Activity 9

Annual Household Survey and Monitoring of Project Effectiveness for eZamokuhle

Document by:

ARM
AIR RESOURCE MANAGEMENT

Final Document:

11th June 2025

Document Title

Client		Eskom
Title		Annual Household Survey and Monitoring of Project Effectiveness for eZamokuhle
Our Reference		ESKPMV1-2025-ACT9
Issued to Client		11th June 2025
Classification		Company Confidential

Document Change Record

Revision Number	Date	Description of Revision
00A	20th January 2025	Creation of Document
00B	14th April 2025	Peer Review of Document
00	7th May 2025	Draft Document issued to Eskom for Review
01	11th June 2025	Final Document

Document Approval

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EXECUTIVE SUMMARY

1. Background

Air quality offsets represent a critical pathway for addressing ground-level emission sources within communities residing near Eskom's coal-fired power stations. Through Eskom's Air Quality Offset (AQO) programme, comprehensive interventions have been systematically rolled out to the communities of KwaZamokuhle, eZamokuhle, and Sharpeville. The programme aims to reduce household emissions from domestic fuel burning while simultaneously improving the quality of life for affected communities. Following the successful implementation of these interventions, continuous monitoring and evaluation have become essential to assess their sustained effectiveness and inform future programme expansion.

2. Study Objective

In accordance with the Planning, Monitoring and Verification (PMV) scope of work, specifically Activity 9 addressing Annual Household Survey and Monitoring of Project Effectiveness, Air Resource Management (Pty) Ltd (ARM) was commissioned to conduct comprehensive household surveys in eZamokuhle. The primary objective was to determine the extent to which households continue to utilize the installed interventions and to evaluate their effectiveness in achieving the Eskom AQO programme's environmental and social objectives. This report presents an inter-annual trend analysis covering Activity 9 (sections 9.8 and 9.9) for eZamokuhle, comparing data from 2023 and 2024. The longitudinal analysis provides essential insights into the sustained impact of Eskom's AQO interventions at the household level, enabling the identification of usage patterns, behavioural changes, and emerging challenges. This temporal comparison is fundamental for assessing the long-term viability of the interventions and informing evidence-based decisions for programme optimization and scalability.

3. Study Methodology

The study employed a mixed-methods approach combining quantitative surveys with qualitative assessments to ensure comprehensive data collection. Initial engagement with the Eskom Communications team facilitated collaboration with local leadership, specifically the Ward Councillors of eZamokuhle, whose permission and support were secured prior to survey implementation. Following established ethical protocols and community engagement principles, ARM proceeded with a systematic recruitment process, comprehensive fieldworker training, and structured survey execution.

The quantitative component involved deploying a team of 10 trained fieldworkers in both 2023 and 2024 to conduct household surveys in eZamokuhle. While the scope of work specified a minimum sample size of 260 households to achieve statistical significance, the actual participation exceeded expectations with 401 households surveyed in 2023 and 381 households in 2024. The survey instrument consisted of an Eskom-approved structured questionnaire administered in isiZulu through mobile devices, ensuring cultural appropriateness and data accuracy. The questionnaire comprehensively captured information across multiple domains including household demographics, energy use patterns, health indicators, education levels, safety considerations, and air quality awareness. Each interview required approximately 30 minutes to complete, with data being securely transmitted to cloud storage in real-time via the JotForm platform, ensuring data integrity and security.

The qualitative component comprised focus group discussions designed to capture nuanced community perspectives and experiences. A single focus group session was conducted with 8 participants from eZamokuhle, comprising 7 women and 1 man, reflecting the gender dynamics of household energy management in the community. The semi-structured discussion guide addressed five key thematic areas: the effectiveness of Eskom's activation and registration process, perceptions of project execution quality, experiences with specific AQO interventions, considerations regarding long-term sustainability, and changes in air quality perceptions within

eZamokuhle. This qualitative data provided contextual depth to complement the quantitative findings and identified implementation issues not captured through structured surveys.

4. Study Results

4.1 Annual Household Surveys

4.1.1 Household Demographics

The demographic profile of survey respondents reveals important characteristics that influence energy use patterns and intervention effectiveness in eZamokuhle. Female respondents comprised the majority of participants in both survey years, representing 78.1% of the sample in 2023 and 75.1% in 2024. This gender distribution is particularly significant given that women typically bear primary responsibility for household cooking activities and consequently experience disproportionate exposure to indoor air pollution from traditional cooking methods.

The age distribution of respondents demonstrates a predominantly young adult population, with individuals aged 20 to 39 years constituting 42.8% of the 2023 sample and increasing to 53.4% in 2024. The mean age of respondents was approximately 40 years across both survey periods, representing an age cohort generally associated with greater resilience to air quality-related health impacts. Despite this demographic advantage, the high representation of young adults suggests a critical window of opportunity for establishing sustainable clean energy practices that could benefit households for decades to come.

Analysis of female-headed households reveals distinct age patterns that have important implications for intervention adoption. Young female adults aged 20 to 39 years headed 35.8% of households in 2023, with a slight decrease to 30.7% in 2024. This demographic segment plays a pivotal role in household energy decision-making and represents a key target group for promoting the sustained adoption and utilization of liquefied petroleum gas (LPG) technologies within the

community. Their relative youth and decision-making authority position them as potential change agents for broader community energy transitions.

Household composition data indicates increasing dependency ratios that impact energy affordability and consumption patterns. The average number of dependents per household increased from 3.2 in 2023 to 3.9 in 2024, substantially exceeding the 2011 Statistics South Africa census figure of 1.99 dependents per household. This growing household size places additional pressure on household resources and energy budgets. Despite these increased dependency burdens, only 3% of surveyed households reported receiving child support grants, while 21% accessed the Social Relief of Distress Grant. This disconnect between household size and social support utilization suggests either barriers to accessing available grants or stringent eligibility criteria that exclude many households. The limited grant uptake, combined with increasing dependency ratios, underscores the ongoing economic challenges faced by eZamokuhle residents and highlights the critical importance of ensuring that clean energy interventions remain affordable and accessible to prevent regression to cheaper but more polluting fuel sources.

4.1.2 Housing

The type and structural characteristics of housing constitute fundamental determinants of health outcomes in low-income communities, directly influencing indoor air quality, thermal comfort, and energy use patterns. According to Statistics South Africa, 88% of South African households resided in formal dwellings as of 2022, providing a national benchmark against which eZamokuhle's housing conditions can be assessed. The 2023 survey revealed that 77.2% of sampled households in eZamokuhle occupied RDP (Reconstruction and Development Programme) housing, indicating a relatively high prevalence of formal housing structures within the community, though still below the national average.

Despite this predominance of formal housing, a critical challenge emerges from the widespread presence of informal backyard structures. Approximately 61% of surveyed households reported having shacks in their backyards, with remarkably consistent figures of 61.4% in 2023 and 61.2% in 2024. These informal structures, typically constructed to generate rental income, present

significant challenges for air quality management and intervention effectiveness. As unplanned dwellings that do not comply with building regulations, backyard shacks lack access to formal electricity connections, water, and sanitation services. This service deficit forces occupants to rely on alternative energy sources, perpetuating patterns of energy stacking that include the use of coal, wood, and other polluting fuels. The persistence of these structures represents a substantial limitation to the comprehensive impact of the AQO interventions, as they create pockets of continued high emissions within otherwise upgraded properties.

The formal RDP houses demonstrate considerably better construction standards and infrastructure provision compared to informal structures. These government-provided homes are typically constructed with brick and mortar, include electrical connections, and qualify for free basic services including electricity and water allocations. Approximately 21% of respondents reported having undertaken improvements to their RDP homes through extensions or modifications, demonstrating both community investment in housing quality and the potential for enhanced living conditions. These improvements contribute to reduced health risks by providing better protection from outdoor air pollution and enabling more effective thermal management.
Analysis of construction materials reveals important implications for thermal comfort and energy efficiency. Roofing materials consisted almost entirely of metal sheets, comprising 98.3% of main dwellings in 2023 and 99.5% in 2024. While metal roofing provides adequate weather protection, it offers limited thermal insulation, contributing to heat loss in winter and heat gain in summer. Floor construction showed greater variety, with cement floors accounting for 51% of dwellings in 2023, decreasing to 37.3% in 2024, while tiled floors comprised the remainder. The proportion of households using carpets increased from 10% in 2023 to 22.6% in 2024, suggesting growing awareness of the thermal comfort benefits provided by floor coverings.

The predominance of concrete floors without adequate insulation represents a significant pathway for heat loss, with estimates suggesting that up to 15% of household heat can be lost through uninsulated concrete floors. This heat loss directly impacts household energy consumption for space heating and undermines the effectiveness of the provided heating interventions. The introduction of insulation materials such as carpets could substantially improve thermal comfort

and reduce heating requirements, potentially enhancing the sustainability of the clean energy transition. However, as noted in the findings, the viability and sustainability of such additional interventions would require careful testing and evaluation by Eskom to ensure cost-effectiveness and community acceptance.

The housing analysis reveals a complex landscape where formal housing improvements coexist with persistent informal structures, creating differentiated conditions for intervention effectiveness. While the quality of formal housing in eZamokuhle provides a reasonable foundation for the AQO interventions, the high prevalence of backyard shacks represents an ongoing challenge that may require innovative approaches to ensure comprehensive air quality improvements across all dwelling types within the community.

4.1.3 Energy use

Access to electricity represents a fundamental requirement for improving quality of life and enabling energy transitions in low-income households. The survey data from eZamokuhle demonstrates near-universal electricity access, with 99.5% of households reporting electricity connections in 2023, though this figure declined slightly to 95.3% in 2024. This high level of electrification provides the essential infrastructure foundation necessary for transitioning households away from solid fuel dependence and represents a significant achievement in service delivery to the community.

Despite widespread electricity access, energy use patterns reveal the complex reality of energy stacking in low-income households. Approximately 50% of surveyed respondents reported relying on multiple energy sources throughout the year, even with available electricity connections. This continued diversification of energy sources is primarily attributed to rising electricity costs, which compel households to seek more affordable alternatives for their daily energy needs. Prior to the AQO interventions, electricity served predominantly three core household functions: lighting, space heating, and cooking, though its use was constrained by affordability concerns that drove households to supplement with cheaper but more polluting alternatives.

The implementation of Eskom's AQO interventions in eZamokuhle catalyzed remarkable transformations in household energy consumption patterns. Post-intervention data reveals significant shifts particularly in space heating and cooking applications, where cleaner energy sources have substantially displaced traditional solid fuels. Electricity usage for space heating increased from 44.2% pre-intervention to 54.1% post-intervention, while cooking applications saw electricity usage rise from 44.2% to 48.8%. These increases in electricity utilization occurred alongside dramatic growth in LPG adoption, which emerged as a major new component of the household energy mix following the distribution of gas appliances through the intervention programme.

The most striking outcome of the interventions is the precipitous decline in solid fuel consumption across the community. Coal usage, which previously served 40.8% of households for space heating and 39.6% for cooking, plummeted to merely 2.4% and 2.0% respectively in the post-intervention period. This represents a reduction of 38.4 percentage points in coal use for space heating and 37.6 percentage points for cooking applications. Similarly dramatic decreases were observed in firewood consumption, which declined from 10.9% to 1.4% for space heating and from 12.9% to 0.9% for cooking. These reductions in coal usage alone represent the elimination of approximately 85% of previous coal consumption in the community, with commensurate reductions in household emissions of particulate matter, sulfur dioxide, and other harmful pollutants.

The successful transition from solid fuels to cleaner alternatives demonstrates both immediate and long-term benefits. The shift away from coal and firewood directly reduces household exposure to indoor air pollution, while the community-wide adoption creates cumulative improvements in ambient air quality. The sustained nature of these changes one year after intervention implementation suggests that households have successfully integrated the new technologies into their daily routines and found them to be viable alternatives to traditional fuels.
This energy transition in eZamokuhle provides compelling evidence for the effectiveness of comprehensive intervention packages that combine technology provision with supportive infrastructure improvements. The dramatic reductions in solid fuel use, coupled with increased

adoption of electricity and LPG, validate the programme design and implementation approach. However, the persistence of energy stacking among 50% of households, driven primarily by electricity affordability, highlights the ongoing economic constraints that could potentially threaten long-term sustainability. This underscores the critical importance of addressing energy affordability through complementary measures such as subsidies or alternative payment mechanisms to prevent regression to cheaper but more polluting fuel sources.

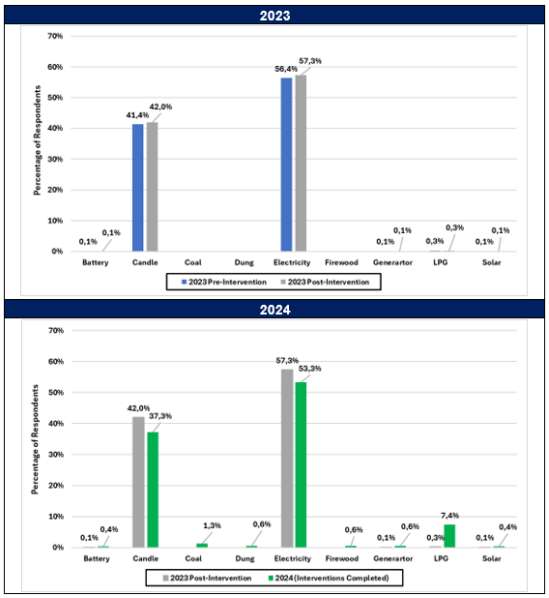

Figure i: Household energy use for Lighting in 2023 and 2024

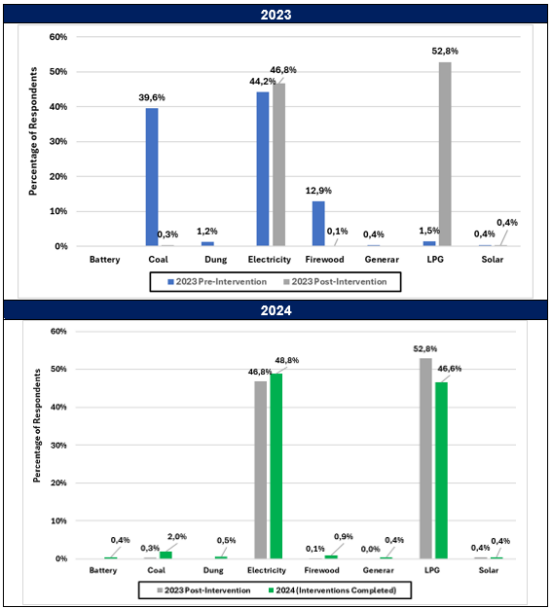

Figure ii: Household energy use for Cooking in 2023 and 2024

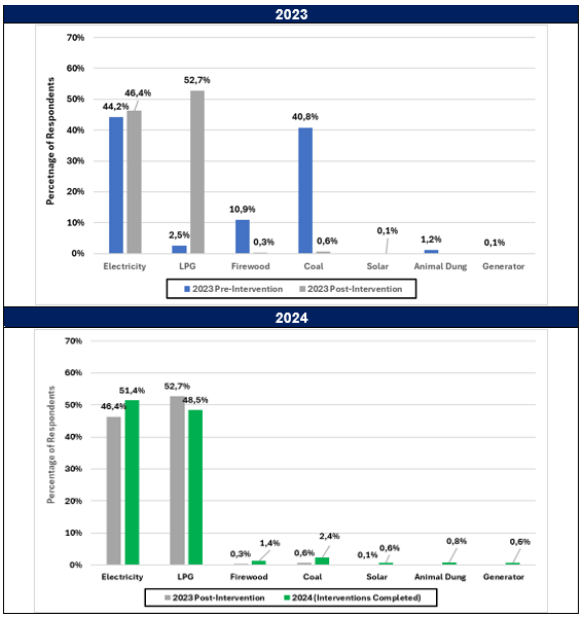

Figure iii: Household energy use for Space Heating in 2023 and 2024

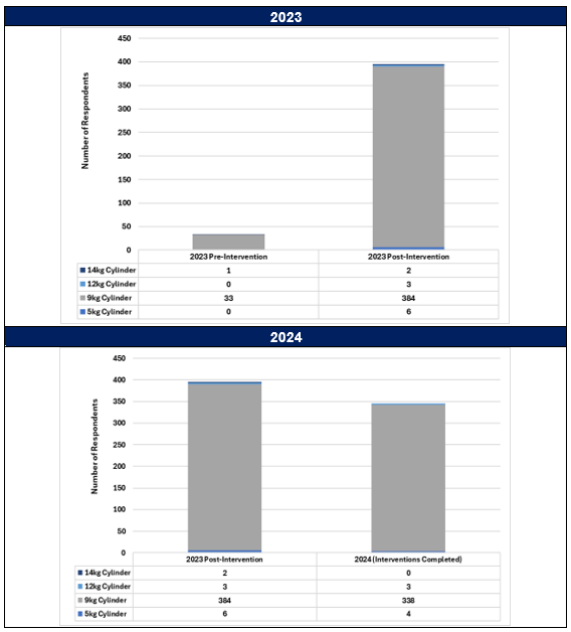

Figure iv: LPG use by respondents in 2023 and 2024

Figure v: Coal use by respondents in 2023 and 2024

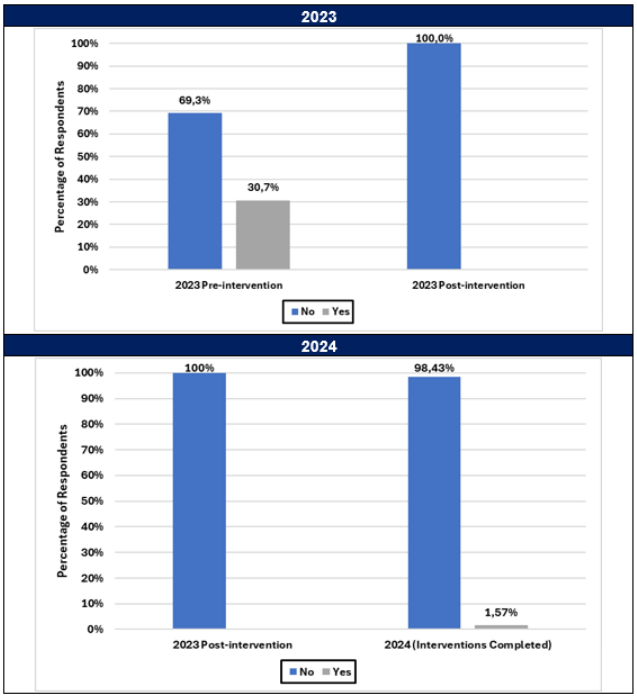

Figure vi: Firewood use by respondents in 2023 and 2024

4.1.4 Project Effectiveness of the Eskom AQO Interventions

4.1.4.1 Eskom's AQO Ceiling Interventions

- ***Installation, Condition and Maintenance***

The ceiling intervention component of Eskom's AQO programme demonstrated high initial quality standards and general satisfaction among beneficiary households. In the 2023 assessment, an overwhelming 97.5% of sampled households reported their newly installed ceilings to be of good quality, indicating successful implementation of technical specifications and installation procedures. However, a small but notable 2.5% of respondents identified quality concerns, primarily related to water leaks and installation deficiencies, suggesting areas requiring attention in quality control processes.

The interaction between Eskom's project implementation teams and household members proved generally positive throughout the installation phase, fostering community acceptance and cooperation. Nevertheless, isolated incidents of property damage during installation and inadequate post-installation cleanup were reported by some residents. These operational challenges, while affecting a minority of households, highlight the importance of comprehensive contractor management and standardized completion protocols to maintain community trust and programme reputation.

Longitudinal assessment of ceiling conditions reveals concerning durability trends that warrant strategic intervention. While 93.3% of respondents in 2023 reported their ceilings remained in the same condition as when initially installed, this figure declined to 92.4% by 2024, indicating emerging degradation in approximately 1% of installations annually. The persistence and potential expansion of leak-related issues represent the primary threat to ceiling integrity and effectiveness. These water infiltration problems not only compromise the thermal efficiency benefits of the intervention but also risk undermining household confidence in the technology.

Maintenance practices and household capacity for repairs emerged as critical factors influencing long-term intervention sustainability. Cost constraints consistently deterred households from undertaking necessary maintenance activities across both survey years, reflecting the broader economic challenges faced by the community. This financial barrier to maintenance creates conditions where minor issues may escalate into major structural problems, potentially negating the benefits of the initial intervention investment.

The patterns of problem reporting and help-seeking behavior reveal important insights into community expectations and support systems. Despite experiencing ongoing issues, the reporting of ceiling problems to Eskom declined between 2023 and 2024, suggesting either resignation to existing problems or barriers to accessing support channels. Paradoxically, a slight increase in households seeking assistance for roof repairs during the same period indicates persistent needs for technical support that may not be adequately addressed through current mechanisms.

A fundamental challenge to programme sustainability lies in the widespread expectation of ongoing Eskom responsibility for ceiling maintenance. In 2023, 303 respondents (77%) expressed the belief that Eskom should bear responsibility for future repairs related to damage or leaks, with this expectation persisting among 270 respondents (70.9%) in 2024. This perception, while understandable given the programme's origins and Eskom's institutional capacity, creates a dependency relationship that may prove financially unsustainable as the programme scales to tens of thousands of households.

The maintenance expectation gap between community perceptions and programme design represents a critical risk to long-term effectiveness. Without clear communication regarding maintenance responsibilities and the establishment of sustainable support mechanisms, the gradual degradation of ceiling installations could erode both the technical benefits and community goodwill generated by the initial intervention. The development of community-based maintenance systems, possibly including trained local technicians and affordable repair services, appears essential for ensuring the longevity of ceiling benefits while managing expectations regarding institutional responsibilities.

These findings underscore the importance of considering full lifecycle costs and support requirements in intervention design, moving beyond initial installation success to address long-term sustainability challenges. The high initial satisfaction rates demonstrate the potential for ceiling interventions to deliver meaningful benefits, but realizing this potential requires proactive strategies to address maintenance barriers and clarify stakeholder responsibilities.

Table i: Condition of respondent's ceiling in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
		2023		2024	
Section	**Question**	**Yes**	**No**	**Yes**	**No**
Ceiling Condition	Ceiling looks the same as when installed	374	27	352	29
	Stains on the ceiling	45	355	46	335

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
		2023		2024	
	Ceiling leaks	105	296	69	312
	Attempt to fix leak by themselves	37	67	34	35
	Did you let Eskom know about the leak	82	22	9	60
	Eskom fixed the leak	5	63	10	59
	Will not fix future leaks due to high cost	206	73	207	55

- ***Respondents' satisfaction with Eskom's Ceiling AQO intervention***

The assessment of household satisfaction with the ceiling interventions reveals overwhelmingly positive outcomes that validate the technical design and implementation approach of this component of the AQO programme. Across both survey years, respondents expressed remarkably high levels of satisfaction with multiple aspects of the intervention, while also identifying specific areas requiring attention to optimize future rollouts.

Safety perceptions of the installed ceilings remained consistently positive throughout the evaluation period. Although a small proportion of respondents (3%) expressed safety concerns related to structural issues such as ceilings beginning to sag or evidence of poor installation quality, the vast majority of households felt secure with their new ceiling infrastructure. Despite these isolated safety concerns, the strength of community endorsement is demonstrated by the fact that 99.2% of respondents in 2024 would still recommend the ceiling installations to other households. This near-universal recommendation rate suggests that even households experiencing challenges recognize the overall value of the intervention.

The primary intended benefit of improved thermal comfort was successfully achieved across the beneficiary population. An extraordinary 99.8% of respondents in 2023 reported experiencing warmer homes following ceiling installation, with this figure remaining remarkably stable at 99.2% in 2024. This sustained thermal comfort improvement over the one-year evaluation period confirms that the ceiling insulation continues to function effectively in reducing heat loss and

maintaining indoor temperatures. The consistency of these results across different household types and conditions demonstrates the robustness of the intervention design.

Overall satisfaction metrics reinforce the positive reception of the ceiling interventions within the community. In 2023, 97% of respondents expressed satisfaction with their ceiling installations, with this figure increasing marginally to 97.6% in 2024. The maintenance or slight improvement in satisfaction levels over time contradicts typical patterns where initial enthusiasm often wanes as challenges emerge, suggesting that households continue to experience tangible benefits that outweigh any emerging issues.

The sources of dissatisfaction, while affecting a small minority of households, provide valuable insights for programme improvement. Poor installation quality and water leaks emerged as the primary drivers of negative experiences, consistent with the technical issues identified in the condition assessment. These specific concerns highlight the critical importance of installation quality control and the need for effective solutions to address water infiltration challenges that compromise ceiling integrity and household satisfaction.

Behavioral changes in energy use provide concrete evidence of the intervention's effectiveness in achieving its environmental objectives. Many respondents reported substantial reductions in coal consumption for space heating following ceiling installation, directly attributable to improved thermal efficiency reducing heating requirements. This behavioral shift represents a tangible environmental benefit beyond the comfort improvements experienced by households, contributing to the programme's air quality objectives.

Community feedback on potential improvements revealed a bifurcated response pattern with important implications for programme refinement. While many respondents indicated that no improvements were necessary, reflecting their satisfaction with the current intervention, those who provided specific feedback consistently highlighted two critical areas: the need for better-skilled installation teams and the use of higher-quality materials. These recommendations align

with the reported issues of poor installation and leaks, suggesting that enhanced contractor training and material specifications could address the primary sources of dissatisfaction.

The persistence of concerns about ceiling conditions, despite high satisfaction levels, reveals an important tension in community perceptions. Households simultaneously appreciate the immediate benefits of warmer homes and reduced heating costs while harboring anxieties about long-term durability and maintenance requirements. This duality underscores the importance of addressing maintenance concerns proactively to sustain the high satisfaction levels currently enjoyed.

The ceiling intervention satisfaction data presents a compelling success story tempered by specific implementation challenges. The near-universal experience of improved thermal comfort, coupled with sustained high satisfaction rates and strong community endorsement, validates the fundamental approach. However, the identified issues with installation quality and water infiltration, though affecting a small percentage of households, require targeted attention to prevent erosion of community confidence and ensure long-term programme success. The community's specific recommendations for improvement provide a clear pathway for enhancing future implementations through improved contractor management and material specifications.

4.1.4.2 LPG Heater Intervention

- ***Refill, Condition, LPG usage and Safety***

The LPG heater intervention demonstrated strong initial acceptance but revealed emerging challenges related to supply chain infrastructure and long-term equipment maintenance. In 2023, an impressive 99% of the 389 respondents who received LPG heaters assessed them as good quality, indicating successful equipment selection and distribution. However, reports of heaters ceasing to function after delivery signaled early concerns about equipment durability or user

operation challenges. By 2024, satisfaction with heater quality had declined notably to 79.5%, suggesting deteriorating equipment conditions or growing user frustrations with operational aspects of the technology.

Supply chain limitations emerged as a critical barrier to sustained LPG adoption in eZamokuhle. The absence of local LPG suppliers within the community forces households to travel considerable distances for cylinder refills, incurring both time and transport costs that undermine the economic viability of LPG use. This infrastructure gap has led many respondents to maintain reliance on coal and wood as backup or alternative fuel sources, perpetuating the energy stacking behaviors the intervention aimed to eliminate. While the number of refill locations increased between 2023 and 2024, the persistent burden of transport costs continues to impede regular LPG usage, particularly among lower-income households with limited mobility options.

The evolution of LPG supply arrangements reveals important market dynamics and consumer preferences. A significant shift occurred from established suppliers in 2023, including BKB Retail Store, Amersfoort Total Garage, and Bhyat Mica, to new entrants in 2024 such as Afgri, Lablu supermarket, and notably, a local spaza shop. This transition was primarily driven by consumer dissatisfaction with cylinder exchange policies at certain suppliers, where customers feared receiving defective or substandard cylinders in exchange for their Eskom-provided equipment. The emergence of a local spaza shop as an LPG supplier represents a positive development in bringing supply closer to the community, though the scale and reliability of this service require further assessment.

Equipment condition and longevity patterns raise concerns about intervention sustainability. While 98.7% of respondents reported their LPG heaters remained in good condition in 2023, by 2024, 4.9% indicated their heaters were either non-functional or no longer in their possession. This deterioration rate, though affecting a minority, suggests potential issues with equipment quality, user maintenance practices, or household dynamics affecting equipment retention. The loss of heaters from some households particularly warrants investigation to understand whether this represents theft, informal trading, or allocation to other family members.

Economic perceptions of LPG usage evolved favorably despite persistent affordability challenges. The proportion of respondents viewing LPG heaters as cost-effective compared to traditional coal alternatives increased substantially, with 81.6% in 2024 finding them cheaper than umbaula or coal heaters. This shift in economic perception, despite actual refill costs remaining significant, may reflect growing appreciation for the efficiency and cleanliness benefits of LPG heating. However, lower-income households continue to face financial barriers that limit their ability to maintain regular LPG usage, highlighting the need for innovative financing mechanisms or subsidies to support sustained adoption.

Safety perceptions and practices revealed both progress and persistent challenges in community adaptation to gas technologies. Confidence in LPG safety improved modestly, with households feeling safe using the technology increasing from 80.4% in 2023 to 82.1% in 2024. Despite comprehensive training provided to 95.1% of households, a concerning gap emerged between training receipt and practical knowledge, with only 68.1% of trained users knowing appropriate responses to gas leaks. The limited interest in additional training (only 24.2% expressing interest) suggests either confidence in existing knowledge or resignation to knowledge gaps, both of which pose risks for long-term safe usage.

The increase in defective heaters from 4 units in 2023 to 22 units in 2024 represents a 450% rise in equipment failures, though from a small base. While some households attempted independent repairs, demonstrating initiative and ownership of the technology, many others cited affordability constraints as barriers to addressing equipment malfunctions. This repair reluctance risks creating a growing pool of non-functional equipment that could drive regression to traditional fuels.
Despite technical challenges, the overwhelming majority of users maintained confidence in LPG safety, with 97.9% in 2023 perceiving heaters as safe, though this confidence showed slight erosion by 2024. Specific safety concerns centered on risks to children and general apprehensions about gas handling, reflecting both legitimate safety considerations and potential knowledge gaps that could be addressed through targeted education.

The behavioral impact of LPG heater adoption proved substantial, with significant numbers of respondents reporting reduced coal consumption for heating purposes. This fuel substitution effect validates the intervention's environmental objectives while demonstrating user acceptance of LPG as a viable alternative to traditional heating methods. The reported adequacy of warmth provided by LPG heaters, despite marginal increases in complaints about insufficient heating, suggests general satisfaction with the technology's performance relative to traditional alternatives.

- ***Respondents' satisfaction with the Eskom's AQO LPG Heater intervention***

The LPG heater intervention achieved exceptional satisfaction levels that remained remarkably stable across the evaluation period, demonstrating successful technology selection and implementation. In 2023, an extraordinary 98.7% of the 384 respondents expressed satisfaction with their LPG heaters, representing near-universal approval of this clean heating technology. This high satisfaction level showed only marginal decline by 2024, when 97.1% of respondents reported continued satisfaction with their heaters, indicating sustained positive experiences despite the passage of time and potential emergence of operational challenges.

Community endorsement of the LPG heater technology extended beyond personal satisfaction to active recommendation for broader deployment. In 2023, 387 out of 389 respondents recommended LPG heater installation in other households, representing a 99.5% endorsement rate that speaks to both the perceived benefits and social acceptability of the technology. This strong advocacy continued into 2024, suggesting that user experiences remained sufficiently positive to overcome any challenges encountered during the first year of operation. Such peer endorsement represents a powerful driver for community-wide adoption and acceptance of clean energy technologies.

The primary functional objective of improved thermal comfort was successfully achieved and sustained throughout the evaluation period. In 2023, 98.5% of respondents reported experiencing warmer homes following LPG heater installation, confirming the technology's effectiveness in providing adequate space heating. While this figure decreased slightly to 96.5% in 2024, the

sustained high percentage indicates that LPG heaters continue to meet household heating needs effectively. The marginal decline may reflect equipment degradation, changing household circumstances, or elevated expectations following initial experiences, but the overall performance remains strongly positive.

The absence of substantial improvement suggestions from the beneficiary community provides important validation of the intervention design and implementation. In 2023, 342 respondents indicated no enhancements were necessary, with this number increasing to 362 respondents in 2024. This pattern suggests that the LPG heaters, as provided, adequately meet household needs without significant design flaws or operational deficiencies requiring modification. The increase in respondents satisfied with the current configuration may indicate growing familiarity and comfort with the technology over time.

The minimal recommendations for improvement that were provided offer valuable insights for programme refinement, though their limited number suggests these represent edge cases rather than systematic issues. The high satisfaction levels across multiple dimensions – overall satisfaction, thermal comfort improvement, and peer recommendation rates – create a compelling evidence base for the effectiveness of LPG heaters as a clean alternative to traditional coal-based heating methods.

The stability of satisfaction metrics between 2023 and 2024 deserves particular attention, as it contradicts typical patterns where initial enthusiasm often diminishes as operational challenges emerge. The maintenance of satisfaction levels above 96% across all measured dimensions suggests that LPG heaters provide sustained value that outweighs any inconveniences related to refilling, costs, or operational requirements. This sustained satisfaction, combined with the reported reductions in coal use for heating, validates both the technical appropriateness and social acceptability of LPG as a transitional fuel for space heating in low-income South African communities.

The overwhelmingly positive response to the LPG heater intervention, as evidenced by these satisfaction metrics, provides strong justification for continued programme expansion while highlighting the importance of addressing the supply chain and maintenance challenges identified in other aspects of the evaluation. The combination of high satisfaction, strong peer endorsement, and sustained thermal comfort benefits creates favorable conditions for achieving lasting behavior change in household energy use patterns.

Table ii: Respondents satisfaction with Eskom's AQO LPG heater in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
LPG Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Usage of LPG	Happy with LPG Heater	384	5	370	11
	House is warmer after installation	383	6	368	13
	Would recommend LPG heater installation to other households	387	2	373	8

4.1.4.3 Eskom's AQO Hybrid Stove Intervention

- ***Installation, Safety and Use***

The hybrid stove intervention demonstrated exceptional implementation quality and sustained user satisfaction throughout the evaluation period. Of the 401 households surveyed in 2023, 391 had received hybrid stoves, with an remarkable 99% expressing satisfaction with the equipment quality. The installation process proved notably successful, with no households reporting property damage during stove installation, indicating well-trained installation teams and appropriate

protocols. By 2024, satisfaction with stove quality remained robust at 97.6%, demonstrating the durability and continued functionality of the distributed appliances.

Physical condition assessments revealed strong equipment resilience, with 98.2% of respondents reporting their stoves maintained their original appearance after installation. The small proportion experiencing changes primarily attributed these to technical malfunctions or removal of the stove from the premises. This high rate of equipment integrity suggests appropriate selection of durable appliances suited to the usage patterns and conditions within eZamokuhle households.

Training provision achieved near-universal coverage, with 95.4% of respondents in 2023 confirming receipt of operational training for their hybrid stoves. This comprehensive training deployment continued in 2024, with 95% coverage maintained. However, a significant knowledge gap emerged between training delivery and practical safety competence. Only 67.4% of trained users in 2023 demonstrated awareness of appropriate safety protocols for gas leak situations, with this figure declining marginally to 67.1% in 2024. This persistent knowledge deficit, affecting approximately one-third of users, represents a critical safety risk requiring intervention.

The disconnect between training receipt and safety knowledge retention suggests potential deficiencies in training methodology, content delivery, or language barriers. The modest proportion of respondents expressing interest in additional training (12.8%) may indicate either misplaced confidence or resignation, both of which pose risks for long-term safe operation. This limited demand for supplementary training, despite evident knowledge gaps, highlights the need for proactive safety reinforcement strategies rather than voluntary participation approaches.

Safety perceptions of the hybrid stove technology remained overwhelmingly positive, with only 1.8% of users in 2023 considering it more dangerous than traditional coal stoves. While this percentage increased slightly to 2.8% in 2024, the vast majority of users felt comfortable with the safety profile of their new cooking technology. The primary safety concern centered on the inherent characteristics of LPG fuel requiring greater caution during use, leading many households to adopt precautionary behaviors such as ensuring adequate ventilation while

cooking. This spontaneous adoption of safety practices demonstrates user awareness of gas-related risks and adaptive behavior to mitigate potential hazards.

Maintenance responsibility perceptions revealed complex expectations within the community. While the majority of respondents indicated willingness to take responsibility for routine repairs, a simultaneous expectation persisted that Eskom should address equipment damage. This dual expectation reflects both acceptance of user responsibility and continued reliance on institutional support for major repairs. Financial constraints emerged consistently as the primary barrier to equipment maintenance, with households across both survey years citing affordability as the main impediment to repairing damaged stoves. This economic barrier risks creating a growing inventory of non-functional equipment that could drive regression to traditional cooking methods.

Economic perceptions of hybrid stove operation showed marked improvement over the evaluation period. The proportion of respondents viewing hybrid stove operation as cost-comparable or superior to coal stoves increased from 76% in 2023 to 87.9% in 2024. This improving economic perception occurred despite acknowledged challenges including LPG refill costs and the absence of credit purchase options for gas cylinders. The shift suggests growing appreciation for the efficiency benefits and time savings offered by the hybrid stove, which may offset direct fuel cost comparisons.

Operational performance of the hybrid stoves exceeded user expectations across multiple dimensions. The vast majority of users experienced minimal technical problems, with only a small percentage reporting defects or malfunctions. Users particularly valued the efficiency gains in cooking times and the technology's ease of use compared to traditional coal stoves. Critically, the hybrid stoves successfully maintained food taste profiles, with users confirming that traditional flavors were preserved despite the change in cooking technology. This taste preservation represents a crucial factor in sustained adoption, as food cultural preferences often present significant barriers to cooking technology transitions.

The limited operational issues, combined with perceived economic benefits and preserved cooking outcomes, created favorable conditions for sustained technology adoption. The hybrid stove's dual-fuel design, incorporating both LPG and electric plates, provided users with fuel flexibility that enhanced resilience against supply disruptions or price fluctuations in either energy source. This design feature appeared particularly valuable given the supply chain challenges identified for LPG distribution within the community.

- ***Respondents' satisfaction with the Eskom's AQO Hybrid Stove intervention***

The hybrid stove intervention achieved exceptional satisfaction levels that remained remarkably consistent across the evaluation period, establishing it as one of the most successful components of the AQO programme. In 2023, 386 individuals, representing 98.7% of recipients, expressed satisfaction with their installed hybrid stoves. This extraordinary approval rating persisted into 2024, with 375 individuals (98.4%) maintaining their positive assessment, demonstrating that user satisfaction remained stable despite extended usage periods and potential operational challenges.

Community endorsement of the hybrid stove technology reached unprecedented levels, with universal recommendation in the initial evaluation period. All participants in the 2023 survey endorsed hybrid stove installation for other households, representing a perfect 100% recommendation rate that underscores both the technology's effectiveness and its cultural acceptability within the community. While this endorsement rate decreased marginally to 98.2% in 2024, with 377 respondents maintaining their recommendation, the sustained near-universal approval indicates that user experiences remained overwhelmingly positive throughout the first year of operation.

The strength of peer recommendations serves as a powerful indicator of intervention success, as community members would unlikely advocate for technologies that failed to meet their practical needs or cultural preferences. This enthusiastic endorsement suggests that hybrid stoves successfully addressed the multiple requirements of cooking performance, economic viability, and

social acceptability within the eZamokuhle context. The minimal decline in recommendation rates between years indicates that initial enthusiasm translated into sustained satisfaction based on actual usage experience.

User feedback on potential improvements revealed high contentment with the current technology configuration. The majority of respondents across both survey years asserted that no modifications were necessary to the hybrid stove design, indicating that the selected technology appropriately matched user needs and preferences. This absence of substantial improvement demands validates the initial technology selection process and suggests that extensive user consultation during programme design successfully identified appropriate specifications.

Among the minority who suggested enhancements, a consistent theme emerged regarding the desire for expanded cooking capacity through the inclusion of two electric plates and two gas plates, compared to the current configuration. This specific recommendation appeared in both 2023 and 2024 surveys, indicating a persistent preference among some users for greater fuel flexibility and simultaneous cooking capacity. The request for dual fuel sources on all plates reflects sophisticated energy management strategies among users who seek to optimize cooking efficiency while maintaining resilience against fuel supply disruptions or price fluctuations.

The consistency of this specific improvement suggestion across both survey years merits consideration for future procurement decisions, as it represents a clear user preference based on practical cooking experiences. The desire for enhanced fuel flexibility aligns with observed energy stacking behaviors and could potentially increase user satisfaction while providing greater resilience against supply chain disruptions affecting either electricity or LPG availability.

The sustained high satisfaction levels with hybrid stoves, exceeding 98% across both evaluation years, provide compelling evidence for the appropriateness of this technology within the local context. The combination of near-universal satisfaction, enthusiastic peer endorsement, and minimal improvement demands creates a strong foundation for programme expansion. The hybrid stove's success in maintaining user approval while facilitating the transition from coal-based

cooking demonstrates the viability of well-designed technological interventions in achieving sustained behavior change in household energy use patterns.

The remarkable consistency in satisfaction metrics between 2023 and 2024 contradicts typical technology adoption patterns where initial enthusiasm often wanes as operational realities emerge. This sustained satisfaction suggests that hybrid stoves continue to deliver tangible benefits that outweigh any inconveniences related to fuel procurement, operational adjustments, or maintenance requirements. The success of this intervention component provides valuable lessons for the design and implementation of similar clean cooking transitions in comparable contexts.

Table iii: Respondents satisfaction with Eskom's AQO Hybrid Stove in 2023 and 2024

Ezamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Satisfaction	Happy with Hybrid stove	386	5	375	6
	Would Recommend Installation of Hybrid Stove in Other Homes	390	0	377	4

4.1.4.4 Eskom's AQO Rewiring Intervention

- ***Installation and Certificate of Compliance***

The household rewiring intervention demonstrated consistently high implementation quality across the evaluation period while revealing important administrative gaps requiring attention. By December 2023, 399 respondents had received wiring interventions as part of the comprehensive AQO package, representing near-complete coverage of the surveyed population. Initial quality assessments proved highly favorable, with 384 respondents (96.2%) reporting good quality wiring

installations. This positive assessment showed only marginal decline by 2024, when 95% of the 362 respondents who provided feedback maintained favorable views of their wiring quality, indicating sustained satisfaction with the technical standards of the electrical work performed.

The installation process demonstrated exceptional care for household property, with only three respondents (0.8%) in 2023 reporting damage to their homes during wiring installation. This minimal property damage rate reflects well-trained installation teams operating under appropriate supervision and safety protocols. The low incidence of installation-related damage contributed to maintaining positive community relations and acceptance of the intervention teams working within private homes.

Longevity assessments of the installed wiring revealed strong durability, with the vast majority of installations maintaining their initial condition over time. In 2023, 388 respondents (97.2%) reported their wiring maintained its original appearance since installation, with this figure remaining stable at 367 respondents (96.3%) in 2024. The small proportion experiencing deterioration primarily attributed damage or defects to poor initial installation quality rather than normal wear or household-induced damage. This attribution pattern highlights the critical importance of installation quality control in determining long-term intervention success.

A significant administrative challenge emerged regarding the distribution of Certificates of Compliance (COC), legal documents essential for insurance claims and property transactions. In 2023, only 300 respondents (75.2%) received their COC documentation, while 164 households remained unaware of their entitlement to receive such certification. This knowledge gap raises serious concerns about household vulnerability in insurance claim scenarios, as the absence of proper electrical compliance certification could invalidate claims related to electrical faults or fires. The lack of awareness about COC requirements suggests insufficient communication during the installation process regarding the legal and practical importance of this documentation.
The programme demonstrated responsive improvement in COC distribution, with the proportion of households receiving certificates increasing dramatically to 356 respondents (93.4%) by 2024. This significant improvement from 75.2% to 93.4% indicates recognition of the initial shortcoming

and implementation of corrective measures to ensure proper documentation delivery. However, the remaining gap still leaves 6.6% of households potentially vulnerable to insurance complications, warranting continued attention to achieve complete COC coverage.

Community endorsement of the rewiring intervention remained exceptionally strong throughout the evaluation period. In 2023, 392 respondents (98.2%) recommended extension of rewiring interventions to other homes, demonstrating near-universal approval of the safety and functionality improvements provided. While this endorsement rate declined slightly to 365 respondents (95.8%) in 2024, the sustained high recommendation level indicates continued recognition of the intervention's value despite any implementation challenges experienced.

The small minority withholding endorsement cited specific implementation failures rather than conceptual opposition to electrical upgrades. Negative experiences predominantly related to incomplete work, where installation teams failed to complete all planned improvements, or poor installation quality that resulted in subsequent faults. These specific criticisms provide actionable feedback for improving contractor management and quality assurance protocols in future rollouts. The rewiring intervention's success in achieving high satisfaction rates while addressing critical safety infrastructure demonstrates the value of including electrical upgrades within comprehensive household improvement packages. The improved electrical safety, combined with enhanced capacity for appliance use, creates enabling conditions for sustained use of electric cooking and heating appliances provided through other intervention components. The strong community endorsement, despite isolated implementation challenges, validates the inclusion of rewiring as an essential element of the holistic approach to household energy transition.

The significant improvement in COC distribution between survey years exemplifies responsive programme management and the importance of continuous monitoring to identify and address implementation gaps. This administrative improvement, combined with sustained high satisfaction with technical quality, positions the rewiring intervention as a successful component that addresses both immediate safety needs and long-term household electrical infrastructure requirements.

- ***Respondents' satisfaction with the Eskom's AQO Rewiring intervention***

The rewiring intervention achieved exceptional levels of community endorsement that, while showing slight decline over time, remained remarkably high throughout the evaluation period. In 2023, an overwhelming 392 respondents, representing 98.2% of beneficiaries, actively advocated for extending the rewiring intervention to other homes within eZamokuhle. This near-universal endorsement demonstrates that households recognized and valued the safety improvements and enhanced electrical capacity provided by the intervention, viewing it as an essential upgrade worthy of community-wide implementation.

The small cohort of seven individuals who expressed reservations in 2023 provided specific, actionable feedback regarding their negative experiences. Their concerns predominantly centered on incomplete work by installation teams, where contractors failed to fulfill the full scope of planned electrical improvements. These experiences of partial implementation represent a failure in project execution rather than fundamental flaws in the intervention design, highlighting the critical importance of contractor supervision and completion verification protocols.

By 2024, while community endorsement remained strong at 95.8% with 365 respondents maintaining their recommendation for broader rollout, the number of hesitant individuals increased to 18. This growing minority of dissatisfied beneficiaries identified poor installation quality, particularly regarding electrical plugs, as their primary concern. The specific focus on plug quality suggests that while major electrical infrastructure improvements met expectations, finishing details requiring precision workmanship showed greater variability in implementation standards.
The evolution of concerns from incomplete work in 2023 to quality issues in 2024 reveals a progression in implementation challenges. Initial problems with work completion appear to have been substantially addressed, as evidenced by fewer complaints about incomplete installations. However, this improvement in completion rates may have occurred at the expense of detailed quality control, resulting in the emergence of workmanship concerns particularly evident in plug installations. This pattern suggests the need for balanced attention to both completion rates and quality standards in contractor management.

