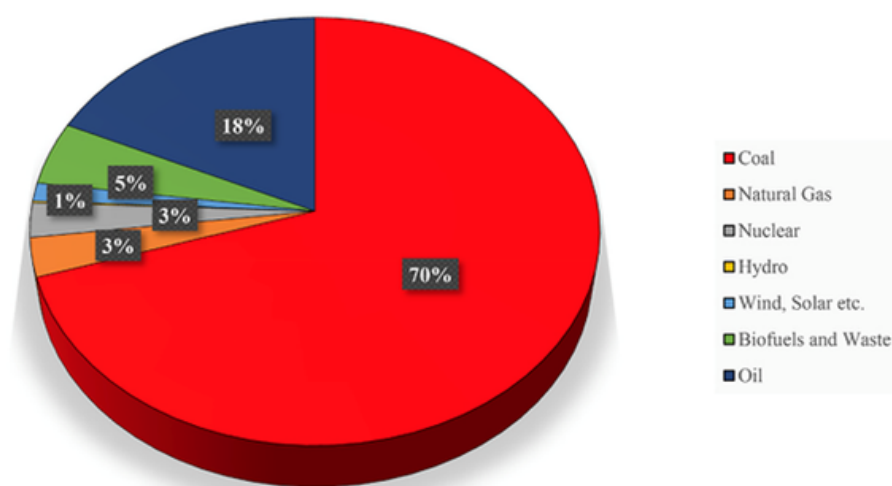


Figure 1: South Africa energy mix. Source (IEA, 2024)

The solar and biogas sub-sectors, represent two critical pillars of South Africa's clean energy landscape, each addressing unique challenges related to energy access, environmental sustainability, and equitable participation in the clean energy economy. Solar energy is widely regarded as one of South Africa's most promising clean energy sources, largely due to its favourable geographic location. The sector has expanded steadily, with increasing applications across various fields. Solar energy is utilized in a wide range of applications, including household devices, water heating, lighting, pumping systems, communications, transportation, and electricity generation (Anekwe et al., 2024). Biogas on the other hand, presents a clean energy option particularly suited for thermal energy needs in rural communities, helping to address ongoing national energy challenges. However, its adoption particularly in rural households remains limited. (Kamusoko & Mukumba, 2025).

The country is also focusing on the 'just transition' which goes beyond simply supplying energy; it requires the fair allocation of resources and opportunities, ensuring that society's most vulnerable groups are not excluded or left behind (IRENA, 2025). This takes a broader focus on the impacts and opportunities of the transition from dirty fuel technologies to clean energy technologies. Empowering youth and women-led clean energy enterprises (CEEs) and increasing their participation in energy production and distribution not only fosters innovation and entrepreneurship but also ensures that the benefits of the clean energy transition are more equitably distributed, contributing to sustainable development goals (SDGs) and broader socio-economic transformation across the region. Addressing these gaps requires evidence-driven interventions that effectively connect market opportunities with the needs, skills, and ambitions of women and youth. This research brief is focused on understanding the status of youth and women-led CEEs in South Africa and reflecting on the challenges existing within the clean energy ecosystem that hinder the access to scaling opportunities.

2. The status of youth and women-led CEEs in South Africa

Comprehensive national statistics specifically tracking youth- and women-owned clean energy enterprises remain limited. Existing evidence suggests that these enterprises are predominantly concentrated within the broader small, medium, and micro-enterprise (SMME) sector and operate across various segments of the clean energy sector, including technology distribution, installation, maintenance, energy services, consulting, waste-to-energy solutions, and energy efficiency services (Mali, 2025). The expansion of the clean energy sector, particularly in response to recurring load shedding, has created new entrepreneurial opportunities for emerging businesses led by women and young people.

Most youth- and women-led enterprises in South Africa's clean energy sector are concentrated in urban and peri-urban economic areas such as Gauteng, Western Cape, and KwaZulu-Natal, where access to markets, finance, technical expertise, and innovation support institutions is relatively stronger. Nevertheless, a growing number of enterprises are also emerging in rural areas, particularly in provinces such as Eastern Cape, Limpopo, and Mpumalanga, where clean energy solutions are addressing energy access challenges and supporting local economic development (Keown, 2019; Diale et al., 2021). These enterprises often operate within community-based and decentralized energy systems, contributing to livelihood improvement and climate resilience.

