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Energy impoverishment and burns: The case for an expedited, safe and inclusive energy transition in South Africa

Significance:

Energy poverty is the constrained access to modern forms of energy. In South Africa, energy impoverished communities are dependent on a mixture of solid fuels (e.g. wood or coal) and hydrocarbons such as paraffin. These, especially paraffin use, are associated with significant negative health outcomes, particularly burns due to accidental fires and spillages, but also paraffin ingestion, and toxic fume inhalation. The energy-poor furthermore suffer disproportionate long-term social, economic and psychological impacts that entrench their impoverished conditions. There is both international and national recognition of these adverse effects of energy poverty and that the universal access to safe and sustainable energy is crucial for the attainment of health and other global social, economic and well-being goals. South Africa is called on to expedite access to modern energy usage, through the enactment of a substantive policy on the provision of safe, clean and affordable energy for energy-impoverished communities and households.

South Africa's energy access challenge

Energy poverty is a recognised obstacle to health and socio-economic well-being.[1] In South Africa, energy poverty is widespread, with about half of all households considered energy-poor in 2012.[2] In 2018, about 600 000 households, or 2 million people, were in extreme energy deprivation, relying on paraffin for domestic energy.[3] These families face disproportionate risks to health, with greater exposure to air pollution, poisoning and burn injury. Energy deprivation is concentrated in the country's informal urban settlements. These settlements remain largely unelectrified, despite South Africa's overall electrification rate of nearly 90% of dwellings. In the context of rapid population migration into the cities and urbanisation, the demand for safe and affordable energy in urban peripheries remains an unresolved political, social and economic issue that results in deleterious health outcomes. The health outcomes are exacerbated by crowded and inferior home structures, under-resourced and congested community spatial arrangements, and limited healthcare and support.[4]

Paraffin combustion is a leading cause of these consequent adverse health outcomes. Households that use paraffin manifest substantially higher risks for injury, directly through fires or indirectly through scalding, ingestion and toxic fume inhalation.[5] However, the health consequences are not necessarily exclusively due to the nature of the fuel. The use of unsound, unsafe and inefficient technologies, the fuel packaging and distribution system are contributors, along with an impoverished socio-environmental milieu.[1] Paraffin stove failures resulting in an explosion are often implicated in the ~5000 shack fires that South Africa's emergency services respond to every year.[6] The consequent flame-burn casualties are associated with the most severe burn injury outcomes, and likely comprise a significant proportion of the 100 000 burn injuries and 2000 deaths reported every year.[1,7]

In South Africa's informal settlements, such fire incidents are common and seemingly perennial, with informal settlement fires mainly caused by paraffin fuels (53%) and candles (30%).[5] Informal dwellings, typically made of flammable materials and often closely spaced, present a manifest vulnerability to runaway conflagrations. Accidental fires, often triggered by a faulty paraffin appliance, may be exacerbated by the flammable materials, congested internal spatial arrangements, and storage of paraffin or other combustibles.[8] If not immediately brought under control, an accidental fire in an individual structure may set off a widespread and devastating community conflagration.

These dangers have been widely recognised, through South Africa's electrification campaign, the 2006 promulgation of the paraffin stove safety standard, and campaigns for improved appliances by the Paraffin Safety Association of South Africa. Regrettably, these actions have not resulted in the desired outcomes. The quality of the available appliances has neither improved nor been effectively monitored. Underperforming appliances are still sold and widely used, even those approved by the South African Bureau of Standards (SABS).[9]

There are other dangers specific to the domestic use of paraffin. It is commonly decanted in neighbourhood spaza shops for sale in smaller, more affordable quantities. However, this perceived user benefit is also a significant ingestion hazard, whereby paraffin purchased and stored in beverage containers is easily mistaken for water or soft drinks. Paraffin ingestion and poisoning may affect up to 3.6% of paraffin-using households[10] and is a leading cause of poisoning to children, with 40% of cases developing chemical pneumonia[11]. There are concerns that paraffin emissions may over time impair lung function and increase the susceptibility to infectious illness, including tuberculosis, already rife in impoverished communities in South Africa, asthma and cancer.[12] There may also be central nervous system effects due to acute and chronic exposure to paraffin fumes, including irritability, restlessness, ataxia, convulsions, and coma.[13]