When solicited for recommendations to enhance the rewiring intervention, the majority of respondents across both survey years indicated satisfaction with the current approach, offering no specific suggestions for improvement. This absence of widespread improvement demands validates the fundamental design of the rewiring intervention as appropriately matched to household needs and expectations. The general satisfaction with the intervention approach, despite isolated implementation concerns, suggests that the core electrical upgrades successfully addressed household safety and capacity requirements.

Among the specific enhancements suggested, a consistent preference emerged for the installation of double plug points rather than the single outlets provided during the current initiative. This recommendation reflects practical household needs in contexts where electrical appliances compete for limited plug points, forcing households to rely on potentially unsafe multi-plug adapters or frequently interchange appliance connections. The request for double plug points represents a modest design modification that could significantly enhance household convenience and safety while potentially reducing the use of unsafe electrical extensions.

The persistence of the double plug point recommendation across both survey years indicates this represents a genuine household need based on lived experience rather than a transient preference. The specificity and consistency of this feedback provide clear guidance for future procurement specifications that could enhance user satisfaction with minimal additional cost. Implementation of this modification would demonstrate responsive programme management that incorporates user feedback into design iterations.

The sustained high endorsement rates for rewiring interventions, exceeding 95% across both evaluation years, establish this component as a valued and necessary element of the household upgrade package. The combination of strong community advocacy, specific but limited improvement suggestions, and identified implementation challenges that are addressable through enhanced contractor management creates favorable conditions for successful programme expansion. The rewiring intervention's success in maintaining community support while providing

essential safety improvements validates its inclusion as a foundational element enabling the broader transition to electrical appliances for cooking and heating applications.

Table iv: Respondents satisfaction with Eskom's rewiring intervention in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Wiring Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Installation	Received wiring intervention	399	2	401	
	Wiring is of good quality	384	15	362	12
	Did you receive a certificate of Compliance	300	99	356	18
	Installation team damaged household	3	396	N/A	N/A
	Does electrical wiring look the same as when installed	388	11	367	7
	Electrical wiring became damaged or defective	16	383	18	356
	Recommend rewiring to be done at other households	392	7	365	9

4.1.5 Regress

The assessment of potential regression to traditional fuel sources reveals both encouraging adherence to clean energy technologies and emerging risk factors requiring strategic intervention. In 2023, an overwhelming 99.2% of respondents, representing 397 individuals, identified electricity subsidies as crucial incentives for preventing household reversion to coal stoves and maintaining use of their new hybrid stoves. While this proportion decreased marginally to 97% in 2024, the sustained near-universal recognition of subsidy importance underscores the fundamental role of affordability support in sustaining clean energy transitions among low-income households.

The absence of new coal stove purchases in 2023 represents a significant achievement in preventing immediate regression to traditional cooking technologies. No respondents reported acquiring additional coal stoves during this period, though one household acknowledged continued use of an existing coal stove, suggesting incomplete transition rather than active regression. By 2024, however, early warning signs emerged with four respondents having purchased new coal stoves and three actively utilizing them. While these numbers remain small in absolute terms, they represent the first documented cases of active regression and warrant careful monitoring to prevent broader reversal trends.

Willingness to abandon clean technologies in favor of traditional coal stoves showed a concerning upward trajectory, though from a very low base. The proportion of respondents expressing readiness to exchange their hybrid stove or LPG heater for a coal stove increased from 1.2% in 2023 to 3.4% in 2024. This near tripling of regression willingness, while still affecting fewer than 4% of households, signals growing frustration or economic pressure that could accelerate if underlying causes remain unaddressed. The increase suggests that initial enthusiasm for clean technologies may be eroding under the pressure of operational costs and supply chain challenges.

Heating preferences demonstrated a strong and increasing preference for LPG technology over traditional coal-based methods. In 2023, 91.4% of respondents selected LPG heaters as their preferred heating method, with this preference strengthening to 95% by 2024. This improving acceptance of LPG heating technology stands in contrast to the emerging regression risks in cooking applications, suggesting that the benefits of LPG heating—including convenience, cleanliness, and effectiveness—outweigh perceived disadvantages more successfully than in cooking applications where cultural preferences and fuel costs play larger roles.

The divergence between strengthening LPG heating preferences and emerging coal stove regression risks highlights the complexity of household energy transitions. While households increasingly appreciate the advantages of LPG for space heating, the economic and practical challenges of maintaining dual-fuel cooking systems appear to strain some household budgets

and patience. This pattern suggests that regression risks may be application-specific rather than representing wholesale rejection of clean energy technologies.

Household mobility emerged as an additional factor potentially influencing intervention sustainability. Small numbers of respondents in both survey years indicated plans to relocate, citing economic pressures including high rent costs and lease expirations as primary drivers. While affecting only a minority of households, residential mobility poses challenges for intervention effectiveness as relocated households may move to dwellings without AQO improvements, and new occupants of upgraded homes may lack training or commitment to maintaining clean energy practices.

The economic drivers of potential relocation—high rent costs and housing insecurity—reflect the broader socioeconomic vulnerabilities of the eZamokuhle community that intersect with energy transition challenges. Households facing housing affordability pressures simultaneously confront energy affordability constraints, creating compound stressors that may drive regression to cheaper traditional fuels despite recognized health and convenience benefits of clean alternatives.

The critical role of electricity subsidies in preventing regression, as recognized by over 97% of respondents across both years, provides clear policy guidance for sustaining intervention gains. Without continued affordability support, the emerging regression indicators could accelerate rapidly, particularly if economic conditions deteriorate or energy prices increase. The documented cases of coal stove purchases and active use in 2024, while limited, represent canaries in the coal mine that signal the fragility of behavior change in the absence of sustained economic support.

These findings underscore that successful energy transitions require more than initial technology distribution; they demand ongoing attention to affordability, supply chain reliability, and household economic stability. The strong and improving preference for LPG heating demonstrates that households value clean energy technologies when they can afford to sustain their use, while

emerging regression risks in cooking applications highlight where additional support remains critical.

Table v: Intervention regress in 2023 and 2024

Ezamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
		2023		2024	
Section	**Question**	**Yes**	**No**	**Yes**	**No**
Regress	Electricity subsidy will promote use of stove	397	3	373	7
	Have you purchased another coal stove	0	401	4	377
	Would you give back the hybrid stove or LPG heater for a brand-new coal stove	5	396	13	368
	Do you prefer to heat your home with LPG heater rather than coal?	361	34	364	17
	Will you be moving away from this house in 2024	3	398	7	374
	Do you have another coal stove in your home	1	400	3	378

The comparative assessment of intervention impacts reveals clear household priorities and the relative value placed on different components of the AQO package. Figure vii illustrates the respondents' perspectives on which intervention made the greatest difference to their quality of life, providing crucial insights into community valuation of the various technologies and improvements provided. In 2023, the ceiling intervention emerged as the most impactful component according to 47.5% of respondents, establishing it as the leading intervention despite strong competition from other components. The hybrid stove and LPG heater followed closely in perceived impact, indicating that while the ceiling intervention led in preference, the margin was relatively narrow and all three major interventions were valued by substantial portions of the community.

This ranking pattern demonstrated remarkable stability and intensification by 2024, when the proportion of respondents identifying the ceiling intervention as most impactful increased to 54.1%. This growth of 6.6 percentage points in ceiling preference suggests that the benefits of improved thermal insulation became more apparent and valued over time, possibly as households experienced full seasonal variations and recognized cumulative energy savings. The strengthening preference for ceiling interventions may also reflect their passive nature, requiring no ongoing costs or behavioral changes while continuously delivering thermal comfort benefits throughout the year.

The increasing dominance of ceiling interventions in household preference rankings carries important implications for programme design and resource allocation. Unlike stoves and heaters that require ongoing fuel purchases and active user engagement, ceiling insulation operates as a passive intervention that delivers benefits without continued household investment or effort. This characteristic may explain why appreciation for ceiling interventions grew over time, as households faced the practical and economic challenges of maintaining LPG supplies for active appliances while ceiling benefits accrued automatically.

The sustained high valuation of all three major interventions, even as ceiling preference strengthened, indicates that the comprehensive package approach successfully addressed multiple household needs. While ceilings claimed the top position, the continued recognition of hybrid stoves and LPG heaters as close competitors suggests these technologies filled important gaps in household energy services. The multi-component approach appears validated by these preference patterns, as households clearly valued having solutions for both thermal comfort and active energy needs.

The evolution of preferences between 2023 and 2024 provides insights into how intervention benefits are perceived and valued over time. Initial assessments may have been influenced by the novelty and immediate utility of cooking and heating appliances, while extended experience allowed recognition of the fundamental value provided by improved building envelope performance. This temporal shift in valuation suggests that long-term programme assessments

may reveal different impact hierarchies than initial evaluations, warranting sustained monitoring to capture evolving household perspectives.

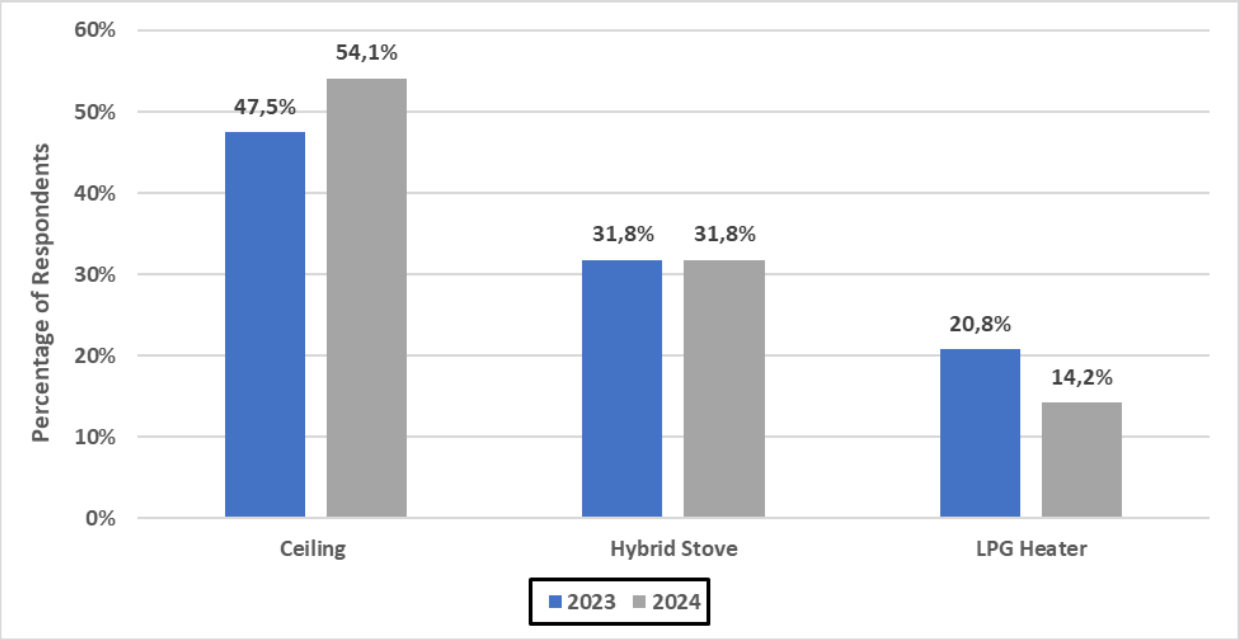

Figure vii: The Eskom AQO intervention ranked by the respondents which made the biggest difference to their quality of life

Overall satisfaction with the comprehensive AQO intervention package demonstrated strong initial acceptance followed by moderate erosion that reflects emerging implementation challenges. In 2023, 85% of respondents expressed contentment with the full suite of interventions, representing a substantial majority endorsement that validates the programme design and implementation approach. This high satisfaction level encompasses the combined impact of ceiling insulation, hybrid stoves, LPG heaters, and rewiring improvements, indicating that the holistic intervention strategy successfully addressed multiple household needs in an integrated manner.

By 2024, however, overall satisfaction declined by 8 percentage points to 77%, marking a notable though not catastrophic reduction in programme approval. While maintaining majority support, this decline from 85% to 77% signals the emergence of factors that diminished household

contentment with the interventions over time. The timing and nature of this satisfaction decrease provide important insights into the sustainability challenges facing comprehensive infrastructure programmes in low-income communities.

The primary driver of reduced satisfaction appears linked to infrastructure durability issues, particularly ceiling integrity during adverse weather conditions. Heavy rains exposed vulnerabilities in ceiling installations through the development of leaks, transforming what had been the most valued intervention into a source of household frustration. The specific attribution of satisfaction decline to ceiling leaks illustrates how single component failures can undermine perception of entire intervention packages, despite other components continuing to function effectively.

The weather-related infrastructure challenges highlight the critical importance of installation quality and material specifications suited to local environmental conditions. Ceiling installations that performed adequately under normal conditions proved insufficient when tested by heavy rainfall, suggesting either inadequate waterproofing, poor integration with existing roof structures, or material specifications unsuited to the intensity of precipitation events experienced in 2024. These technical failures directly impacted household living conditions through water ingress, potentially damaging property and creating unhealthy damp conditions that negate the thermal comfort benefits of the insulation.

Institutional responsiveness to these emerging challenges demonstrates programme management commitment to addressing quality concerns. Eskom's acknowledgment of the feedback regarding quality issues, as confirmed through personal communication with the PMO team (Nxumalo, 2025), indicates organizational awareness of the problems and commitment to remediation. The active measures being undertaken by the Eskom Project Management Office to address these quality issues represent essential steps in preventing further satisfaction erosion and restoring community confidence in the interventions.

The 77% satisfaction rate maintained in 2024, despite acknowledged ceiling problems, suggests resilient overall programme support based on continued benefits from functioning components. This glass-three-quarters-full perspective indicates that while ceiling leaks created significant dissatisfaction among affected households, the majority continue to experience net positive benefits from the intervention package. The sustained majority satisfaction provides a foundation for programme recovery if quality issues are effectively resolved.

The satisfaction trajectory between 2023 and 2024 underscores the temporal dynamics of infrastructure interventions in challenging environments. Initial high satisfaction based on immediate benefits can erode when durability challenges emerge, particularly when these affect highly valued components like ceiling insulation. The experience emphasizes the importance of robust quality control, appropriate material specifications, and responsive maintenance systems in sustaining community satisfaction with development interventions.

The documented institutional response to quality concerns offers encouragement that satisfaction levels may recover if remedial actions effectively address the identified problems. However, the eight percentage point decline serves as a warning that implementation quality and long-term durability are as important as initial intervention design in determining sustained programme success. The challenge facing programme management involves not only addressing current ceiling leak issues but also preventing similar quality problems from emerging in other intervention components as they age and face environmental stresses.

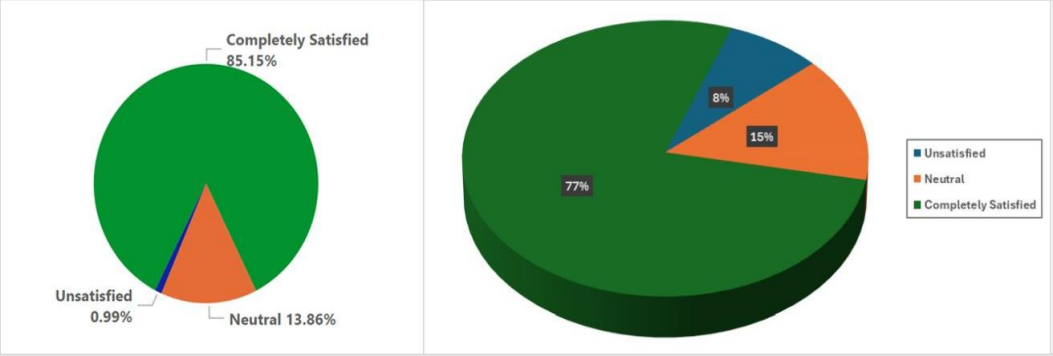

Figure viii: Household satisfaction with Eskom AQO Phase 1 interventions in eZamokuhle (left is 2023 and the right pie-chart is for 2024).

The economic drivers underlying potential regression to traditional fuels emerged clearly through respondent feedback, with affordability concerns dominating the rationale for considering abandonment of clean energy technologies. Figure viii reveals that respondents consistently cited the comparative affordability of coal versus LPG and electricity as their primary motivation for contemplating a return to coal stoves. This economic reality underscores the fundamental challenge facing energy transition initiatives in low-income communities, where immediate household budget constraints often override longer-term health and environmental considerations.

The persistence of coal's cost advantage creates a continuous gravitational pull toward regression, particularly during periods of economic stress or energy price escalation. Despite experiencing the convenience and health benefits of clean cooking technologies, households facing budget constraints must make difficult daily choices between competing essential needs. The lower upfront cost of coal, combined with its availability in small quantities that match irregular income patterns, provides a flexibility that prepaid electricity and cylinder-based LPG cannot easily replicate. This economic structure favors short-term decision-making that privileges immediate affordability over sustained health benefits.

Community awareness of environmental threats to programme sustainability demonstrated sophisticated understanding of both internal and external challenges facing the AQO initiative. Respondents recognized that continued burning of coal and wood within the community represented significant dangers to the offsets project's air quality objectives in both survey years. This awareness indicates successful environmental education components within the programme, as community members understood the collective action problem where individual household fuel choices impact community-wide air quality outcomes.

The evolution of threat perceptions between 2023 and 2024 revealed expanding environmental consciousness and recognition of multiple pollution sources. Figure x illustrates how respondent perspectives broadened from a 2023 focus primarily on fuel burning to encompass informal dumping sites as additional threats by 2024. This expanded threat recognition suggests growing

environmental awareness and understanding of the interconnected nature of pollution sources affecting community air quality.

The identification of informal dumping sites as emerging threats in 2024 represents an important evolution in community environmental consciousness. While the AQO programme specifically targets household fuel emissions, residents recognized that accumulating solid waste and potentially burning of refuse at informal dumps creates additional pollution sources that undermine air quality improvements achieved through household interventions. This systemic perspective demonstrates community understanding that air quality management requires comprehensive approaches addressing multiple emission sources.

The predominant concern with fuel burning, particularly coal and wood combustion, across both survey years validates the programme's fundamental targeting of household energy transitions. Community members clearly understood that continued or renewed use of solid fuels by some households could negate the air quality benefits achieved by those maintaining clean energy practices. This recognition of interdependence in air quality outcomes suggests potential for community-based enforcement or peer pressure mechanisms to support sustained adoption of clean technologies.

The intersection of economic and environmental concerns creates a complex challenge for programme sustainability. While respondents demonstrated clear understanding of environmental threats posed by solid fuel use, the economic realities pushing households toward coal adoption remain powerful countervailing forces. This tension between environmental awareness and economic necessity highlights the critical importance of addressing affordability barriers through subsidies, innovative financing, or alternative support mechanisms that make clean energy choices economically viable for vulnerable households.

The broadening of threat perceptions to include informal dumping sites by 2024 also suggests the need for integrated environmental management approaches that extend beyond household energy interventions. Community recognition of multiple pollution sources indicates readiness for

comprehensive environmental improvements that could include waste management systems, community cleaning initiatives, and enforcement of anti-dumping regulations. This evolved understanding presents opportunities for leveraging AQO programme successes into broader environmental management initiatives.

The documented community awareness of both economic drivers and environmental threats provides a foundation for developing targeted interventions to support programme sustainability. Understanding that affordability drives regression risk enables focused development of economic support mechanisms, while recognition of environmental threats creates opportunities for community mobilization around air quality protection. The challenge lies in translating this awareness into sustained behavior change despite persistent economic constraints.

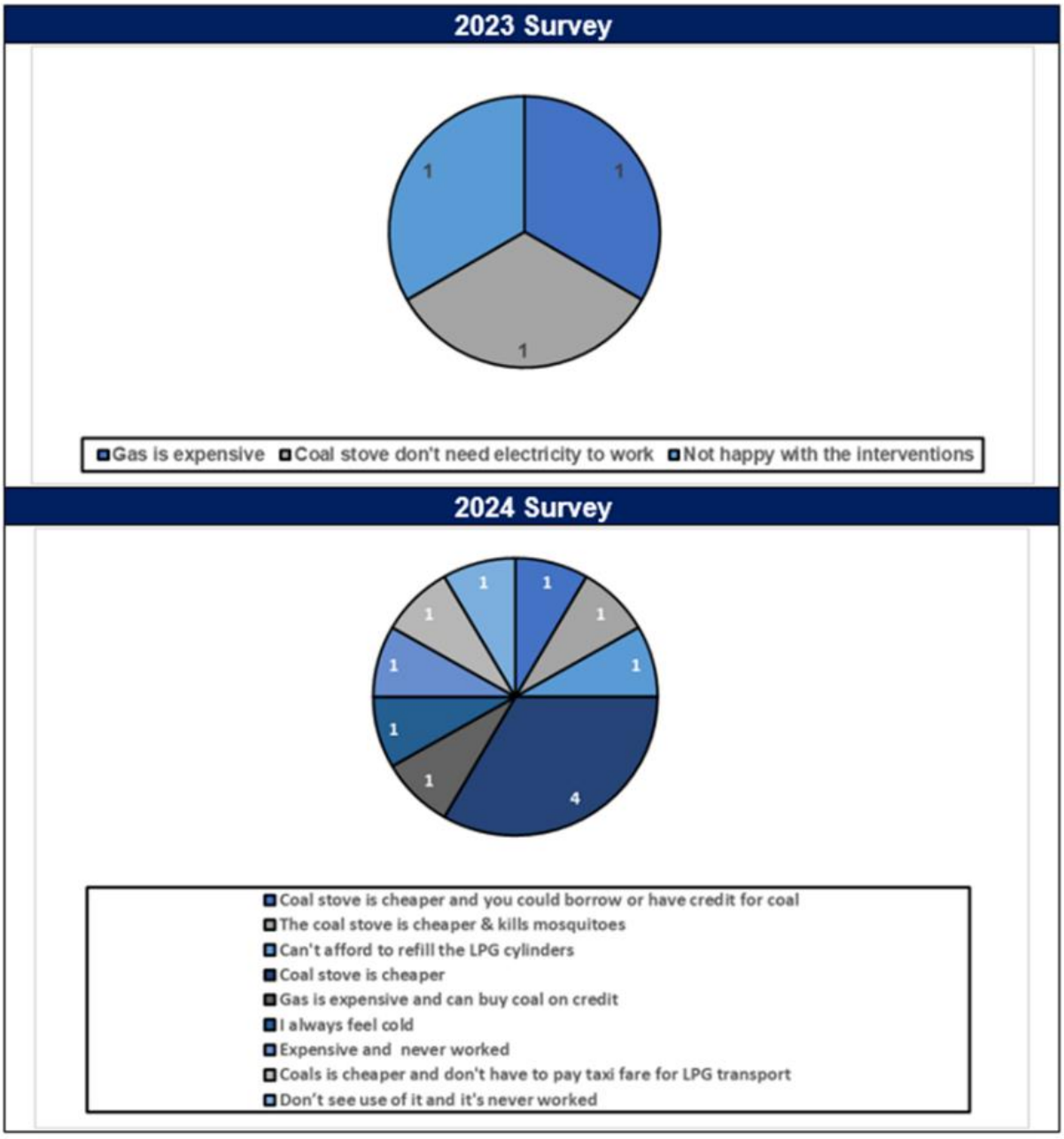

Figure viiii: Respondents reason to give back the coal stove in exchange for a brand new coal stove

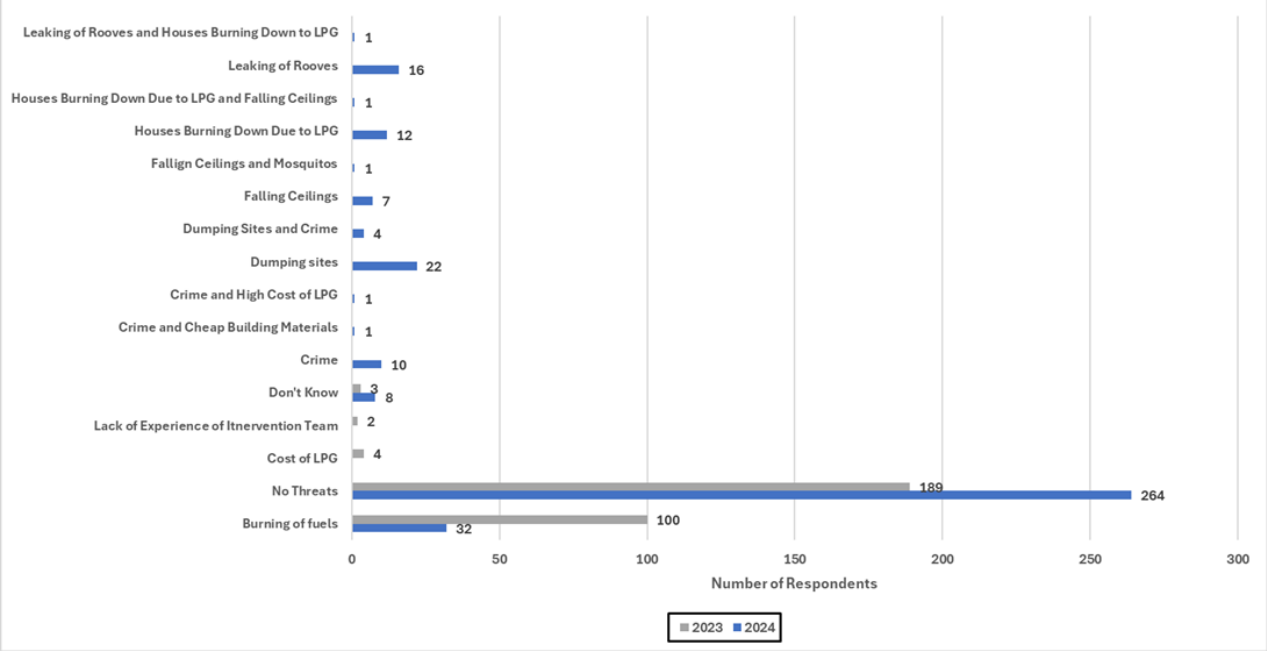

Figure x: Perspectives of respondents regarding potential future threats to the Eskom's AQO Project in eZamokuhle

4.2 Focus Group Discussions

4.2.1 Activations and Registration Process

The qualitative insights gathered through focus group discussions revealed critical implementation challenges that quantitative surveys alone could not fully capture. Participants acknowledged that the initial sign-up process for the AQO interventions was straightforward and accessible, indicating successful design of the registration mechanisms to accommodate the community's literacy levels and administrative capacity. However, this initial positive experience was significantly undermined by subsequent communication failures that created substantial inconvenience and frustration among beneficiary households.

The most significant operational challenge identified was the systematic failure of installation teams to provide advance notification of their arrival schedules. This communication breakdown

forced households to hastily rearrange daily routines, work schedules, and childcare arrangements when installation teams arrived unannounced. For families where adults maintain informal employment or piece work requiring daily presence, such unexpected disruptions could result in lost income and strained household resources. The lack of scheduling communication demonstrated insufficient consideration for the complex daily realities of low-income households where flexibility is often limited.

Beyond scheduling notifications, households experienced confusion regarding the scope of work to be performed during each visit. Participants reported uncertainty about which specific interventions would be implemented at their homes and in what sequence. The particular example of spray polyurethane foam (SPF) insulation application highlighted how technical terminology and intervention components were not adequately explained to beneficiaries. This information gap left households unable to prepare appropriately for the disruption levels associated with different intervention types, such as clearing furniture for ceiling work or ensuring adequate ventilation during foam application.

The focus group participants demonstrated remarkable problem-solving orientation by proposing specific solutions to address these communication challenges. Their suggestion for an SMS-based notification system reflects both the ubiquity of mobile phone access within the community and pragmatic recognition of feasible communication channels. The proposed SMS system would provide three critical pieces of information: First, advance notice of scheduling for ceiling installations and spray foam applications, allowing households to prepare spaces and make necessary arrangements. Second, specific timing for gas device installations, enabling households to ensure responsible adults are present for safety training. Third, expected duration for each intervention task, allowing families to plan around the disruption period.

The SMS notification proposal demonstrates sophisticated understanding of project management needs from the beneficiary perspective. By requesting duration estimates, households showed awareness that different interventions require varying time commitments and disruption levels. This level of detail in the proposed solution indicates that participants had given considerable

thought to how communication improvements could minimize intervention burden while maintaining implementation efficiency.

A particularly concerning pattern emerged regarding work completion standards, with installation teams frequently leaving jobs partially finished. Participants reported that teams would commence work, encounter obstacles or reach shift end, and depart without completing the planned intervention. The return patterns for work completion proved highly variable, with some teams returning after significant delays while others never returned to complete initiated work. This inconsistency in work completion created multiple problems: households lived with partially completed interventions that provided limited benefits, trust in the programme eroded as promises went unfulfilled, and the technical integrity of partial installations potentially compromised safety and effectiveness.

The work incompletion issue suggests systemic problems in contractor management, quality control, and project supervision. The absence of clear completion standards, verification protocols, and accountability mechanisms allowed installation teams to move between houses without ensuring satisfactory completion at each location. For households, incomplete installations represented not just inconvenience but potential safety hazards, particularly for electrical work or gas appliance installations requiring proper commissioning.

These operational challenges identified through focus group discussions highlight the critical importance of viewing interventions from the beneficiary perspective. While technical specifications might be met through eventual work completion, the process experience significantly influences community acceptance, trust, and long-term programme support. The communication failures and work incompletion patterns risk undermining the substantial investments in equipment and materials by eroding the social capital essential for sustained community engagement.

4.2.2 Project Execution

The focus group discussions revealed a significant divergence between quantitative satisfaction metrics and qualitative experiences of project implementation, highlighting the limitations of survey data in capturing nuanced implementation challenges. While the project effectiveness questionnaire indicated general household satisfaction with installation teams' work, focus group participants expressed substantial dissatisfaction with both the professionalism and quality of execution. This disconnect suggests that survey respondents may have felt grateful for the interventions received while simultaneously harboring serious concerns about implementation standards, or that the structured questionnaire format failed to elicit critical feedback captured through open discussion.

Participants identified systemic problems with work completion standards that went beyond isolated incidents to suggest widespread quality control failures. The specific examples of unfinished distribution board (DB) boxes and incomplete ceiling installations represent serious safety and functionality concerns. Distribution boards serve as critical electrical safety infrastructure, and incomplete installations could expose households to electrical hazards while limiting the functionality of newly installed wiring. Similarly, partially completed ceilings fail to deliver the full thermal efficiency benefits while potentially creating structural vulnerabilities to weather infiltration.

A particularly troubling dimension of these quality issues was the reported inaccessibility of installation teams when households attempted to address problems. Participants felt unable to approach teams for assistance with major issues, suggesting either poor communication protocols, dismissive attitudes from contractors, or absence of clear escalation channels for problem resolution. This communication barrier transformed what could have been correctable installation deficiencies into permanent household problems, as residents lacked mechanisms to ensure proper work completion.

The electrical wiring component generated specific and detailed criticism that revealed fundamental flaws in the installation approach. Focus group participants emphasized that the placement of electrical outlets requires careful consultation with households due to the severe space constraints characteristic of RDP housing. In these compact living environments, furniture placement, appliance positioning, and movement patterns are carefully optimized to maximize limited space. When installation teams made unilateral decisions about outlet locations without consulting residents, they inadvertently created permanent constraints on how households could arrange their living spaces.

The failure to consult on outlet placement demonstrates a technical approach that prioritized installation efficiency over user needs. While electricians may have followed standard spacing protocols or minimal code requirements, the unique constraints of small homes demand customized solutions developed in partnership with residents. The resulting poorly placed outlets force households to use extension cords, relocate furniture suboptimally, or forego the use of certain appliances in preferred locations, undermining the quality of life improvements intended by the intervention.

Participants also highlighted concerning inconsistencies in the technical standards applied across households, particularly regarding outlet sizes. The variation in outlet specifications between homes suggests either poor inventory management, use of multiple suppliers without standardization, or individual installer preferences overriding project specifications. This lack of uniformity creates practical problems when households share appliances or when replacement parts are needed, as different outlet types require different plugs and accessories. The inconsistency also raises questions about whether some households received substandard components that may prove less durable or safe over time.

The focus group's concluding recommendations demonstrated sophisticated understanding of the systemic changes needed to address these execution failures. Their call for Eskom to conduct thorough post-installation inspections recognizes that contractor self-reporting and superficial oversight enabled the quality problems experienced. Comprehensive inspections would need to

verify both technical compliance and functional suitability, ensuring that installations meet both code requirements and household needs.

The demand for stricter oversight over installation team qualifications goes beyond individual worker competence to question the contractor selection and management processes. Participants recognized that unqualified or inadequately supervised teams produced the variable quality and incomplete work plaguing the programme. Their recommendation implies need for verified training credentials, demonstrated experience with similar installations, and ongoing performance monitoring to maintain quality standards across thousands of installations.

These execution challenges reveal the complex relationship between technical specifications, implementation quality, and user satisfaction in large-scale infrastructure programmes. While providing modern electrical infrastructure represents a significant investment in community development, realizing the full benefits requires implementation approaches that respect household needs, maintain consistent quality standards, and create accountability mechanisms ensuring work completion. The focus group insights suggest that achieving high technical standards requires not just qualified contractors but also implementation philosophies that position households as partners rather than passive recipients in the upgrade process.

4.2.3 AQO Interventions

4.2.3.1 Hybrid Stove and LPG Heater

The focus group discussions regarding hybrid stoves and LPG heaters revealed a nuanced evolution in user experiences and perceptions over the evaluation period, demonstrating both successful technology adoption and persistent challenges requiring attention. In 2023, participants confirmed that safety training had been successfully delivered to households, establishing a critical foundation for safe operation of gas technologies. The confirmation that households received essential training, including specific safety protocols for gas device

operation, validates the programme's recognition that technology distribution must be accompanied by comprehensive user education to ensure safe and effective utilization.

Despite successful training delivery, participants identified vulnerable groups requiring additional support to achieve equitable technology adoption. Their advocacy for educational campaigns specifically targeting elderly community members reveals sophisticated understanding of differentiated user needs within the community. Elderly residents face unique challenges in adapting to gas technologies, including potential physical limitations in handling gas cylinders, reduced comfort with new technologies, and established cooking practices developed over decades using traditional fuels. The recommendation for targeted elderly support demonstrates community recognition that universal training approaches may leave vulnerable groups behind.
The practical challenges of gas cylinder transportation emerged as a significant barrier particularly affecting older individuals. Participants highlighted how the physical demands of transporting 9kg gas cylinders create hardship for elderly users who may lack personal vehicles or physical strength to carry heavy cylinders over distances. This transportation challenge intersects with the previously identified supply chain limitations, creating compound barriers for vulnerable users. The suggestion for more convenient transport systems indicates community readiness to identify practical solutions that could include cylinder delivery services, community transport arrangements, or lighter cylinder options.

Initial perceptions of gas heater costs revealed interesting interactions between different intervention components. While participants perceived gas heaters as costlier to operate, they reported using them less frequently due to the improved thermal efficiency provided by ceiling insulation. This behavioral adaptation demonstrates sophisticated energy management strategies where households optimized their use of different interventions to minimize costs while maintaining comfort. The reduced heater usage attributable to better insulation validates the synergistic benefits of the comprehensive intervention package approach.

By 2024, the focus group feedback reflected a marked transformation in user satisfaction following extended experience with the technologies. After a full year of hybrid stove utilization, participants

had developed appreciation for multiple operational advantages. The improved cooking times represented not just convenience but also energy savings and lifestyle benefits, allowing for more efficient meal preparation. The ease of heat management compared to traditional coal stoves eliminated the constant vigilance required to prevent food burning, reducing cooking stress and improving food quality outcomes.

The transformation in cooking experience from constant monitoring with coal stoves to controlled heat management with hybrid stoves represents a fundamental quality of life improvement. Traditional coal stove cooking demanded continuous attention to manage inconsistent heat output, adjust coal placement, and prevent overcooking. The hybrid stove's controllable heat settings liberated users from this demanding oversight, allowing attention to other household tasks while cooking proceeded reliably. This operational advantage likely contributed significantly to the sustained high satisfaction rates with hybrid stoves documented in the quantitative surveys. Winter season experiences with LPG heaters provided practical validation of their effectiveness relative to traditional heating methods. Participants acknowledged achieving enhanced warmth compared to umbaulas (traditional braziers), confirming that the technology met its primary functional objective. The specific comparison to umbaulas demonstrates user evaluation against familiar benchmarks, with LPG heaters proving superior in heat output and room warming capability. This experiential confirmation after a full winter season carries more weight than initial impressions, as users had opportunity to test the technology under demanding conditions.

However, the 2024 feedback also revealed persistent economic concerns despite acknowledged technical benefits. Participants suggested that a hybrid heater model offering both electric and LPG options would be beneficial, reflecting sophisticated understanding of energy cost optimization. This recommendation parallels the hybrid stove design that successfully provides fuel flexibility, suggesting users value the ability to switch between energy sources based on availability and cost considerations. The continued perception of LPG heating as relatively expensive, despite its efficiency advantages, highlights the ongoing tension between technology benefits and household budget constraints.

The evolution from 2023's focus on safety and logistics to 2024's emphasis on operational benefits and cost optimization demonstrates successful technology integration accompanied by emerging second-order concerns. Users had moved beyond basic operation to develop nuanced appreciation of technology advantages while identifying design modifications that could enhance economic sustainability. This progression indicates that the fundamental technology adoption challenge has been successfully addressed, with attention now turning to optimization for long-term sustainability within household economic constraints.

4.2.3.2 Ceiling

The focus group discussions regarding ceiling interventions revealed a dramatic deterioration in user experiences between the initial installation period and subsequent exposure to severe weather events. In 2023, households expressed general satisfaction with their newly installed ceilings, confirming the quantitative survey findings of high approval rates. Participants particularly noted the contribution of ceiling installations to creating warmer living environments, validating the primary objective of improving thermal comfort through better insulation. This initial satisfaction reflected successful implementation of the technical intervention and immediate realization of expected benefits.

The positive reception in 2023 established ceilings as a valued intervention that delivered tangible improvements to household comfort without requiring ongoing costs or behavioral changes. Unlike stoves and heaters demanding continuous fuel purchases and active management, ceiling insulation operated passively to retain heat and reduce temperature fluctuations. This passive benefit delivery likely contributed to the high satisfaction levels, as households experienced improved comfort without additional effort or expense.

However, by 2024, the focus group revealed a stark bifurcation in ceiling performance and household experiences. While some ceilings maintained their good condition and continued effectively retaining heat, demonstrating potential for long-term durability under favorable conditions, others experienced catastrophic failures that fundamentally undermined their

functionality and created new household hazards. This divergence in outcomes suggests variable installation quality, differential exposure to weather conditions, or heterogeneous integration with existing roof structures across households.

The emergence of leaks as a widespread problem represented more than minor inconvenience, forcing households to take protective actions that compromised their living conditions. Reports of households removing lighting fixtures during heavy rains illustrate the severity of water ingress and the immediate safety hazards created. The necessity to disconnect electrical fixtures during rain events not only eliminated lighting precisely when overcast conditions required it most but also created risks of electrical hazards from water contact with wiring systems. These protective measures transformed what should have been weather-resistant home improvements into sources of vulnerability during adverse conditions.

The development of holes in ceilings marked an escalation from leaks to structural failure, representing complete breakdown of the intervention's integrity. A considerable number of residents reporting such catastrophic deterioration indicates systemic problems rather than isolated incidents. The attribution of this damage to intense rainfall experienced between December 2024 and January 2025 provides crucial context for understanding the failure mechanisms. This specific weather period apparently exceeded the design parameters or installation quality standards of the ceiling systems, exposing fundamental inadequacies in weatherproofing, material selection, or integration with existing structures.

The temporal correlation between heavy rainfall and ceiling deterioration suggests multiple possible failure pathways requiring investigation. Water ingress could have occurred through compromised roof sheeting, inadequate sealing at ceiling perimeters, or failure of the spray foam insulation to maintain adhesion under moisture exposure. The development of holes indicates that water accumulation may have exceeded the load-bearing capacity of ceiling materials, causing progressive failure from initial leaks to structural collapse. Alternative failure mechanisms could include degradation of adhesives under moisture exposure or expansion and contraction cycles weakening material bonds.

The contrast between households maintaining good ceiling condition and those experiencing failures raises critical questions about installation consistency and quality control. Variable outcomes under similar weather exposure suggest that installation quality, rather than inherent technology limitations, may determine long-term performance. Factors such as installer skill, supervision quality, material batch variations, or site-specific conditions could explain why some ceilings proved resilient while others failed catastrophically.

The progression from universal satisfaction in 2023 to significant structural failures by 2024 demonstrates the critical importance of durability testing and weather resistance in intervention design. While ceilings successfully delivered immediate benefits under normal conditions, their vulnerability to intense rainfall events reveals inadequate consideration of local climate extremes in technical specifications. The December 2024 to January 2025 rainfall, while intense, represents weather events likely to recur with climate change, making current ceiling vulnerabilities unsustainable for long-term programme success.

These ceiling failures carry implications beyond individual household inconvenience to threaten overall programme credibility and community trust. Households experiencing leaks and structural failures may question the value of all interventions, potentially undermining sustained use of stoves and heaters despite their continued functionality. The transformation of ceilings from the most valued intervention to a source of significant problems illustrates how implementation quality and durability considerations can determine whether infrastructure investments deliver sustained benefits or become community liabilities.

4.2.4 Sustainability

4.2.4.1 Hybrid Stove and LPG Heater

The focus group discussions on long-term sustainability revealed fundamental concerns about maintenance responsibilities and supply chain infrastructure that could determine the ultimate success or failure of the clean energy transition. When participants contemplated the five to ten-year trajectory of hybrid stove and gas heater usage, maintenance emerged as the paramount

concern transcending immediate operational issues. This forward-looking perspective demonstrates community recognition that sustainable technology adoption requires not just initial distribution but ongoing support systems to address inevitable wear, damage, and component replacement needs.

A clear consensus emerged across both 2023 and 2024 discussions regarding institutional responsibility for ceiling maintenance, with participants firmly asserting that Eskom should retain this obligation. This expectation reflects both practical considerations and implicit social contracts established through the programme structure. However, participants explicitly rejected financial compensation models where Eskom would provide funds for homeowners to arrange their own maintenance. This preference against monetary transfers reveals sophisticated understanding of local market dynamics and the practical challenges facing individual households in procuring quality maintenance services.

The rejection of financial compensation models stemmed from participants' direct experience with local contractor markets. They cited the difficulties and time-consuming nature of finding reliable and reasonably priced contractors for maintenance work, challenges that would be multiplied across thousands of households attempting individual procurement. The preference for direct Eskom management of maintenance recognizes economies of scale, quality control advantages, and bargaining power that institutional procurement could provide versus atomized household contracting. This position also suggests limited trust in local contractor markets to deliver quality services at fair prices without institutional oversight.

Supply chain infrastructure emerged as an equally critical sustainability determinant, with the absence of local gas distributors identified as a significant threat to project sustainability in 2023. The concrete example of households paying R380 for gas refills at distant locations in Standerton and the local Total garage illustrated the economic burden of transportation costs added to fuel prices. These additional costs effectively increased the price of clean energy beyond simple fuel costs, creating economic barriers that could drive regression to locally available coal.

The reluctance to exchange gas bottles at nearby Bhyat Mica revealed additional supply chain quality concerns beyond simple availability. Residents' fears about receiving defective or outdated bottles in exchange for their Eskom-provided equipment demonstrate how quality uncertainty in supply chains can deter usage even when suppliers exist. This concern reflects rational risk aversion where households protect valuable assets (quality gas cylinders) from potential degradation through unfavorable exchanges, even at the cost of convenience.

The vulnerability of households to exploitation emerged through reports of scam incidents when seeking gas refill assistance. Some residents who arranged for others to refill bottles in nearby towns lost both gas bottles and money to fraudulent intermediaries. These exploitation incidents illustrate how supply chain gaps create opportunities for predatory behavior targeting vulnerable communities, adding risk dimensions beyond simple inconvenience or cost. The existence of such scams could deter gas usage among risk-averse households, particularly elderly or vulnerable residents.

By 2024, marginal improvements in supply infrastructure had occurred, though fundamental challenges persisted. The emergence of a local supplier in eZamokuhle capable of delivering to residents who placed advance orders represented a positive development in bringing supply closer to demand. However, this single supplier operating on a pre-order basis provided limited relief to the broader supply challenge, particularly for households unable to plan fuel needs in advance or lacking capital for advance purchases.

The sustained inadequacy of gas supply infrastructure after a full year of programme operation demonstrates the difficulty of stimulating private market responses to new demand in low-income areas. Despite hundreds of households creating new LPG demand, the number of suppliers remained essentially unchanged, suggesting market failures in supply response. This inelastic supply situation maintains the competitive advantage of established coal distribution networks, which feature multiple suppliers, credit arrangements, and small-quantity purchases matching irregular household income patterns.

Participants' advocacy for integrating coal merchants into LPG distribution networks represents creative problem-solving leveraging existing infrastructure. Coal merchants already possess distribution capabilities, customer relationships, and credit systems serving the target market. Their conversion to multi-fuel suppliers could rapidly expand LPG availability while providing business diversification opportunities for merchants facing declining coal demand. This proposal demonstrates community understanding of practical transition pathways that build on existing systems rather than requiring entirely new infrastructure development.

The sustainability discussions revealed that successful long-term adoption of clean energy technologies requires more than initial enthusiasm and functional equipment. Without accessible maintenance systems and reliable, affordable supply chains, even well-designed interventions face gradual degradation and abandonment. The community's clear articulation of these sustainability requirements provides actionable guidance for programme modifications essential to achieving lasting impact. Their rejection of household-managed maintenance in favor of institutional systems, combined with creative proposals for supply chain development, demonstrates readiness to sustain clean energy transitions given appropriate supporting infrastructure.

4.2.4.2 Ceilings

The focus group discussions regarding ceiling sustainability revealed a dramatic shift in community assessment between 2023 and 2024, marking a transition from qualified optimism to fundamental rejection of the intervention's viability. In 2023, the group deemed the ceilings sustainable, but this assessment came with a critical caveat that would prove prescient. Participants emphasized that sustainability hinged entirely on Eskom's willingness and capacity to assist with maintenance whenever problems arose, establishing institutional support as a non-negotiable requirement for long-term success.