Solar PV systems dominate the activities of youth- and women-led clean energy enterprises. This reflects South Africa's abundant solar resources, declining solar technology costs, and increasing demand for alternative energy solutions from households, businesses, and public institutions (DMRE, 2019). Many enterprises are involved in solar PV installation, solar water heating, battery storage solutions, and solar-powered productive-use applications. Other enterprises focus on energy efficiency technologies, clean cooking solutions, biogas systems, waste-to-energy innovations, and water-energy nexus technologies, although these subsectors remain comparatively smaller (Mali, 2025). Despite their growing presence, women- and youth-led enterprises continue to represent a relatively small share of South Africa's clean energy sector and remain underrepresented in higher-value segments such as project development, manufacturing, and large-scale energy generation. Their participation is often concentrated in downstream activities such as distribution, installation, maintenance, and energy service provision. This pattern reflects broader structural barriers related to access to finance, technical skills, market opportunities, and procurement systems, which continue to shape participation and growth within the clean energy ecosystem (Osunmuyiwa & Ahlborg, 2022; Mahwai, 2025). Consequently, targeted support measures are needed to strengthen the ability of women and youth entrepreneurs to move beyond small-scale operations and participate more effectively across the clean energy sector.

3. Methodology

3.1 Research design

The study adopted an exploratory qualitative case study design to examine the experiences of women- and youth-led CEEs in South Africa. The case study approach enabled an in-depth examination of how enterprises navigate finance, markets, technology, regulation, institutional support and other conditions affecting their development and scaling. The study focused primarily on enterprises operating in the solar and biogas sectors.

3.2 Case study selection

Four women- and/or youth-led CEEs were selected as case studies: Amahlathi Eco-Tech (AET Africa), Kusini Water, Kaeane Renewable Energy Developers, and Tshilidzi Tshawe (His Grace) Cooperative. The cases were selected to provide practical insights into enterprises operating with different technologies, business models and market contexts.

The cases were not intended to be statistically representative of all women- and youth-led CEEs in South Africa. Rather, they provide context-specific evidence on the opportunities, challenges and enabling conditions experienced by enterprises attempting to develop and scale clean energy solutions. The report itself notes the limited availability of comprehensive national data on women- and youth-led CEEs.

3.3 Data collection

Primary data were collected through Key Informant Interviews (KIIs) with selected clean energy entrepreneurs. The interviews explored enterprise development and experiences relating to technology and innovation, access to finance, market development, skills and business capabilities, institutional support, partnerships, regulation and certification, gender and youth inclusion, and opportunities for enterprise scaling. The interviews were complemented by documentary evidence relevant to the selected enterprises and the wider clean energy ecosystem. Combining interviews with documentary evidence provided additional context for understanding the development and scaling experiences of the four enterprises.

3.4 Data analysis

The interview and documentary data were analysed using a thematic approach. The analysis identified recurring patterns across the four case studies and organised them into broader themes relating to enterprise development and scaling. Key themes included access to finance, market development and consumer awareness, regulatory and certification challenges, infrastructure and operational constraints, gender-related barriers, skills and business-development needs, and institutional support. The analysis also compared experiences across the cases to identify both common challenges and differences associated with enterprise technologies, business models and operating contexts.

3.5 Ethical considerations

The EVI-SICEE South Africa case studies were conducted in accordance with established ethical principles for qualitative research. Participation was voluntary, and participants were informed about the purpose of the study and how the information collected would be used. Informed consent was obtained before participation.

Confidentiality and privacy were maintained throughout data collection, analysis and reporting. Findings and quotations were reported accurately and in ways that minimised the disclosure of sensitive personal or business information. Ethical approval was obtained from the University of Johannesburg Research Ethics Committee, reference number 2024SECO146.

3.6 Study limitations

The study has several limitations. First, the small number of case studies means that the findings cannot be generalised statistically to all women- and youth-led CEEs in South Africa. The cases instead provide in-depth evidence of enterprise experiences and recurring challenges that may be relevant to other CEEs operating under similar conditions.

Second, the study was constrained by the limited availability of comprehensive and disaggregated data on women- and youth-led CEEs in South Africa. This makes it difficult to determine their total number, geographical distribution and representation across different clean energy technologies and value chains. Finally, the findings rely substantially on entrepreneurs' accounts of their experiences and should therefore be interpreted as qualitative, context-specific evidence rather than estimates of the prevalence of particular barriers across the sector. Despite these limitations, the cases provide useful evidence on how financial, market, regulatory, institutional, technical and gender-related factors interact to influence the development and scaling of women- and youth-led CEEs in South Africa.

4. Case studies of successful enterprises

While the data is sparse and limits are ability to give exact numbers of youth and women-led CET enterprises in South Africa, our study did find a few case studies of successful youth and women-led CEE.