The survivors of exposure to burns, poisoning and inhalation may suffer immediate and long-term physical, psychological and socio-economic consequences. Burn injuries that require hospitalisation involve intensive, invasive, painful and often long-lasting treatment and care. Those who survive burns may face permanent scarring, in some cases with limited physical functionality or dexterity; those with visible scars may report social stigmatisation from strangers, peers, and even family members.[7] The physical recovery may be slow, and some

health consequences may endure due to the immune and inflammatory responses. Survivors report increased risks for cancer, cardiovascular disease, nervous system disorders, diabetes, musculoskeletal disorders, gastrointestinal disease, and infections over time.[14] Psychological outcomes are also reported in the immediate aftermath and may persist, with a significant incidence of post-traumatic stress disorder, depression, and anxiety.[7] The economic impacts are significant – burn care is expensive. The cost of hospitalisation and treatment for survivors who have sustained burns over 20% of their body ranges between ZAR103 000 and ZAR154 000.[1] At least ZAR490 million is spent caring for patients who have suffered paraffin burns.[15] Up to ZAR180 million is estimated to be lost annually in razed home structures.[6]

International mobilisation and demonstrations of alternative, safe and clean energy

The adverse health and social impacts of energy poverty have been recognised in the United Nations 2030 Agenda for Sustainable Development, which has declared universal access to safe, affordable, sustainable and modern energy a global priority.[16] The UN's Sustainable Development Goal 7 for universal access to safe and sustainable energy is considered a crucial point on which other global social, economic and well-being goals may depend, including poverty eradication, gender equality and the formation of sustainable cities and communities.[16] South African institutions, such as the Human Rights Commission, have noted that access to safe energy is constitutionally protected and should be recognised as a key aspect of the country's social justice agenda.[17]

This international and national recognition aligns with recent evidence that energy poverty can be addressed by substituting hazardous fuels with cleaner and safer alternatives.[1] In particular, electricity and liquid petroleum gas (LPG) have been globally recognised as clean, safe and health-promotive domestic energy technologies.[18] At the same time, in the case of South Africa, others may include ethanol, solar and biogas. Internationally, electricity is a preferred energy carrier due to its versatility, ease of use and 'cleanness' at the point of use. South Africa has made significant efforts with electrification, with 90% of households now connected to the grid compared to 35% three decades ago.

However, adequate electricity access is hampered by cost and grid limitations which often cause even on-grid low-income households to revert to paraffin and other 'dirty' fuels.[19] In some instances, LPG may be a more effective replacement for paraffin due to better technological attributes, a low emission profile, ease of use and greater suitability for remote off-grid settings.[20] The environmental footprint of LPG is negligible compared to biomass and other hydrocarbon fuels due to its efficient and complete combustion.[18] LPG and electricity provide specific respective advantages. The former is thus also recommended as a safe fuel alternative for resource-poor settings.[21] There have been encouraging experiences in implementing large LPG initiatives in countries with similar socio-economic and energy profiles to South Africa. These countries include Indonesia, where 50 million households were converted from paraffin to LPG between 2007 and 2011, thus reducing extreme energy poverty and saving on fuel expenses and paraffin subsidies.[22] Despite misperceptions about affordability and safety[17] and concerns that it is a non-renewable fuel, South Africa's and others' uses of LPG have provided encouraging results on user satisfaction[23] and well-being promotion. Despite these good experiences, there has been only limited implementation of LPG or electricity in South Africa's energy-poor locations.

A call to action

In February 2021, a multi-sectoral grouping of South African and international academics, civic coalitions, government and corporate partners joined a No Paraffin! Campaign Webinar Series[1], hosted by the Academy of Science of South Africa (ASSAf) and the University of South Africa. In these webinars, speakers explored South Africa's inequalities in energy risk, best and emerging safe energy practices, and the institutional and policy pathways for an inclusive domestic energy transition that foregrounds the country's impoverished communities.[1] An ASSAf Statement, 'The No Paraffin! Campaign: A Call to Action'[24] was authored by the authors of this commentary, drawing on the presentations and discussions arising from the Webinar Series. The Call makes an empirical case and an appeal for an accelerated transition to safe, affordable and modern energy, with this energy transition to be actioned, in part, through a No Paraffin! Campaign.[24] The Campaign is to be directed at:

- reducing health risks to the energy-poor, through the phasing out of paraffin as a domestic fuel;
- strengthening protections for paraffin users during phase-out; and
- scaling up implementation of a modern energy alternative, either electricity or LPG, and possibly other locally proven, feasible energy alternatives for energy-poor settings.