This conditional sustainability assessment in 2023 demonstrated sophisticated understanding of infrastructure lifecycle requirements in challenging environments. The group recognized that even

well-installed ceilings would face inevitable degradation from weather exposure, structural settling, and material aging. Their emphasis on Eskom assistance for problem resolution reflected awareness that individual households lacked both technical capacity and financial resources to address ceiling failures independently. This position aligned with broader survey findings, where 76.5% of respondents believed Eskom should bear responsibility for addressing leaks or roof damage, indicating widespread community consensus on institutional maintenance obligations.

The alignment between focus group perspectives and quantitative survey results in 2023 reinforced the validity of maintenance concerns as central to sustainability planning. The overwhelming majority expectation of Eskom responsibility was not merely preference but recognition of practical realities where household-level maintenance would prove technically challenging and economically prohibitive. This shared understanding across different assessment methods suggested that maintenance support represented a fundamental design requirement rather than an optional service enhancement.

By 2024, however, the focus group's assessment underwent complete reversal, with participants declaring the ceilings definitively unsustainable. This stark shift from conditional sustainability to outright rejection occurred in response to empirical evidence of widespread failures rather than theoretical concerns. The increasing number of households experiencing leaks and structural collapses had transformed abstract maintenance needs into immediate crisis management, overwhelming any residual optimism about long-term viability.

The progression from leaks to structural collapses represented an escalation in failure severity that fundamentally altered sustainability calculations. While leaks might be addressed through targeted repairs, structural collapses indicated systemic failures requiring complete replacement rather than maintenance. The proliferation of such catastrophic failures across multiple households suggested that the ceiling systems had failed to meet basic durability requirements for the local environment, rendering maintenance strategies insufficient to ensure sustainability.

The declaration of unsustainability carried profound implications beyond technical assessments to challenge the fundamental viability of ceiling interventions in their current form. Participants' judgment reflected not just current problems but projection of accelerating failure rates that would

overwhelm any reasonable maintenance capacity. The shift from viewing Eskom support as enabling sustainability to viewing the intervention itself as inherently unsustainable marked recognition that design or implementation flaws transcended what maintenance could address.

Eskom's acknowledged awareness of quality issues, as confirmed through communication with the PMO team (Nxumalo, 2025), indicates institutional recognition of the severity of ceiling problems. The active measures being undertaken to address these quality issues represent necessary but possibly insufficient responses if fundamental design flaws exist. The challenge facing Eskom involves determining whether current failures result from correctable implementation deficiencies or require reconceptualization of ceiling interventions for the local context.

The community's evolution from conditional support to rejection of ceiling sustainability provides crucial feedback on intervention limits. Their 2023 position established clear requirements for institutional maintenance support that, even if fully met, proved insufficient given the scale of failures emerging by 2024. This trajectory suggests that sustainability planning must account not just for normal maintenance needs but for potential systemic failures that exceed reasonable support capacity.

The ceiling sustainability crisis illustrates broader challenges in infrastructure interventions where initial technical success may mask fundamental vulnerabilities to environmental stresses. The focus group's clear declaration of unsustainability, based on lived experience of accelerating failures, provides unambiguous guidance that current ceiling approaches require fundamental revision rather than incremental improvement. Their assessment that increasing leaks and collapses have crossed the threshold from manageable maintenance to unsustainable failure rates demands serious reconsideration of whether and how ceiling interventions can contribute to sustainable air quality improvements.

4.2.5 Perception of air quality

The focus group discussions on air quality perceptions revealed encouraging awareness of improvements while identifying persistent and emerging environmental challenges requiring attention. In the 2023 Focus Group Interview, residents of eZamokuhle expressed notably positive perceptions of their local air quality, representing a significant shift from typical assessments in coal-burning communities. Participants specifically noted improvements both within their community spaces and inside their homes, demonstrating recognition of air quality changes at multiple scales. This dual-scale improvement awareness suggests successful internalization of the connection between household energy choices and broader environmental conditions.

The attribution of air quality improvements to ongoing projects aimed at air purification indicates successful community education regarding the AQO programme's objectives and mechanisms. Residents understood the causal relationship between intervention implementation and experienced air quality benefits, rather than viewing improvements as coincidental or unrelated to programme activities. This accurate attribution demonstrates effective programme communication and community understanding of how household-level changes aggregate to community-wide environmental benefits.

Despite recognizing improvements, participants demonstrated sophisticated understanding of remaining pollution sources by identifying specific contributors to local air quality degradation. The identification of coal burning as a significant pollution source, even amid widespread transition to cleaner fuels, suggests awareness that incomplete community coverage or partial regression could undermine collective air quality gains. This recognition of the commons problem in air quality management indicates community readiness for peer influence or collective action to maintain clean energy practices.

The unusual identification of discarded shoe incineration as a pollution source reveals hyperlocal knowledge of community-specific practices affecting air quality. This practice, likely related to informal recycling or disposal methods, represents the type of localized pollution source that

external assessments might miss but community members experience directly. The specificity of this observation demonstrates acute environmental awareness and suggests that residents actively monitor and evaluate various pollution sources in their environment.

By 2024, the focus group reiterated their positive air quality assessments while noting evolutionary changes in environmental challenges. The emergence of mosquito proliferation as a new concern represents an unexpected consequence potentially linked to environmental or climate changes. While not directly an air quality issue, the mention of mosquitoes in air quality discussions suggests holistic environmental thinking where residents recognize interconnections between various environmental health factors. The proliferation might indicate standing water from ceiling leaks or climate conditions favorable to mosquito breeding, creating additional health risks beyond air pollution.

The community's evolution from passive recognition to active mitigation of waste burning demonstrates growing environmental agency and collective action capacity. While acknowledging waste burning as a current threat to air quality, residents reported community-initiated efforts to monitor and restrict burning in proximity to residential areas. This transition from observation to intervention marks important development in community environmental management capacity, suggesting readiness for expanded roles in maintaining air quality improvements.

The specific focus on restricting waste burning near residential areas reveals pragmatic prioritization of exposure reduction where complete elimination proves infeasible. By concentrating enforcement efforts on high-exposure zones, the community maximizes health protection benefits while recognizing practical limits to controlling all burning activities. This targeted approach demonstrates sophisticated understanding of exposure pathways and risk management principles typically associated with formal environmental management.

The sustained positive perception of air quality across both years, despite acknowledged ongoing challenges, suggests that improvements have reached a threshold where benefits are tangible and valued by residents. The ability to perceive air quality improvements amid persistent sources indicates that the scale of household energy transition has created noticeable environmental

change. This perceptual shift provides important validation that technical emission reductions translate into experienced benefits that communities can recognize and appreciate.

The progression from simple appreciation of improvements to active environmental management represents crucial evolution in community capacity for sustaining air quality gains. The 2024 focus group's combination of continued positive assessment, identification of emerging challenges, and report of community-led mitigation efforts suggests growing ownership of environmental outcomes. This ownership transition from external intervention to community stewardship provides essential foundation for long-term sustainability of air quality improvements beyond the formal programme period.

5. Recommendations

The study results clearly indicate that residents express a high level of satisfaction with the current project interventions, perceiving them as a beneficial influence on the community. Nevertheless, there are specific aspects of the project that have been highlighted herein as possible recommendations for Eskom’s consideration. This is summarised in Table vi.

Table v: Summary of Recommendations from the Annual Household & Project Effectiveness Surveys

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
1. Ceiling intervention	▪ It is recommended that inspections are carried out immediately after implementation has been concluded and a time period after the installation is completed	▪ It's recommended that Eskom ensures the sub-contractors hire more skilled/experienced people ▪ It's recommended that better building quality materials are used, especially for the cornices ▪ It's recommended that the teams take more care into the finish of the interior (better painting, better glue and better ceiling finish)	▪ Teams need to complete the work done in each household

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
2. LPG Heater	▪ A targeted awareness and safety training in terms LPG to the old female (60 to 99) adult segment may plausibly result in a higher uptake herein.	▪ Respondents want more gas cylinders to be provided for the heaters ▪ It's recommended that heaters are provided per room of a household	▪ It's recommended a better way to transport gas bottles for the elderly is introduced

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
3. Hybrid stove	▪ A well-established LPG distribution provider is needed for the community to prevent the possibility of regress due to difficulties in obtaining LPG locally	▪ Majority of respondents requested that the stoves have 2 plates that use electricity and 2 plates that use gas. ▪ Respondents recommended that more gas cylinders are provided to the households	▪ It's recommended that an education campaign targeted at the elderly community members would assist in easing the older age groups into using gas technologies ▪ It's recommended a better way to transport gas bottles for the elderly is introduced
4. Wiring Intervention	▪ The ARM team recommends that certificates of compliance are made mandatory for insurance purposes ▪ Better communication lines between the sub-contracting team and the residents need to be established to keep a healthy relationship with Eskom and the community	▪ It's recommended that double plug points are installed instead of the single point plugs ▪ It's recommended that Eskom ensures the sub-contractors hire more skilled/experienced people	▪ Participants suggested that uniformity is needed with the plug points as some households had different sized plug points installed ▪ It's suggested communicate with the household be open to allow for plug points to be installed or not

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
5. Other	▪ Eskom to develop suitable financing models (such as credit) with local retailers & fuel merchants for the supply and access to gas in the community. ▪ Given the rising cost of living, we propose offering 5kg and 9kg LPG cylinders instead. The more affordable 5kg cylinder will contribute to long-term sustainability of Eskom's AQO Project. ▪ Eskom to establish a network of community technicians capable of offering both repairs and replacement parts for the provided stoves. ▪ Eskom consider replacing any rusted components of the roof prior to application of the SPF celling. ▪ Implementing dust suppression/solutions of unpaved roads in low-income settlements ▪ Implementing veld fire management solutions ▪ Eskom evaluates the feasibility of mini and micro grids in appropriate locations ▪ Eskom in conjunction with local municipalities assess the potential for biogas generation from Waste and Sewage treatment plants. ▪ Eskom to consider the feasibility and viability of paving the unpaved roads. ▪ Rollout of carpets to households to aid in improving the thermal comfort of the homes in winter ▪ Fruit and vegetables are not grown nor sold on the properties except for a few exceptions. An opportunity could exist to promote	▪	▪

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
	the development of subsistence market gardens which may directly help to reduce fugitive dust emissions in the area		

6. Conclusion

The assessment of Eskom's Air Quality Offset programme in eZamokuhle through comprehensive annual household surveys and project effectiveness monitoring provides compelling evidence of successful intervention implementation and sustained community benefits. Air Resource Management (Pty) Ltd conducted rigorous evaluations encompassing 400 households in 2023 and 381 households in 2024, ensuring robust longitudinal data capture from beneficiaries who received the complete suite of AQO interventions including hybrid stoves, LPG heaters, electrical rewiring, and ceiling insulation.

The Project Effectiveness Survey results demonstrate remarkable consistency in household satisfaction with the quality of Eskom-provided interventions across both evaluation years. This sustained approval across multiple intervention components validates both the technical specifications of selected technologies and the implementation approaches employed. The comprehensive nature of the intervention package, addressing cooking, heating, electrical safety, and thermal efficiency simultaneously, created synergistic benefits that exceeded what individual components could achieve in isolation.

Ceiling installations emerged as particularly successful in achieving their primary objective of thermal comfort improvement. The extraordinary 99.8% satisfaction rate in 2023, maintained at 99.2% in 2024, represents near-universal acknowledgment that ceiling insulation effectively enhanced home warmth and comfort. While the marginal decline may reflect emerging durability challenges documented elsewhere in this assessment, the sustained exceptional satisfaction levels confirm that beneficiaries continue to experience tangible benefits from improved thermal efficiency. The slight increase in overall contentment from 97% to 97.6% suggests that despite isolated challenges, the net beneficiary experience remains overwhelmingly positive.

The LPG heater intervention achieved similarly exceptional satisfaction levels that demonstrated remarkable stability across the evaluation period. With 98.7% of respondents expressing approval in 2023 and 97.1% maintaining satisfaction in 2024, the technology proved well-suited to household heating needs while successfully displacing traditional coal-based heating methods. The functional validation that 98.5% of respondents experienced noticeably warmer homes in 2023, sustained at 96.5% in 2024, confirms that LPG heaters effectively meet their core performance requirements while delivering the comfort improvements households value.

Hybrid stove adoption represented perhaps the most culturally sensitive intervention given the central role of cooking in household routines and preferences. The achievement of nearly universal endorsement in 2023, maintained with continued strong recommendations in 2024, demonstrates successful navigation of potential cultural barriers to cooking technology change. The sustained approval indicates that hybrid stoves successfully balanced performance

requirements, fuel flexibility needs, and taste preservation concerns that often impede cooking transitions.

The electrical rewiring component, while less visible than appliance interventions, provided essential safety improvements and enabling infrastructure for electrical appliance usage. The overwhelming 98.2% advocacy rate in 2023 for extending rewiring to other community homes reflects recognition of both immediate safety benefits and enhanced electrical capacity supporting modern appliance usage. The persistence of this strong endorsement in 2024 confirms sustained appreciation for electrical infrastructure improvements as foundational to broader household modernization.

The documented transitions in household energy use patterns provide quantitative validation of the qualitative satisfaction measures. Dramatic reductions in coal usage for both heating and cooking, accompanied by substantial increases in electricity and LPG utilization, demonstrate that high satisfaction ratings translate into sustained behavioral change. These usage transitions directly support programme objectives of reducing household emissions and improving indoor air quality, with community-wide adoption creating cumulative benefits for ambient air quality.

Beyond individual component successes, the evaluation reveals important insights about comprehensive intervention packages in complex socioeconomic contexts. The synergistic interactions between interventions, such as reduced heater usage due to improved ceiling insulation, demonstrate sophisticated household optimization of the full technology suite. This holistic utilization suggests that comprehensive approaches may achieve greater and more sustainable impact than piecemeal interventions addressing single household needs.

However, the assessment also identifies critical challenges requiring attention to ensure long-term sustainability. Infrastructure durability, particularly regarding ceiling performance under extreme weather conditions, emerged as a significant threat to sustained benefits. Supply chain limitations for LPG distribution and the absence of established maintenance systems represent structural barriers that could undermine continued technology utilization despite high satisfaction

levels. The documented expectation that Eskom maintain responsibility for infrastructure maintenance highlights the need for clear sustainability planning beyond initial implementation.
The remarkable achievement of near-universal satisfaction across multiple intervention components, sustained over the evaluation period, establishes the eZamokuhle implementation as a successful model for household-level air quality interventions. The demonstrated improvements in quality of life, validated through both quantitative metrics and qualitative assessments, confirm that well-designed and properly implemented technology packages can achieve meaningful and valued benefits in low-income communities. These successes provide crucial evidence supporting programme expansion to additional communities while highlighting specific areas requiring enhancement to ensure lasting impact.

The Eskom AQO interventions have proven their potential to deliver significant quality of life improvements while advancing environmental objectives through reduced household emissions. The challenge moving forward lies in addressing identified sustainability barriers to ensure that initial successes translate into permanent improvements in household energy practices and community air quality. With appropriate attention to infrastructure durability, supply chain development, and maintenance systems, the programme can build on its strong foundation to achieve lasting transformation in household energy use and community wellbeing.

1. BACKGROUND

1.1 ESKOM'S APPROACH TO AIR QUALITY OFFSETS

The Department of Environment, Forestry & Fisheries (DFFE) Air Quality Offset Guideline has shaped and informed Eskom's Air Quality Offsets Implementation Plan. This Plan has been based on a scientific process of feasibility studies, testing and demonstration, and on consultation with key stakeholders. Figure 1 illustrates the concept schedule for the phased implementation of Eskom's air quality offsets.

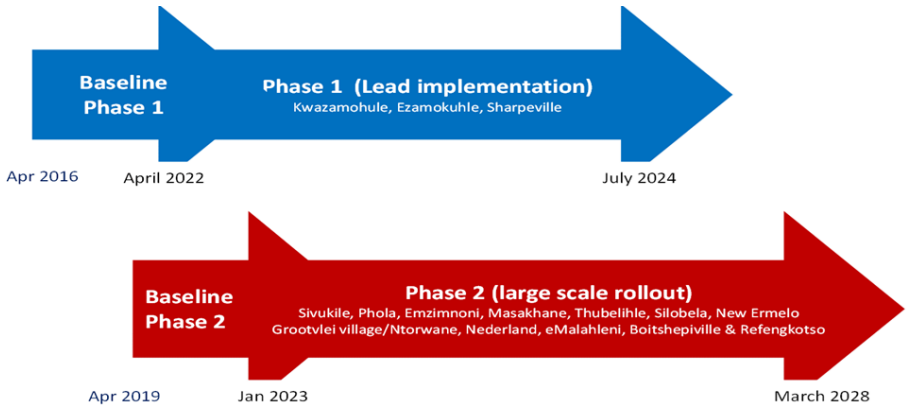

Figure 1: Concept Schedule for the implementation of Eskom's air quality offsets (Matimolane, 2023).

Eskom has adopted the phased approach (Figure 2) herein to increase the probability of success and to ensure that learnings from early phases are incorporated into the large-scale roll-out. (Matimolane, 2020).

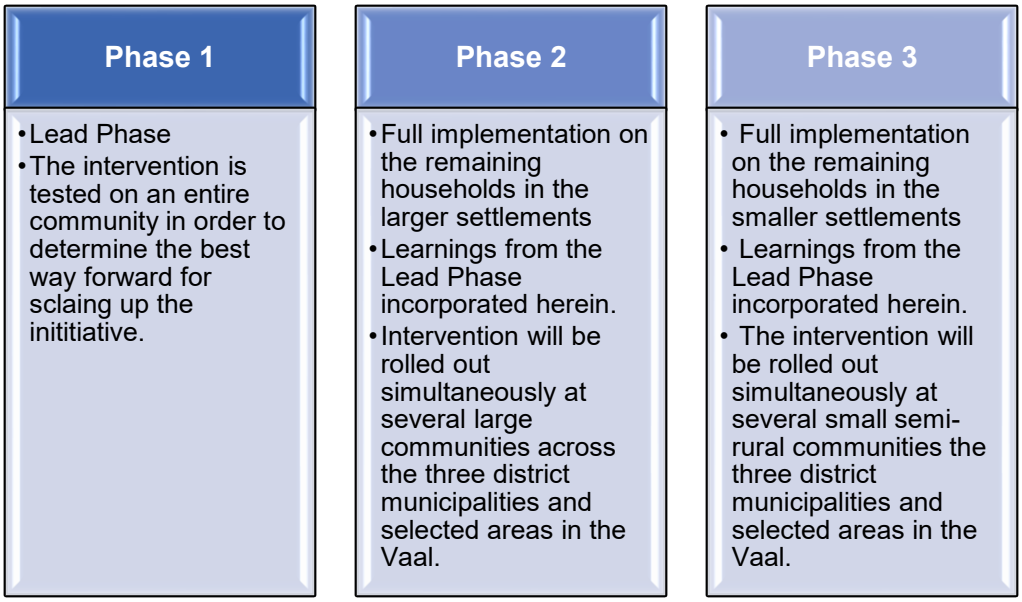

Figure 2: Eskom's Phased approach to the rollout of air quality offset interventions (Matimolane, 2020).

Eskom's air quality offsets programme is designed to reduce human exposure to harmful levels of air pollution by reducing emissions from local sources, like domestic coal burning and waste burning. Thus, air quality offsets can improve ambient air quality in low-income communities in the vicinity of Eskom's power stations. Eskom has developed air quality offset (AQO) implementation plans for Majuba Power Station (eZamokuhle township); Hendrina Power Station (KwaZamokuhle township) and Lethabo Power station (Sharpeville). eZamokuhle, Kwazamokule and Sharpeville are characterised by a myriad of particulate matter (PM) emission sources which are all located near one another.

1.2 ESKOM'S PLANNING, MONITORING AND VERIFICATION (PMV) PROJECT

For Eskom's PMV Project, interventions to reduce household emissions from domestic coal/wood burning will be rolled out in KwaZamokuhle and eZamokuhle in the Mpumalanga Highveld. For formal dwellings the intervention will be a thermal insulation retrofit and an electricity starter pack and installation. The intervention for informal dwellings still needs to be selected and tested.

Interventions also need to be identified and implemented to improve air quality in Sharpeville, Gauteng. Since domestic coal burning is less prevalent in Sharpeville, it is expected that a community-scale intervention, like reducing waste burning, will be more suitable there.

Air Resource Management (ARM) (Pty) Ltd has been appointed by Eskom to support the PMV services in support of the *Phase 1: Lead implementation* at: KwaZamokuhle; eZamokuhle and Sharpeville. Its ARM (Pty) Ltd understanding that the overall objective *Lead Implementation Phase* is to benefit the specific local communities, minimize implementation risk, increase practical and scientific knowledge, and develop and refine monitoring, reporting and verifications processes. To achieve this, Eskom has included sixteen targeted work package Activities (Table 1) for these respective communities. This report focuses on an inter annual (2023 & 2024) trend analysis for *Activity 9: Annual Household Survey and Monitoring of Project Effectiveness for eZamokuhle.*

Table 1: Eskom PMV Activity Schedule (Eskom PMV NEC Contract,27082020)

Activities	Kwazamokuhle	Ezamokuhle	Sharpeville
Activity 1: Preliminary air quality assessment		✓	
Activity 2: Gather Area intelligence		✓	
Activity 3: Rapid in situ assessment		✓	
Activity 4: Obtain ethical clearance		✓	
Activity 5: Census	✓	✓	✓
Activity 6: Community source survey		✓	
Activity 7: Fuel source survey		✓	
Activity 8: Household surveys		✓	
Activity 9: Annual (household/community) surveys and monitoring of project effectiveness	✓	✓	✓
Activity 10: Ambient air quality monitoring	✓	✓	✓
Activity 11: Conduct indoor air quality monitoring	✓	✓	
Activity 12: Atmospheric Dispersion Model	✓	✓	✓
Activity 13: Design of Intervention		✓	✓
Activity 14: Development of Database Reporting	✓	✓	✓
Activity 15: Strategic Assistance and offsets methodology	✓	✓	✓
Activity 16: Research and Development	✓	✓	✓

1.3 Scope of Work

There is an increasing demand for current and detailed demographic and socio-economic data for households and individuals in developing countries [1] (IMF,2020). Such data has become indispensable in economic and social policy analysis, development planning, programme management and decision-making at all levels. To meet this demand, policy makers and other stakeholders have frequently turned to household surveys. It is also important to record the community's perceptions of newly introduced technologies and interventions that will impact their daily living conditions. Consequently, household surveys have become one of the most important mechanisms for collecting information on populations in developing countries.

In accordance with the scope of work, for Activity 9: *Annual Household Survey and Monitoring of Project Effectiveness,* ARM is to conduct household surveys on a statistically significant number of households in eZamokuhle, which will be 10% of the total households in eZamokuhle (260 intervened households) which will allow a margin of error of ±5% with a 95% confidence level. This is aligned to international best practice for scientific research. The main purpose of the surveys is to determine the extent to which the project measures continue to be used by households and to determine their effectiveness in meeting the Eskom AQO programme objectives.

This report focuses on an inter annual trend analysis for *Activity 9 (9.8 & 9.9) Annual Household Survey and Monitoring of Project Effectiveness for eZamokuhle.* This inter annual analysis is essential for comprehensively & holistically understanding the impact of Eskom's AQO interventions at the household level in eZamokuhle.

[1] https://www.imf.org/en/Publications/fandd/issues/2020/03/changing-demographics-and-economic-growth-bloom, https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_216451.pdf https://unstats.un.org/unsd/hhsurveys/pdf/household_surveys.pdf

METHODOLOGY

Conducting an inter-annual (2023 and 2024) trend analysis for household surveys is crucial for understanding the extent to which the project measures continue to be used by households and to determine their effectiveness in meeting the Eskom AQO programme objectives. This allows for comparing and monitoring the changes over time, identifying patterns and correlations and assessing the long-term impact to allow for more informed decision making.

2.1 APPROACH

In this study ARM focused on using the most appropriate survey sampling methods. The study employed a stratified random sampling design with ward-level stratification to ensure representative coverage across the eZamokuhle community. Our approach (Figure 3) was framed considering the following mandatory principles below:

1) Consent is first obtained from the local leadership (Councilor's) to conduct the surveys in the community.

2) A fair and transparent recruitment processes is followed aligned to both Eskom's and the local leadership's guidance.

3) It remains the responsibility of ARM to preserve the academic integrity of the study by ensuring compliance with ethical principles at every stage of the research process. ARM did obtain formal Eskom permission for use of the questionnaires and the method allowed for effective collection of data. Care was taken to ensure that the identities of the respondents are protected and that both confidentiality and anonymity is maintained during the data collection process. The researcher ensured integrity of the research process by accurately reporting findings.

4) Data collected was securely stored to maintain anonymity. All recordings are safely stored for a period of five years and thereafter erased.

5) To mitigate existing assumptions and to achieve reflexivity, ARM made use of fieldworkers to aid with the gathering of data. All fieldworkers were fluent in Zulu to enable meaningful communication & participation with all the participants in eZamokuhle.

6) The researcher fulfilled an ethic role and objectively viewed, interpreted, and reported on research findings.

2.1.1 Sampling Design and Representativeness

The stratified random sampling approach ensured comprehensive representation across eZamokuhle through the following mechanisms:

Stratification by Ward: The sample was stratified across Wards 3, 4, 10, and 18, with sample sizes proportionally allocated based on the number of households that received complete AQO interventions in each ward. This geographic stratification prevented over-representation of any single area and ensured community-wide insights.

Random Selection Within Strata: Within each ward stratum, households were randomly selected from the comprehensive list of intervention beneficiaries. This random selection process, validated through local leadership involvement, eliminated selection bias and ensured every eligible household had an equal probability of inclusion within their ward.

Sample Representativeness: The sampling frame consisted exclusively of households that received the complete Eskom AQO intervention suite (hybrid stove, LPG heater, electrical rewiring, and ceiling insulation). In 2023, 400 households were sampled from this population, with 381 households successfully tracked in 2024, representing a 95.25% retention rate. This high retention ensures robust longitudinal comparability and minimizes attrition bias.

Quality Assurance: The use of Zulu-fluent fieldworkers ensured linguistic accessibility across all demographic groups within the community. The large sample sizes provide statistical robustness with margins of error well within acceptable ranges for community-based intervention evaluations.

Figure 3 highlights the process that ARM adopted to conduct the household survey in eZamokuhle. At a high level, a fair & transparent recruitment process was first conducted. Thereafter training and capacity building was provided to the successful incumbents. A pilot study was conducted prior to execution of the annual household survey to test sampling procedures and questionnaire clarity. The fieldworkers captured the household respondents' answers onto an online questionnaire, which enabled real-time monitoring of sample distribution across wards. Thereafter the data and results were analysed.

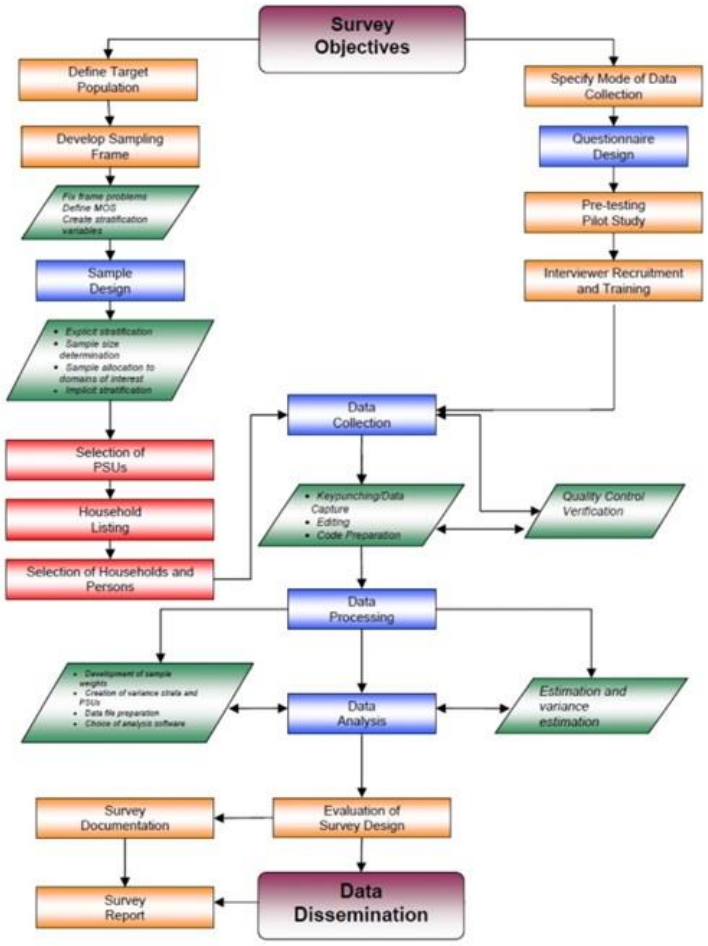

Figure 3: Flowchart of the household survey process that was adopted for the study

2.1.1 Permission To Conduct The Study

In conjunction with Eskom Communications team, the local leadership (Councillors) of eZamokuhle were engaged to obtain their permission and support to conduct the annual household survey in Ezamokuhle. An in-person meeting was held with the local eZamokuhle ward councillors to highlight the: (1) proposed recruitment process; (2) data collection methods; (3) reporting; (4) ethical considerations, and (5) the intended contribution of the study. After obtaining the guidance, support and buy-in from the councillors, the team thereafter proceeded with the recruitment process.

2.1.2 Recruitment of Fieldworkers

ARM followed the recruitment process as advised by the eZamokuhle Ward 7 and ward 8 councillors, which was further supported by the wider Eskom team. Advertisements noting the positions, amount of people and scope of work were distributed at the main areas in Ward 7 and Ward 8, with candidates being able to leave their curriculum vitae's, ID copies, and of proof residence at the project management team's office located at the Amersfoort municipality building. Interviews were then conducted with 20 interviewees. The 11 candidates scoring the highest scores from the interview panel were offered fieldworker positions. A copy of the advertisement is shown in Annexure 1.

2.1.3 Training of Fieldworkers

Training sessions held with the fieldworkers at the eZamokhule Library (Figure 4). The topics covered included:

- Safety induction and training including the risk assessment for the household survey component,
- Correct use of the PPE that ARM had issued to all fieldworkers,
- An overview of the Eskom Air Quality Offset Project including the PMV component,
- The household survey required for Activity 9,
- The detailed questionnaire to be utilized for Activity 9,

- Inform which questions will be seen as too sensitive to be asked in the community,
- The JotForm mobile application that was to be utilized for capturing the questionnaire

Additionally, all fieldworkers were provided with access to all materials presented at the training workshop.

Figure 4: Fieldworker training workshop at Ezamokuhle Library

2.1.4 FIELD SURVEYS IN 2023 & 2024

On the 4th of December 2023, our team of 10 fieldworkers started the field survey. The team worked in pairs (one male and one female) to ensure that our team was always safe. As per the SoW (section 1), a total of 260 households were required to be sampled in eZamokuhle. Thus 130 households per eZamokuhle ward (Figure 5) was required to be sampled. The household survey Eskom-approved questionnaire (Annexure 1) was conducted in Zulu by the fieldworkers onto mobile devices. The questionnaire captured key themes including *inter alia*: household details; main dwelling characteristics; electricity and energy use; cooking devices; health & well-being; education; safety & security; standard of living; air quality awareness and project effectiveness. The questionnaires took no longer than 30 minutes for each household to complete. The data from these devices were securely transferred to the cloud in real-time in JotForm. It is noted that our team did exceptionally well as at the end of the campaign, a total of 400 households completed the questionnaire.

The same exercise and process above was conducted on the 18th of November 2024 with the same team of 10 fieldworkers, targeting the same households that were approached in 2023. A total of 381 households were assessed during the 2024 survey.

Figure 5: Ezamokuhle Wards

2.1.5 Focus Group Discussion

Focus group research is a qualitative method that is performed by planned discussion and interview with a small group of people conducted by a moderator. The participants are sampled from the study population, with qualitative results collected through the participants' considerations and ideas on a topic. Focus Group Discussions (FGD) are not a group interview, but a group discussion focused on a topic.

For eZamokuhle,10 participants were selected and invited to the FGD three weeks prior to the interviews taking place. Of the 10 invited participants, 8 participants attended (7 women,1 man) in both 2024 and 2025.

The questions asked to the participants were sub-divided into 5 sections;

1. Activation and Registration Process
2. Project Execution
3. Interventions
4. Sustainability
5. Perception of Air Quality

The facilitator introduced the purpose of the session and ARM's involvement within the Air quality offsets project in eZamokuhle. After the introduction, the participants were more than happy to discuss and deliberate with the team and fellow participants, as they expressed that they understood the importance of the session and how information can be beneficial to the project and community.

Figure 6: Ezamokuhle FGD participants

2.1.6 Data Capture & Analysis of Field and FGD Surveys

- *Field surveys*

The quantitative and qualitative data collected by the survey differed in complexity and purpose. For the field surveys (section 2.1.4), data was collected through a simple questionnaire (Annexure 1) that featured a mix of qualitative and quantitative answers from the respondents, as a result simple statistical analysis methods would be employed. Most item responses constitute free text where the fieldworker captured responses in JotForm.

- *FGDs*

The deliberations of the discussion were recorded and noted down and then reviewed by the recorder and facilitator to complete the notes. The team noted that for the group, the eldest woman present was seen as the key voice of discussion between the participants. To mitigate the possibility of bias of the participants echoing the eldest's opinions, the facilitator would ask each member to further explain their answer to allow each user to express their opinions openly and clearly.

▪ RESULTS AND DISCUSSION

Section 3.1 articulates the findings of the annual household survey, while Section 3.2 assesses the extent to which households continue to utilize the project measures and evaluates their effectiveness in achieving the objectives of the Eskom AQO program.

3.1 ANNUAL HOUSEHOLD SURVEYS

A total of 401 participants completed the questionnaire (Annexure1) in 2023 and a further 381 households completed the 2024 survey in eZamokuhle. The annual household survey captured a plethora of data from the households in eZamokuhle encompassing the following themes: household demographics; housing; energy use; cooking, space heating and lighting; as well as quality of life. These results are presented in sections 3.1.1 to 3.1.5.

3.1.1 Household Demographics

The gender distribution of survey respondents reveals critical insights into household energy decision-making and exposure patterns. While females constituted the majority of respondents (78.1% in 2023 and 75.1% in 2024), this predominance carries profound implications beyond simple demographic representation.

Gendered Vulnerability and Exposure Dynamics

The female-dominated response pattern reflects the intersection of gender roles and environmental health risks in South African households. Women's disproportionate representation as primary household energy managers positions them as both the most vulnerable to indoor air pollution and the most influential in sustaining clean energy transitions. Their direct, prolonged exposure to cooking emissions makes them primary beneficiaries of AQO interventions, while their role as household decision-makers makes them critical gatekeepers for technology adoption and sustained use.

Strategic Implications for Intervention Success

This gender distribution validates the programme's implicit targeting effectiveness. By reaching those most affected by indoor air pollution, the interventions address health inequities at their source. The high female participation rates suggest successful engagement with the demographic most capable of translating individual benefits into household-wide behavioral change. Their experiential knowledge of pre-intervention health impacts provides them with compelling motivation to maintain cleaner technologies, potentially explaining the sustained high satisfaction rates despite emerging challenges.

Knowledge Transfer and Community Influence

Women's central role in household management extends beyond individual homes to community networks. Their predominant participation in the survey indicates their position as primary knowledge holders regarding intervention performance, maintenance needs, and operational

challenges. This positions them as key informants for programme improvement and potential champions for community-wide adoption. Their experiences and satisfaction levels likely influence neighboring households' perceptions and willingness to participate in future programme expansions.

Evolving Gender Dynamics

The slight increase in male participation from 21.9% to 24.9% between survey years suggests evolving household dynamics around energy decisions. This trend may indicate growing male recognition of clean energy benefits or increasing shared responsibility for household energy management. Such shifts could strengthen intervention sustainability by broadening the base of household members invested in maintaining new technologies.

The gender distribution thus represents more than a demographic datapoint – it confirms appropriate intervention targeting, validates the programme's potential for addressing gendered health inequities, and identifies women as crucial partners in achieving sustained community-wide air quality improvements. Future programme design should explicitly leverage this female expertise and influence while encouraging continued expansion of male engagement to ensure whole-household commitment to clean energy transitions.

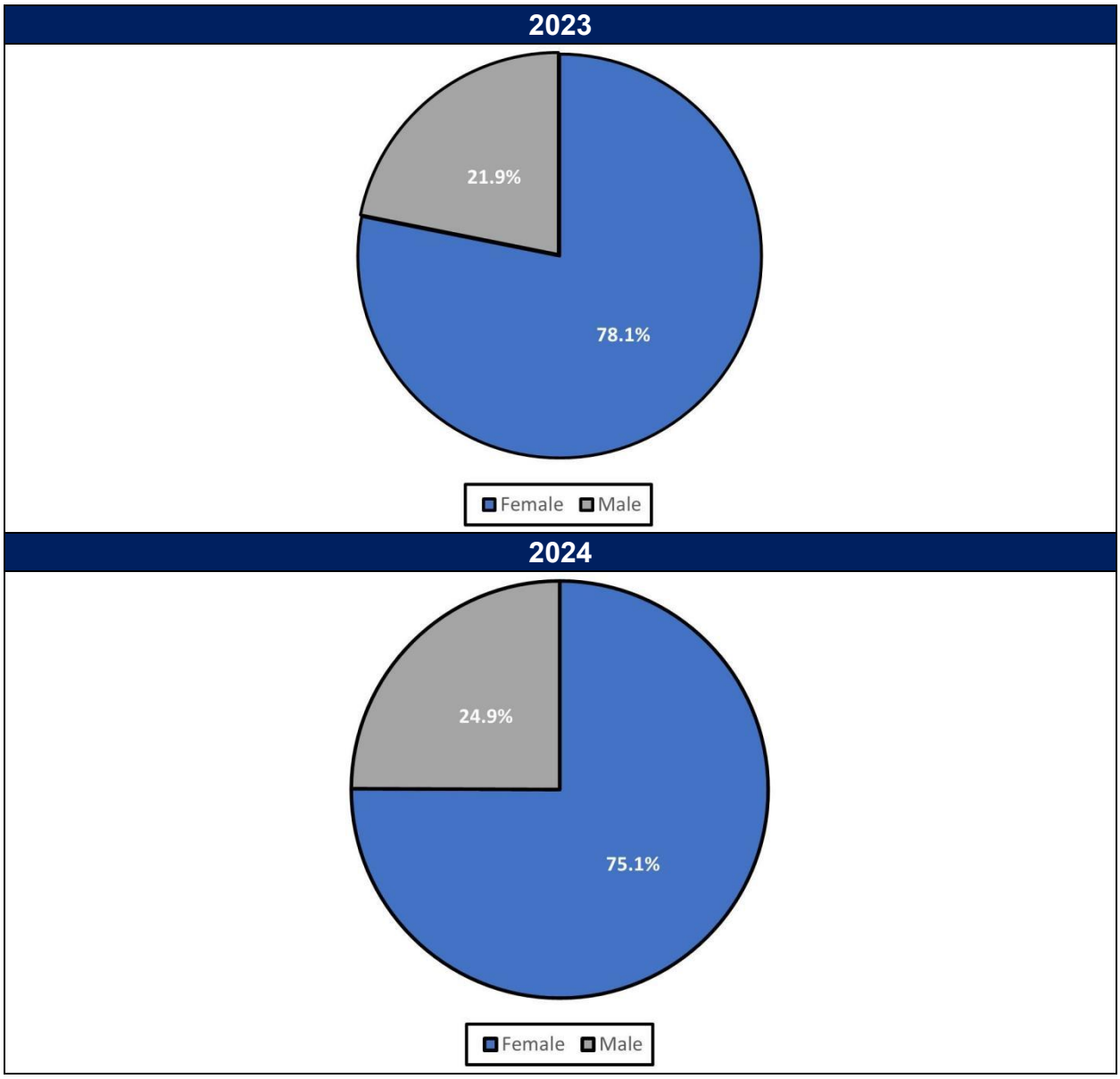

Figure 7: Gender distribution in percentage for eZamokuhle in 2023 and 2024.

Figure 8 is indicative of the age distribution of the surveyed eZamokuhle population for the two surveys. Table 1 is a summary of the data represented in Figure 2 and 3. The 2023 dataset highlight that 42.8% are young adults (20 to 39 years old); 29.1% are middle aged adults (40 to 59 years old) and 15.9% are older adults (60 to 99), whilst the 2024 dataset highlight that 53.4% are young adults (20 to 39 years old); 28.4% are middle aged adults (40 to 59 years old) and 12.1% are older adults (60 to 99) (Figure 8).

It's evident from (Figure 8) that most of the respondents are between the ages 19-60 years (mean age: ≈40). Typically, people in this age group are more resilient to air quality related illnesses which is noted with the response received from the respondents when asked about their satisfaction of their personal health.

An analysis of the age distribution for female headed households (Figure 9) indicate for the 2023 dataset that 35.8% are headed by young female adults (20 to 39 years old), with 38.4% headed by middle aged female adults (40 to 59 years old) and 25.2% headed by old female adults (60 to 99). The 2024 dataset indicate that 30.7% are headed by young female adults (20 to 39 years old), with 44.0% headed by middle aged female adults (40 to 59 years old) and 24.5% headed by old female adults (60 to 99). This cohort of female play a pivotal role in the continued adoption and utilization of LPG in the community. Eskom should continue the training and awareness programmes on both air quality and LPG usage targeting this cohort.

Table 2: Age distribution of general population and female heads of families in eZamokuhle in 2023 and 2024.

Age distribution (%)	General population		Female heads of families	
	2023	2024	2023	2024
0 to 19	12.4	6.6	0.7	0.8
20 to 39	42.8	53.4	35.8	30.7
40 to 59	29.1	28.4	38.4	44.0
Older than 60	15.9	12.1	25.2	24.5

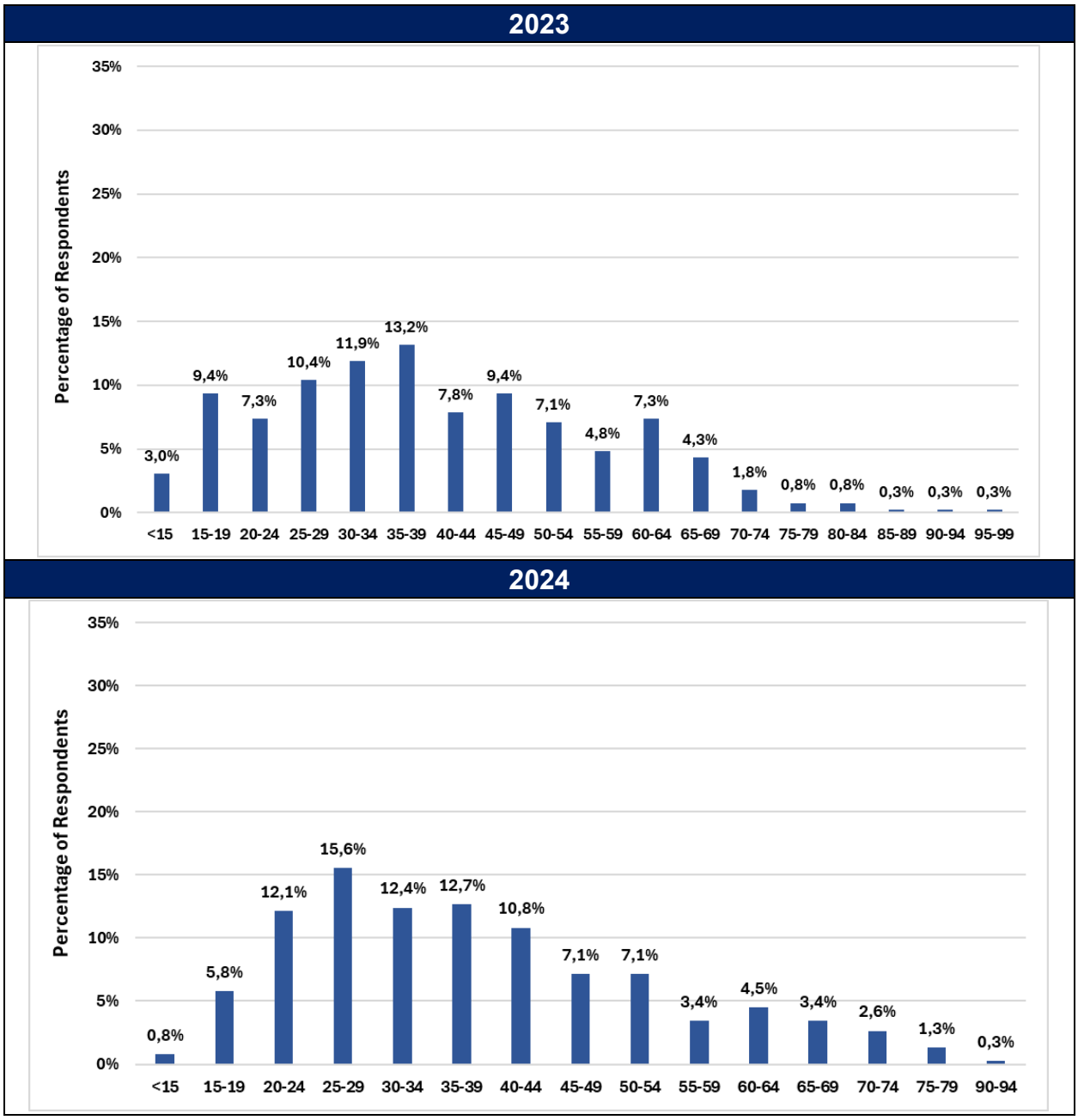

Figure 8: Age distribution in eZamokuhle in 2023 and 2024

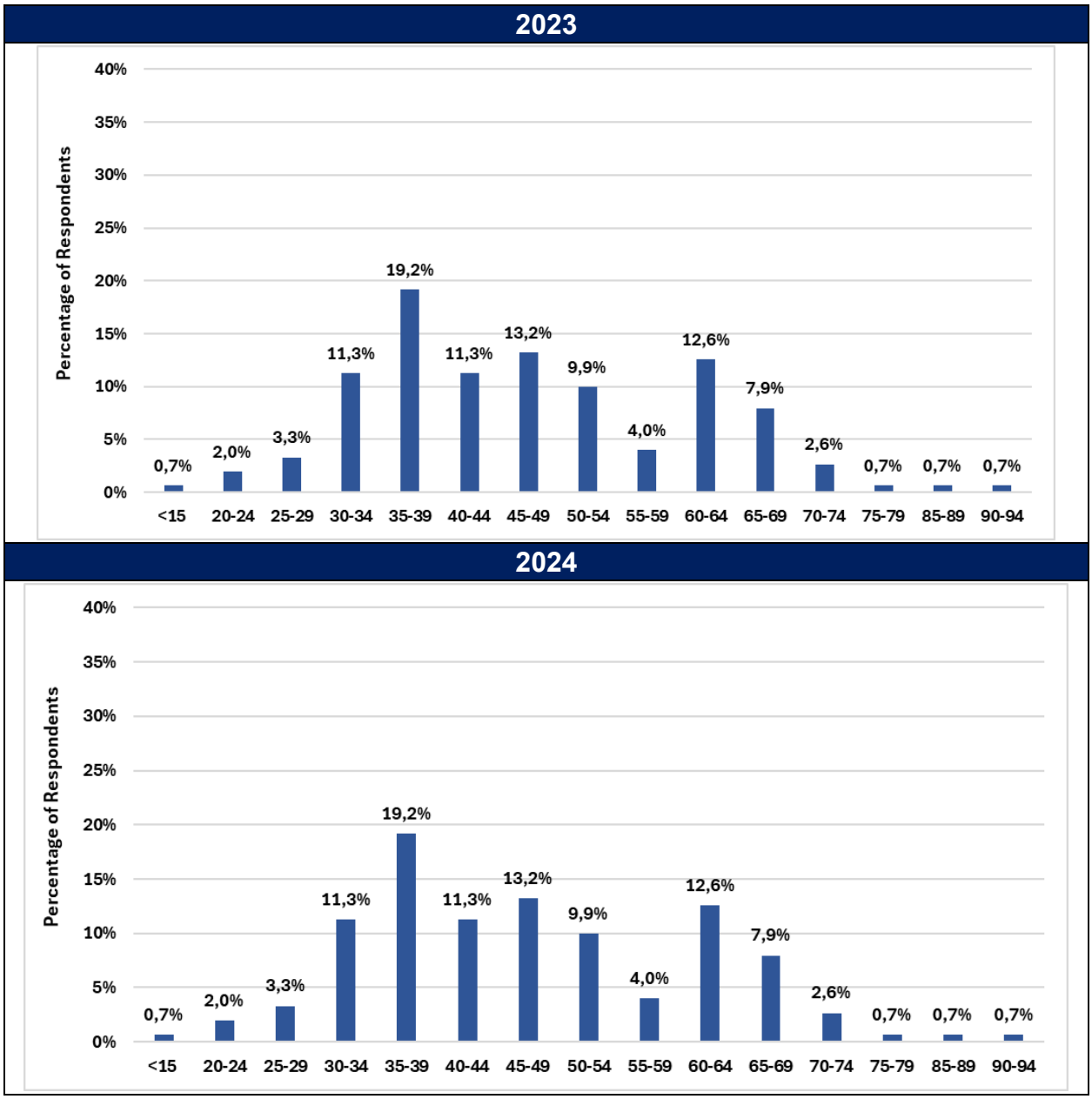

Figure 9: Age distribution of female heads of families in 2023 and 2024.