The project narrowed down onto four of these cases and conducted in-depth interviews and document analysis relating to these. These cases are briefly introduced here before we move into an overview of the challenges they faced. Given the limited number of these enterprises that we found and the fact that our case studies still faced significant challenges, we believe highlighting these challenges and considering the implications for policy and regulation is important. We can hypothesise that if the challenges affecting these successful cases are addressed, it will assist others considering starting out and policy makers in reviewing the incentives and policy changes needed to encourage an increase in these enterprises to assist the country in its achievement of the just transition.

Case study 1: Amahlathi Eco-Tech (AET Africa)

Amahlathi Eco-Tech (AET) is a woman-led clean technology enterprise founded in 2012 by Sandiswa Qayi. The company focuses on developing energy-efficient technologies aimed at reducing household and small business electricity costs, particularly in water heating systems. AET's flagship innovation, the HotSpot device as shown in Figure 2, is a retrofit solution for electric and solar geysers that allows users to heat only the amount of water needed, thereby reducing electricity consumption and lowering household energy costs. The company also developed the Heat Radar, a system designed to capture waste heat from cooling systems and redirect it for water heating purposes.



Figure 2: Sandiswa Qayi, co-founder, AET-Africa, holding the HotSpot device.

Source (Vukuzenzele, 2017)

The inspiration for AET emerged from the growing burden of electricity costs in South Africa and the need for locally relevant clean energy solutions. Sandiswa Qayi's background in development studies and economic development shaped her systems-thinking approach to clean energy innovation. Her experience observing how households manually controlled geysers to save electricity motivated the development of practical and affordable energy-saving technologies. AET received significant recognition both locally and internationally. The company won awards such as the Department of Energy Young Woman in Energy Award and the Enviropaedia Eco-Logic Award for Energy Efficiency, while also participating in international innovation and entrepreneurship platforms in India and Switzerland.

These achievements increased the visibility of the enterprise and positioned it as a promising clean energy innovator within South Africa. The case study highlights the importance of institutional support in enabling clean energy entrepreneurship. AET benefited from funding and incubation support from organizations such as the Technology Innovation Agency (TIA), Industrial Development Corporation (IDC), Council for Scientific and Industrial Research (CSIR), and the Global Cleantech Innovation Programme (GCIP). These interventions supported product development, commercialization, business incubation, and international exposure.

Despite these successes, AET encountered several systemic challenges that constrained its ability to scale. One of the major barriers was obtaining certification from the South African Bureau of Standards (SABS), largely because no existing certification standard adequately accommodated the company's innovation. The absence of certification limited market access, exports, and partnerships with larger industry players. The company also faced resistance from established geyser manufacturers who viewed the technology as disruptive to traditional business models. Additional challenges included difficulties sourcing specialized materials, high manufacturing and operational costs, weak market uptake, and limited access to large-scale commercialization funding. Although the company secured research and development support, maintaining sustainable production and balancing cash flows proved difficult due to slow inventory turnover and limited consumer awareness.

The case study also emphasizes the gendered dimensions of clean energy entrepreneurship. As a woman leading a technology enterprise within a male-dominated industry, Sandiswa Qayi faced scepticism and gender bias in technical and manufacturing environments. Nevertheless, her leadership demonstrates the important role women can play in driving innovation and sustainable development within the clean energy sector. AET highlights the importance of supportive financing mechanisms, business incubation, certification reform, inclusive policy environments, and market development initiatives in enabling clean energy enterprises to scale and contribute meaningfully to South Africa's just energy transition.

Case study 2: Kusini Water

Kusini Water is a youth-led social enterprise established in 2016 to address water insecurity and unequal access to safe drinking water in underserved communities. Founded by Murendeni Mafumo, a former water engineer, the enterprise combines clean energy technologies, water purification systems, and community-based entrepreneurship to provide sustainable and affordable clean water solutions across South Africa. The company utilizes advanced water purification technologies, including Reverse Osmosis (RO) and Ultrafiltration (UF), integrated with hybrid energy systems powered by both solar energy and conventional municipal electricity (see Figure 3). These systems are deployed through mobile water trailers and stationary kiosks that operate in rural and peri-urban communities with unreliable infrastructure. The hybrid design enables operational flexibility while improving resilience in areas affected by inconsistent electricity supply and water access challenges. A central feature of Kusini Water's model is its community-driven approach. Local residents are trained as "water champions" who manage and operate the water kiosks within their communities. This model promotes local ownership, entrepreneurship, and long-term sustainability while creating employment and income-generating opportunities at the local level.



Figure 3: Kusini water filtration system combining solar, reverse osmosis and ultrafiltration technologies.