The Campaign thus recognises the challenges experienced with the domestic use of paraffin, especially in informal, minimally protected settings. Therefore, it calls on the South African government for more stringent measures to curtail and eventually eliminate the domestic use of paraffin while simultaneously advancing efforts to implement either electrification or, where not suitable, safe and cost-effective alternative energy such as LPG, or a locally proven renewable source. While the Campaign emphasises government leadership and championship, its success is also contingent on public mobilisation and support, local empirically produced information, and a regularised communication strategy, all constituents of previous successful health campaigns.[1] The impact of past initiatives has been maximised where government has championed an issue through partnerships with civil society and community actors, researchers and industry. Broad-based partnerships facilitate the mobilisation of public support for the adoption of behaviours required for the implementation of interventions.[1] The Campaign has proposed a staggered scaling-up of the required energy interventions through specific near- and longer-term measures.[24]

Near-term interim measures: Hazard control and removal

The South African government, licenced appliance manufacturers and distributors, and civic partners are called to champion key near-term policy and implementation recommendations. These recommendations align with established public health approaches that seek to strengthen hazard management through removal while paraffin is being phased out but still in use. The following steps are recommended:

- The manufacturers of paraffin stoves should strengthen efforts to ensure that domestic products comply with design and construction standards. The National Regulator for Compulsory Standards is to increase its enforcement of these standards and curtail, e.g. through harsher penalties, the local manufacture and distribution of risky sub-standard stoves. The current compulsory paraffin stove standard is dated.[25] SABS is requested to institute an urgent review to address its shortcomings.[9]
- SABS should formulate a standard for a bitterant to be added to illuminating paraffin to reduce accidental ingestion and poisoning cases.
- Safety educational campaigns should disseminate information on safe stove use behaviours and emergency responses to prevent or respond to poisoning or fire accidents. This could be further enabled through compulsory stove and paraffin packaging information on safe use.[4] The campaigns should be facilitated as a joint effort between government, industry, academic and relevant civil society groups.

Short- to medium-term measures: Engagement, policy, implementation and monitoring

The South African government is called on to prioritise, develop and enact a substantive policy on safe energy provision for energy-impoverished

communities and households (alongside other interventions to support suitable housing and regular household incomes in impoverished households and communities). Key elements of this policy should include:

- A White Paper to specify the milestones, timelines and necessary mechanisms for the gradual phase-out of paraffin and the introduction and upscaling of the chosen safer energy alternatives.
- SABS to develop design and construction standards for all emerging domestic energy appliances.
- An engagement strategy to facilitate public interest in an energy transition programme and the use of safe energy alternatives, specifically for affected communities and households. This strategy could include a national awareness campaign to highlight attributes of the replacement energy, the characteristics of replacement appliances, and the required safe stove use behaviour.
- A distribution infrastructure to support energy user access and safe use of the replacement energy. This would include distribution networks, financial support and incentive systems for a sustainable energy technology acquisition, and monitoring of energy distributors and stove producers.
- A monitoring and evaluation programme to determine the readiness of local users to adopt alternative energy, identify implementation issues, assess household energy technology performance and usage patterns, and report on local safety, health and cost outcomes.

Government has a model for the implementation of such campaigns. The District Development Model, or DDM, coordinates the government's response to the interconnected challenges of poverty and is proposed as the governmental focal point for implementing the Campaign in local communities.[26] The DDM was launched in 2019 as a model to coordinate the government's response to the challenges of poverty, unemployment and inequality and accelerate and integrate service delivery. Safe and healthy energy provision is key to its mandate. The DDM could initially provide a small-scale platform as a 'real-life' site for targeted implementation, testing, evaluation and demonstration of replacement energy to establish context-specific safe energy usage practices and concerns. This initial implementation would provide a platform for local empirical support to enable coordinated, phased, and broader scale roll-outs to transition energy-poor communities away from high-risk energy carriers and technologies.[24]

This Campaign therefore aligns with the United Nations 2030 Sustainable Development Goal on universal access to safe and sustainable energy. It responds to persisting and widespread energy impoverishment in South Africa, the complex health and safety challenges specifically to domestic paraffin use, and recent demonstrations of feasible alternatives. The Campaign calls for championship from government, civil society, research and industry; local empirical research into the use, impact and cost-effectiveness of alternative energy; a scaled-up implementation plan for the safe energy carrier; and the adoption of clear milestones to record progression towards more equitable, safe and healthy energy use in South Africa.[24]

Competing interests

We have no competing interests to declare.

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