The number of dependents that each household must support is also an indicator of the amount of disposable income available to a family to spend on electricity and other sources of energy. It is also an important proxy for the indoor air quality. The 2023 and 2024 surveys (Figure 10) indicated an average number of 3.2 dependents per household for 2023 and 3.9 dependents per household for 2024, compared to the number of 1.99 dependents reported by the 2011 STATSA census[2], with a high of 12.0 dependents in certain instances. Comparatively, according to a study conducted by Stats SA in 2021, South Africa, has an average household size of 3.34 persons nationally[3]. Interestingly, only about 3% reported using child grants, and only 21% accessed Social Relief Distress Grant despite this dynamic.

[2] Stats SA, https://www.statssa.gov.za/?page_id=4286&id=11564
[3]Stats SA, https://www.statssa.gov.za/?p=15473#:~:text=Nationally%2C%20more%20than%20half%20(52,at%20least%20one%20elderly%20person.

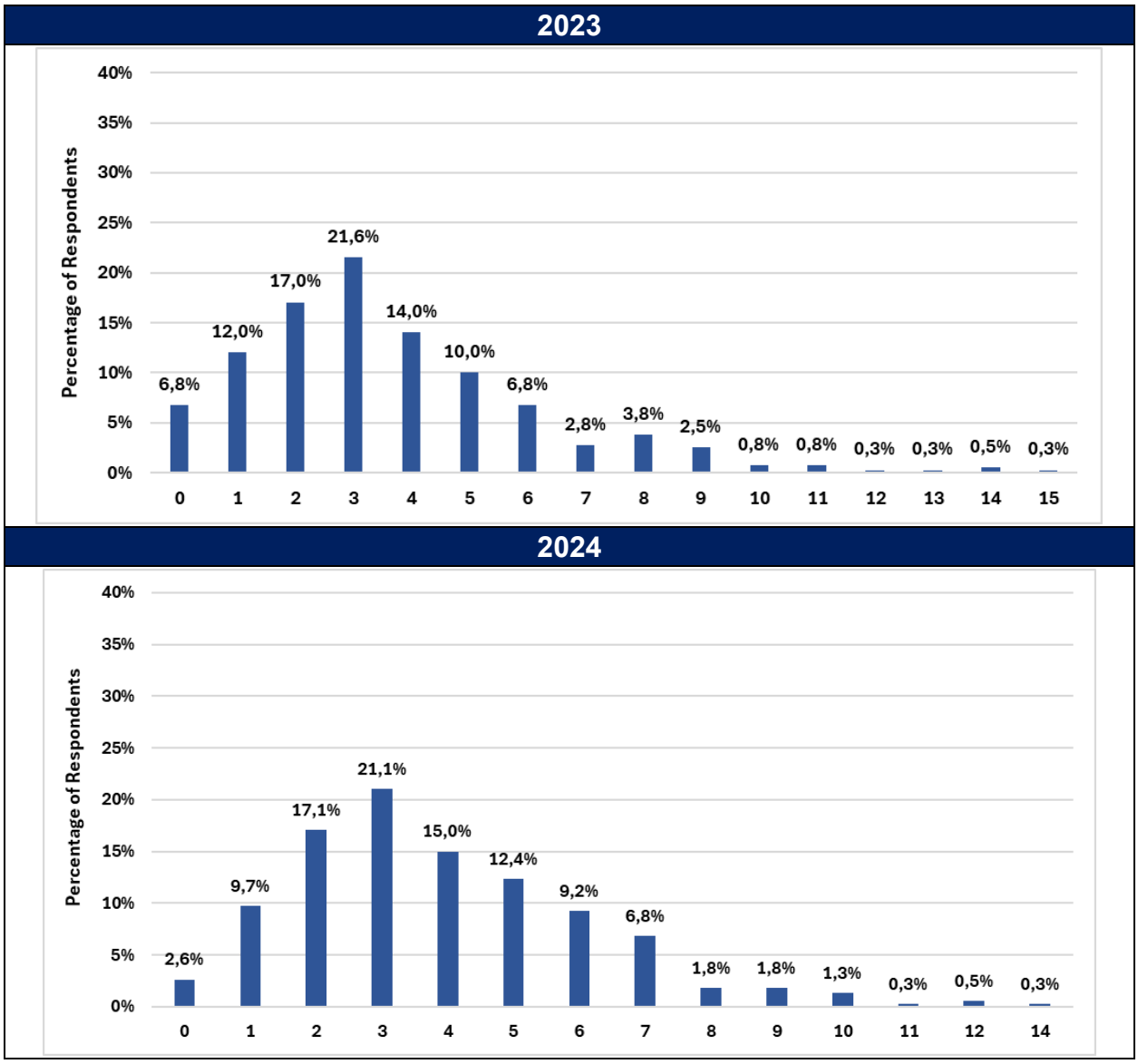

Figure 10: Number of dependents supported per household in 2023 and 2024.

3.1.2 HOUSING

The type and structure of housing in any settlement is often seen as a social determinant of health, particularly in low-income households. The direct effects of physical housing defects are an important causal pathway for health-related issues in low-income, vulnerable households[4].

According to Stats SA, in 2022, more than four-fifths (88%) of all households lived in formal dwellings; 8.1% lived in informal, and 3.1% lived in traditional, dwellings[5] (dwellings one made of clay, mud, thatch or other traditional materials. It can be round or square in shape). Almost 65% of households owned the dwelling they lived in while 22.2% rented it and 13% indicated that they lived in their dwellings without charge.[6]

The sampled households interviewed during the 2023 survey fall primarily into three categories as illustrated by Figure 11. By far, the largest percentage of households (77.2%) were residing in RDP housing. Twp percent (2.0%) of households lived in self-built housing, and 20.8% households have converted their homes from formal RDP houses to more spacious dwellings. On average, homes had 3.4 rooms.

[4]Krieger,J.,Higgins,D.L, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1447157/
[5] STATSSA, https://census.statssa.gov.za/#/statsbytheme
[6] Stats SA,General Hosuehold Survey 2022, https://www.statssa.gov.za/publications/P0318/P03182022.pdf.

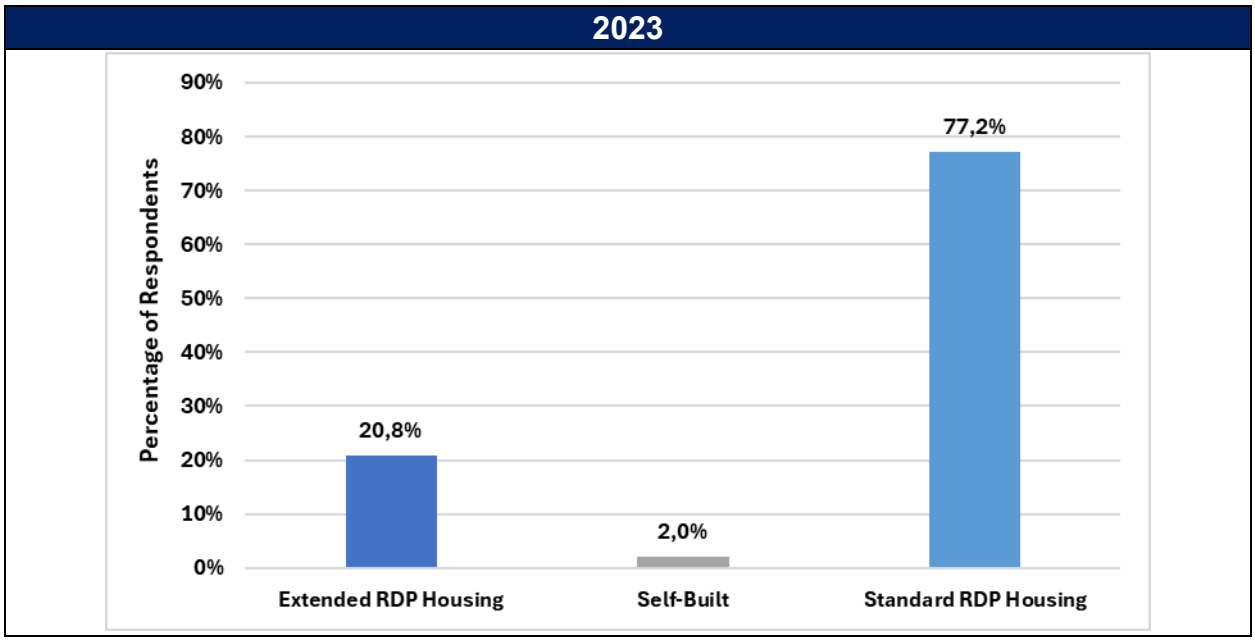

Figure 11: Type of dwelling of eZamokuhle Respondents that Participated in the Eskom Offsets Retrofitting Exercise.

The percentage of shacks in backyards in eZamokuhle of the sampled households are illustrated in Figure 12 for the two surveys. The 2023 dataset indicate 61.4%, whilst the 2024 dataset indicate 61.2% backyard dwellings (Figure 12) which compares quite high to the national Census number of 3.3%[7]. This is concerning as "shacks" present an extraordinary structural challenge based on the materials of construction such as wood, tin, plastics etc. Shacks are illegal dwellings that RDP homeowners build in their backyards to generate income in the form of rent. Shacks do not conform to any building regulations and are unserviced with respect to electricity, water and sanitation, forcing people to move to alternate "dirty" fuels as a result of energy stacking thus predisposing them to poor air quality. Eskom must proceed sensitively with the AQO intervention roll out as not doing anything with respect to the shacks may create social unease and distrust.

[7] Stats SA,General Hosuehold Survey 2022, https://www.statssa.gov.za/publications/P0318/P03182022.pdf.

Education and awareness and extremely selective interventions such as stove roll outs to shacks may address some of these concerns.

RDP houses on the other hand are better constructed using bricks and mortar in most cases. They are generally electrified and have access at the very least to free basic electricity (FBE), which is electricity allocated to support low-income households, enough to run basic lighting, basic media access, basic ironing and boil water using an electrical kettle. Indigent households can qualify for at least 6kl of water and 50 kWh of basic electricity per household per month. Households are required to register with municipalities to qualify for these free basic services and successful applicants are granted indigent status. Different municipalities have different criteria to qualify as indigent. According to COGTA (Cooperative Governance and Traditional Affairs), South Africa's 257 municipalities registered 3.51 million indigent households in 2017. That's nearly 1 in every 5 of the country's 16.2 million households. Whilst this survey recognizes this important parameter as an omission and will include this as a question in subsequent surveys, it is a safe assumption that generally all RDP homes qualify as indigent. Furthermore, in eZamokuhle, ~21% of respondents have also either improved their RDP homes by either extending or modifying the houses or have proper brick housing which minimises health risks from poor indoor air quality. Improvements broadly describe extensions to the homes, and other minor modifications such tiling of floors etc.

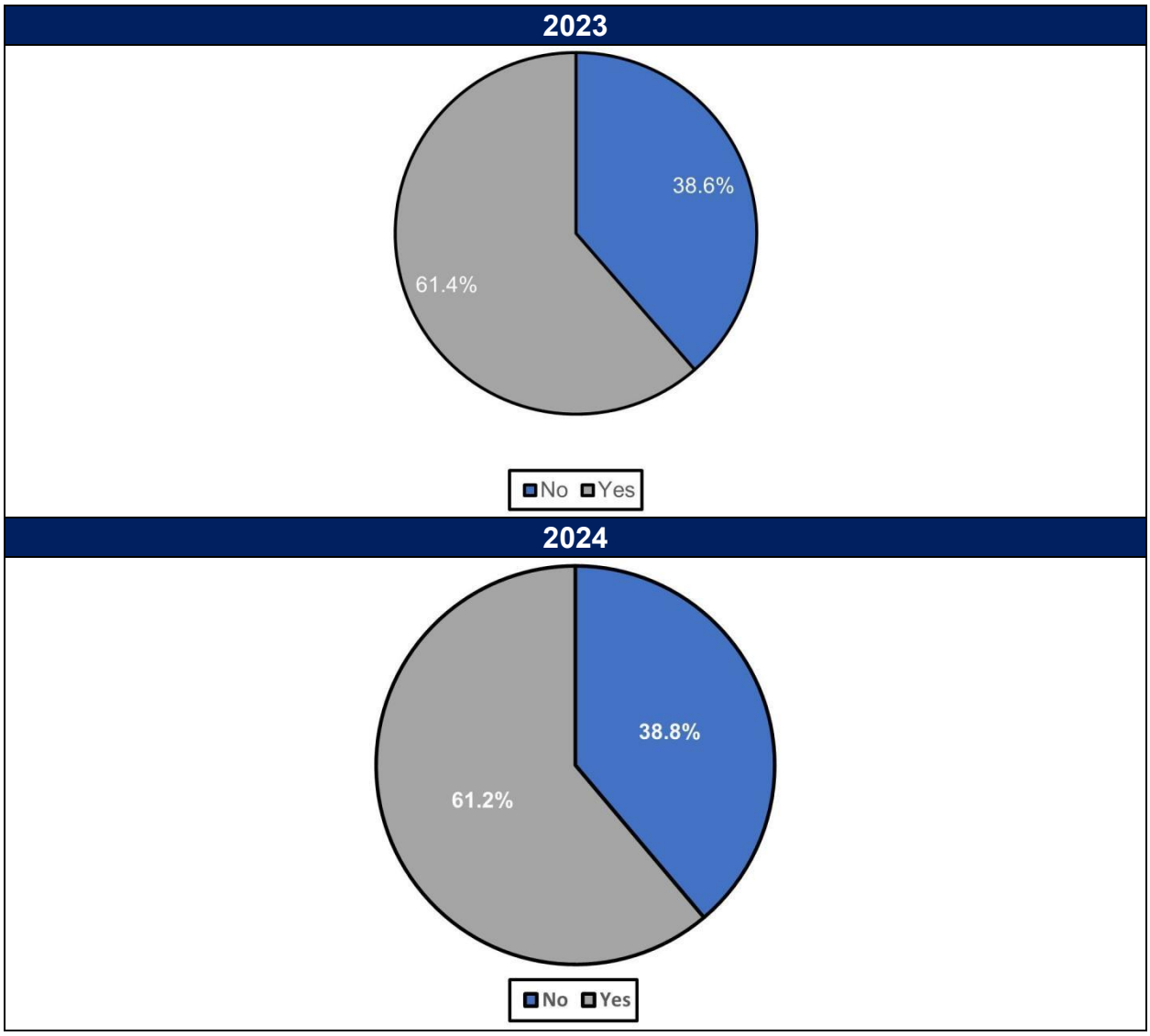

Figure 12: Number of backyard dwellings in eZamokuhle in 2023 and 2024.

MATERIALS USED IN CONSTRUCTION

The materials used in housing construction is a key determinant of thermal comfort and subsequently indoor air quality. The thermal comfort is low in a house where there are neither ceilings nor plastering of the walls, and where space heating is affected by solid fuel burning.

From the sampled households in 2023, 98.3% of the roofing was made up of metal sheets and the remainder was constructed of tile and cement, whereas during the 2024 survey 99.5% of the roofing was made up of metal sheets and the remainder was constructed of tiles (Figure 13).

In terms of the main dwellings floor type, the 2023 survey highlighted that half of floors (51%) were of cement and the balance were covered by tiles), whilst about 10% of households used carpets. The 2024 survey indicate a similar trend of 37,3% cement and the balance were covered by tiles, whilst about 22,6% of households used carpets (Figure 14)

Adequate concrete floor insulation like polystyrene blocks or sheets on which either carpets or wooden tiles are placed will greatly help in reducing heat loss, improving comfort and conserving energy. Although concrete floors look solid, it is actually very porous, leading to the penetration of moisture. Around 15% of heat loss from a building can be through the floor. Without much effort, perhaps a low hanging fruit could be the rollout of carpets to households to aid in improving the thermal comfort of the homes in winter[8], however the socio-economic viability of this hypothesis will need to be tested.

[8] MccNeil,S https://www.researchgate.net/publication/298352974_The_Thermal_Properties_of_Wool_Carpets

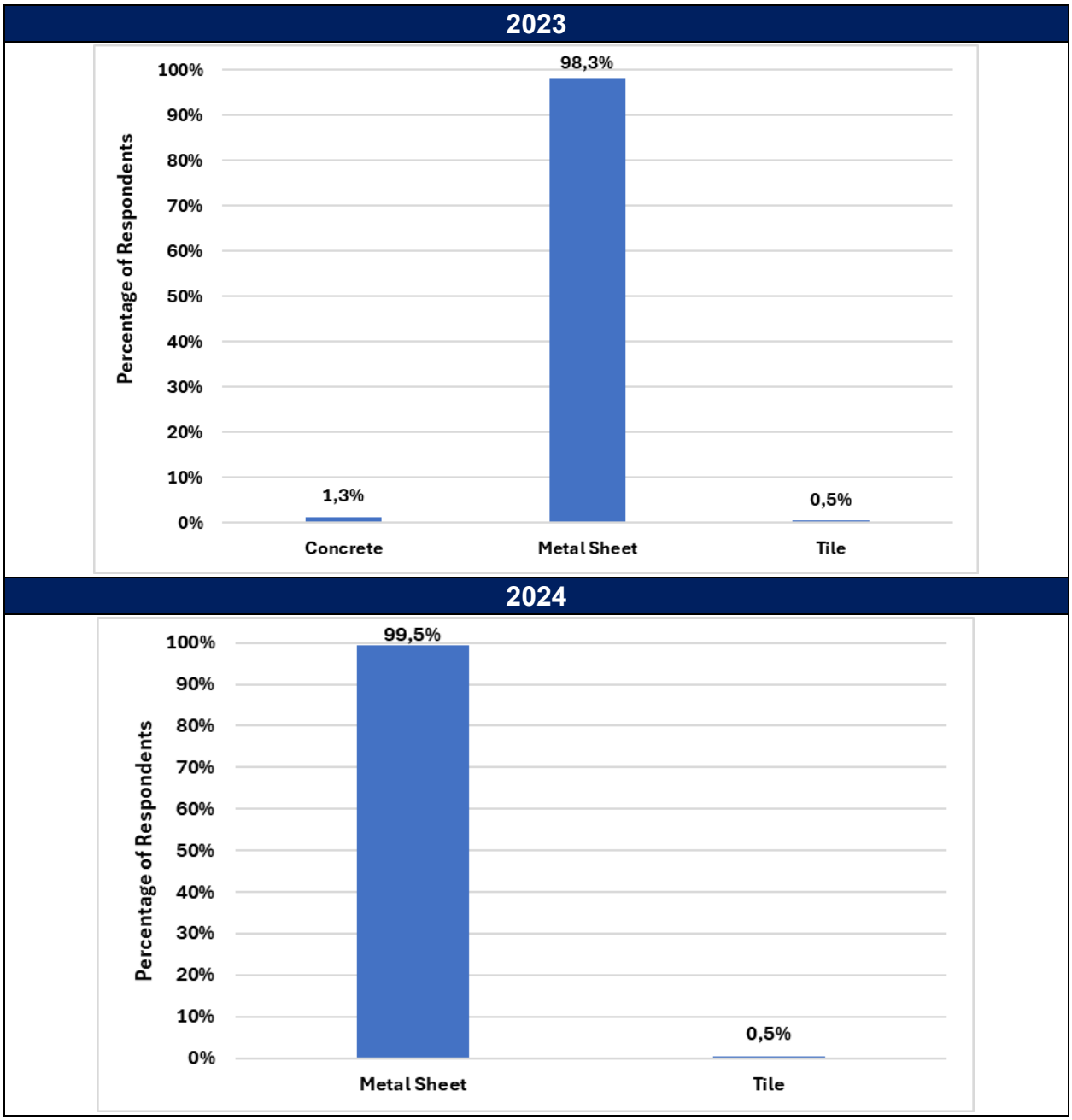

Figure 13: Main dwelling roof types in eZamokuhle in 2023 and 2024.

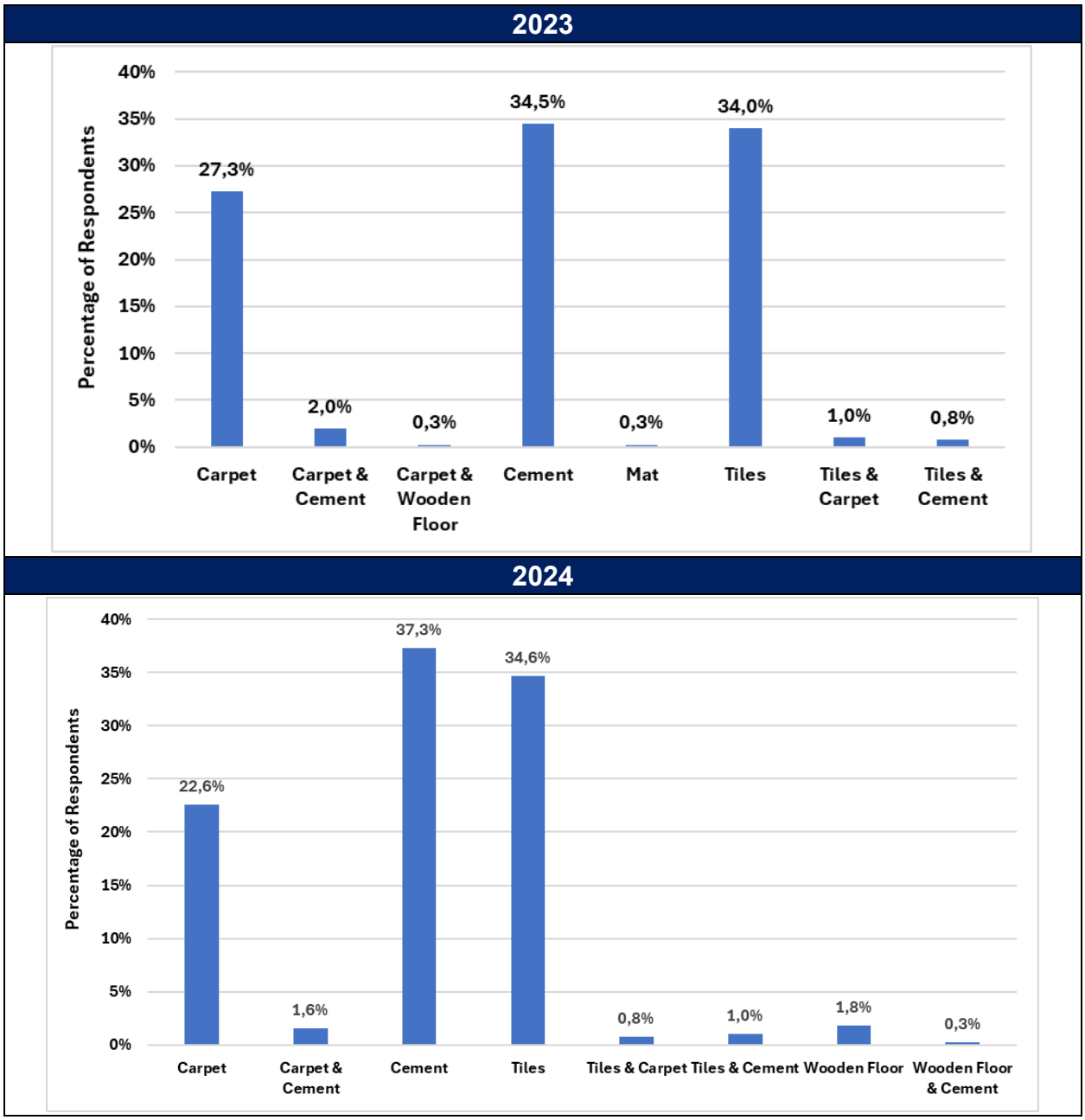

Figure 14: Main dwelling floor types in eZamokuhle in 2023 and 2024.

3.1.3 ENERGY USE

Access to electricity shifts households up the energy ladder[9] (Hanna). However, in low-income households, socio-economic conditions and electricity availability (e.g., loadshedding), drive households towards the energy stacking model and fuel switching towards biomass. Coal becomes a reality particularly in winter months. Typically, low-income households have access to free basic electricity. Almost all the respondents 99.5% indicated for the 2023 survey that they have access to electricity, whilst a slight reduction to 95.3% is noted for the 2024 survey (Figure 15).

Interestingly, even with access to electricity, ~50% households indicated in the 2023 and 2024 surveys they utilise electricity continuously through the year before and after interventions. This is attributed to the rising cost in electricity for the 50% of respondents, who then must rely on other energy sources (Figure 16). This implies that electricity is the primary energy source for the 50% of respondents during 2023 and 2024, and fuel switching is limited irrespective of time of year.

Electricity is used predominantly for heating, cooking and lighting (Figures 15 to 17). Figure 17 is indicative of energy use for space heating. Figure 11 illustrates a 44.2% electricity, 40.8% coal, 10.9% firewood and 2.5% LPG usage for 2023 pre-interventions. The 2024 survey (after the interventions were completed) indicates an increase of energy use for space heating to 54.1% for electricity and 48.5% for LPG, whilst a significant reduction of coal and firewood usage to 2.4% and 1.4% respectively. This reduction of coal (38.4%) and wood (9.5%) usage for space heating will have a significant contribution towards improving the ambient air quality in the region.

[9] Hanna,R.,Oliva,P. https://epod.cid.harvard.edu/sites/default/files/2018-03/moving_up_energy_ladder.pdf

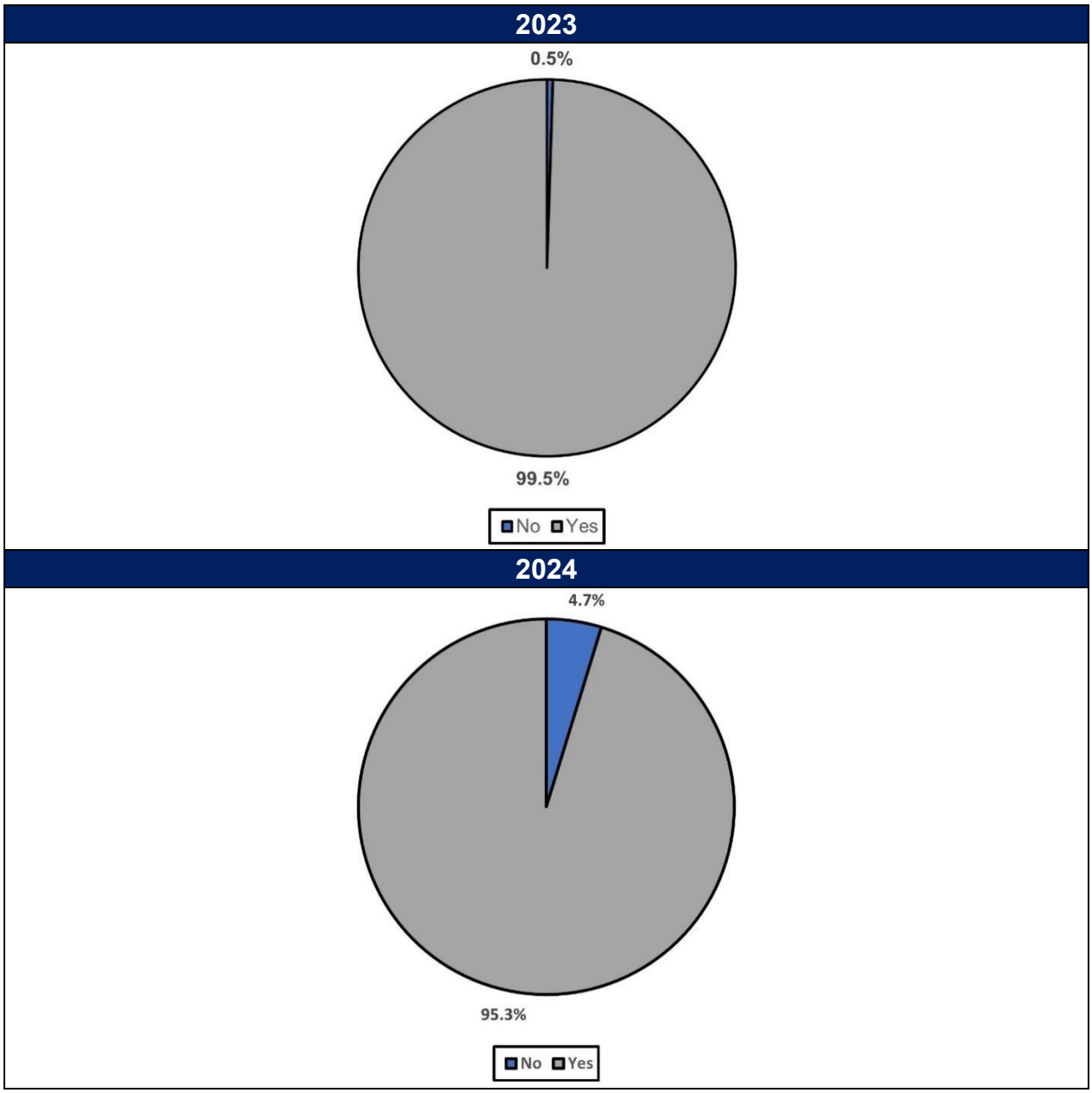

Figure 15: Number of sample households with an electricity connection in 2023 and 2024

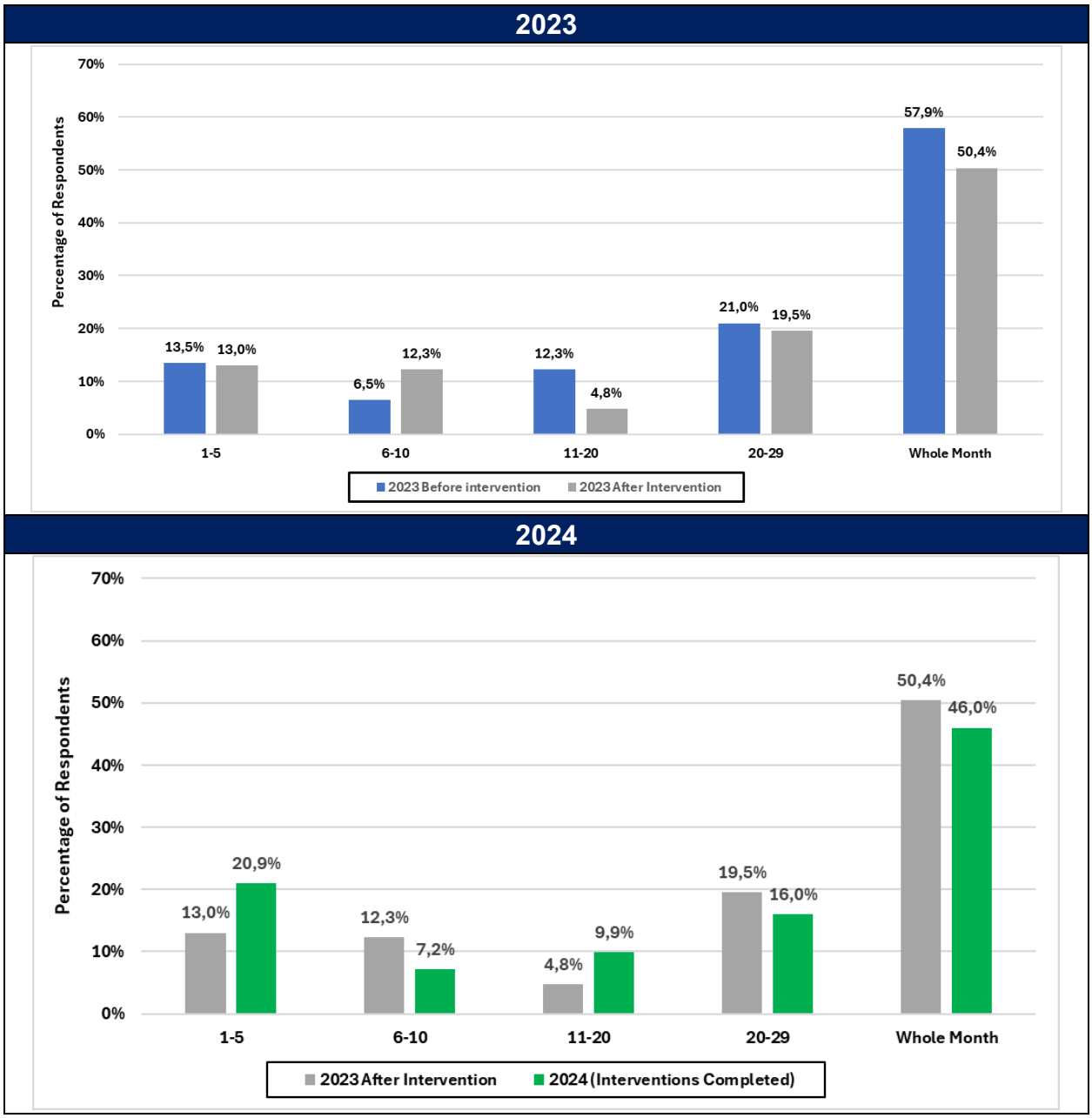

Figure 16: Days electricity is used in the sample households in eZamokuhle in 2023 and 2024

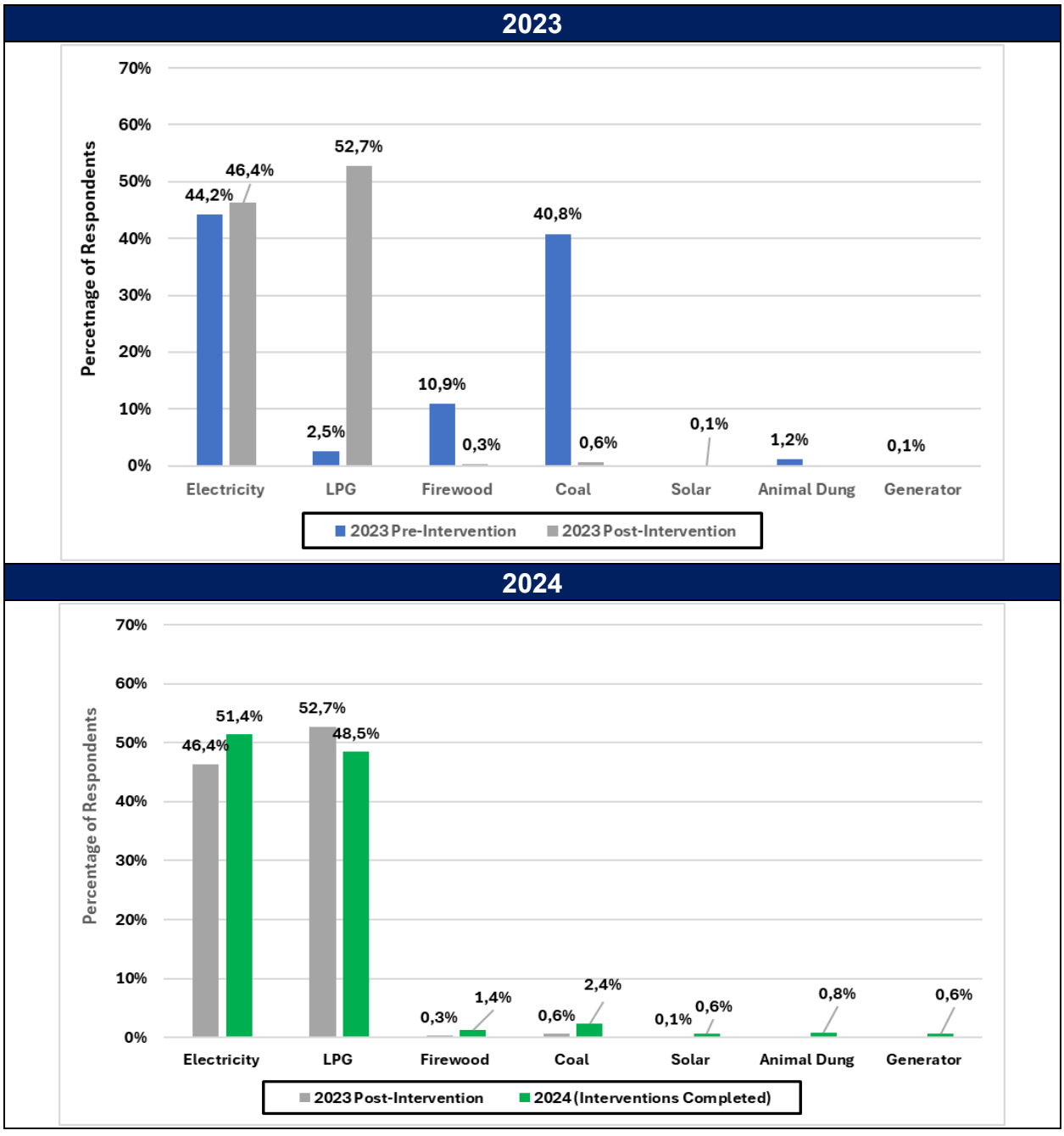

Figure 17: Household energy use for Space Heating in 2023 and 2024

Figure 18 is indicative of energy use for cooking. Figure 12 illustrates a 44.2% electricity, 39.6% coal, 12.9% firewood and 1.5% LPG usage for 2023 pre-interventions. The 2024 survey (after the interventions were completed) indicates an increase of energy use for cooking to 48.8% for electricity and 46.6% for LPG, whilst a significant reduction of coal and firewood usage to 2.0% and 0.9% respectively. This significant reduction of coal (37.6%) and wood (12.0%) usage for cooking will add to the improvements of air quality materialised for the space heating.

Interestingly, Census 2023, shows that the proportion of households using electricity for cooking increased from 47.5% to 73.9% in 1996 to 2011, and then decreased to 64.9% respectively in 2023, compared to 47% in eZamokuhle. The proportion of households using paraffin, wood and coal as sources of energy for cooking decreased from 21.6%, 23.0% and 3.6% to 8.5%, 12.5% and 0.7% in Census 1996 and 2011 respectively, and then further decreased to 2.7%, 6.1% and 0.2% in 2022, compared to 1% coal use and 0% firewood use in eZamokuhle.

Figure 19 is indicative of energy use for lighting. Figure 19 illustrates a 56.4% electricity and 41.4% candle usage for 2023 pre-interventions. The 2024 survey (after the interventions were completed) indicates a slight decrease of energy use for lighting to 53.3% for electricity and 37.7% for candle usage respectively. A significant increase in LPG usage for lighting from 0.3% to 7.4% is indicative in 2024.

Census 2023 indicated that households using electricity for lighting increased from 58.2% in 1996 to 84.7% in 2011, and then to 94.7% in 2022, with 57% households in eZamokuhle using electricity for lighting. while those using paraffin and candles decreased over the same period. The use of paraffin and candles for lighting also decreased from 12.7% to 3.0% and from 28.7% to 11.4% in 1996 and 2011, respectively, and further decreased to 0.9% and 3.2%, whilst in eZamokuhle 42% of households used candles.

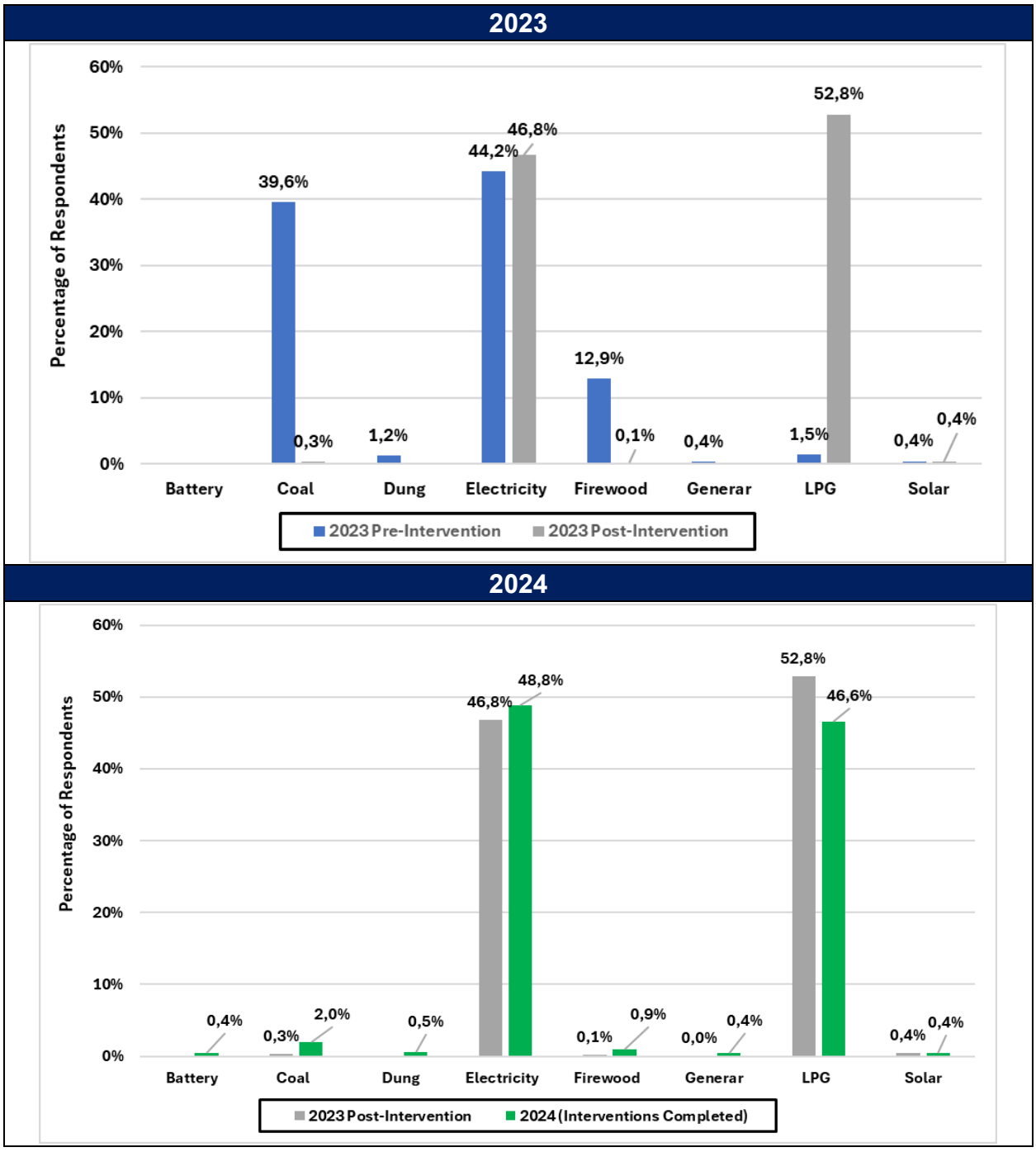

Figure 18: Household energy use for Cooking in 2023 and 2024

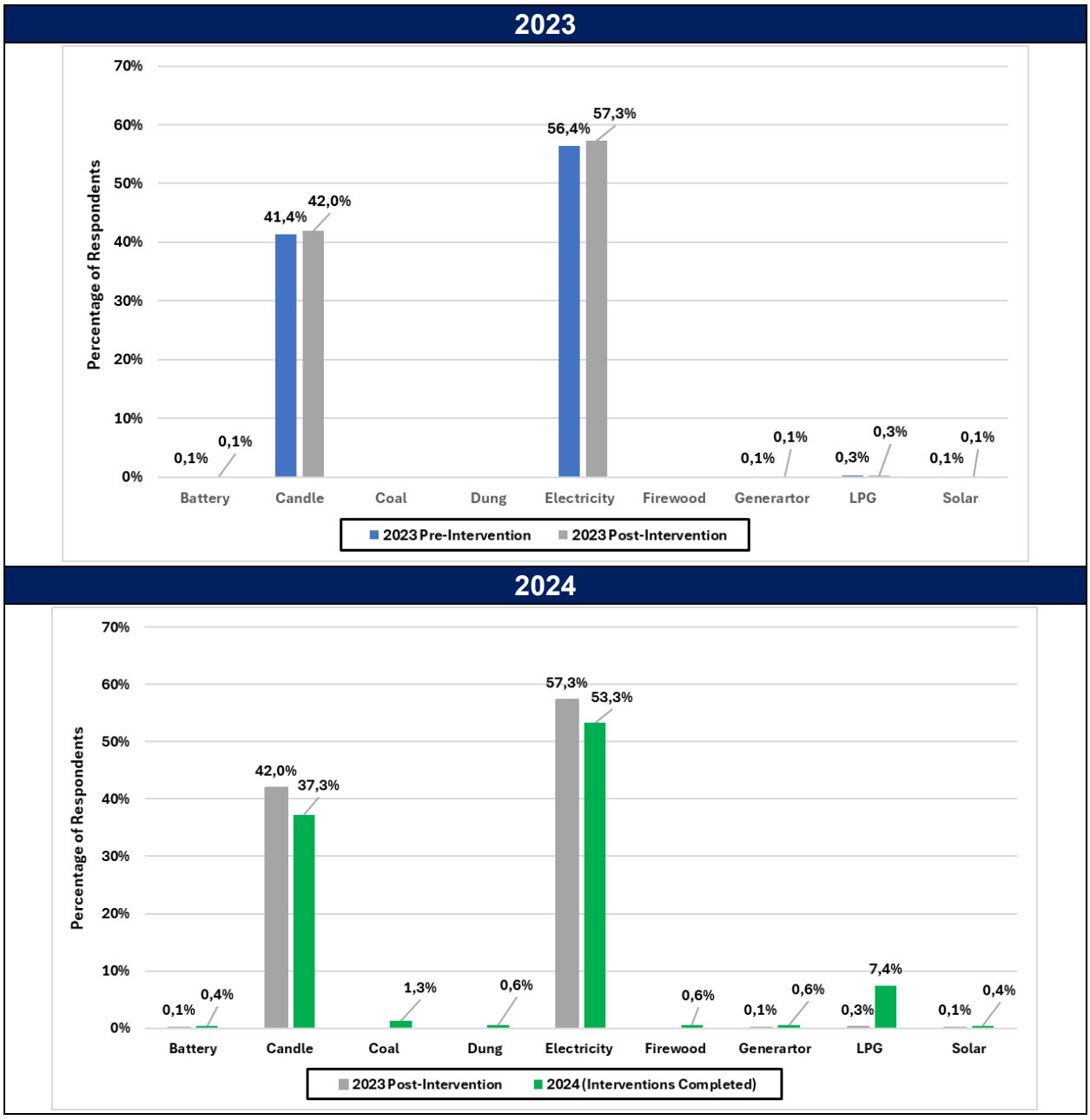

Figure 19: Household energy use for Lighting in 2023 and 2024

Whilst the shift to cleaner fuels for heating and cooking represents a tremendous step in managing and improving air quality for Eskom, early celebrations may have to be tempered as this could be a seasonal representation of the consumption of coal. Winter may present a different picture but will be a good gauge of how effective the interventions are. This said and in order to maintain this pattern of energy use and prevent fuel switching, Eskom will have to continue its training and awareness programmes.