The motivation behind the enterprise stemmed from Murendeni Mafumo's personal experiences growing up in Limpopo, where many rural households relied on unsafe water sources such as streams. Although he worked within municipal water systems, he felt disconnected from the realities facing underserved communities and sought to develop practical, scalable, and socially impactful solutions to improve water access. Despite its success and growing impact, Kusini Water has encountered several operational and systemic challenges. One major challenge is identifying and training suitable "water champions" who possess both community commitment and entrepreneurial skills needed to manage kiosks effectively. Many participants understand the need for clean water but lack business management capabilities, creating sustainability concerns for kiosk operations. The enterprise also faces internal capacity constraints due to rapid organizational growth. Expanding projects and increasing staffing requirements have created infrastructure and operational pressures, including the need for larger office and manufacturing spaces. Additionally, theft of solar infrastructure in disadvantaged communities has emerged as a major obstacle, forcing the company to adopt hybrid systems that rely partly on municipal electricity to reduce vulnerability to theft.

Another significant challenge relates to unreliable public infrastructure. In many communities, aging water systems, burst pipes, and delayed municipal maintenance limit access to clean water even when water resources are available. Kusini Water must therefore continuously adapt its technologies and operational models to work around these infrastructure failures. The case study highlights the important role of institutional partnerships and business support in enabling enterprise growth. Kusini Water secured major support through partnerships with organizations such as Nedbank CSI, Edge Growth, ABSA, the U.S. Embassy, and other development partners. Notably, a partnership with Nedbank enabled the deployment of over 80 water kiosks across South Africa between 2023 and 2024, significantly expanding the company's reach and impact. In addition to financial support, the company benefited from mentorship and business coaching provided through Edge Growth, which supported strategic planning, organizational development, and operational sustainability. These interventions strengthened the enterprise's ability to scale and improve internal systems.

Case study 3: Kaeane renewable energy developers

Kaeane renewable energy developers is a youth-led clean energy enterprise that specializes in the development and installation of biogas systems using organic waste. Figure 4 below demonstrate a biogas digester under construction by Kaeane renewable energy developers. The company was founded more than five years ago under the leadership of CEO Letsoela Bennett Nkhasi and focuses on converting biodegradable waste from households and farms into renewable biogas for cooking, heating, and lighting applications. The CEE primarily constructs fixed-dome biogas digesters designed for use in homes, schools, farms, communal kitchens, guest lodges, and other institutions. Through these systems, Kaeane promotes sustainable waste management while addressing energy access challenges in rural and semi-urban communities.



Figure 4: Biogas digester under construction by Kaeane Renewable Energy Developers.

Source([https://www.facebook.com/photo.php?](https://www.facebook.com/photo.php?fbid=1287469606721068&set=pb.100063741232030.-2207520000&type=3)

[fbid=1287469606721068&set=pb.100063741232030.-2207520000&type=3](https://www.facebook.com/photo.php?fbid=1287469606721068&set=pb.100063741232030.-2207520000&type=3))

The company's work contributes to reducing dependence on traditional biomass fuels and lowering greenhouse gas emissions associated with unmanaged organic waste. The motivation behind establishing Kaeane was strongly influenced by the failure of previous biogas projects within local communities. According to the company, earlier installations by other providers often failed to generate usable gas and were poorly constructed, resulting in widespread distrust of biogas technology. In response, Kaeane sought to restore confidence in clean energy systems by developing technically reliable, research-driven biogas solutions capable of delivering tangible results for communities. Kaeane currently operates as a self-financed enterprise without external investors or strategic partners. The company relies on internally generated revenue, direct marketing, site assessments, and customized client quotations to sustain operations. Its customer-centered model involves engaging directly with communities, conducting feasibility assessments, and tailoring installations to specific user needs.

The case study highlights several capabilities identified as important for future business expansion. These include strengthening expertise in electrical engineering to improve system design and efficiency, enhancing branding and marketing through graphic design, and incorporating information technology systems to support project management, customer engagement, and digital monitoring of biogas systems.

Despite its progress, Kaeane has faced several significant challenges. One major barrier has been limited access to startup capital and external financing, which constrained the company's ability to scale operations and invest in advanced technologies. Another key challenge has been overcoming negative perceptions surrounding biogas technologies caused by failed earlier projects in the region. Building community trust therefore required extensive awareness campaigns, demonstrations, and engagement activities. The CEE also experienced difficulties related to delayed client payments and incomplete payments after installations were completed, creating cash flow pressures and operational strain. In response, the company introduced formal contractual agreements and payment policies to reduce financial risks and improve revenue management. Institutional support played an important role in strengthening the company's business operations. Kaeane received incubation support from Prime Cubate, which provided training and mentorship in areas such as financial management, marketing, business administration, and organizational management. This support improved the company's internal capacity and investment readiness.

Overall, the Kaeane case study illustrates the challenges facing youth-led clean energy enterprises in Africa's biogas sector. The enterprise demonstrates how locally driven innovation, community engagement, and practical clean energy solutions can contribute to sustainable development and energy access. At the same time, the case highlights the importance of financing, technical support, business incubation, and public trust in enabling clean energy enterprises to scale successfully and contribute meaningfully to Africa's energy transition.

Case study 4: Tshilidzi Tshawe Cooperative

Tshilidzi Tshawe (His Grace) Cooperative is a youth-led rural enterprise in that combines agricultural production with clean energy initiatives, particularly in the biogas sector. The cooperative primarily focuses on vegetable farming for local communities while also engaging in the maintenance of community biogas digesters and awareness campaigns promoting clean energy technologies. The cooperative has partnered with Professor David Tinarwo and the University of Venda through a programme focused on promoting organic waste-to-energy technologies and accelerating biogas market development in South Africa. Through this collaboration, members of the cooperative received technical training in biogas digester maintenance, operation, and construction, enabling them to support the functionality of rural clean energy systems while strengthening their own technical capabilities. The motivation behind the cooperative's involvement in biogas technology is closely linked to the lived experiences of its director, Thilivhali Eugene Rasimpi, who grew up in a rural community heavily dependent on firewood for cooking and heating. Exposure to biogas technology revealed its potential as a cleaner and more sustainable alternative to traditional energy sources, inspiring the cooperative to promote clean energy solutions that reduce environmental degradation and improve rural livelihoods.

Tshilidzi Tshawe operates a hybrid business model that integrates agriculture, clean energy awareness, and technical support services. In addition to farming activities, the cooperative conducts awareness campaigns, supports the maintenance of biogas digesters, and utilizes bioslurry generated from digesters for agricultural production. Although the enterprise has not yet scaled into full biogas production, it plays an important role in bridging technical knowledge and service gaps within rural communities. The case study identifies limited access to finance as one of the enterprise's most significant challenges. The cooperative currently relies entirely on internal funding from its directors and has not secured external investment or financial support. This lack of capital limits the cooperative's ability to expand outreach activities, conduct site visits, implement awareness campaigns, and scale its clean energy services. Low market awareness and limited public understanding of biogas technology also emerged as major barriers. Many rural communities remain unfamiliar with biogas systems, while financial institutions often lack sufficient understanding of the sector to provide funding support.

These challenges make it difficult for enterprises like Tshilidzi Tshawe to penetrate the market and attract investment. Another important challenge relates to persistent misconceptions about the viability of biogas technology. According to the cooperative, many people perceive biogas as an impractical or unsustainable business opportunity. To address these misconceptions, the cooperative has focused on community education, demonstrations, and awareness campaigns aimed at building trust and showcasing the practical benefits of biogas systems. The study further highlights the importance of business support and capacity development. Participation in the University of Venda programme provided the cooperative with technical training as well as business and soft skills development, including customer engagement, pitching, business management, and communication strategies. These interventions strengthened the cooperative's ability to deliver services, engage communities, and position itself for future growth.

Gender inclusivity is another key feature of the cooperative's operations. Both men and women participate equally in decision-making and organizational activities, reflecting an inclusive leadership model that values equal participation regardless of gender. This approach contributes to stronger collaboration, innovation, and organizational cohesion within the enterprise. Finally, the case study identifies emerging opportunities for scaling clean energy initiatives through funding programmes offered by organizations such as the Technology Innovation Agency (TIA) and Nedbank. These opportunities could support enterprise expansion, improve service delivery, and strengthen the cooperative's contribution to clean energy adoption and climate resilience in rural South Africa.

5. Systemic challenges affecting women and youth-led clean energy enterprises

Despite the growing contribution of women- and youth-led clean energy enterprises (CEEs) to South Africa's clean energy transition, the findings reveal that these enterprises continue to face multiple systemic barriers that constrain their growth, sustainability, and scalability. These barriers operate across financial, institutional, technical, regulatory, and socio-cultural dimensions, limiting the ability of emerging entrepreneurs to participate meaningfully in the clean energy economy.

- **Limited access to finance and investment capital**

One of the most significant challenges identified across the case studies is limited access to finance and investment capital. Many youth- and women-led enterprises struggle to secure startup funding, working capital, and commercialization support necessary for scaling their operations. For example, Tshilidzi Tshawe Cooperative and Kaeane Renewable Energy Developers rely heavily on internal financing due to limited access to external funding mechanisms. This restricts their ability to expand outreach activities, invest in infrastructure, employ skilled personnel, and scale clean energy services within underserved communities. Similarly, although AET Africa received support from institutions such as the TIA, IDC and CSIR, the company still experienced difficulties sustaining production and balancing operational costs due to slow market uptake and insufficient commercialization financing.