- *3.1.3.1 Use of electricity from interconnected grid or isolated system*

Virtually all households have an electricity meter (99%) and use electricity for lighting, electric appliances and cooking. From the 2023 survey results it's evident that only 52% use energy saving light bulbs pre-intervention and saw a small decrease to 50% post-intervention. In the 2024 study a decrease is noted with 47,5% of households utilising energy saving light bulbs. A total of 56.4% households reported electricity spend of between R200-R500 per month pre-intervention and dropped to 40.6% (162) post-intervention and then increased in 2024 to 57%. Whilst an increase is noted between the pre and 2023 post-intervention for the R1-200 from 16,8% (67) to 42,9% (171) and then decreasing in 2024 to ~21%.

Statistically this represents a positive for people following the energy stacking principles and using multiple fuels at the same time, particularly post intervention.

In case of electricity failure most (89,5%; 359) use candles as a backup in 2023 while almost none use gas lamps, generators, car batteries or any other backup. In 2024 this number would decrease slightly to 342 respondents of 381 using candles as a backup.

- *3.1.3.2 Candle use*

The 2023 survey revealed that 88.2% of households utilise candles every month pre-intervention, and there isn't a notable change (read negligible reduction) after all the interventions were implemented (2024), with 84.3% households using candles; mainly for home use during load shedding (Figure 20). Candles are used for lighting and present a major fire hazard more so than contributing to poor air quality.

Figure 21 is indicative of the number of candles used by the households per month. During 2023 41.6% and 23.2% of the households utilised 7 and 12 candles before the interventions. The 2024 survey highlight 93.1% households utilised 6 or less candles after the interventions were completed. This is a clear indication of a shift from candles to alternative fuels for lighting.

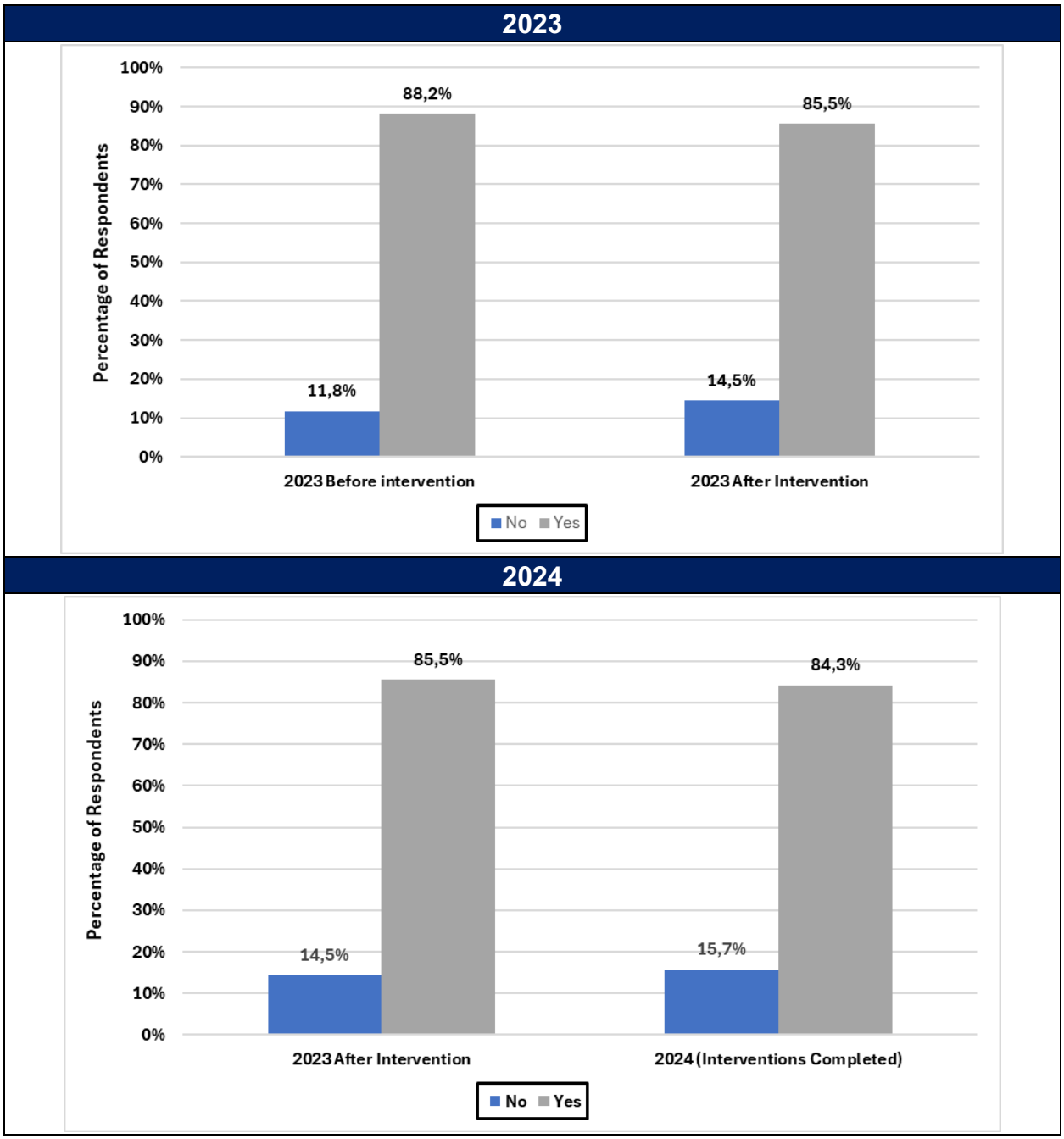

Figure 20: Respondent Households that use Candles in eZamokuhle in 2023 and 2024

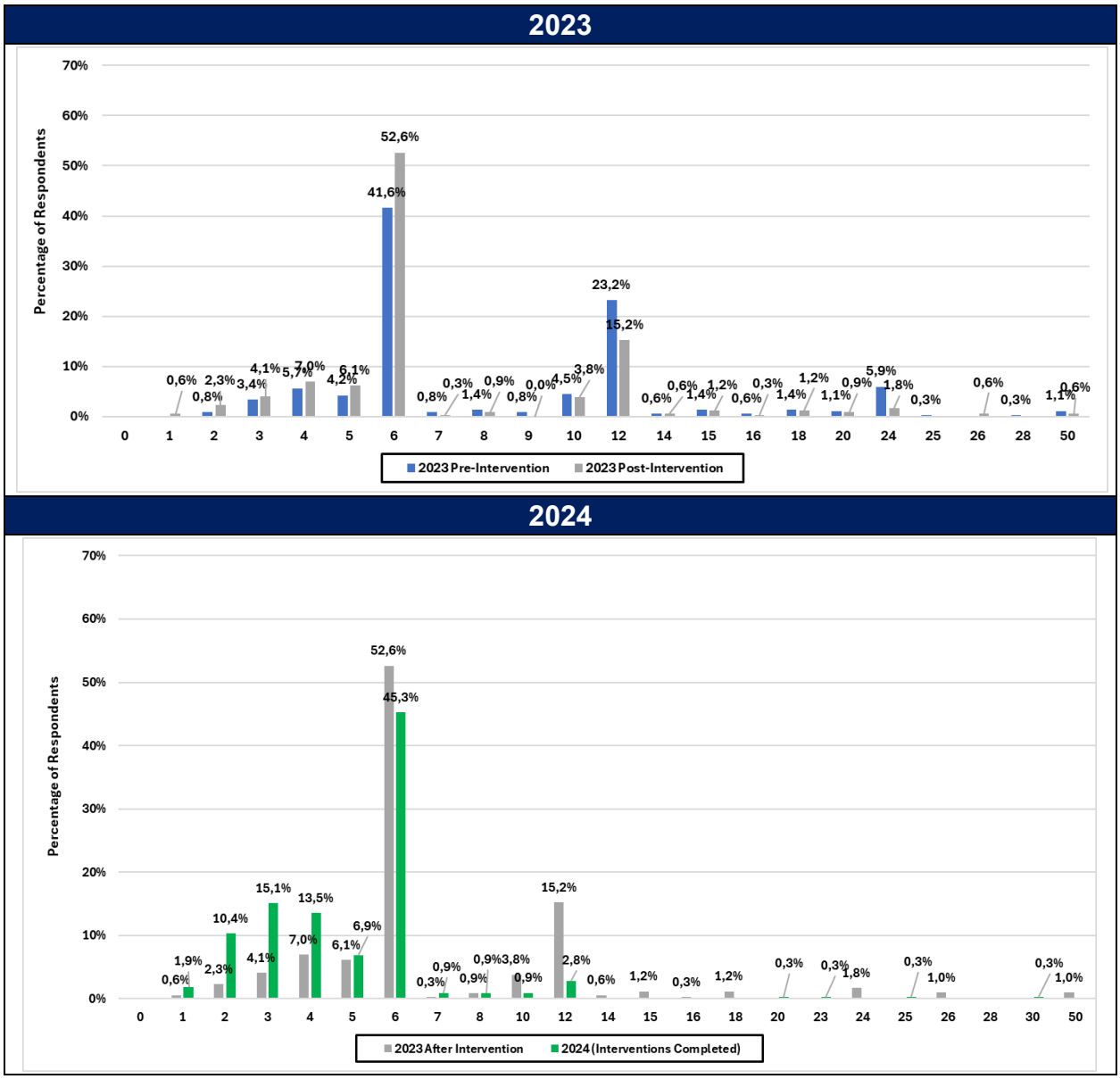

Figure 21: Number of candles used by respondent households in 2023 and 2024

3.1.3.3 Use of LPG

LPG should ordinarily be considered a cleaner transition fuel. However, for low-income houses both perceptions of safety and energy value as well as costs deter more widespread utilisation. As noted by the focus group interviews distribution and last mile delivery present challenges and limits more extensive users. LPG distribution in townships is limited to stores such as hardware and retail service stations or respondents need to travel out to nearby towns to refill cylinders.

From the sampled households, 7.8% (34) households indicated that they used LPG pre-intervention, and this has increased to 379 (96.4%) post-intervention, with the most popular cylinder being the 9kg cylinder for both periods (33 pre-intervention, 384 post intervention). In the 2024 post intervention study 338 households indicated to still be using LPG, with the 9kg cylinder still being the most popular cylinder (Figure 22).

LPG is mostly used for heating (LPG heater) and cooking for the pre-intervention period and would then change with the LPG stove and oven combination being the second most used LPG device after the LPG heater as indicated in Figure 23. This trend is the same for 2024 with and increase number of households adopting LPG for heating and cooking post interventions.

The continued adoption and use of LPG is dependent on a number of factors including availability, accessibility, last mile delivery, pricing and safety. There are a number of innovative, new modalities for LPG gas sales and use that Eskom may want to pursue. This include interventions such as “pay as you gas” i.e., users can decide exactly how much they would like to spend on gas, whether it be R10 or R100 OR “pay as you use” – users receive a filled gas cylinder and pay for only what they use. This has the potential to develop a whole new LPG distribution and SSME ecosystem.

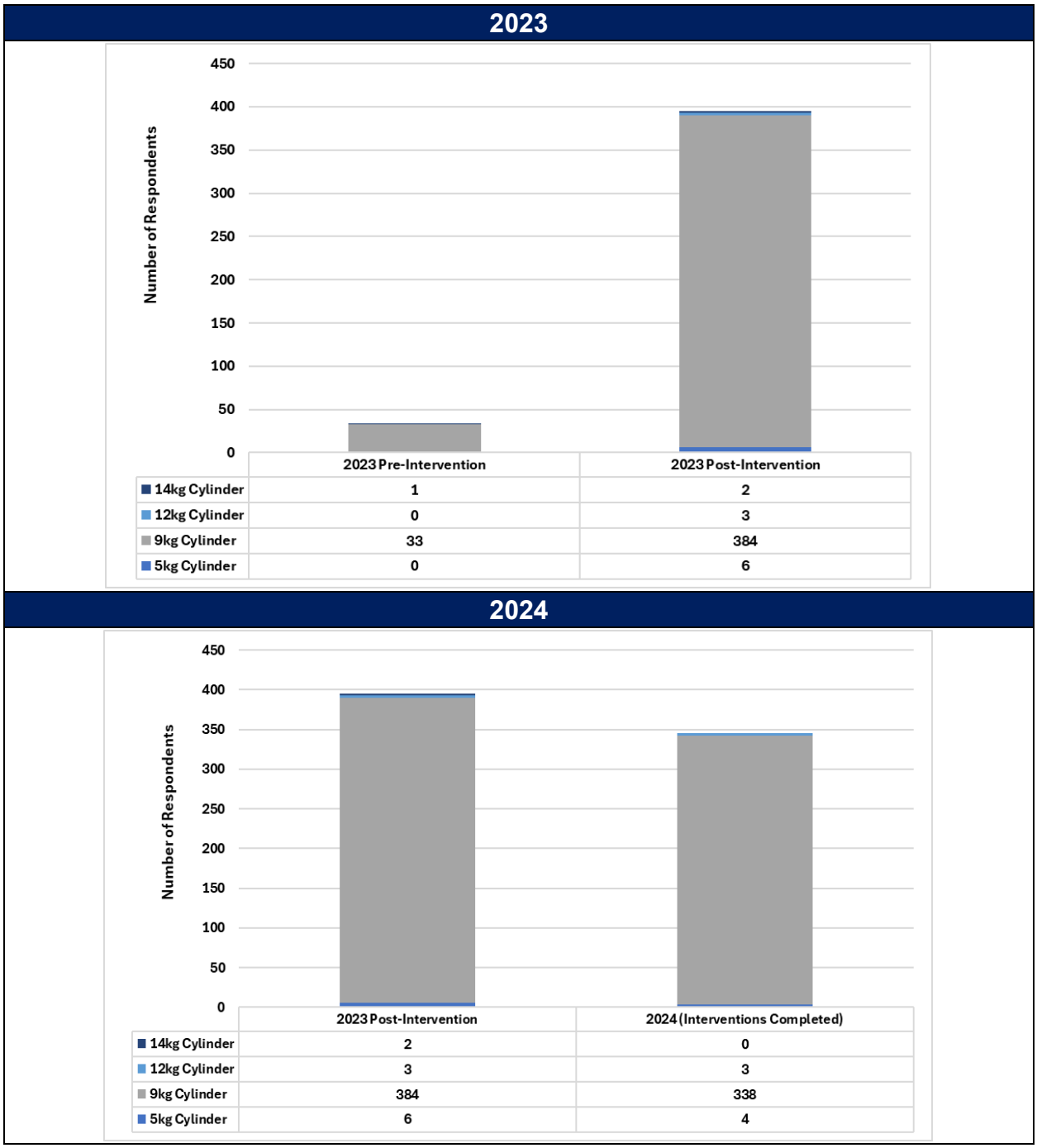

Figure 22: Gas Cylinder use of Respondents in 2023 and 2024.

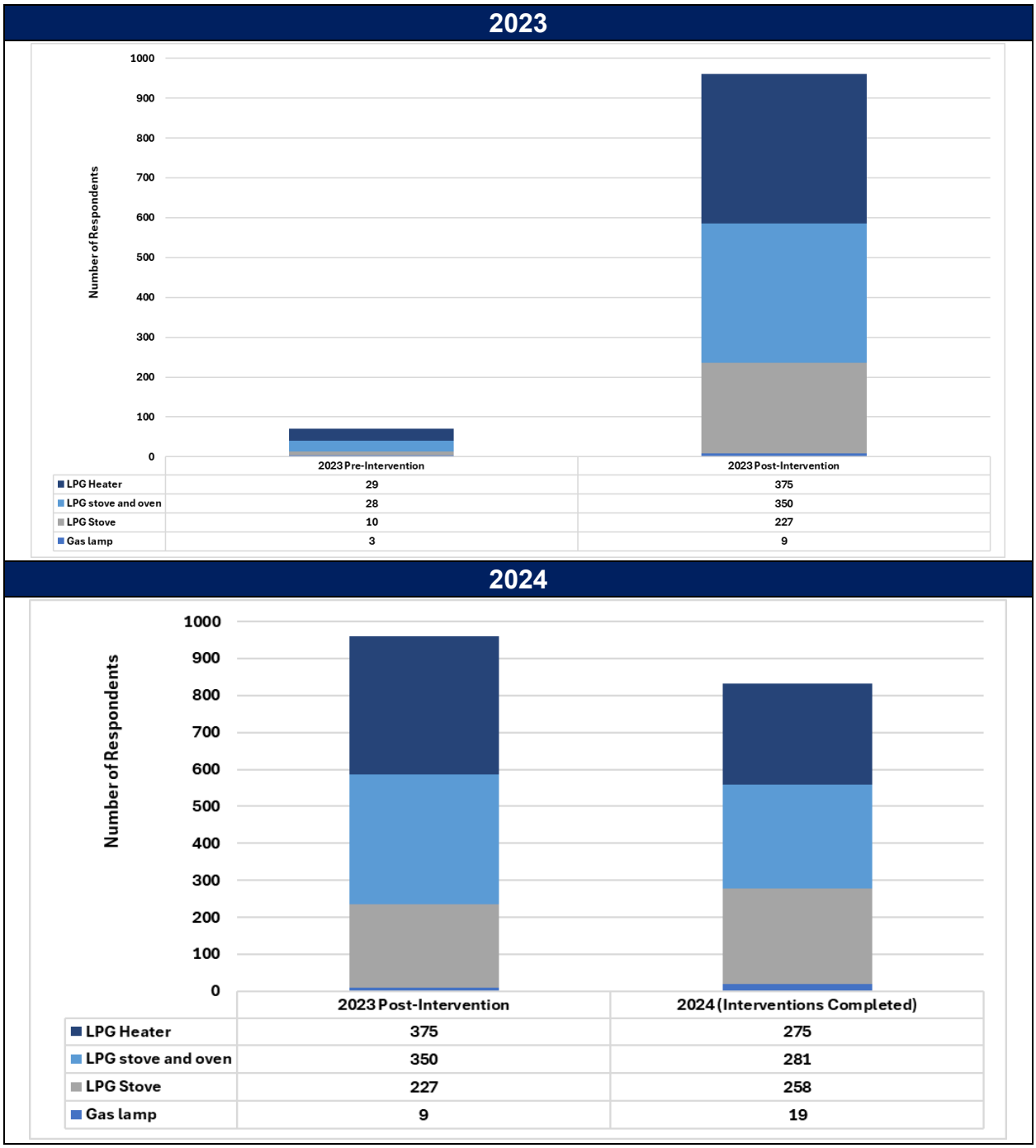

Figure 23: Gas Devices used by Respondents in 2023 and 2024.

3.1.3.4 Firewood

Firewood was more often used than LPG before interventions had been implemented. Firewood is a cheap, easily available fuel source for cooking and heating in eZamokuhle, with respondents indicating that they can collect firewood near their households, or from nearby farms. However, firewood contributes to poor air quality as a result of particulate matter (PM) emissions. Figure 24 indicate that 30.7% of the household's utilised firewood in 2023 pre-interventions. This amount decreased significantly during the post-intervention period of 2024 to 1.57%.

Figure 25 highlights that 6 and 116 households collected and purchased firewood respectively for the 2023 pre-intervention period. For those that gather their firewood, this is sourced mostly from what respondents refer to as the forest, resulting in deforestation and soil erosion which then compounds atmospheric particulate matter through fugitive dust emissions. The 2024 post-intervention period highlighted a reduction to 0 and 6 households gathering and purchasing firewood respectively. This highlights the importance of the LPG intervention and establishment of a reliable LPG source to prevent users regressing to firewood usage.

Figure 26 and Figure 27 illustrates where the households collect, as well as the distance travelled to collect the firewood respectively for the 2023 pre-intervention period.

Figure 28 is indicative of the cost of firewood purchased with 100 households paying more that R 71.00 for firewood during the 2023 pre-intervention period. The number of households reduced significantly to 4 households paying more the R 71.00 for firewood during the 2024 post-intervention period. Figure 29 highlights the amount of days these purchased bundles of firewood lasted for the pre- and post-intervention periods.

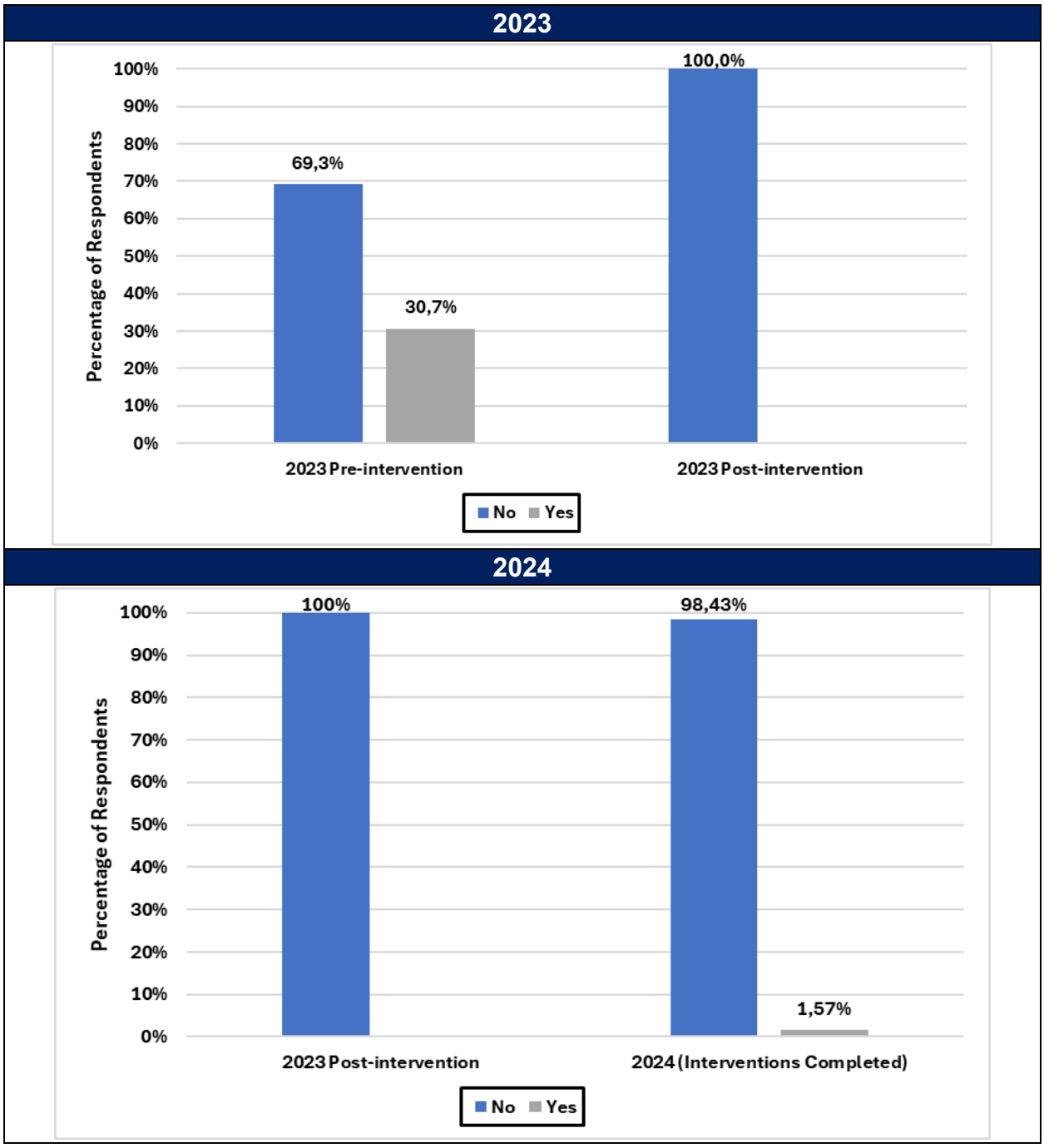

Figure 24: Households that use firewood in eZamokuhle in 2023 and 2024

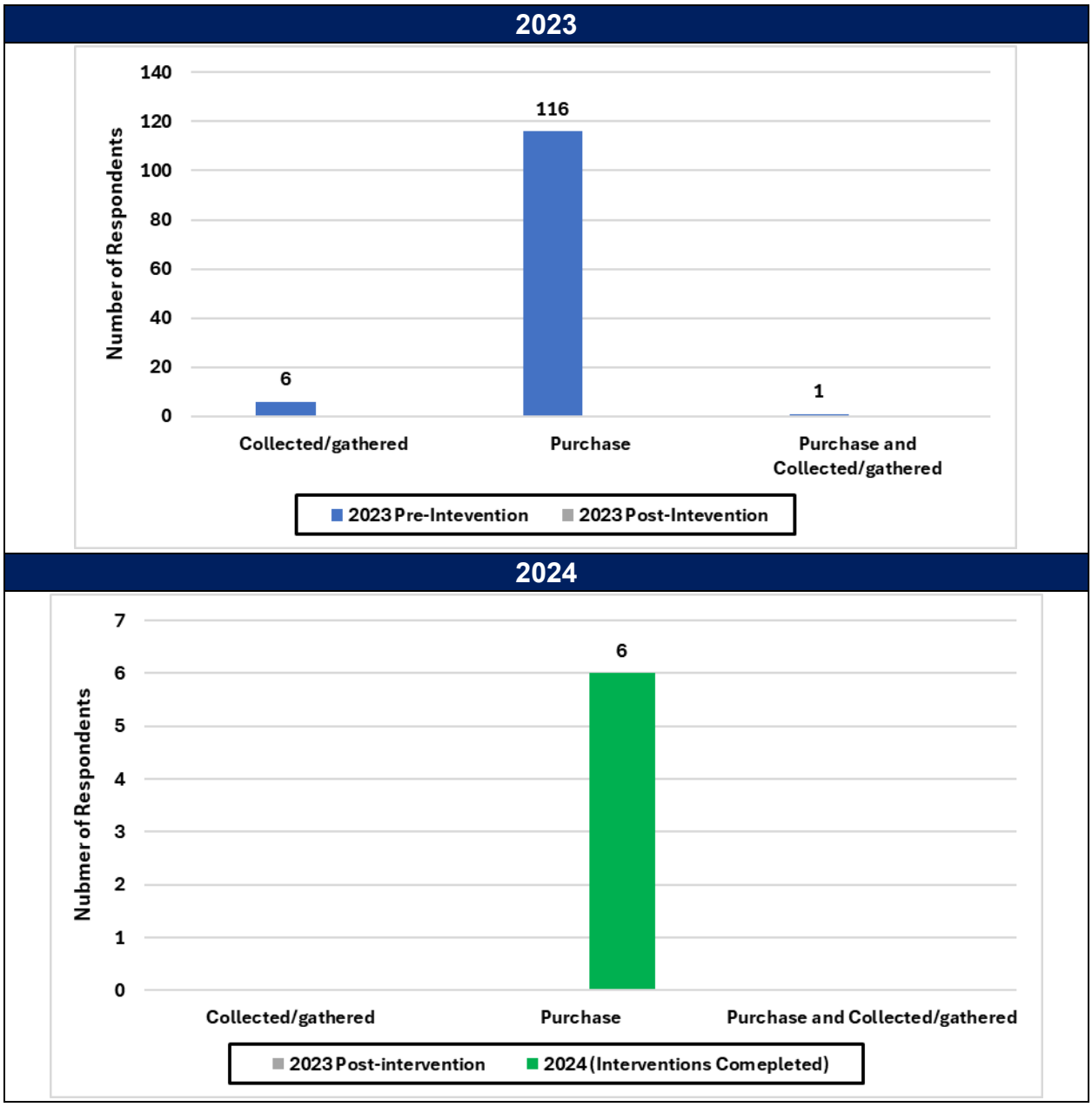

Figure 25: How respondent households obtain firewood in eZamokuhle in 2023 and 2024

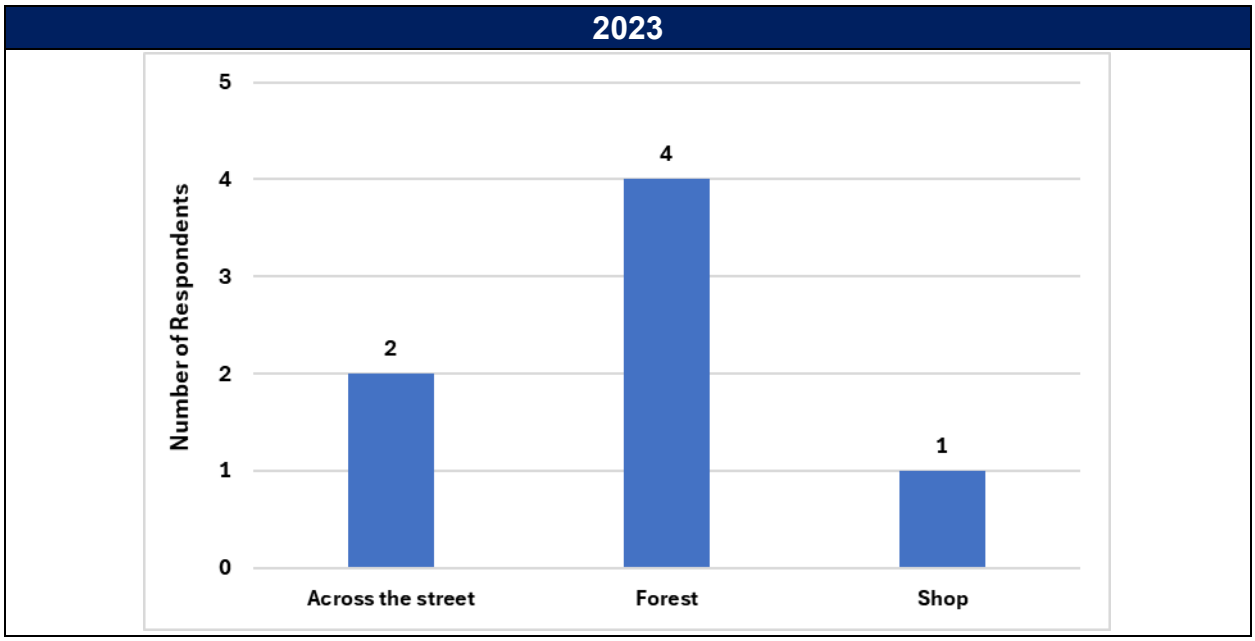

Figure 26: Where respondent households collect firewood in eZamokuhle in 2023

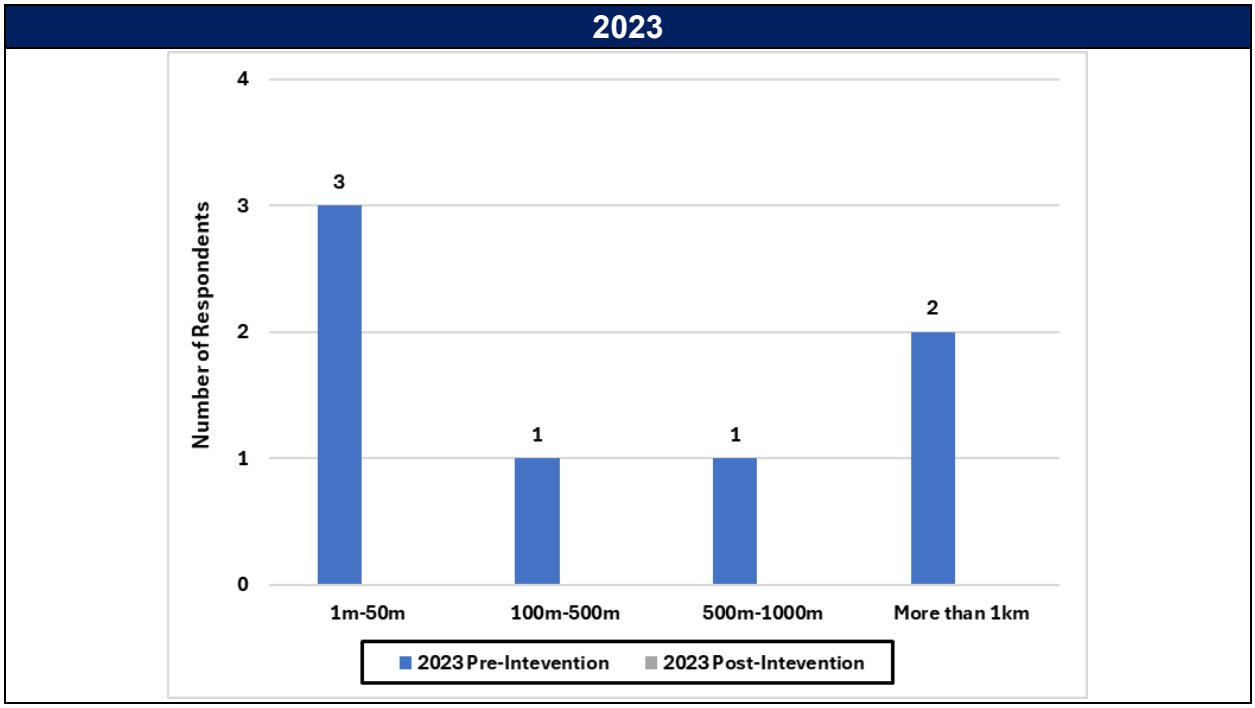

Figure 27: Distance travelled by respondent households to collect firewood in eZamokuhle in 2023.

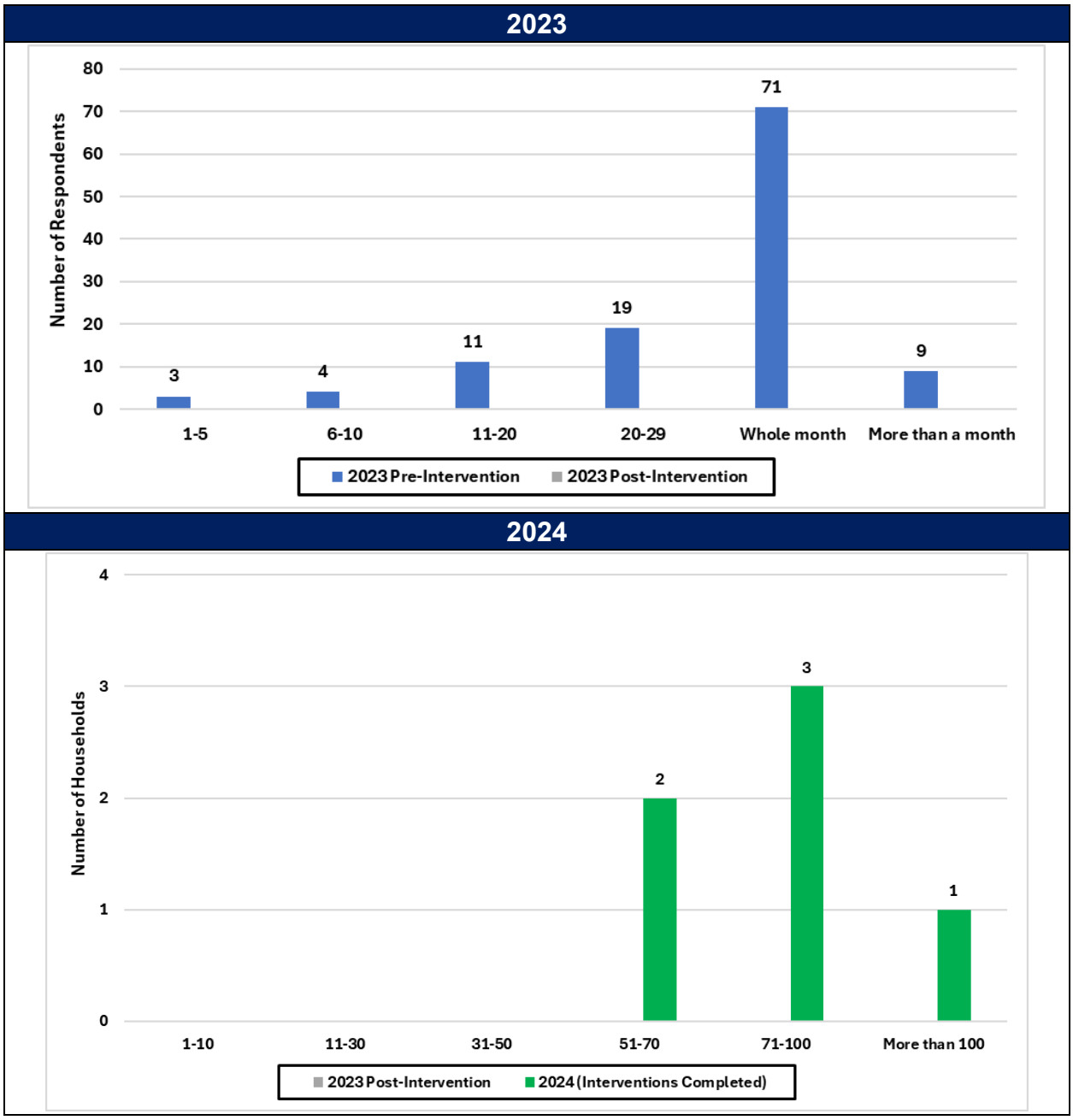

Figure 28: Cost of firewood purchase for respondent households in eZamokuhle in 2023 and 2024

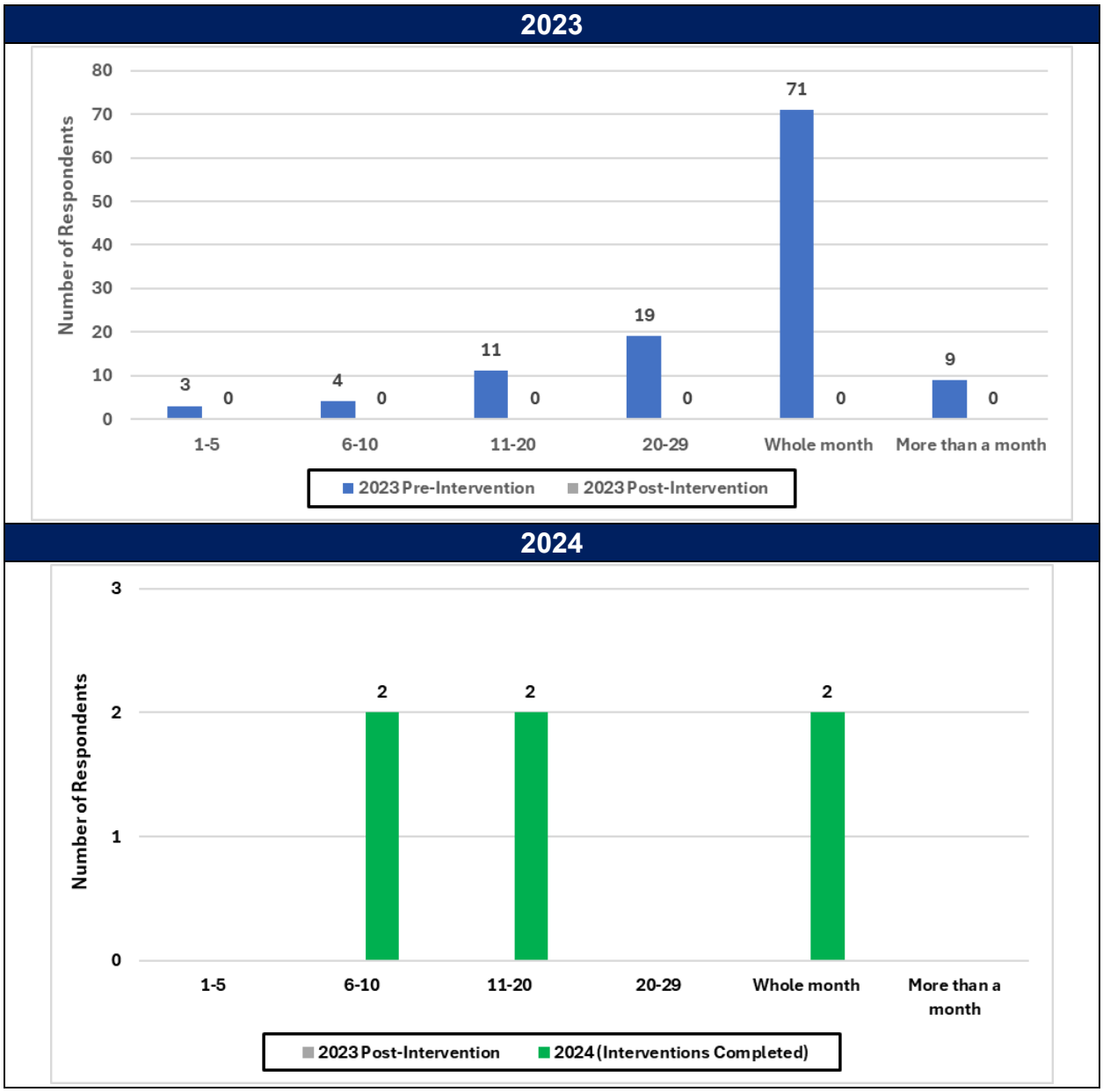

Figure 29: Amount of days bundle of purchased firewood lasted for respondent households in eZamokuhle in 2023 and 2024.

- *3.1.3.5 Use of charcoal*

Only 0.3% of household used charcoal pre-intervention and as a result the data is very limited for the purposes of this analyses (Figure 30). This is probably because coal is more readily available and cheaper than charcoal and households tend to migrate towards coal. For the 2024 post-intervention period an increase is noted to 1.84% of households utilising charcoal.

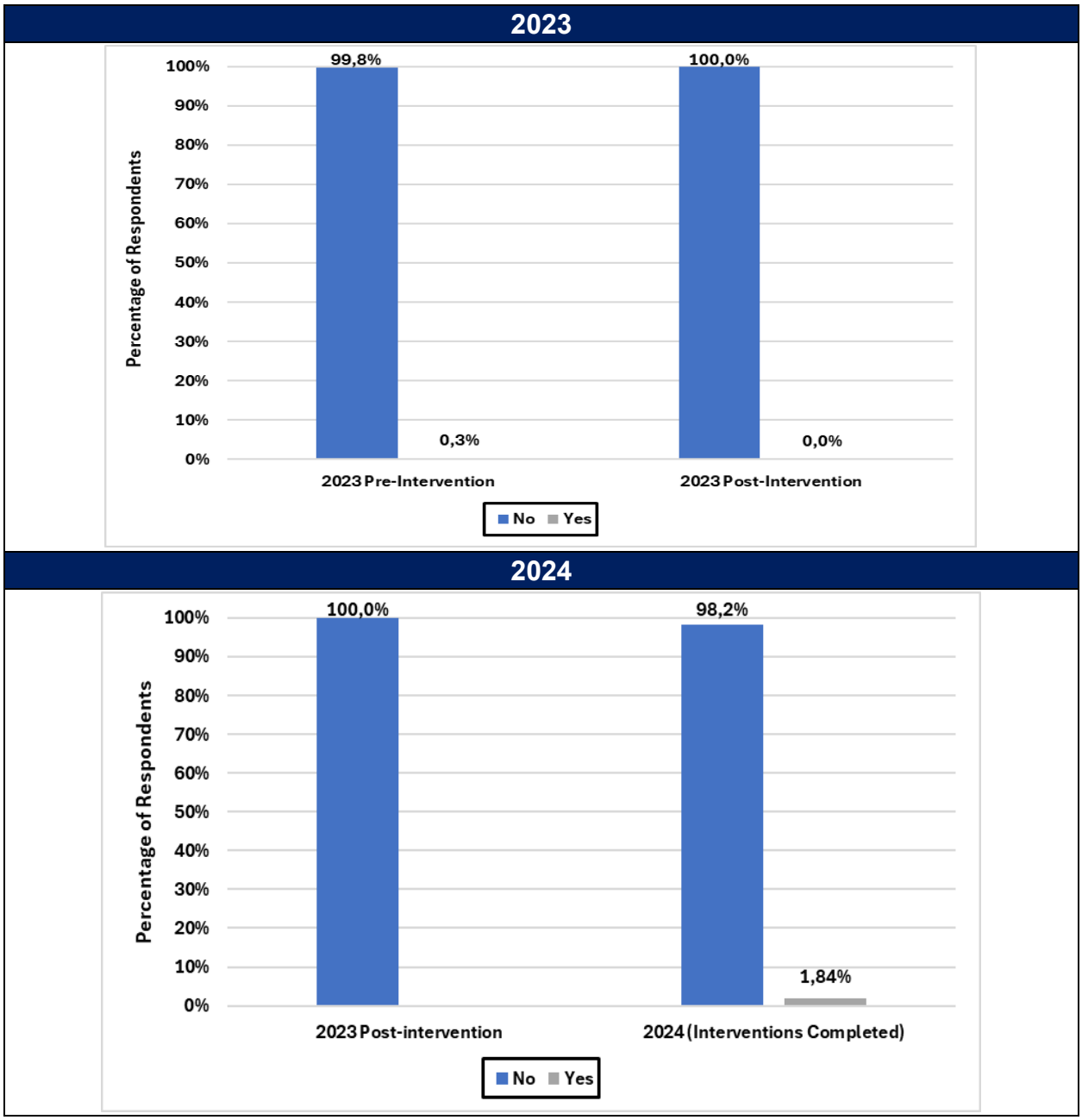

Figure 30: Respondent charcoal use in eZamokuhle in 2023 and 2024

- *3.1.3.6 use of coal*

Of all the fuels used by low-income households, coal has probably the highest pollutant emission potential. Coal combustion significantly elevates gaseous pollutant concentrations in indoor air. Coal is a widely used solid fuel for cooking and heating activities in low-income households, whose incomplete combustion in inefficient household stoves releases a range of gaseous and particulate pollutants.