- **Weak market penetration and limited consumer awareness**

Weak market penetration and low levels of public awareness regarding clean energy technologies also emerged as major barriers. In both the solar and biogas sectors, CEEs reported difficulties convincing consumers, financial institutions, and industry stakeholders about the viability and benefits of clean energy solutions. This slows market penetration and limits enterprise growth.

- **Regulatory and certification challenges**

Regulatory and certification barriers continue to constrain the growth of CEEs. AET's experience with obtaining SABS certification for the HotSpot device demonstrates how current regulatory systems are often not well suited to emerging grassroots innovations.

The absence of an appropriate certification category for the technology prevented the enterprise from accessing larger retail markets, forming partnerships with established industry players, and exporting the product internationally. These barriers reveal the need for more adaptive, innovation-friendly, and SME-responsive regulatory systems capable of supporting locally developed clean technologies.

- **Infrastructure and operational constraints**

Infrastructure limitations and operational challenges also undermine enterprise sustainability and expansion. Kusini Water highlighted how unreliable municipal infrastructure, including aging water systems, burst pipes, delayed maintenance, and inconsistent electricity supply, creates operational difficulties for decentralized clean technology systems operating in rural and peri-urban communities. Additionally, theft and vandalism of solar infrastructure in disadvantaged communities emerged as a major challenge. In response, Kusini Water adopted hybrid systems combining solar and municipal electricity to improve operational resilience and reduce risks associated with infrastructure theft.

- **Gendered inequalities in the clean energy sector**

Gendered inequalities remain a persistent structural barrier affecting women entrepreneurs within the clean energy ecosystem. Women operating within technical and manufacturing sectors continue to encounter bias, exclusion, and limited recognition in industries that are traditionally male dominated. Sandiswa Qayi of AET Africa noted that women leaders in technical industries often face scepticism when engaging with manufacturers, suppliers, and industry stakeholders. These structural inequalities reduce women's access to strategic partnerships, financing opportunities, and leadership roles within the broader clean energy sector.

- **Skills gaps and limited business development support**

Capacity gaps and limited entrepreneurial support also affect the long-term sustainability of youth- and women-led enterprises. While many entrepreneurs possess strong technical knowledge and innovative ideas, they often lack the business development skills, market access support, and management capacity necessary for scaling operations successfully. For example, Kusini Water experienced challenges identifying and training suitable "water champions" capable of sustainably managing water kiosks at the community level. Similarly, several enterprises emphasized the importance of mentorship, incubation programmes, and technical training in strengthening organizational resilience, improving investment readiness, and supporting enterprise development.

6. Recommendations

The findings highlight the need for targeted and coordinated interventions to strengthen the participation and scalability of women- and youth-led CEEs. While the case studies demonstrate significant innovation potential and social impact within the solar and biogas sectors, they also reveal persistent systemic barriers related to financing, market access, technical capacity, policy support, and gender inequality. Addressing these challenges will require collaborative efforts from government, development finance institutions, private sector actors, research institutions, and innovation support organizations to create an enabling ecosystem that supports inclusive clean energy entrepreneurship and accelerates South Africa's just energy transition.

- There is a need to expand accessible and targeted financing mechanisms for youth- and women-led clean energy enterprises. Government institutions, development finance agencies, and private sector partners should establish blended finance instruments, concessional loans, grant programmes, and innovation funds specifically tailored to emerging clean energy SMEs. Financing support should also extend beyond startup capital to include commercialization, certification, market expansion, and operational scaling.