In the eZamokuhle 2023 household survey, pre-intervention coal use was 85.3% of the households (Figure 31), and the coal is typically sourced within 50 meters of the dwelling (Figure 32), paying more than R100 (Figure 33) for a load of roughly 50 kg and lasting for a month. The 2024 post-intervention dataset highlights a significant reduction of 82.3%. Only 3.15% of the households indicate coal use, whilst the coal is now sourced 500 meters from the dwelling. The coal supplied to the households is provided by multiple sources and is a reliable source of energy to the households (Figure 34).

It should be noted that even though a large majority of the households made the shift to gas and is less reliant on coal, the coal suppliers are still seen as reliable. Hence, if households were to see LPG as a difficult energy source to acquire and maintain, they can easily regress back to coal as the supply chain would still be reliable to use. Substitution and supply chain efficiencies are important to entrench LPG consumption and to dissuade the regression to coal usage.

Figure 31: Respondent households using coal in 2023 and 2024

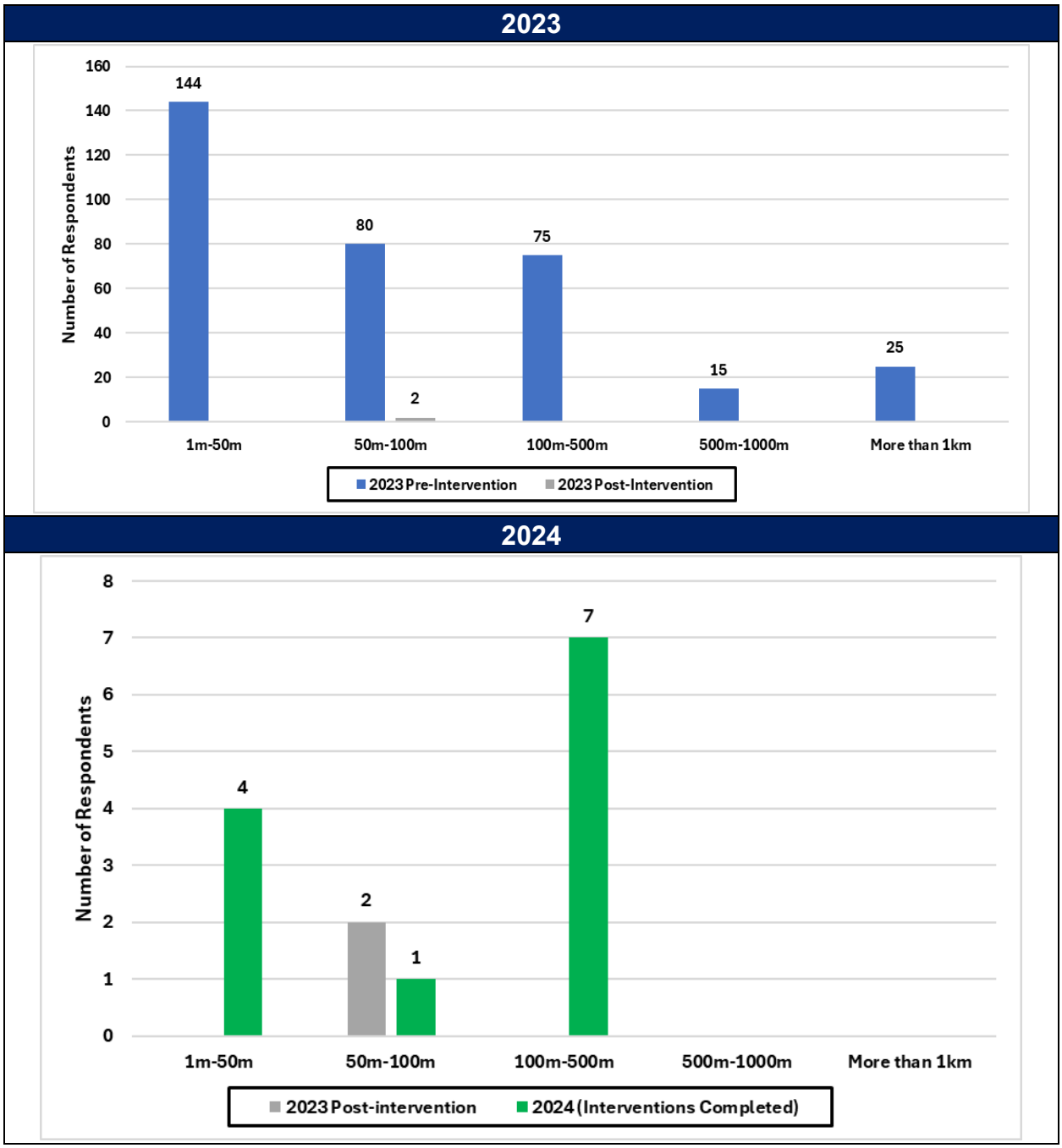

Figure 32: Distance travelled by households to purchase coal in 2023 and 2024.

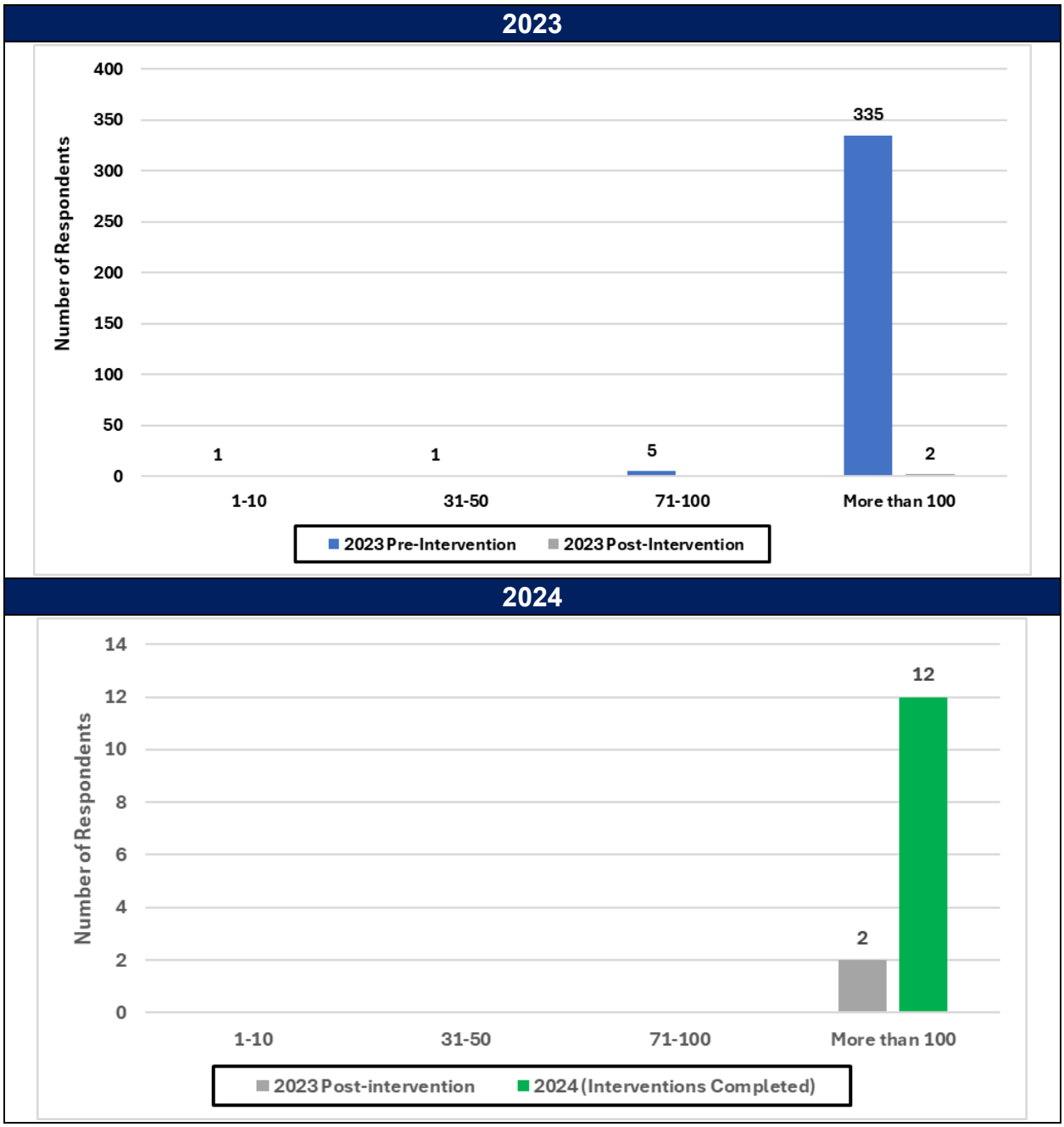

Figure 33: Average cost of coal respondent households pay per month in 2023 and 2024

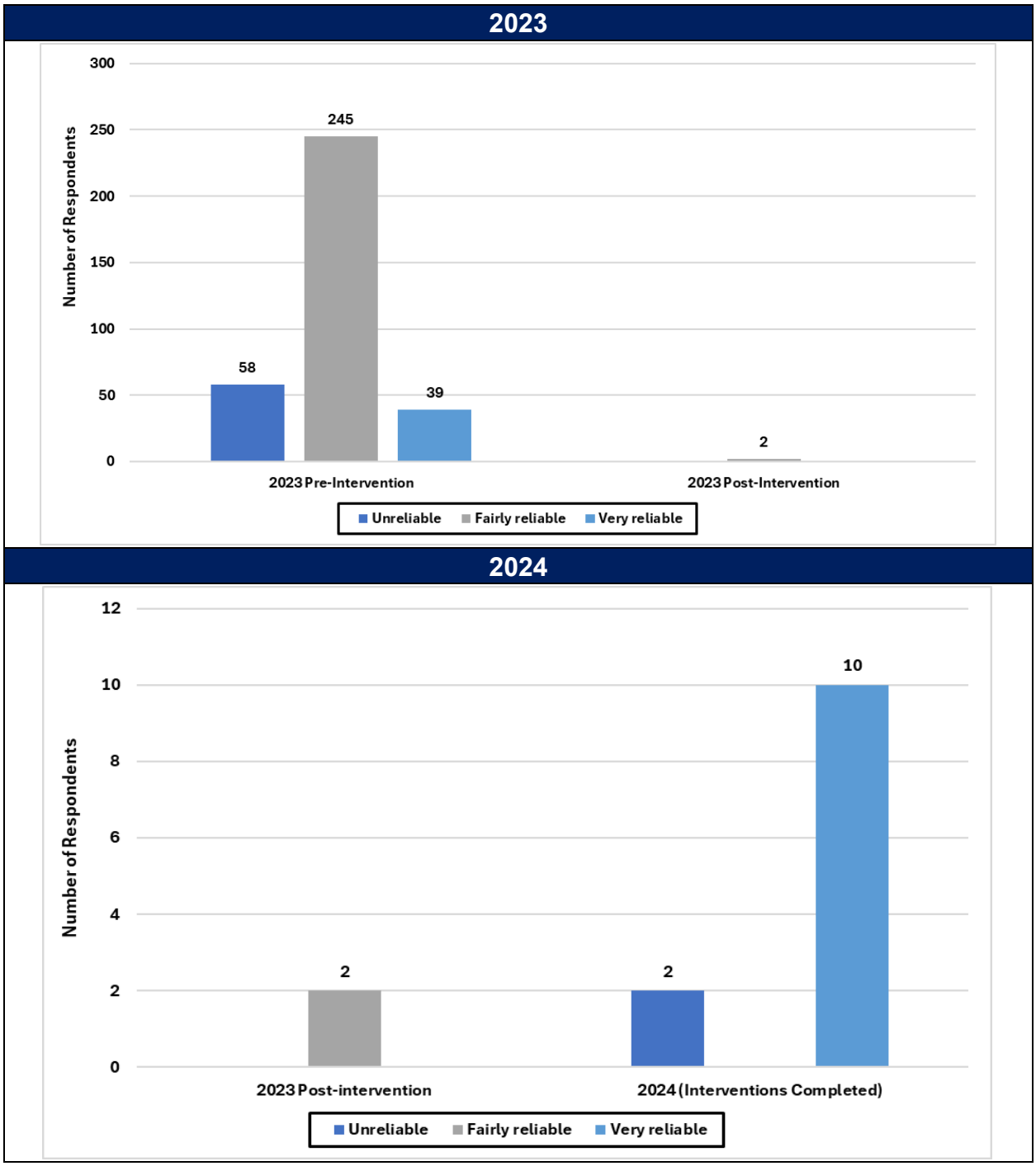

Figure 34: Reliability of respondent household's coal source in 2023 and 2024

3.1.3.7 Animal dung

Only 3.25% of households surveyed during 2023 pre-intervention period indicated the utilisation of animal dung as an energy source in eZamokuhle (Figure 35). It was reported that the collection of dung to place between 3 to 5 times a week. A reduction of reported dung users was reported for the 2024 post-intervention period to 0.79%.

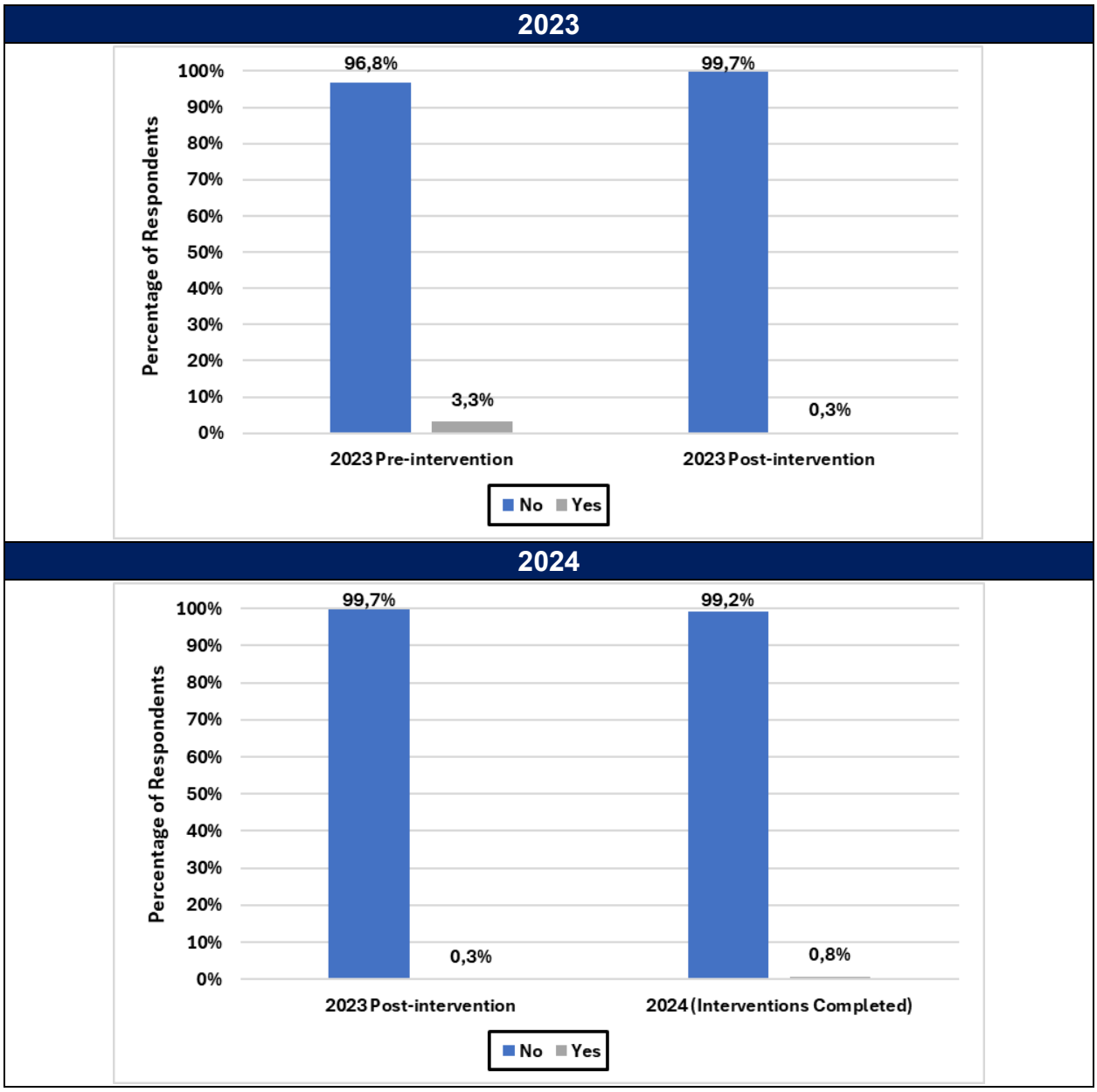

Figure 35: Respondent households using animal dung in 2023 and 2024.

- *3.1.3.8 A comparison of the energy mix across household income levels*

A comparison of the different fuel types used by the respondents across the different income levels for the 2023 pre-intervention and 2024 post-intervention period (Figure 36) indicates:
Electricity is the dominant fuel type; however availability (load-shedding) and utilisation is moderate as only 65% of respondents indicated that they utilise electricity continuously throughout the year (**Figure 16**)

- Candles are utilised across all income levels in terms of load-shedding situations as the preferred lighting solution and stays consistent post-intervention,
- Whilst LPG is utilised in small amounts by the households with a lower income, it seems that there is a large increase in LPG use associated with the households that have a higher income threshold (> R20 000) and in the R1-R400 income bracket. With the introduction of the interventions in the households, there is a substantial increase in LPG use across the income levels (Figure 23).
- The usage of both firewood and coal plays a dominant role as part of the energy mix for the household's pre-intervention, but we observe a significant reduction in use after the interventions have been implemented in the households (Figure 24 and Figure 31). Conversely, both animal dung and charcoal play an insignificant role

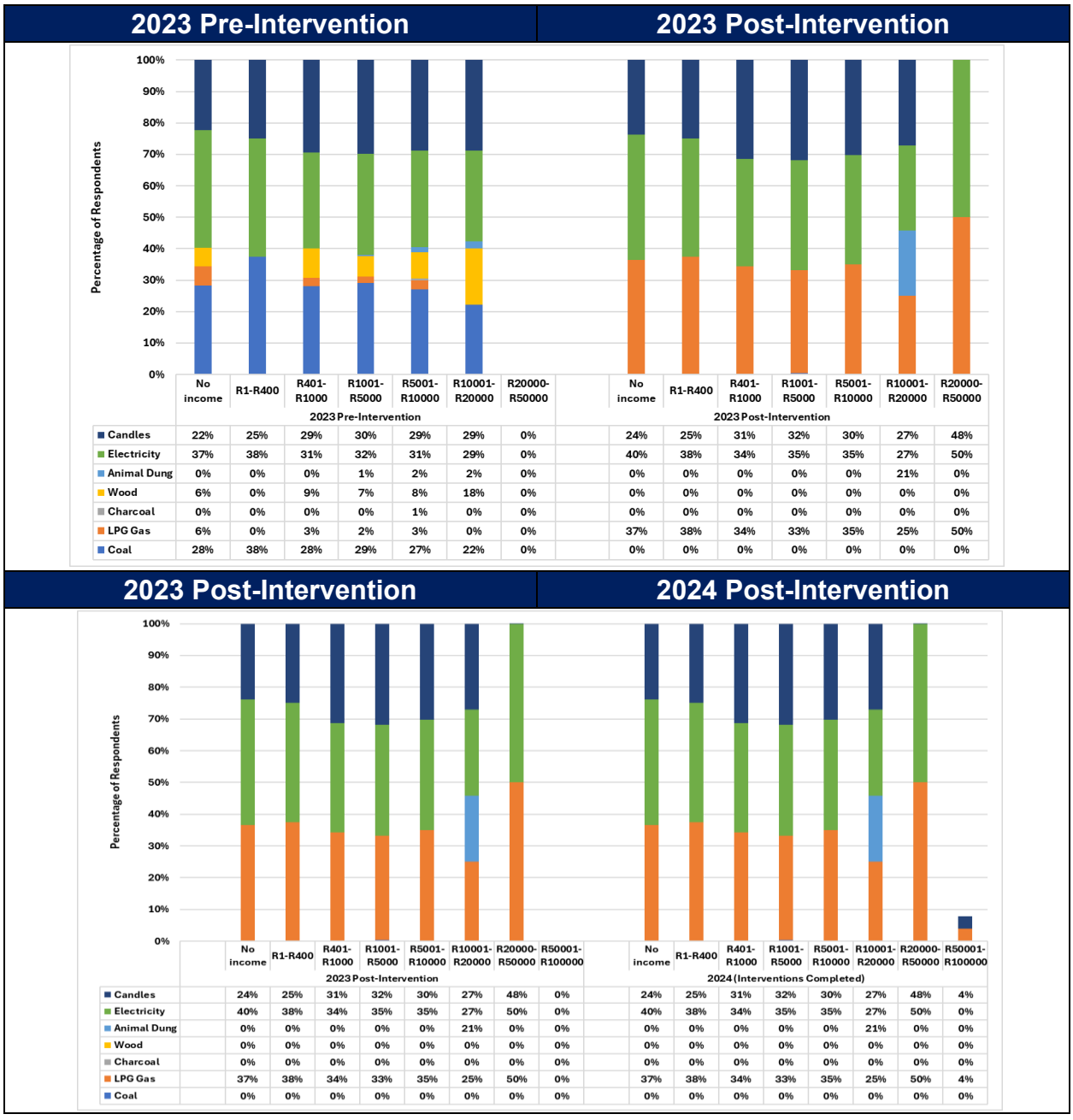

Figure 36: Energy mix across the different household income levels for eZamokuhle in 2023 and 2024

3.1.4 Cooking, Space Heating & Lighting

Electricity is used predominantly for cooking, heating and lighting (Figure 37 to Figure 39). Figure 37 is indicative of energy use for cooking. Figure 37 illustrates a 44.2% electricity, 39.6% coal, 12.9% firewood and 1.5% LPG usage for 2023 pre-interventions. The 2024 survey (after the interventions were completed) indicates an increase of energy use for cooking to 48.8% for electricity and 46.6% for LPG, whilst a significant reduction of coal and firewood usage to 2.0% and 0.9% respectively. This significant reduction of coal (37.6%) and wood (12.0%) usage for cooking will have a significant contribution towards improving the ambient air quality in the region.

Figure 38 illustrates the energy use for space heating. Figure 38 indicate a 44.2% electricity, 40.8% coal, 10.9% firewood and 2.5% LPG usage for 2023 pre-interventions. The 2024 survey (after the interventions were completed) indicates an increase of energy use for space heating to 54.1% for electricity and 48.5% for LPG, whilst a significant reduction of coal and firewood usage to 2.4% and 1.4% respectively. This reduction of coal (38.4%) and wood (9.5%) usage for space heating will add to the improvements of air quality materialised for cooking.

Figure 39 is indicative of energy use for lighting. Figure 13 illustrates a 56.4% electricity and 41.4% candle usage for 2023 pre-interventions. The 2024 survey (after the interventions were completed) indicates a slight decrease of energy use for lighting to 53.3% for electricity and 37.7% for candle usage respectively. A significant increase in LPG usage for lighting from 0.3% to 7.4% is indicative in 2024.

Also worth mentioning is that more than half the households (68%) use electricity for lighting, supplementing the use of candles as an alternative source of light during 2023. This number increased to 93.1% households utilising candles as an alternative in 2024.

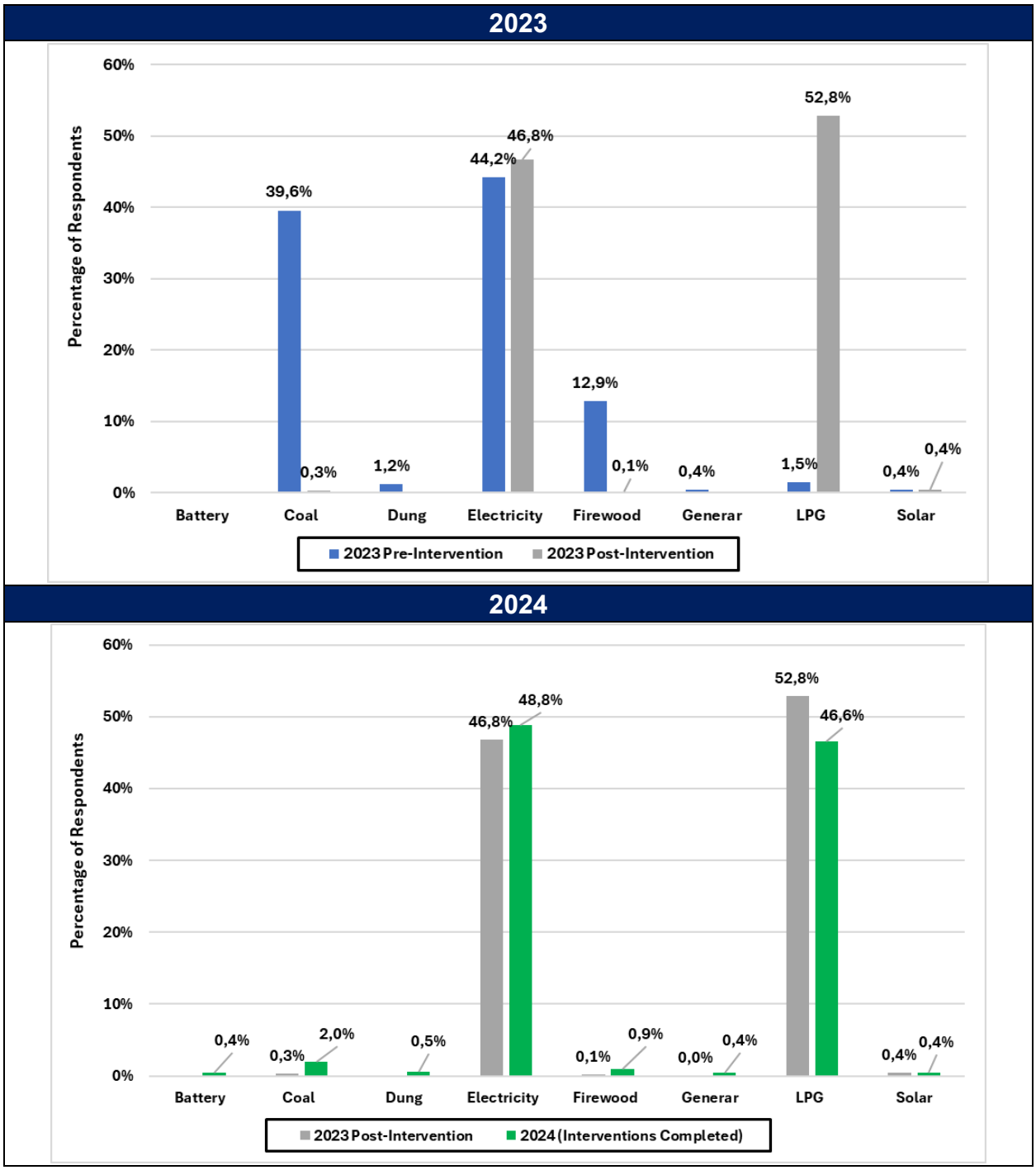

Figure 37: Household energy use for Cooking in 2023 and 2024

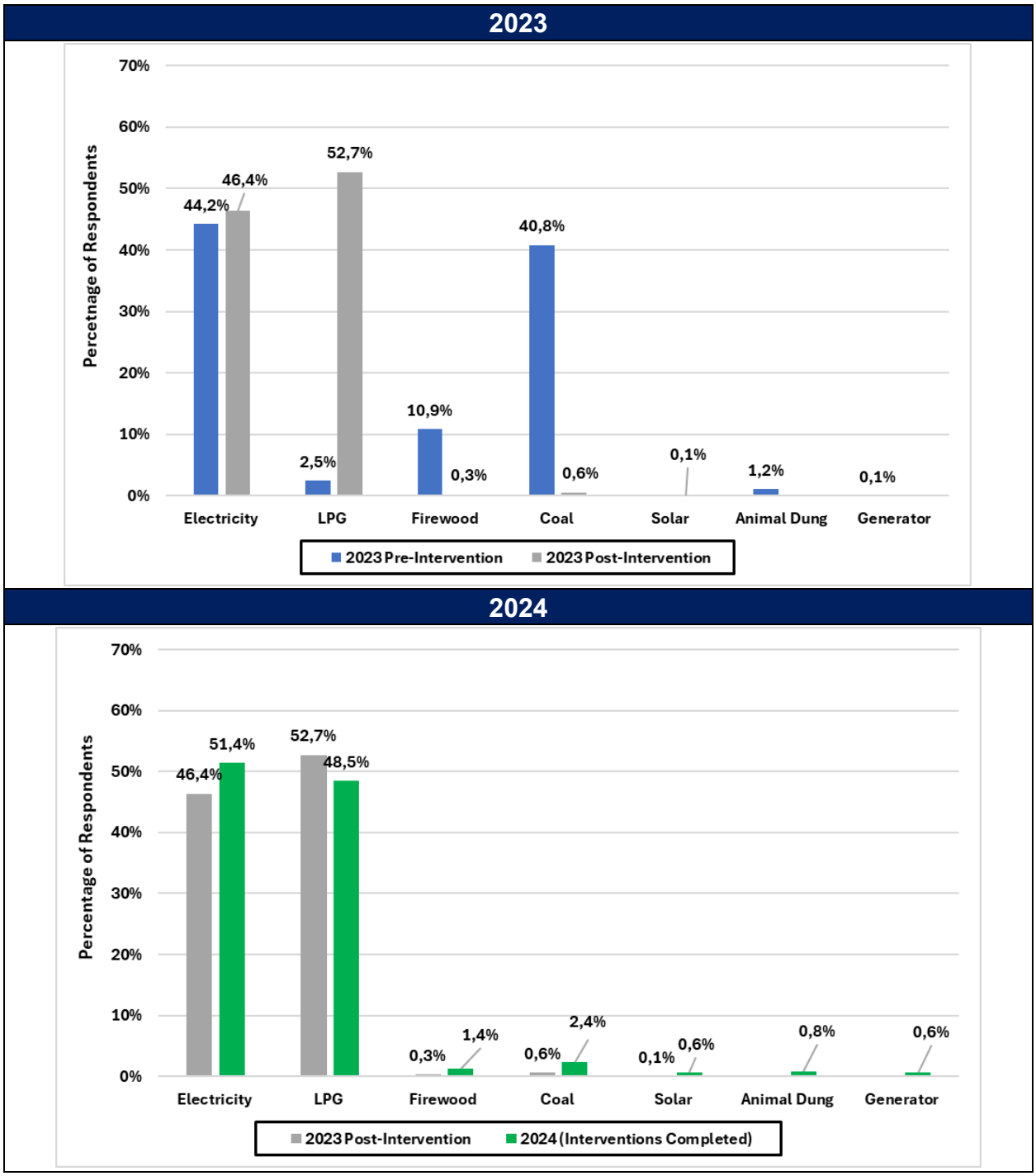

Figure 38: Household energy use for Space Heating in 2023 and 2024

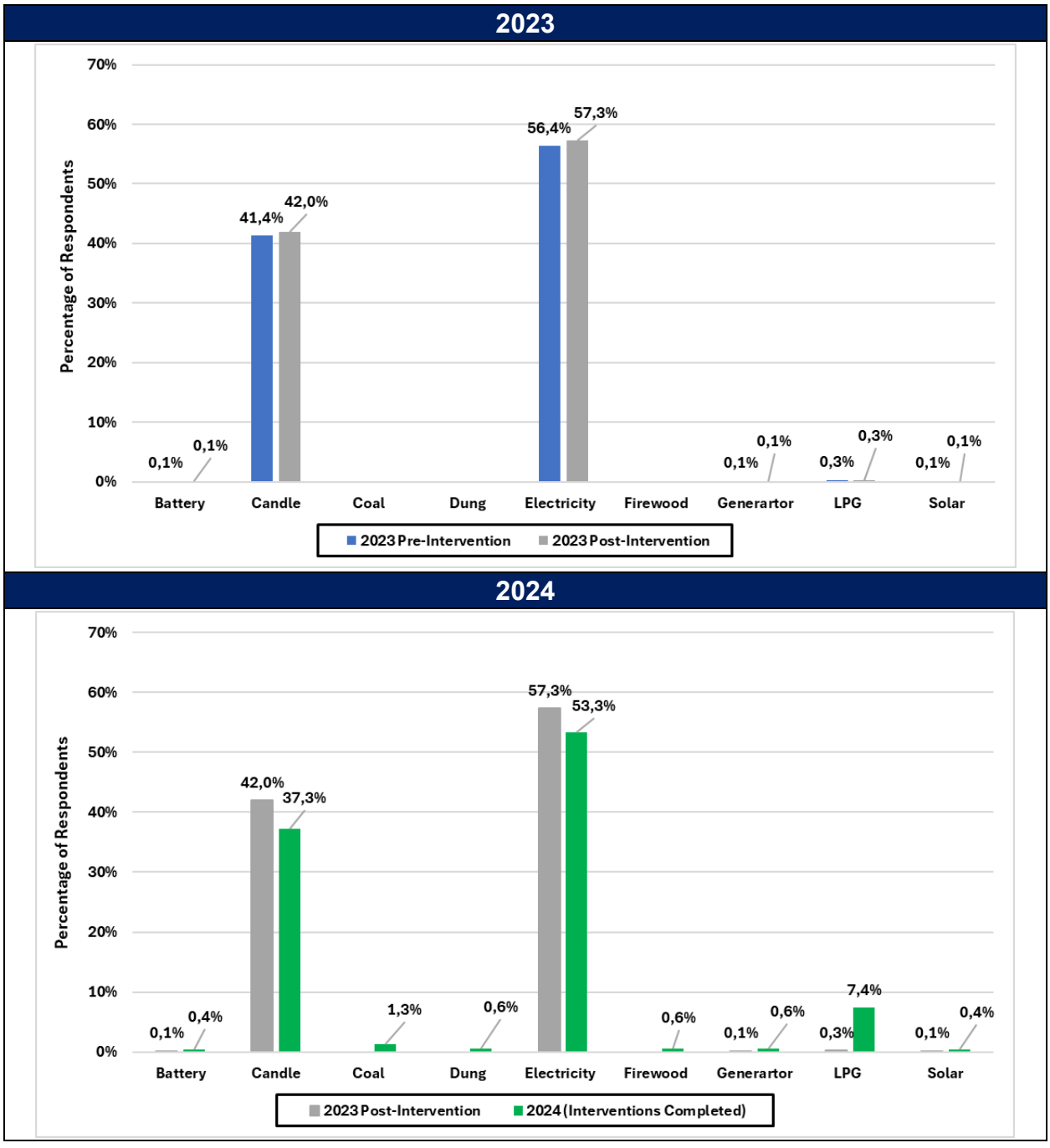

Figure 39: Household energy use for Lighting in 2023 and 2024

Cooking

Use of inefficient cooking appliances increases the risk of gaseous and particulate pollutant emissions and subsequently poor indoor air quality. From the 2023 pre-intervention household survey in eZamokuhle, 24.8% of the households used a traditional stove, 58.5% households and 11.5% used an electric stove (Figure 40). These figures drastically changed after the 2024 offset project interventions, with 12.4% of households utilising a gas stove from 0.8%; 3.0% of households utilizing the hybrid stove to 70% of household utilising a hybrid stove in 2024, and only 0.3% still using a traditional stove (Figure 40). Most homes have only one window in the cooking area using predominantly either electricity, coal or firewood. With poor ventilation, exposure to indoor air pollution is exacerbated.

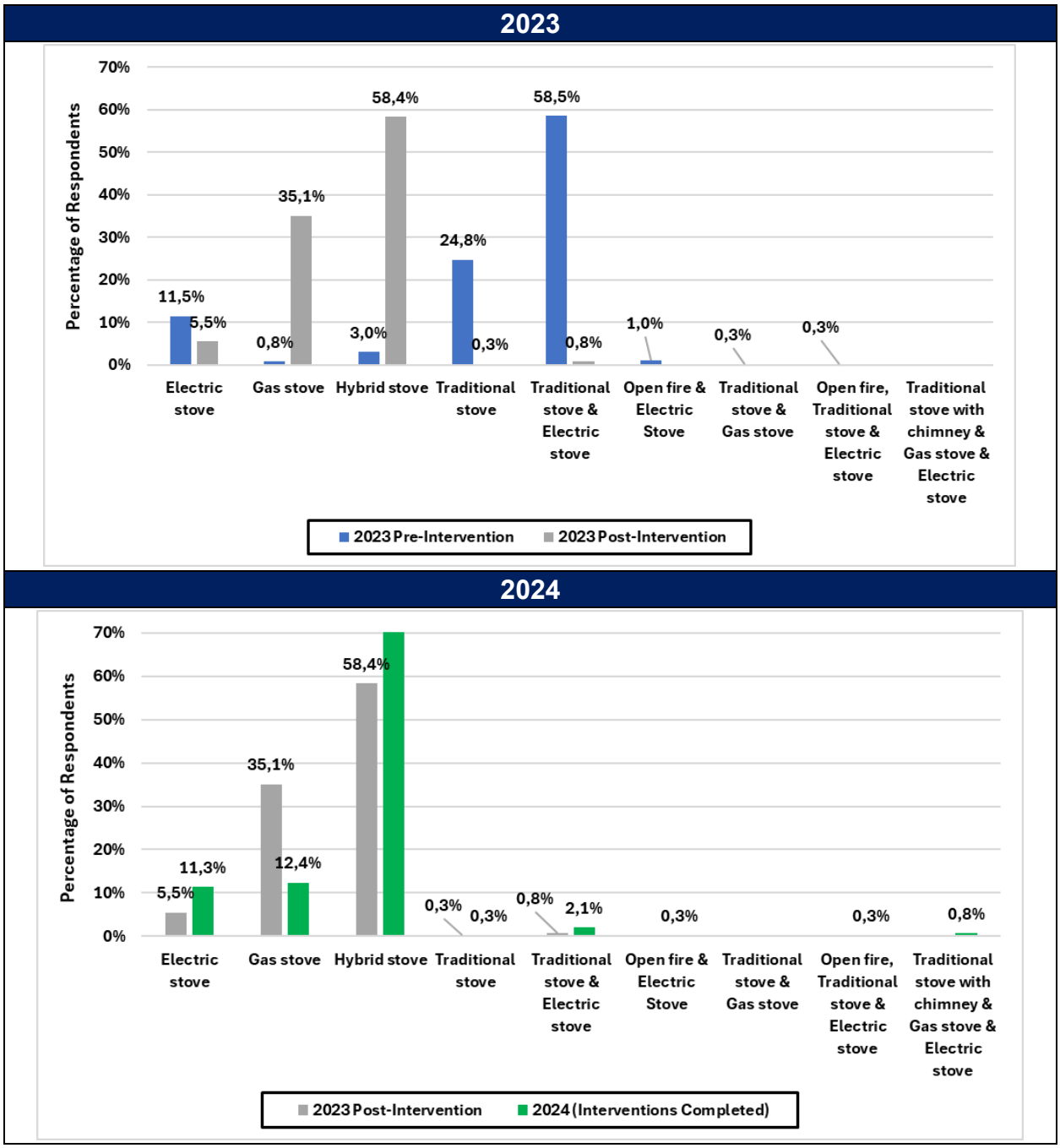

Figure 40: Stove Tyes Used by Respondents to Cook in 2023 and 2024

3.1.5 Quality of Life

The household survey also determined the quality of life in the affected community in eZamokuhle. We utilised the conceptual framework of "*Fundamental human needs and human-scale development*" (Figure 41) to qualitatively determine the quality of life for the households at eZamokuhle. In this system, there is no hierarchy of needs (apart from the basic need for subsistence or survival) as postulated by Western psychologists such as Maslow, rather, simultaneity, complementarity and trade-offs are features of the process of needs satisfaction. Manfred Max-Neef and his colleagues developed a taxonomy of human needs and a process by which communities can identify their "wealth's" and "poverties" according to how their fundamental human needs are satisfied. The following metrics of health, well-being, education, standard of living, safety and security and air quality was utilised herein.

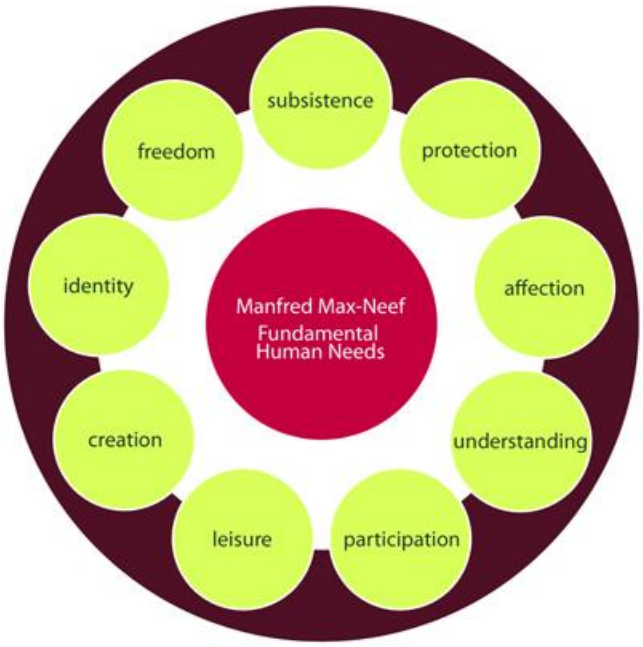

Figure 41: Manfred Max-Neef Fundamental Human Needs

3.1.5.1 HEALTH

One of the key challenges noted in the sustainable development goals for good health and wellbeing (SDGs 3) is both ambient and household air pollution. Household solid fuel combustion represents one of the biggest threats to human health in South Africa. In the 2023 pre-intervention survey for eZamokuhle, 73.8% of the respondents indicated an overall satisfaction with their overall health, only 5.6% felt dissatisfied, whilst 20.8% remained neutral (Figure 42). The 2024 post-intervention survey revealed that 75.2% of the respondents indicated an overall satisfaction with their overall health, only 7.76% felt dissatisfied, whilst 17.2% remained neutral.

Often chronic respiratory cardio- and cerebrovascular morbidity and mortality because of air pollution may be masked as acute effects like asthma exacerbation, skin and eye irritation. For the 2023 pre-intervention phase of the project, eye diseases or irritation was reported by 47.6% of households with varying degrees of severity (Figure 43) while 52.4% of households did not report any problems. The 2024 post-intervention survey revealed a slight increase to 53.9% of households experiencing eye disease or irritation with varying degrees of severity, whilst 46.5% of households did not report any problems.

Cough was reported as a slightly more common occurrence during 2023; 67.8% and 32% never experienced coughs, whilst in 2024 Additionally, it is important to note that the respondents in 2023 indicated that ~53% of the households are non-smoking (Figure 44). This precludes smoking as a contributor or confounding factor to respiratory diseases for these households. For the smoking households 47%, 58% had one smoker whilst the remainder of these households had two or more smokers. It is important to note that the respondent figures did not change significantly between the two project periods due to the short time frame.