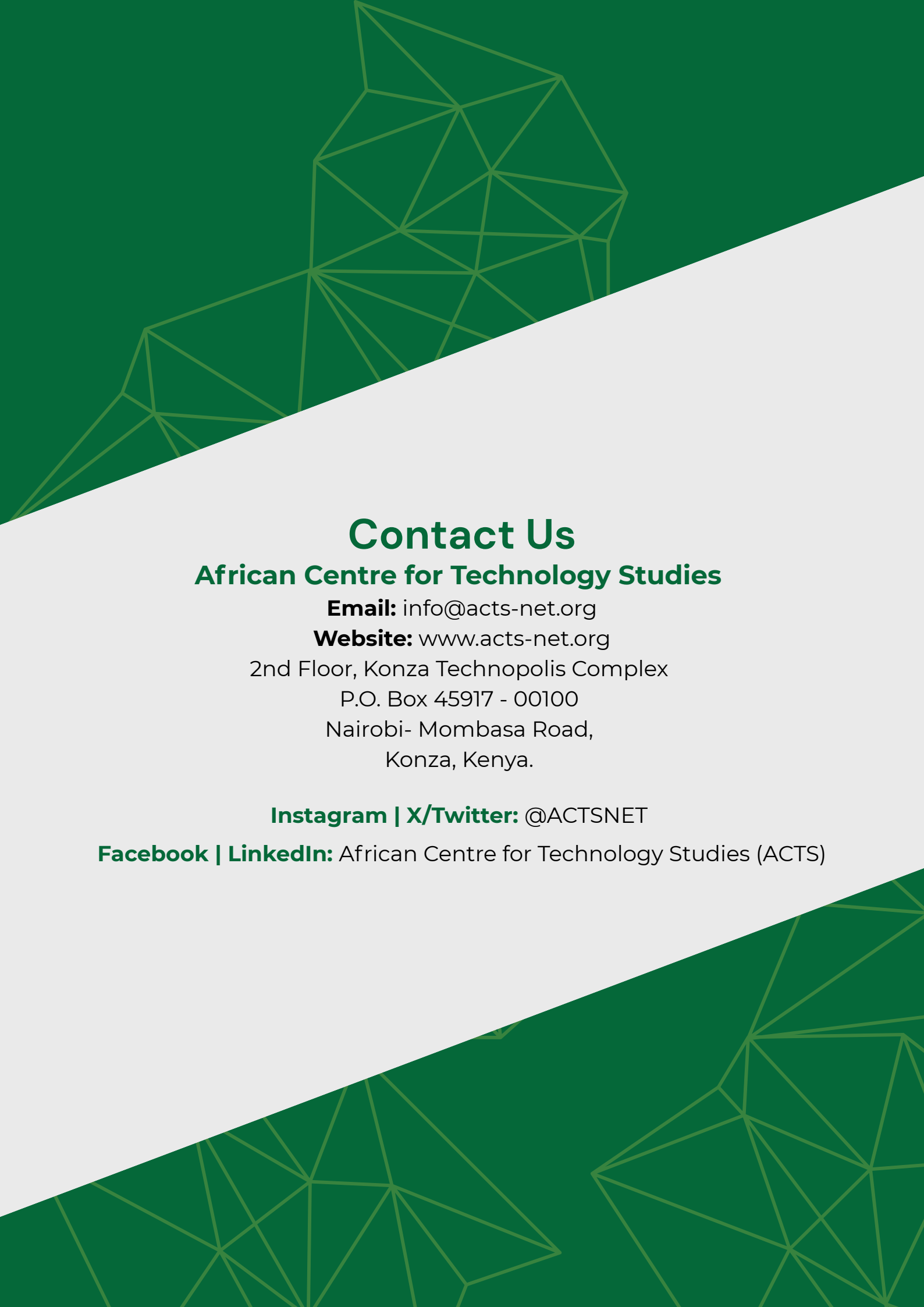
- Strengthening entrepreneurship incubation programmes, mentorship initiatives, and technical training platforms will be essential for improving enterprise sustainability. Capacity-building interventions should combine technical clean energy skills with business management, financial literacy, marketing, digital innovation, and leadership development. Universities, innovation hubs, and technical institutions can play an important role in strengthening entrepreneurial ecosystems for women and youth.
- There is a need for more coherent and inclusive policy frameworks that support small-scale clean energy enterprises. Regulatory systems should be streamlined to reduce certification barriers and improve market entry opportunities for grassroots innovations. Institutions such as the South African Bureau of Standards (SABS) should develop adaptive certification pathways suitable for emerging clean technologies developed by SMEs.
- Policy interventions should intentionally address gendered inequalities within the clean energy sector by promoting women's participation in technical, managerial, and leadership roles. Gender-responsive financing, mentorship programmes, procurement frameworks, and innovation support mechanisms can strengthen women's participation within clean energy sector.
- Public awareness campaigns, demonstration projects, and community engagement initiatives are needed to improve understanding and acceptance of clean energy technologies, particularly within the biogas sector. Supporting local market development will help strengthen consumer confidence, reduce misconceptions, and create sustainable demand for clean energy solutions.
- Greater collaboration among government agencies, financial institutions, universities, incubators, private sector actors, and civil society organizations is necessary to strengthen the broader clean energy entrepreneurship ecosystem. Integrated support systems can improve coordination, reduce duplication, and enhance access to resources, training, investment, and market opportunities for SMEs.