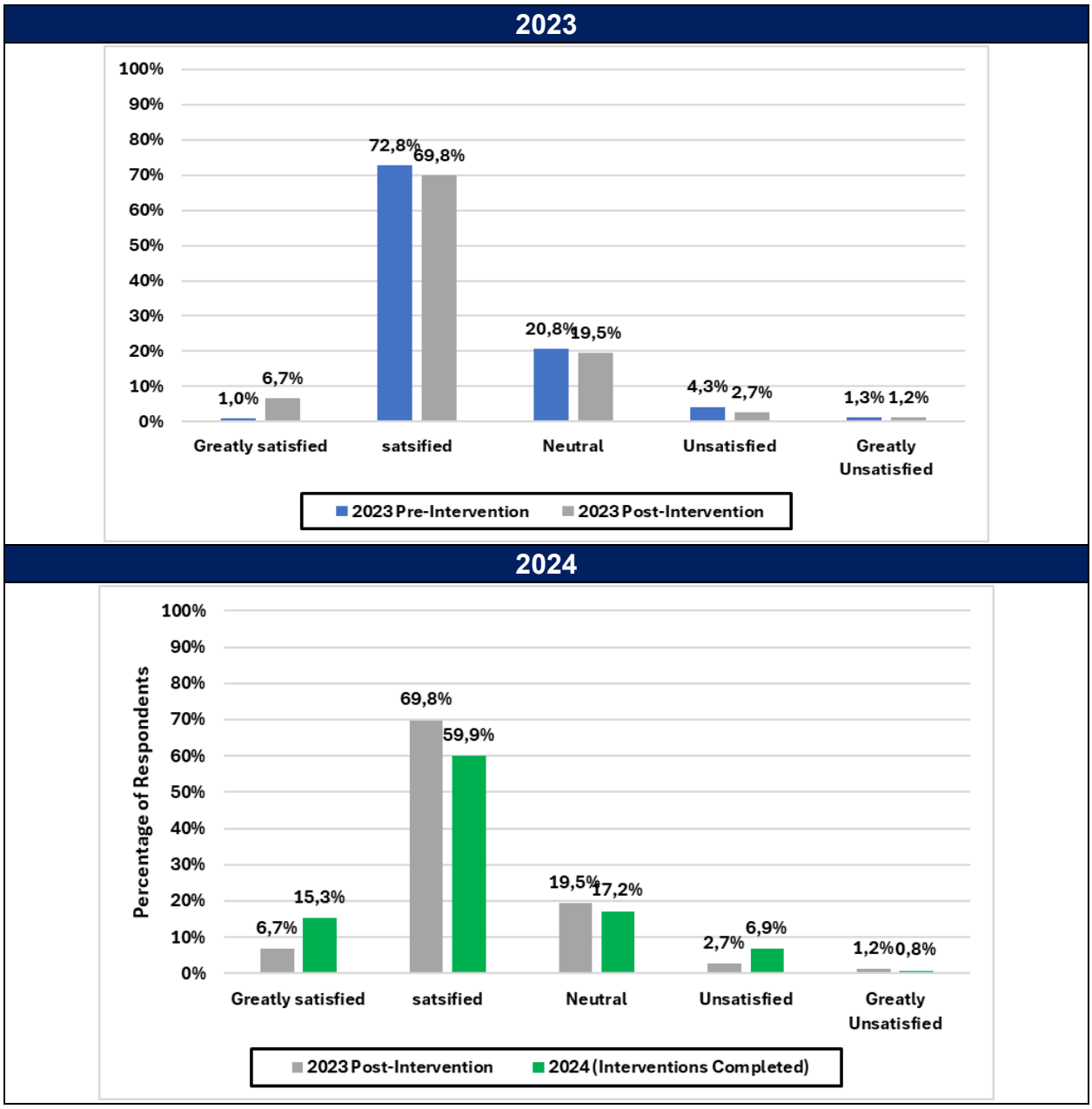

Figure 42: Respondents Satisfaction with Health in 2023 and 2024

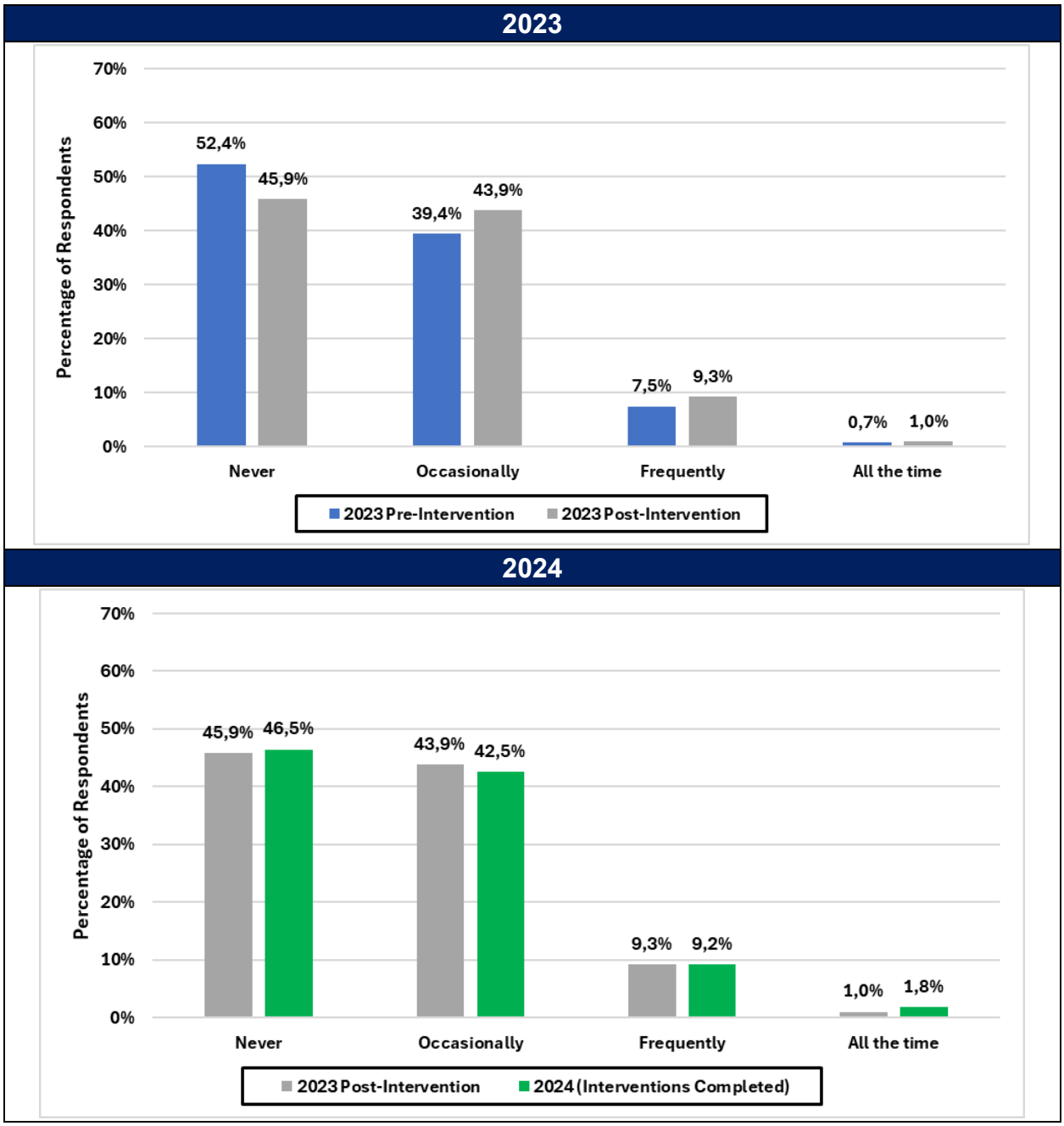

Figure 43: Frequency of Respondent Household members Experiencing Eye Disease or Irritation in 2023 and 2024

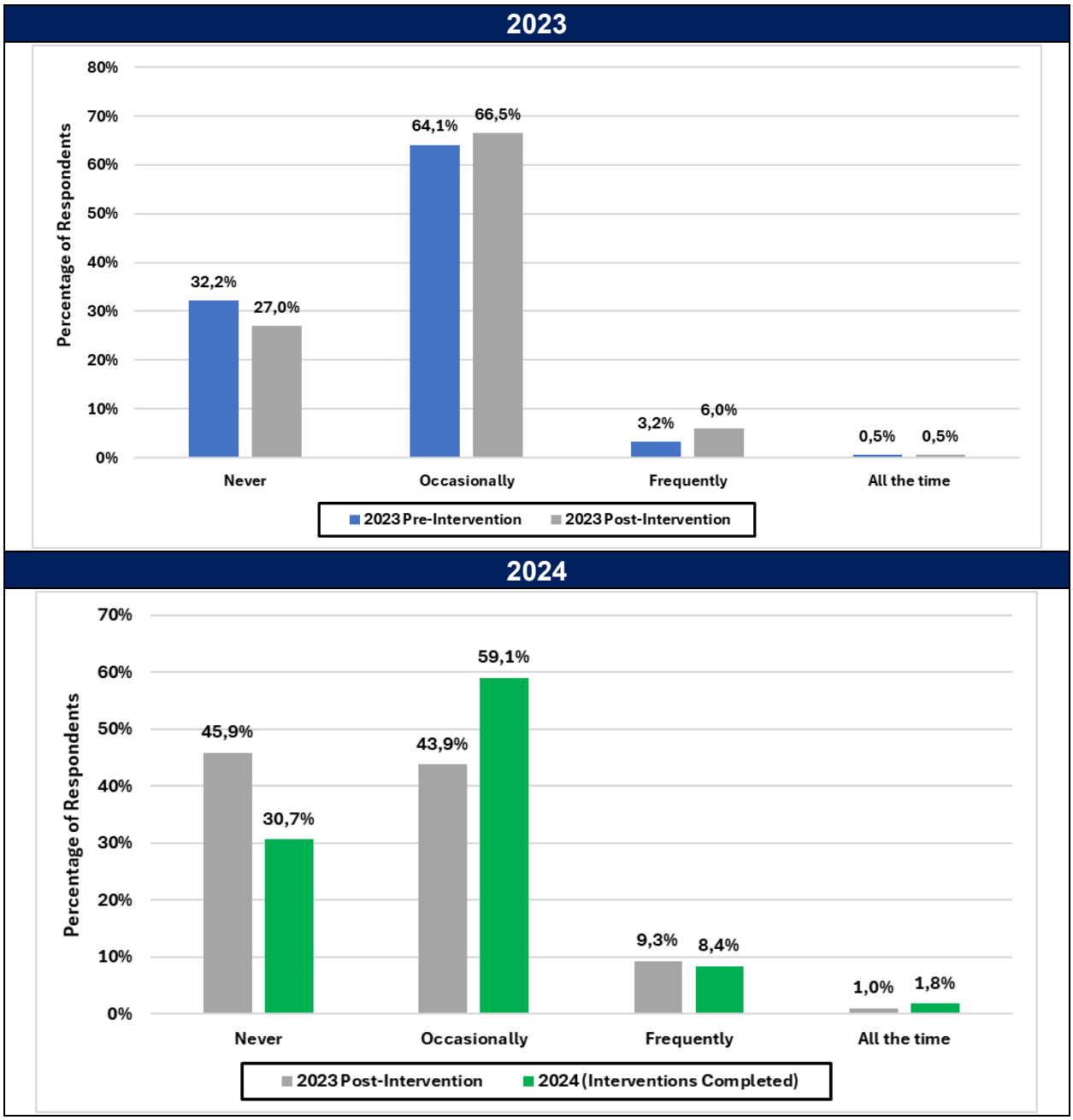

Figure 44: Frequency of Respondent Household members an illness with a cough in 2023 and 2024

3.1.5.2 WELLBEING

According to Stats SA, in 2023, income from wages and salaries (53%) and from social grants (23%) were the most common source of income for households, followed by remittances (9.6%) and income from a business (10%) across all sectors.

Comparatively, for eZamokuhle, most households (71.2%) earn reliable incomes of above R400 the 2023 survey, whilst a slight reduction to 69.0% is noted for the post-intervention 2024 survey The income is mainly through pensions or grants with few inhabitants employed (Figure 45). Fruit and vegetables are not grown nor sold on properties except for a few exceptions. This is reflective of the national norm with high unemployment rates and reliance on the basic income grants. Generally, in eZamokuhle there isn't enough disposable income left over for energy purchases, and therefore energy stacking becomes significant. This factor can influence the viability and sustainability of wide-scale LPG adoption in eZamokuhle for the Eskom AQO Project.

Income is an indicator of available disposable income. For low-income households, generally there isn't enough disposable income left over for energy purchases, and therefore energy stacking becomes significant.

3.1.5.3 EDUCATION

Basic and higher education are important levers for households to break the cycles of poverty and improve socio-economic circumstances. The bulk of respondents and breadwinners have a Grade 8-Matric qualification for the 2023 pre-intervention survey (Figure 46 , Figure 47, Figure 48), whilst the same trend is indicated during the 2024 post-intervention survey. Seen simplistically, it will be a challenge for most respondents to break the cycle of their current socio-economic circumstance.

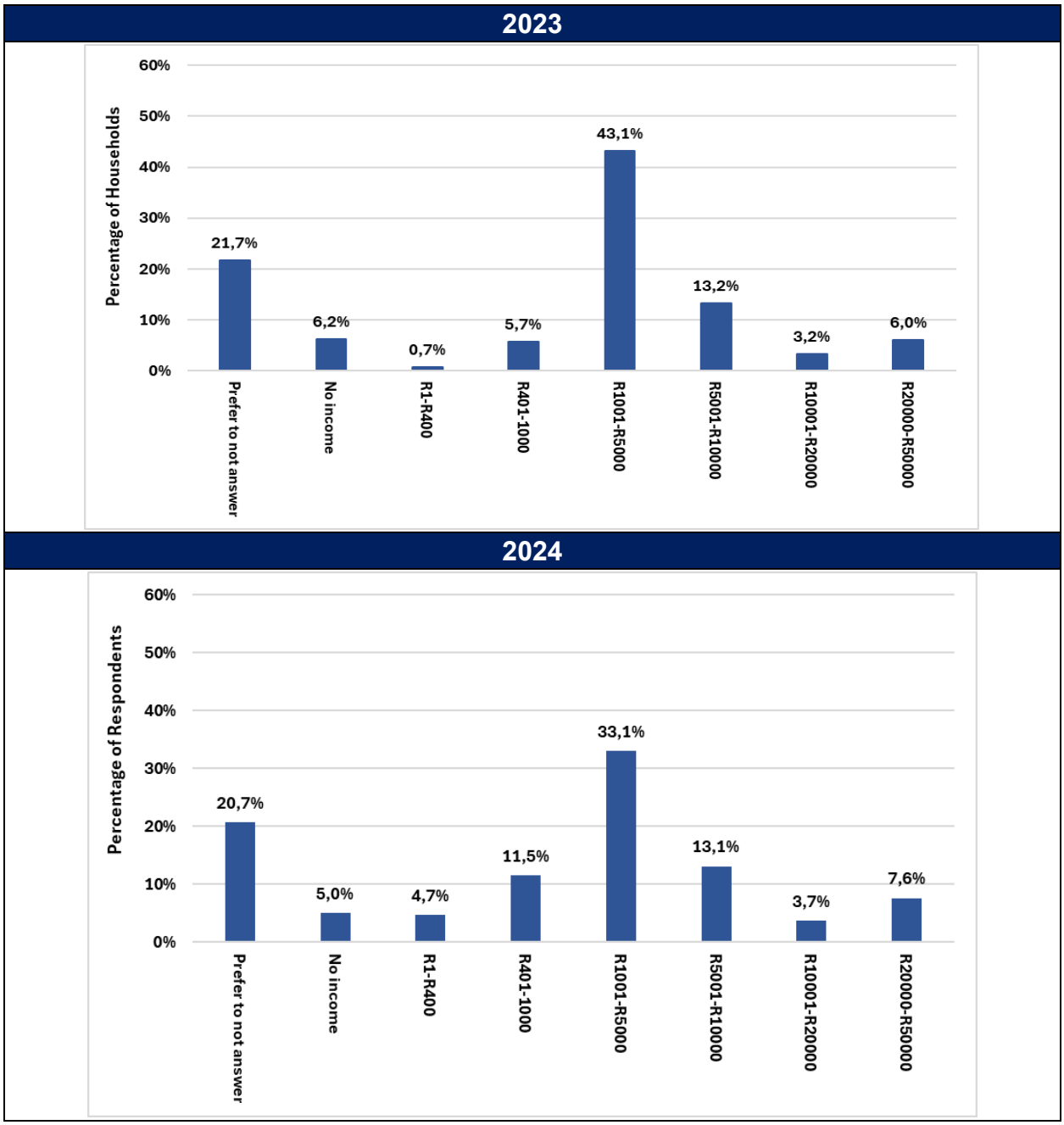

Figure 45: Respondent household Monthly income in 2023 and 2024

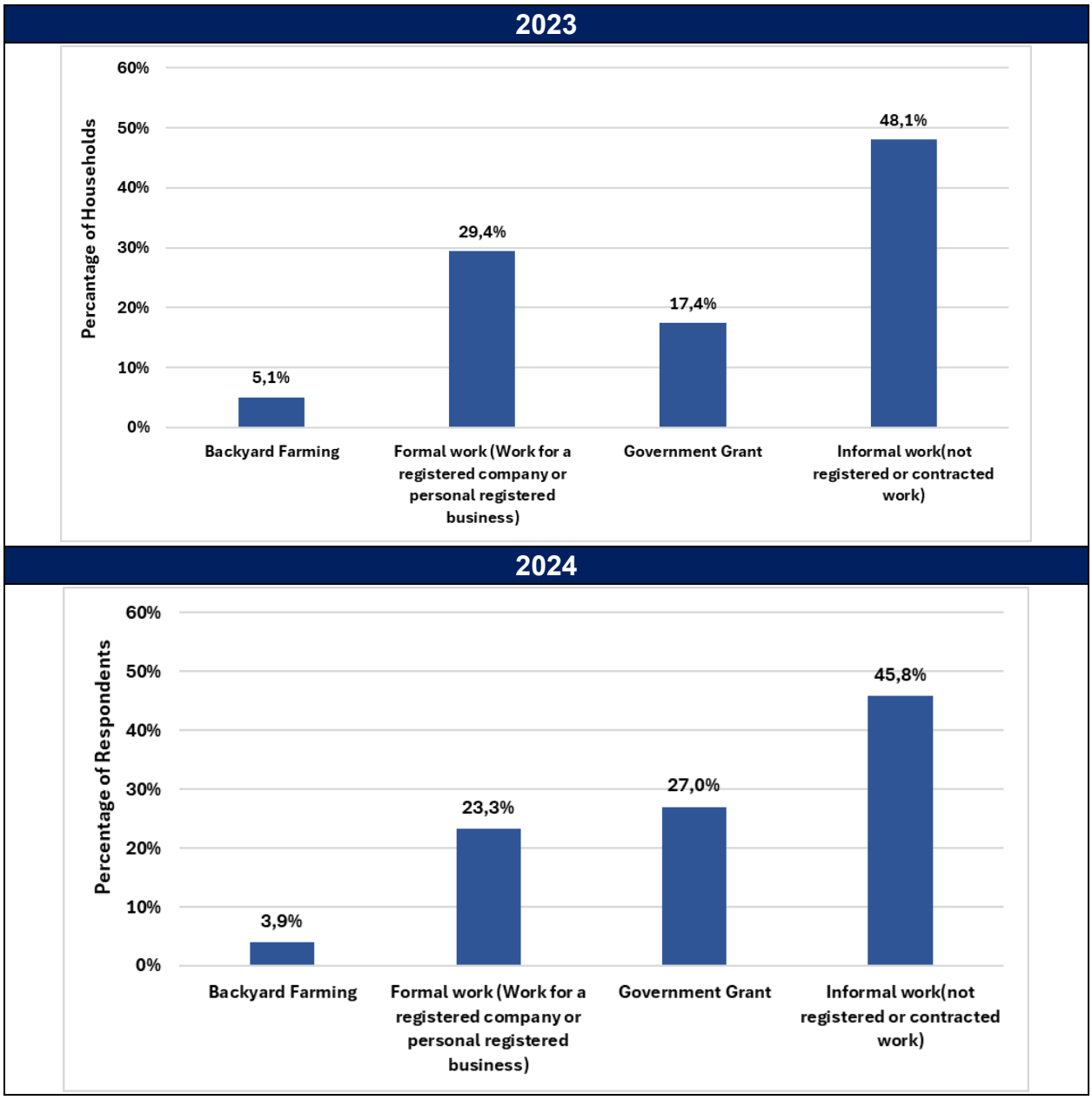

Figure 46: Primary Source of Income of Respondents in 2023 and 2024

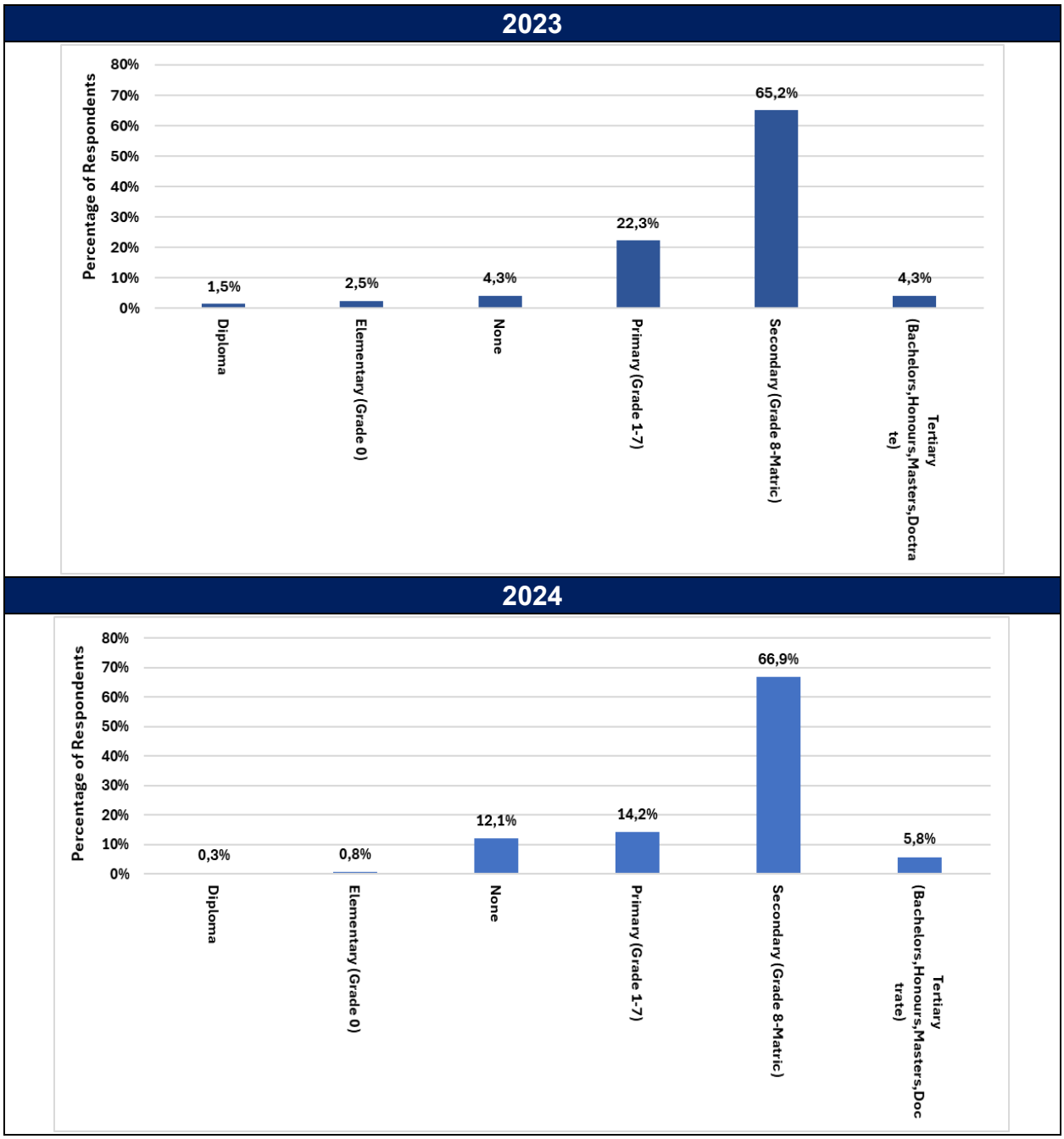

Figure 47: Respondents highest level of education in 2023 and 2024

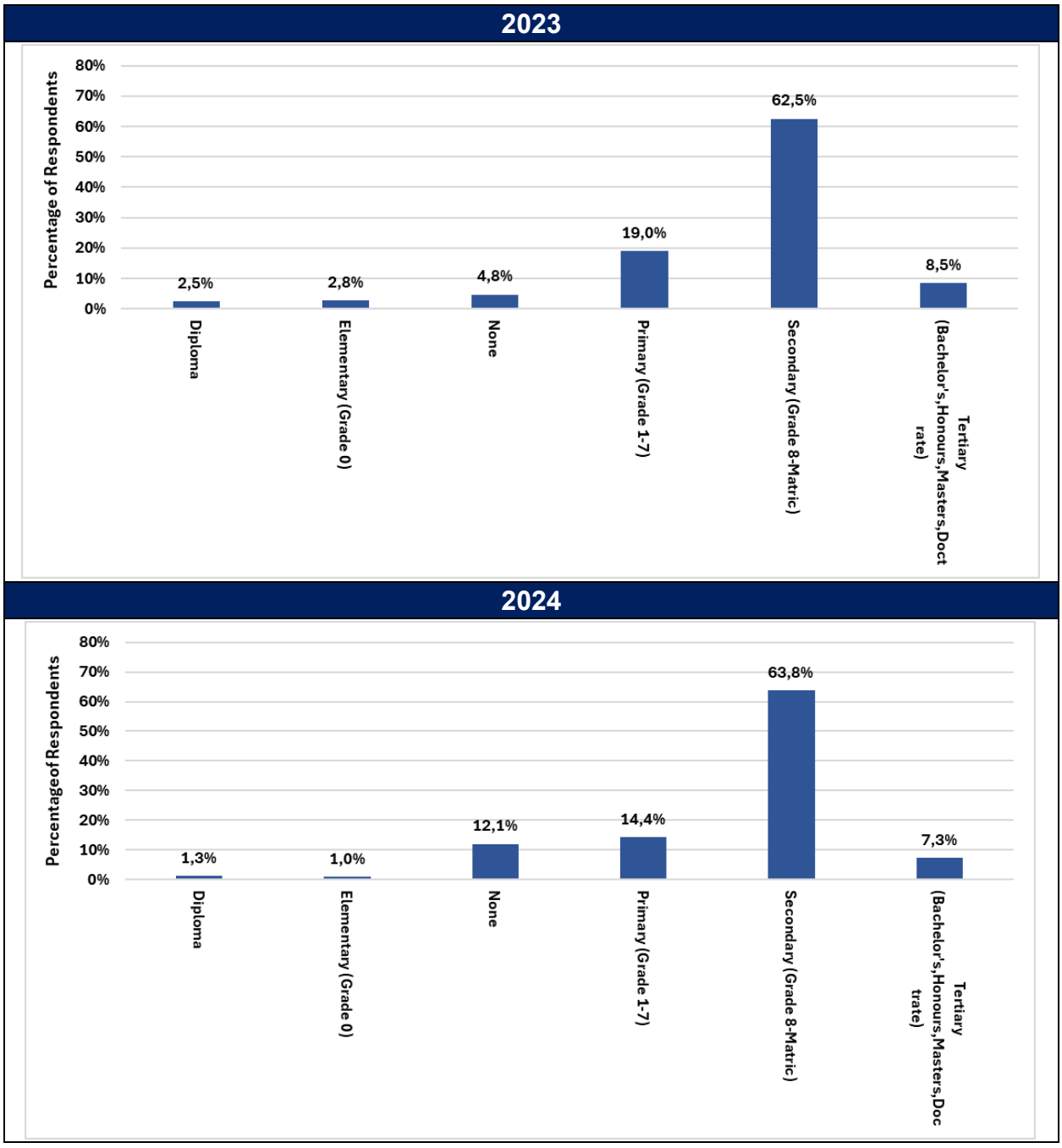

Figure 48: Breadwinners level of education in 2023 and 2024

3.1.5.4 STANDARD OF LIVING

Standard of living reflects on other services received by households such as water, sanitation and refuse removal. Although not key determinants of air pollution and associated health risks, they play an equally important role in overall socio-economic conditions and health impacts on people in low-income households.

3.1.5.4.1 WATER

According to Stats SA 88.55% of all households used tap water in their dwellings, their yards or from their neighbour's or communal taps, only 45.8% had water inside their dwellings. An evaluation by income quintile https://www.statssa.gov.za/?p=15473 - _edn1 shows that the percentage of households with access to piped water in the dwelling increases with higher income quintiles, while reliance on other sources, including using taps in the yard, decreases. The converse is true for low-income households.

In eZamokuhle for the 2023 pre-intervention survey, households have access to piped water with 20.4% of respondents indicating that they must source water from long distances (Figure 49), and this percentage decreased slightly for the 2024 post-intervention survey to 19.7%. The 2023 pre-intervention survey also indicate that 80.5% of respondents obtain water from either outdoor taps or 4.8% from indoor taps with 14.5% of households (Figure 50) obtaining from both outside and indoor taps which is below the national norms. A slight increase to 7.9% is noted for the 2024 post-intervention survey, with a slight reduction of 79.5% and 12.1% for outside and outside/indoor taps respectively.

However, availability of water is intermittent. Every month, water is available between 11 and 20 days (20.8%) with some households (26.8%) reporting 100% availability for the 2023 pre-intervention survey. A slight increase is noted for the 2024 post-intervention survey with water availability of 31.1% between 20 and 29 days, but a slight reduction of 21.6% water availability for the whole month (Figure 51). Most households reported water costs being less than R500.

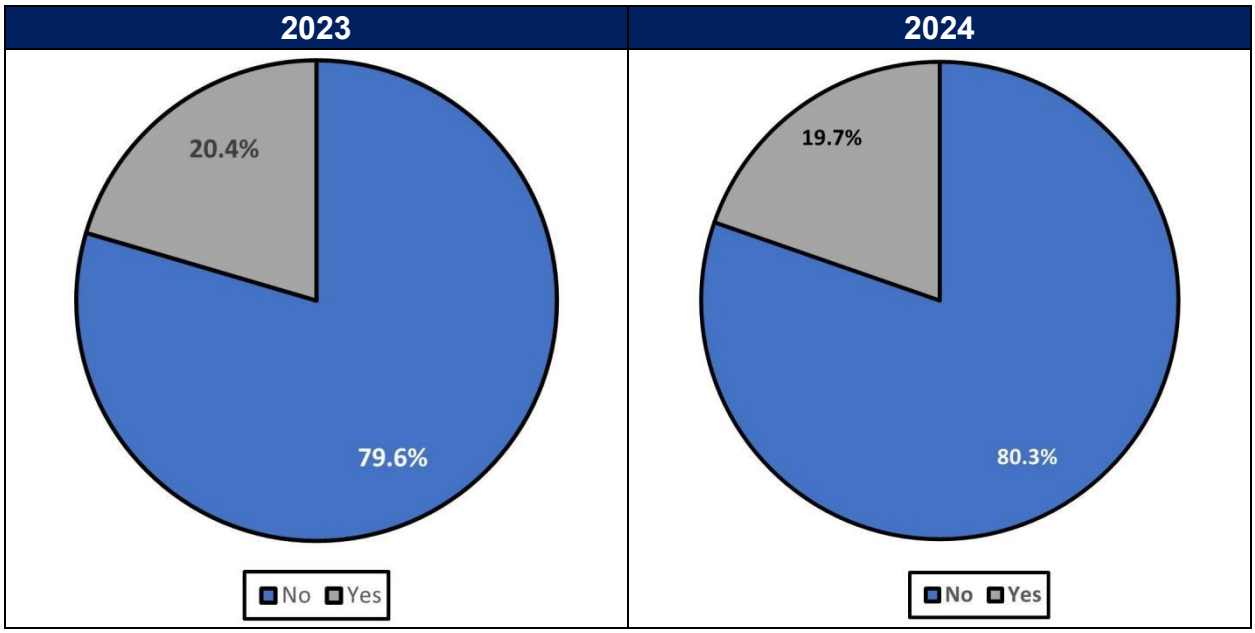

Figure 49: Respondent households must walk from home to fetch water in 2023 and 2024

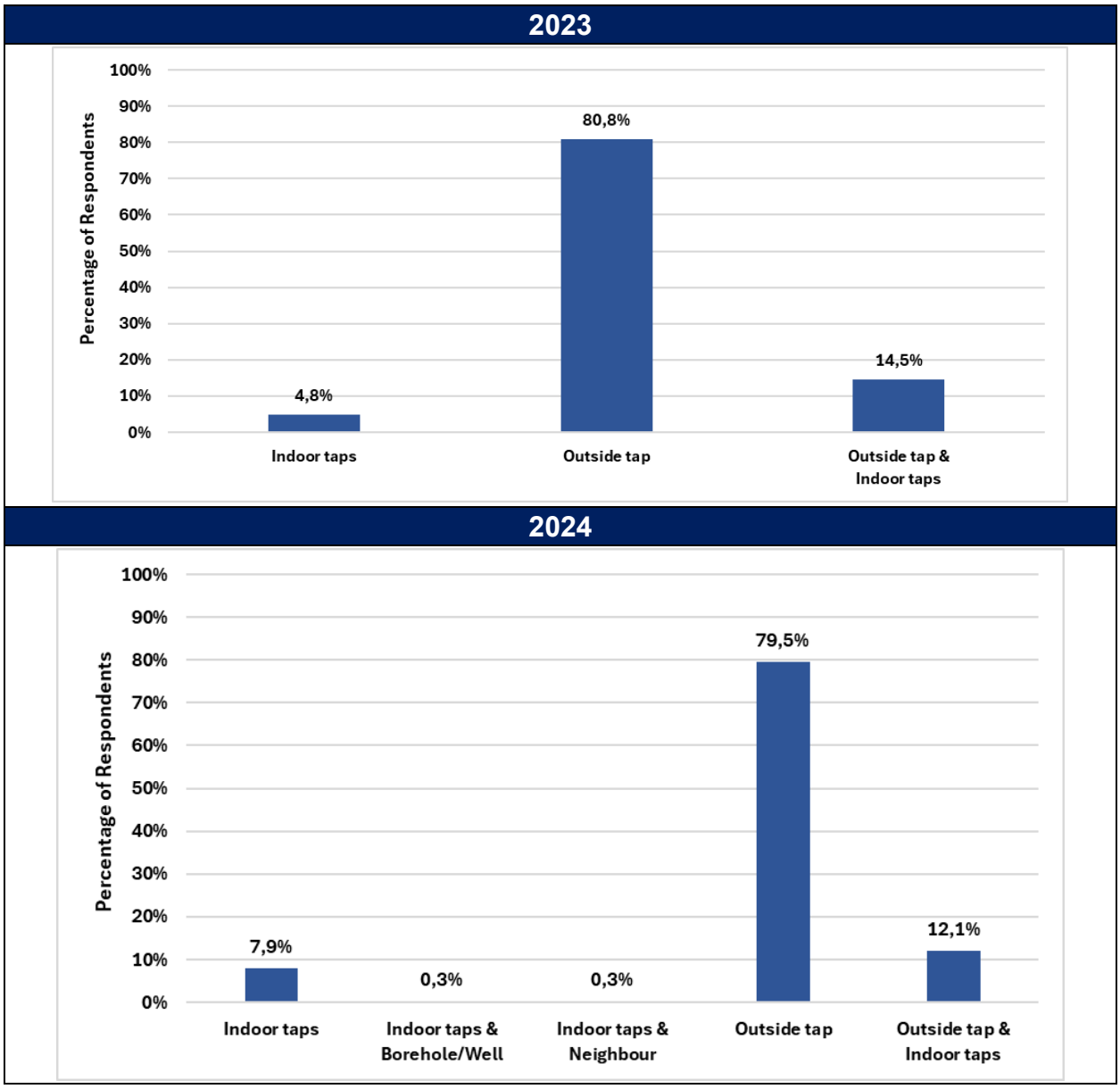

Figure 50: Respondent households' main source of water supply in 2023 and 2024

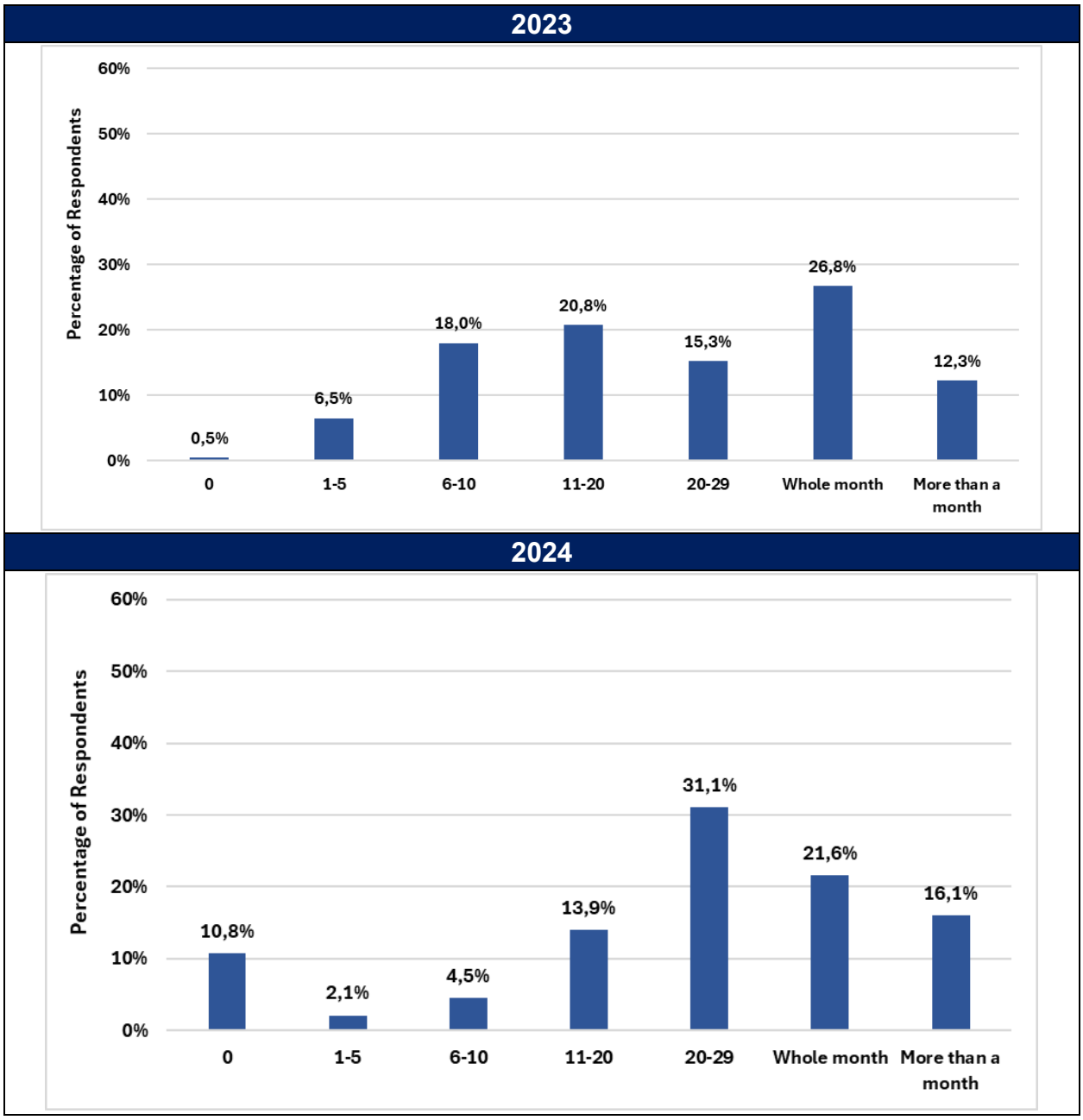

Figure 51: Number of days respondents have water in 2023 and 2024.

3.1.5.4.2 SANITATION

Stats SA (2022)[10] reported that household access to sanitation increased from 61.7% in 2002 to 83.2% by 2022. Nationally, only 65.8% of households used flush toilets, while 17.5% used pit toilets with ventilation pipes, and 13.5% used pit toilets without ventilation pipes.

In eZamokuhle 94,7% of households surveyed had flushing toilets on the property during the 2023 pre-intervention survey, with a slight increase to 95.0% for the 2024 post-intervention survey (Figure 52).

3.1.5.4.3 WASTE

Stats SA (2022)[11] also indicated that household refuse was removed at least once per week or less often for 62.6% of all households, while more than one-third (34.5%) of households had to rely on communal or their own refuse dumps. Refuse removal was most common in urban areas (84.9%) while 79% of rural households used their own refuse dumps.

The 2023 pre-intervention survey reveal that waste is collected at 98.5% of the surveyed households, whilst a slight decrease (95%) was reported for the 2024 post-intervention survey (Figure 53), from outside the house, once a week; and the collection is reported as reliable for both surveys (Figure 54). When the waste is not collected the homeowner waits for the next collection day, or takes the waste to the waste dump, whilst waste burning is also common practise (Figure 55). This suggested that eZamokuhle is in a better position than other places in the country. More importantly, if waste is regularly collected, it negates waste dumping and waste burning which leads to increased air pollution.

[10] Stats SA,General Household Survey 2022, https://www.statssa.gov.za/publications/P0318/P03182022.pdf.
[11] Stats SA,General Household Survey 2022, https://www.statssa.gov.za/publications/P0318/P03182022.pdf.

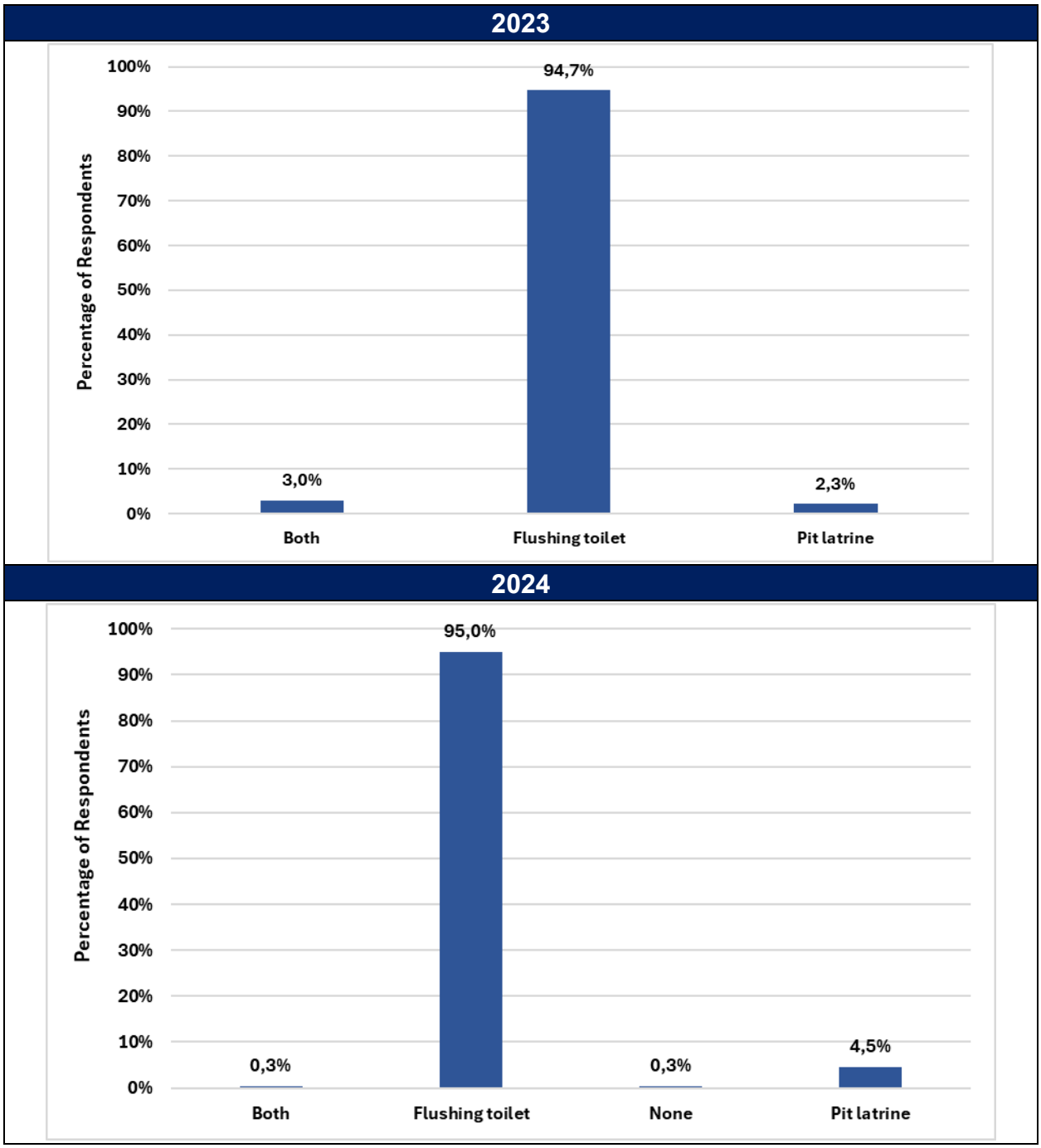

Figure 52: Percentage of households with either a flushing toilet, pit latrine or both in 2023 and 2024.