7. Conclusion

The study demonstrates that women- and youth-led CEEs are playing an increasingly important role in advancing South Africa's energy transition. Enterprises operating within the solar and biogas sectors are developing innovative, community-centered, and locally appropriate solutions that address energy access, environmental sustainability, employment creation, and socio-economic development. The case studies illustrate the transformative potential of youth and women entrepreneurs to drive clean energy innovation while also highlighting the systemic barriers that continue to constrain enterprise growth and scalability. Challenges related to financing, certification, technical capacity, market access, infrastructure limitations, and gender inequality continue to limit the ability of many enterprises to expand their impact. Nevertheless, the findings reveal substantial opportunities for scaling inclusive clean energy entrepreneurship in South Africa. With targeted financing, supportive policy frameworks, business incubation, technical capacity development, and stronger institutional coordination, youth- and women-led enterprises can contribute significantly to South Africa's just energy transition while supporting broader development goals related to employment, sustainability, and social inclusion. Ultimately, strengthening inclusive clean energy entrepreneurship will not only accelerate clean energy adoption but will also empower women and youth as innovators, employers, and leaders within Africa's emerging green economy.

References

- Department of Mineral Resources and Energy (DMRE). (2019). Integrated Resource Plan (IRP 2019). <chrome-extension://efaidnbmninnibpcapjpcglclefindmkaj/https://www.energy.gov.za/IRP/2019/IRP-2019.pdf>
- Diale, C. D., Kanakana-Katumba, M. G., & Maladzhi, R. W. (2021). Ecosystem of Renewable Energy Enterprises for Sustainable Development: A Systematic Review. *Advances in Science, Technology and Engineering Systems Journal*, 6(1), 401–408. <https://doi.org/10.25046/aj060146>
- ECA. (2026). United Nations Economic Commission for Africa. Why Africa Must Put Women and Youth at the Centre of Clean Energy Transition. <https://www.uneca.org/stories/%5Bblog%5D-why-africa-must-put-women-and-youth-at-the-centre-of-clean-energy-transition>
- IEA. (2024). South Africa—Countries & Regions. IEA. <https://www.iea.org/countries/south-africa/energy-mix>
- IRENA. (2025). A just energy transition for communities: Large-scale wind and solar projects in Sub-Saharan Africa. <https://share.google/wq83w7UJkthgGAZ6v>
- Kamusoko, R., & Mukumba, P. (2025). Valorization of Maize Stover into Biogas for Heat and Power Generation: A South African Perspective. *Fermentation*, 11(6), 338. <https://doi.org/10.3390/fermentation11060338>
- Keown, H. (2019). The development of a socio-economic model to promote women empowerment initiatives in the renewable energy sector of South Africa. <https://doi.org/10.13140/RG.2.2.16486.37443>
- Mahwai, M. (2025). Access to finance barriers affecting women owned SMMEs in the renewable energy sector: A case of South Africa. <https://open.uct.ac.za/items/58183846-dee9-4a93-ba91-1281094fd1e7>
- Mali, N. (2025). An exploratory study of financial access along the renewable energy sector value chain: The case of SMMEs in South Africa. <https://open.uct.ac.za/items/afb13df6-3ac7-44a0-85aa-8c7811caf8cb>
- Osunmuyiwa, O. O., & Ahlborg, H. (2022). Stimulating competition, diversification, or re-enforcing entrepreneurial barriers? Exploring small-scale electricity systems and gender-inclusive entrepreneurship. *Energy Research & Social Science*, 89, 102566. <https://doi.org/10.1016/j.erss.2022.102566>
- Smarte Anekwe, I. M., Akpasi, S. O., Mkhize, M. M., Zhou, H., Moyo, R. T., & Gaza, L. (2024). Renewable energy investments in South Africa: Potentials and challenges for a sustainable transition - a review. *Science Progress*, 107(2), 00368504241237347. <https://doi.org/10.1177/00368504241237347>
- UNFCCC. (2015). The Paris Agreement | UNFCCC. <https://unfccc.int/process-and-meetings/the-paris-agreement>
- Vukuzenzele, G. (2017). Entrepreneur wins award for innovative energy saving device. <https://www.timeslive.co.za/sebenza-live/features/2017-10-18-hot-spot-will-save-electricity/>



Contact Us

African Centre for Technology Studies

Email: info@acts-net.org

Website: www.acts-net.org

2nd Floor, Konza Technopolis Complex

P.O. Box 45917 - 00100

Nairobi- Mombasa Road,

Konza, Kenya.

Instagram | X/Twitter: @ACTSNET

Facebook | LinkedIn: African Centre for Technology Studies (ACTS)