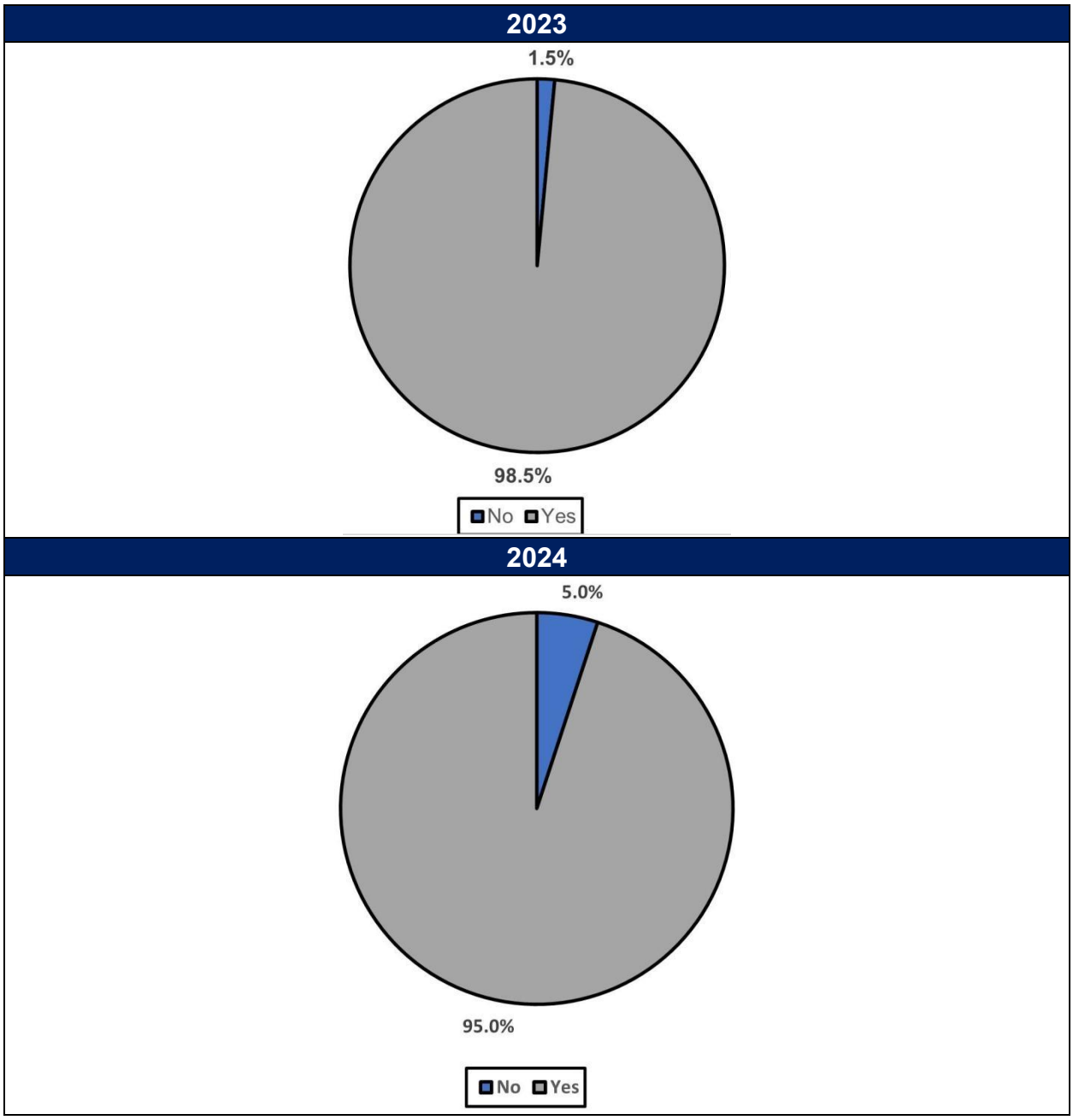

Figure 53: Respondent households that have household waste collected in 2023 and 2024

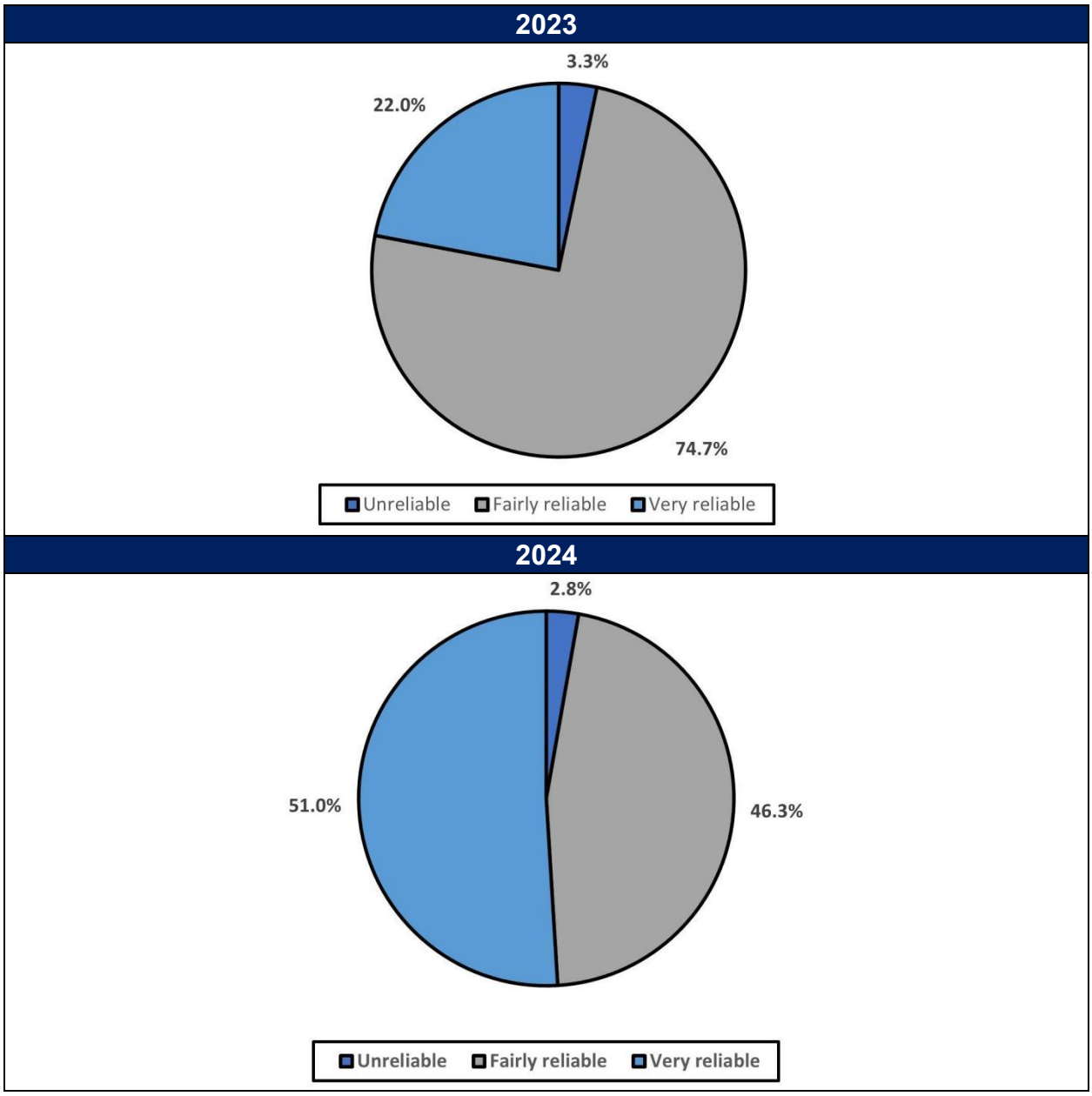

Figure 54: Reliability of waste collection to respondent households in eZamokuhle in 2023 and 2024

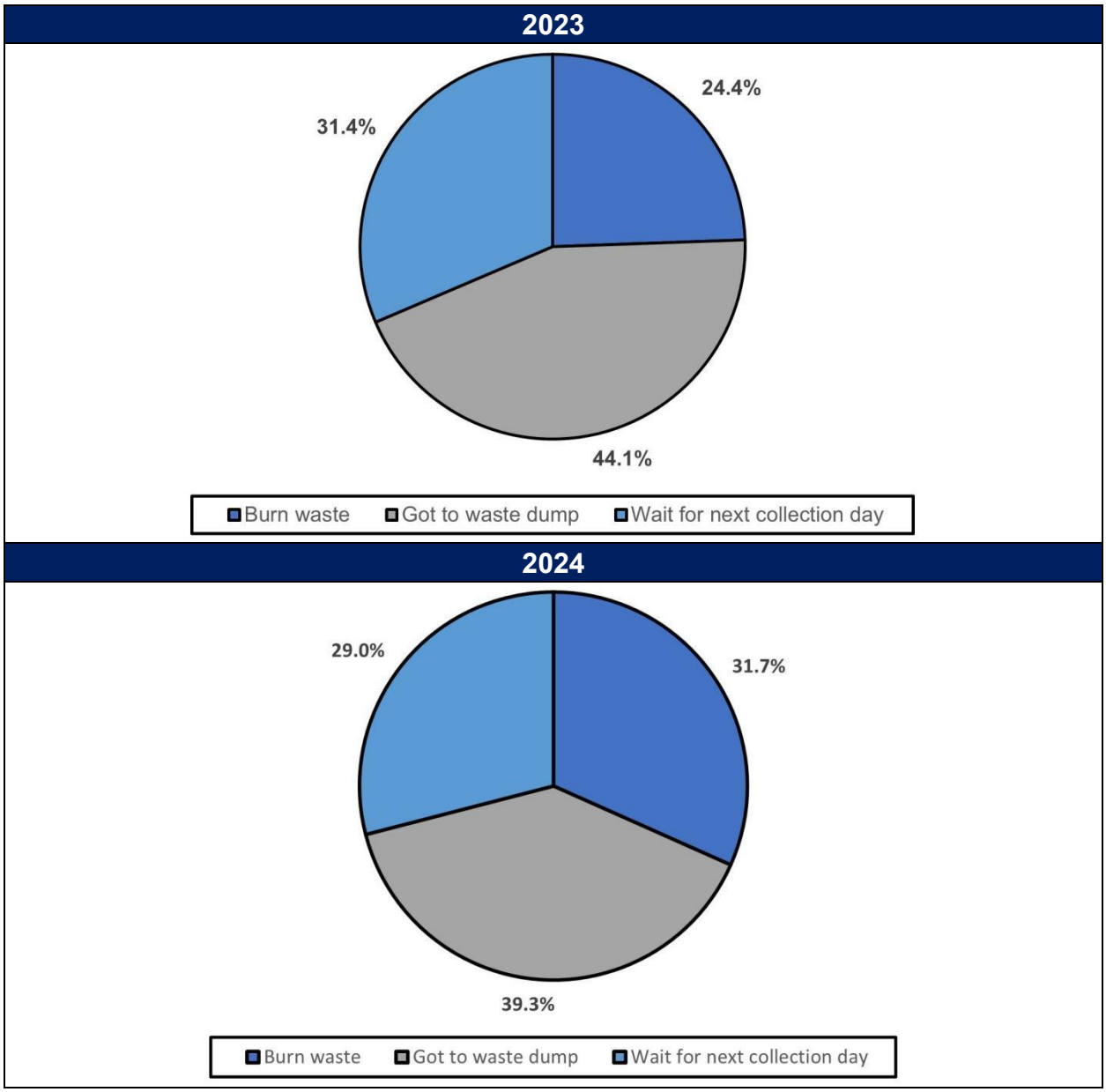

Figure 55: Alternate waste removal method if waste is not collected at respondent households in 2023 and 2024

3.1.5.5 Air Quality Awareness

The 2023 pre-intervention survey indicate that 71.8% of the respondents indicated that they were generally satisfied with the air they breathe (Figure 57) and 28.2% of respondents did not feel that air pollution was a problem or stayed neutral. An increase to 78.8% of the respondents indicated that they were generally satisfied with the air they breathe, whilst 21.2% of respondents did not feel that air pollution was a problem or stayed neutral during the 2024 post-intervention survey.

Figure 56 indicates for the 2023 pre-intervention survey that 17.8% of the respondents does not think of air pollution problems in eZamokuhle, with an increase to 30.2% for the 2024 survey. This could be a false positive if the respondents were unable to directly attribute poor health to air quality.

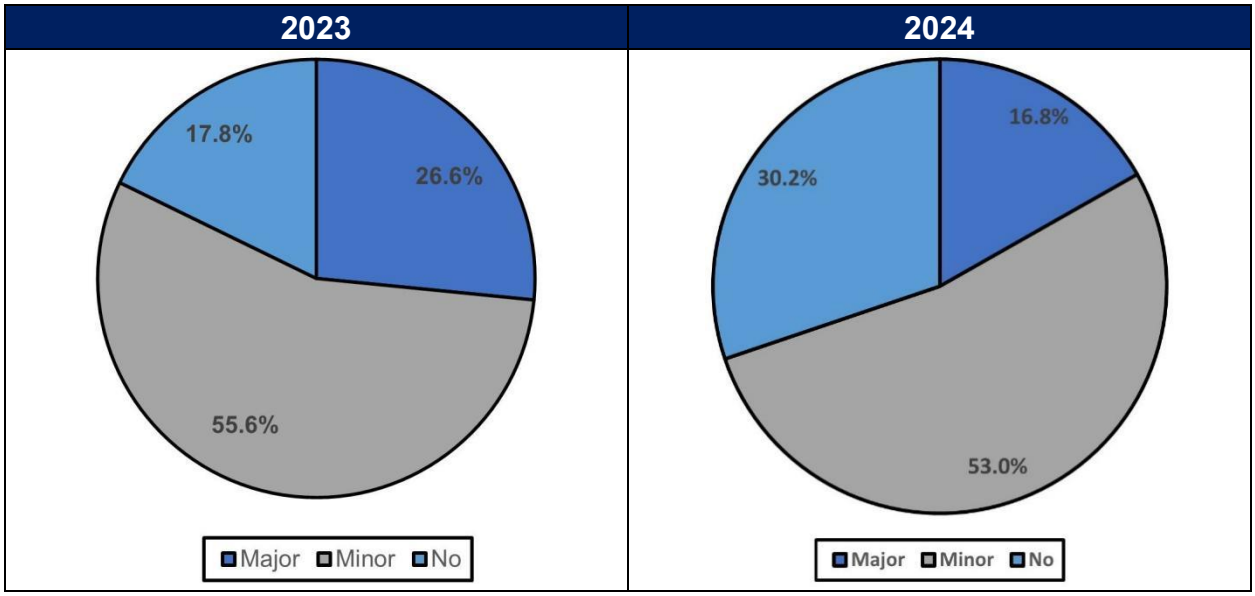

Figure 56: Respondents thoughts on air pollution being a problem in eZamokuhle in 2023 and 2024

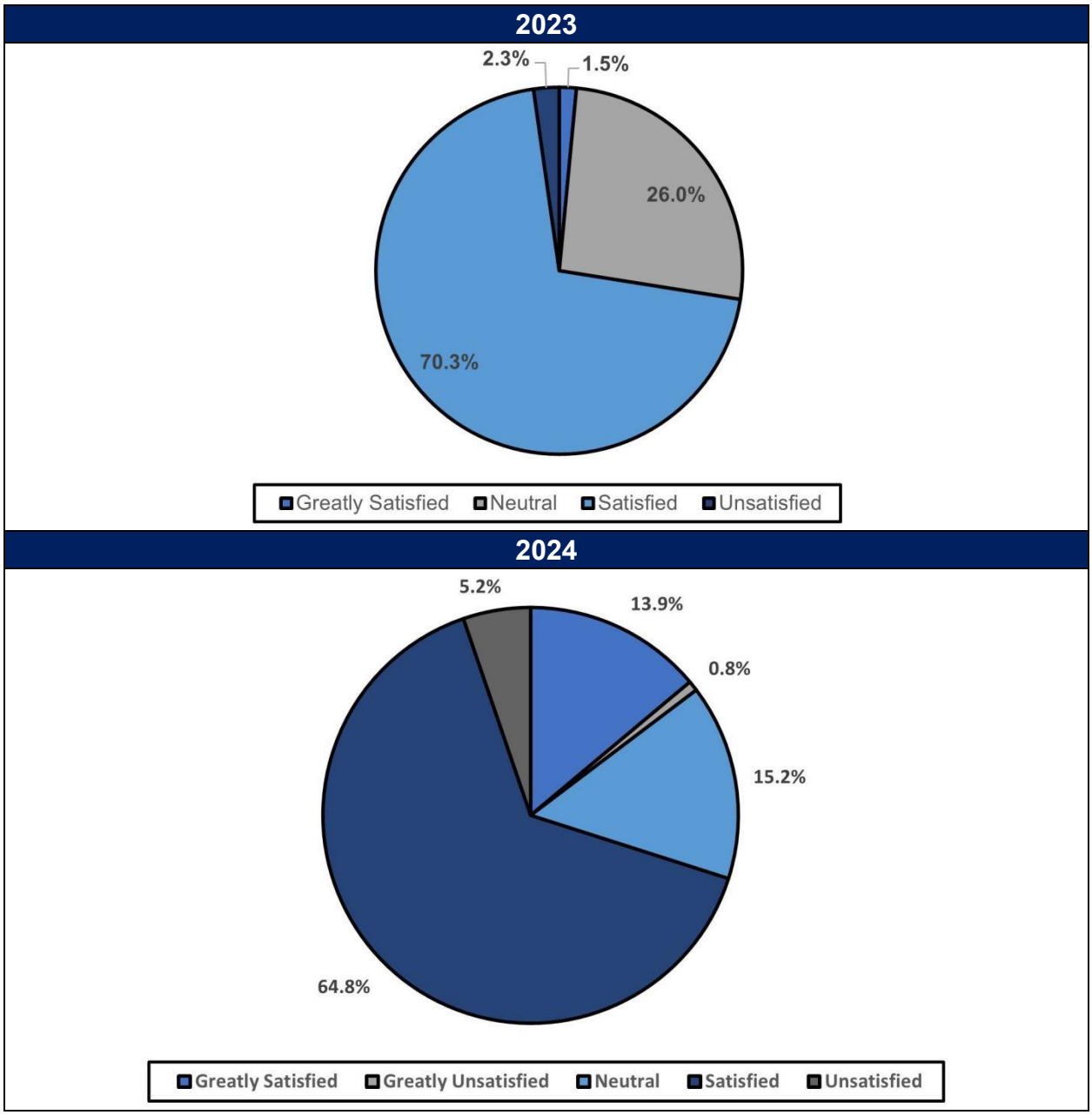

Figure 57: Respondents satisfaction with air they breathe in 2023 and 2024

3.2 PROJECT EFFECTIVENESS

Before examining the effectiveness results, it is crucial to distinguish between two complementary but distinct measures of programme success:

Intervention Effectiveness refers to the technical performance of individual components—whether the hybrid stoves cook food adequately, whether LPG heaters warm homes sufficiently, whether ceilings reduce heat loss, and whether rewiring improves electrical safety. This measures if each technology functions as designed at the household level.

Project Effectiveness encompasses the broader systemic impact—whether the combined interventions achieve the AQO programme's objectives of reducing emissions, improving air quality, transforming energy use patterns, and enhancing quality of life across the community. This measures whether the intervention package creates meaningful, sustained change at scale.

The distinction matters because interventions can be technically effective while failing to achieve project-level transformation. Conversely, project success may persist despite individual component challenges if synergies between interventions compensate for specific weaknesses. The eZamokuhle assessment reveals both dynamics at play.

3.2.1 CEILING INTERVENTION

Ceiling Installation

Of the sampled households in 2023, 391 respondents (97.5%) reported that they viewed the ceiling to be of good quality (Table 3). Of the 10 respondents (2.5%) indicated a negative view of the ceiling quality, 4 of the respondents indicated that the poor ceiling was leaking, with the other 6 respondents indicating the ceiling was of poor quality, poorly installed or not completely installed, as summarised in Table 4.

Table 3:Ceiling installation in eZamokuhle 2023

eZamokuhle Post Eskom AQO Intervention Roll-out	Number of Respondents	Total number of Respondents

Ceiling Intervention: Ceiling Team				
Section	**Question**	**Yes**	**No**	
Ceiling Work	Is the Eskom installed ceiling of a good quality?	391	10	401
	Household items damaged by ceiling installation team	19	382	
	Ceiling team left a mess	14	387	

Interaction between the teams involved in the project and the households is important to maintain trust between Eskom and the community. In 2023, when asked about the intervention teams, only 19 respondents (4.7%) reported having the ceiling teams damage items in their household. Damaged items ranged from broken windows in the bedroom to damaged couches and curtain rails as seen in Table 4.

Fourteen (14) respondents (3.4%) reported that the ceiling team did not clean up after the ceiling interventions were installed. The respondents noted that mostly items related to the ceiling were not cleaned up by the team (leftover SPF, leftover cuts from the ceiling and cornice) as noted in Table 4.

Table 4:Ceiling intervention quality in 2023

Ceiling Intervention Quality		
Issue	**Reason**	**Number of Respondents**
Why ceiling quality is not of good quality	Incomplete installation	1
	Lights were not installed	1
	Poor ceiling installation	2
	Poor ceiling quality	2
	Water leaks	4
Damage done to home by installation team	Broke a table	3
	Broke a window	5
	Bulb holder damaged	1
	Damaged toilet	1
	Damaged the wall	2
	Damaged the wall and the frame of the door	1
	Electricity plug damaged	1
	Fridge damaged	1
	Broken glass	1
	Metal sheet damaged	2
	Television damaged	1
Type of mess left by team	Left the house dirty	14

Ceiling Condition

Respondents in 2023 were asked if their ceiling was in the same condition when interviewed as when installed with 93.3% (374 respondents) indicating the ceiling is still in the same condition as when installed (Table 5). The other 27 respondents (6.8%) indicated that they experienced the roof showing stains, leaking, as well as having the roof cornices becoming loose over time. In 2024, 352 of respondents (92.4%) indicated that the ceiling is still in the same condition as when installed (Table 5). Twenty-nine (29) respondents indicated that the ceiling condition was not the same due to water leaks and ceiling stains, and /or the roof being damaged, as shown in Image 1 (Table 7).

In 2023, 105 respondents experienced roof leaks that were mostly caused by the ceiling not sticking well to the wall, or the metal sheet on the roof being damaged (Table 6). In 2024 69 respondents experienced roof leaks that were mostly caused by the ceiling not sticking well to the wall or the metal sheet on the roof being damaged. Only 37 of the respondents attempted to fix the leaking rooves by themselves in 2023 and 34 respondents in 2024. Eighty-two (82) of the 105 respondents reported to Eskom about the leaks in 2023. In 2024 only 34 respondents attempted to fix the leaking rooves by themselves, and only 9 of the 69 respondents reported to Eskom about the leaks. Five (5) of the respondents reported that their rooves were fixed after reporting the leaks to Eskom in 2023, and 10 respondents in 2024.

A larger percentage of household received assistance from Eskom in the 2024 survey period as compared to 2023, as 10 respondents (14.5%) would have their rooves fixed. This is further supported by the feedback received in the focus group interviews and feedback from the ground team as community leaders compiled lists of respondents experiencing leaks to distribute to Eskom. Compared to 2023, the number of respondents that indicated that they would not fix future leaks due to high costs and the opinion stayed relatively the same with 207 respondents in 2024.

Table 5: Condition of respondent's ceiling in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Ceiling Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Ceiling Condition	Ceiling looks the same as when installed	374	27	352	29
	Stains on the ceiling	45	355	46	335
	Ceiling leaks	105	296	69	312
	Attempt to fix leak by themselves	37	67	34	35
	Did you let Eskom know about the leak	82	22	9	60
	Eskom fixed the leak	5	63	10	59
	Will not fix future leaks due to high cost	206	73	207	55

Table 6:Ceiling condition quality in 2023

Ceiling Condition Quality		
Issue	**Reason**	**Number of Respondents**
Why Ceiling Condition is Different	Ceiling damaged	4
	Ceiling Stains	8
	Peeling ceiling edges	1
	Water leaks	10
	Water leaks; Ceiling stains	4
Description of Stain and Cause	Black; Cause not mentioned	3
	Brown; Cause not mentioned	21
	Brown; Caused by rain	10
	Grey; Cause not mentioned	3
	Rain; Cause not mentioned	1
	White; Cause not mentioned	2
	White and black; Cause not mentioned	1
Cause of Ceiling Leak	Ceiling is not sticking well into the wall	37
	Damaged metal sheet	26
	Don't know	6
	Metal sheet is too old	2
	Nail problems	1
	Hole in bulb holder	1
	Rain	31
	Wall damage	1

Table 7:Ceiling condition quality in 2024

Ceiling Condition Quality		
Issue	**Reason**	**Number of Respondents**
Why Ceiling Condition is Different	Ceiling damaged	3
	Ceiling stains	10
	It's dirty	2
	Painted another colour	1
	Peeling edges	1
	Water leaks	8
	Ceiling stains	4
Description of Stain and Cause	Black	8
	Black and brownish;caused by rain	1
	Brown	15
	Brown/black	2
	brown;Caused by rain	8
	Black; water leaks	1
	Grey	1
	Grey brown	1
	Rain	2
Cause of Ceiling Leak	Damaged metal sheets	11
	Issue with glue used for the cornice	7
	Nail problems	4
	Not sure	1
	Old metal sheets	6
	Rain	29
	Roof is old	1

Image 1: Ceiling stains noted in household

Ceiling Cornices

In 2023, 20 of respondents reported having the wall cornices becoming loose as shown in (Figure 59) with poor installation and water leaking through the metal sheets being named as the main causes of the loose cornices (Figure 58). In 2024, 21 respondents reported having the wall cornices becoming loose, with a majority of respondents indicating the lack of glue being applied to the cornices being a factor for them being loose (Figure 58).

Eight (8) of the 20 respondents attempted to fix the loose cornices in 2023, with 7 of the respondents informing Eskom of the issue (Table 8), whilst in 2024 10 respondents reported that they attempted to fix the loose cornice themselves (Table 8). In 2023 18 respondents reported their problem of the loose cornice to Eskom in 2023, whilst a low number of respondents (5) reported their issues to Eskom regarding the loose cornice in 2024. Two (2) of those respondents reported that the loose cornice was fixed in 2023 (Table 8). whilst in 2024 3 of the 5 respondents reported that Eskom did come back to fix the loose cornice (Table 8).

Table 8:Ceiling cornices of respondent households in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Ceiling Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Ceiling Cornices	Cornice becoming loose	20	381	21	360
	Trying to fix loose cornice	8	12	10	11
	Did you let Eskom know of the loose cornice	18	2	5	16
	Did Eskom fix the loose cornice	2	18	3	18

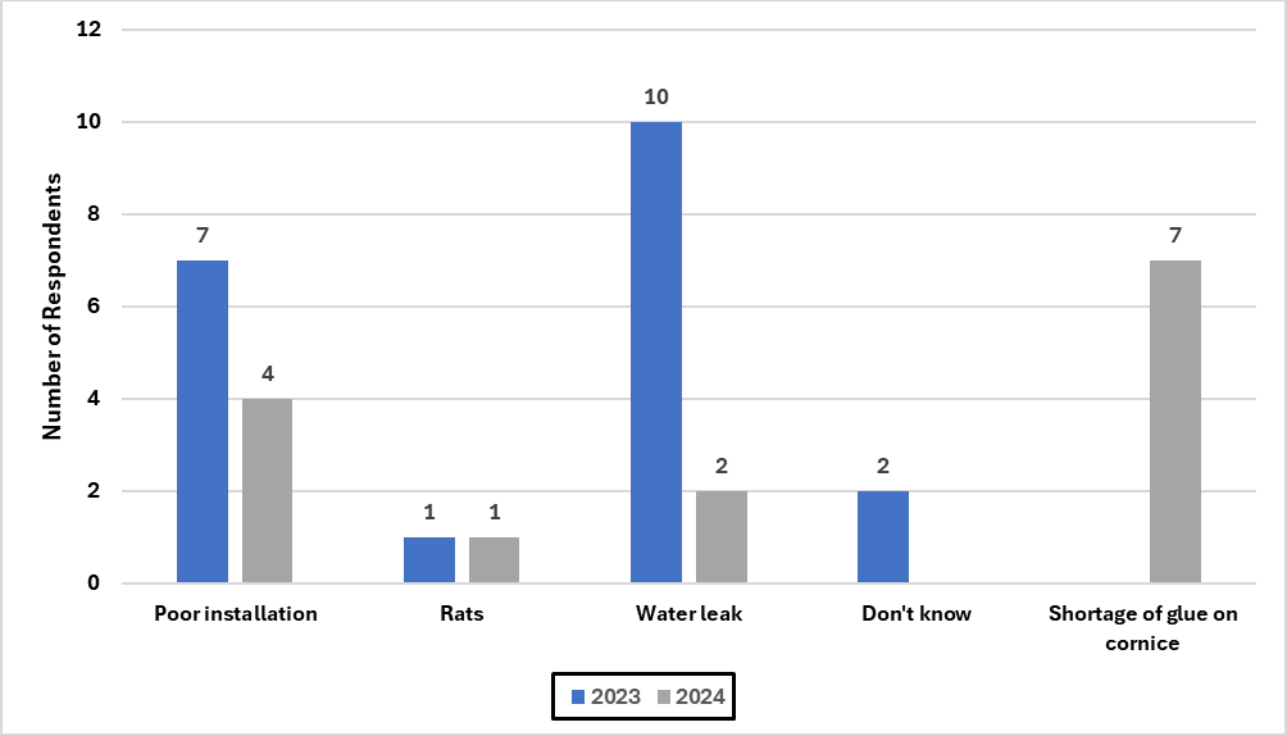

Figure 58: Cause of loose cornice on wall or ceiling in 2023 compared to 2024

Figure 59: Loose cornice in a respondent's household

Ceiling Maintenance

The 2023 survey highlighted that 92 of respondents indicated that they conduct maintenance on the ceiling, with the main reason being to keep the roof in good condition and to prevent water leaks (Table 9). In 2024, 115 of the 381 respondents (30.2%) reported to currently conduct maintenance on their ceilings, stating the same reasons as in 2023 to keep the roof in good condition and to prevent water leaks (Table 9). The other 309 respondents in 2023 (Table 9) indicated they would not conduct maintenance due to their current ceiling being in good condition and therefore not needing maintenance at the moment, or that they could not afford to conduct maintenance as it is expensive. In 2024 the other 266 respondents indicated they would not conduct due to their current ceiling being in good condition and therefore not needing maintenance at the moment and that it is too expensive to conduct maintenance on their ceiling. The matter of affordability to maintain the ceiling is supported by the income profile of eZamokuhle showing many respondents being in the low-income earning bracket of R 1000 – R 5000, and with some dependent on government grants.

When the respondents were asked if they would fix the ceiling damage by themselves in 2023(Table 9), 151 indicated they would fix the damage, with the main reason being to keep the ceiling in good condition. In 2024 117 respondents (30.7%) reported that they will fix any future ceiling damage (Table 9), which is a decrease from 2023 where 151 respondents indicated that they would fix any damage. It is important to note that there is a perception from the respondents that Eskom should be responsible to fix the ceilings in the future if any damage or leaks are experienced, with 303 respondents (77%) reporting this sentiment in 2023 and 270 respondents (70.9%) in 2024.

Table 9: Ceiling maintenance in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Ceiling Intervention					
		2023		2024	
Section	**Question**	**Yes**	**No**	**Yes**	**No**
Maintenance	Currently conduct maintenance on ceiling	92	309	115	266
	Fix any future ceiling damage	151	248	117	264
	Eskom should fix future water leaks or damage	303	93	270	111

Respondents' satisfaction with Ceiling

Respondents were asked questions to indicate overall satisfaction with the ceiling intervention in 2023 and 2024. Twelve (12) of respondents (3%) feel that the ceiling is not safe. Reasons quoted include: (1) the ceiling started to fall, or (2) not being in a general good condition after being installed (Table 10). Despite this, nearly all the respondents (396 out of 401) recommended ceiling installations to be done in other households. In 2024 372 respondents (97.6%) still view the ceiling as being safe, with those that see the ceiling as being unsafe attributing this view to the ceilings leaking and possibly falling due to the water damage (Table 10). Three hundred and seventy-eight (378) of respondents (99.2%) would recommend ceilings being installed in other households

Four hundred (400) respondents (99.8%) indicated that their homes were warmer due to the newly installed ceiling in 2023 (Table 10),whilst in 2024 378 respondents (99.2%) indicated that their house feels warmer than before the ceiling interventions (Table 10).

Overall,389 respondents (97%) were happy with their ceiling in 2023 (Table 10), and 372 respondents (97.6%) in 2024 (Table 10).

Figure 60 shows the respondents coal use to keep the household warm after ceiling interventions in 2023 and 2024. 388 respondents indicating that they use less coal to keep their house warm during cold weather conditions compared to before the ceiling interventions were implemented during 2023. In 2024 318 respondents mentioning that they are using less coal to keep the households warm in cold weather conditions than before the ceiling interventions were completed.

Figure 61 shows the reasons as to why the respondents are not happy with the ceiling installation in 2023 and 2024. Respondents that were not happy with the ceiling installations in 2023 cited poor installations and roof leaks as their main sources of unhappiness with the ceiling. In 2024 respondents were unhappy with the ceiling installation due to the ceiling now being in a bad condition and that it is leaking.

Figure 62 shows the respondents recommendations on how Eskom can improve on the ceiling installations in 2023 and 2024. In 2023 324 respondents (85%) respondents indicated they had

nothing to recommend, and 11 respondents indicating better skilled labourers need to be recruited by the installation contractor. It is worth noting that the other recommendations such as using better quality materials and hiring of experienced skilled personnel were items mentioned during the focus group interviews and these issues needs to be communicated to future installation contractors. This feedback could be used to address these issues when implementing the ceiling interventions in other areas. In 2024 292 respondents (76.6%) indicated they had nothing to recommend, and 4 respondents indicating better skilled labourers need to be recruited by the installation contractor.

Table 10: Respondent satisfaction with ceiling in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Ceiling Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Satisfaction	Ceiling is safe	389	12	372	9
	Recommend ceiling installation to other households	396	5	378	3
	Home is warmer with new ceiling	400	1	378	3
	Happy with installed ceiling	389	12	372	9

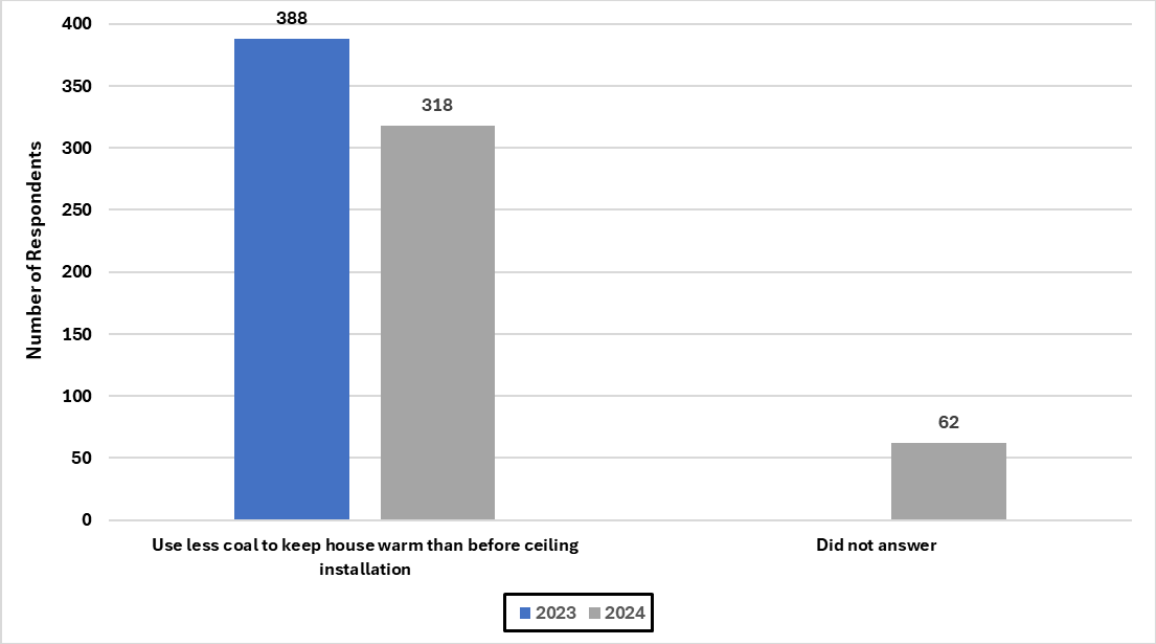

Figure 60:Respondents Coal use to keep the household warm after ceiling interventions in 2023 and 2024

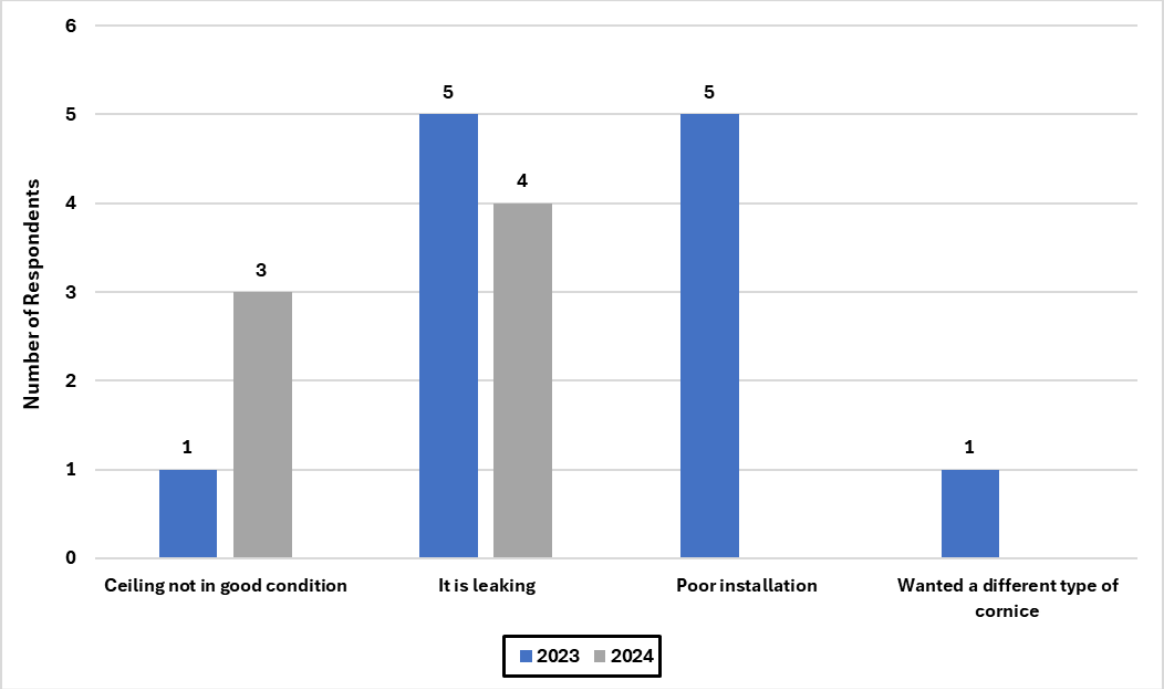

Figure 61: Reason respondents are not happy with ceiling installation in 2023 and 2024

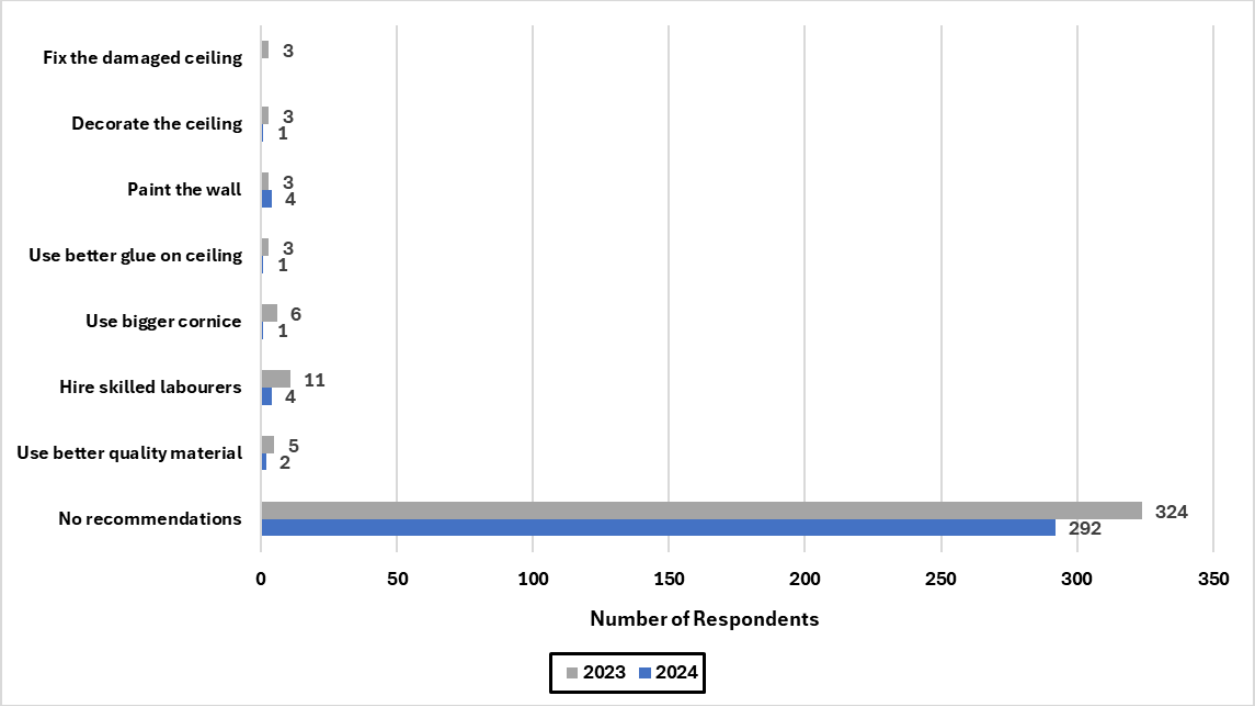

Figure 62: Respondents' recommendations on how Eskom can improve on the ceiling interventions

3.2.2 LPG Heater Intervention

LPG Installation

At the time of the survey being conducted in 2023, only 389 respondents indicated that they had received LPG heaters (Table 11). Three hundred and eighty-five (385) respondents (99%) indicated that they viewed the LPG heater as being of good quality. Only 3 of 4 respondents indicated the biggest issue being that the heaters stopped working after delivery (Table 15). During 2024, 372 respondents (79.5%) reported that the heater is of good quality (Table 9).

An issue that can hinder a supply of an energy source, would be the absence of a strong supply chain within a community. In this case, the lack of an LPG supplier close to eZamokuhle could lead to respondents relying again on reliable coal and wood sources. In 2023, 273 of respondents (70.2%) indicated they had a place where they could refill their gas cylinders, with the suppliers being mostly situated in Amersfoort. The 2024 survey highlighted more respondents (303) indicating that there are places available for them to refill the LPG cylinders (Table 9). Despite the increase in available places for LPG refills, it is important for locally placed LPG distributors to be established within eZamokuhle, as respondents have indicated that transport costs are a limiting factor for them when it comes to LPG usage.

Worthy to mention is that during 2023, 1 respondent indicated that the LPG installation damaged items in their household when installing the LPG heater.

Figure 63 shows where respondents refill their gas cylinders in 2023 and 2024. In 2023 respondents indicated that the BKB Retail Store, Amersfoort Total Garage and Bhyat Mica were some of the larger LPG suppliers in Amersfoort. In 2024 a shift in suppliers is noted, with respondents favouring filling stations as their main LPG provider and moving away from BKB Retail store, and a large portion of respondents shifting away from Bhyat Mica from 40 respondents in 2023 to 2 respondents in 2024. It was noted that between the 2023 and 2024 survey new LPG suppliers were established, with respondents now utilising Afgri, Lablu supermarket and a local spaza shop in 2024. The shift in suppliers, especially from Bhyat Mica, could be attributed to the point that was raised in the focus group interviews that users of LPG were limited to only LPG

cylinder exchanges at some suppliers. This is a problem for residents as they are afraid of losing their Eskom supplied LPG cylinder and then receiving a defective or badly damaged cylinder when they must exchange their LPG cylinders.

Table 11:LPG installation quality in 2023 and 2024

Ezamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
LPG Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Installation	LPG heater is of good quality	385	4	372	9
	Place available to refill cylinders	273	116	303	78
	Team damaged items in household	1	388	N/A	

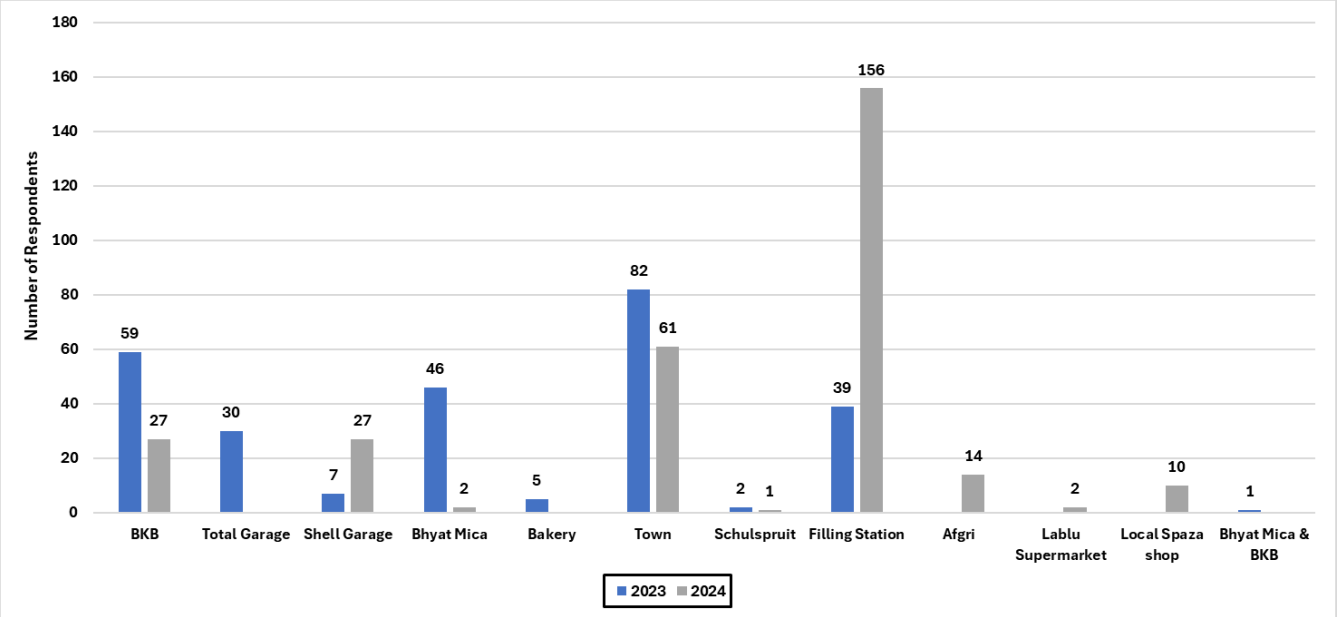

Figure 63: Where respondents refill their gas cylinders in 2023 and 2024

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Respondents' LPG Usage

In 2023, 385 respondents (98.7%) indicated that their LPG heaters are still in good condition as of the day of the interviews (Table 12), thus 1.3% respondents unhappy with the LPG heater condition. In 2024, 19 respondents (4.9%) reported that their LPG heater was not in the same condition as when delivered, due to their heaters being broken, or no longer being in their possession.

The 2023 survey highlighted 278 respondents (71.5%) indicated that the LPG heater was not expensive to use, compared to the coal alternatives such as the umbaula or a coal heater. However, the 2024 survey indicate that 311 respondents (81.6%) reported that the LPG heater is not expensive to use. This supported with the feedback from the focus group interviews where respondents reported that in comparison to the coal prices and rising electricity prices, it is much cheaper for respondents to use an LPG heater than an umbaula or an electric heater. More respondents indicated that they are not scared of using the heater (80.4% in 2023 compared to 82.1% in 2024).

LPG costs prove difficult for respondents that are within the R 1000 - R5000 income bracket as the household budget would be constrained, forcing the respondents to use cheaper fuels such as coal or wood.

In the 2023 survey ,257 respondents (84.5%) indicated that they still have 9kg LPG cylinders (Table 12), whilst in 2024, 262 respondents reported having 9kg cylinders left.

Figure 64 shows respondents view on why the LPG heater is expensive to use in 2023 and 2024.In 2023 .In 2023 111 respondents noted in Table 12 that they view LPG heaters as expensive stated due to: 1) the high cost of refilling the gas cylinders; 2) Not being able to buy the LPG on credit and ;3) Respondents being unemployed. However, in 2024 only 70 users view the LPG cylinders to be expensive due to: 1) high cost of refilling the LPG cylinders;2) LPG not lasting long and 3) respondents being unemployed

Figure 65 shows residents who are scared to use the heater in 2023 and 2024. Through the surveys children are seen as the more vulnerable group when it comes to LPG use. Thus, it would be a beneficial for safety campaigns to be run at schools to inform children on the dangers and ways to keep safe when utilising LPG devices.

Figure 66 shows why households do not feel warm in 2023 and 2024. In 2023, 2 respondents (1.5%) indicated that their home has not been warm after the installations due to the respondents not having the LPG heater in their possessions (Figure 15). These respondents indicated that either the landlords would take the heaters for their own use, or they would send the heater to be used by a relative. In 2024, 13 respondents (3.4 %) indicated that their home has not been warm after the installations due to the respondents not having the LPG heater in their possessions

Figure 67 shows how many gas cylinders households have left in 2023 and 2024. Two hundred and thirteen (213) households in 2023 have 2 9Kg cylinders in the household, whilst in 2024 204 respondents indicating they still had 2 LPG cylinders left, with 57 respondents indicating they only have 1 LPG cylinder left, compared to 31 respondents in 2023.

Figure 68 shows the household's view on coal usage to keep their homes warm since the LPG Heater installation in 2023 and 2024. Three hundred and seventy-eight (378) respondents (97.1%) reported using less coal to keep their homes warm during cold conditions compared to before the introduction of the LPG heaters to their homes in 2023, whilst in 2024 376 respondents (98.7%) reported using less coal to keep their homes warm during cold conditions compared to before the introduction of the LPG heaters to their homes

Table 12:Respondent use of LPG heater in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
LPG Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Usage of LPG	LPG heater still in as good condition as when delivered	385	4	362	19
	LPG heater expensive to use	111	278	70	311
	Anyone at home scared to use the heater	76	313	84	297
	Still have any 9kg cylinders left	257	131	262	119
	House is warmer after installation	383	6	368	13

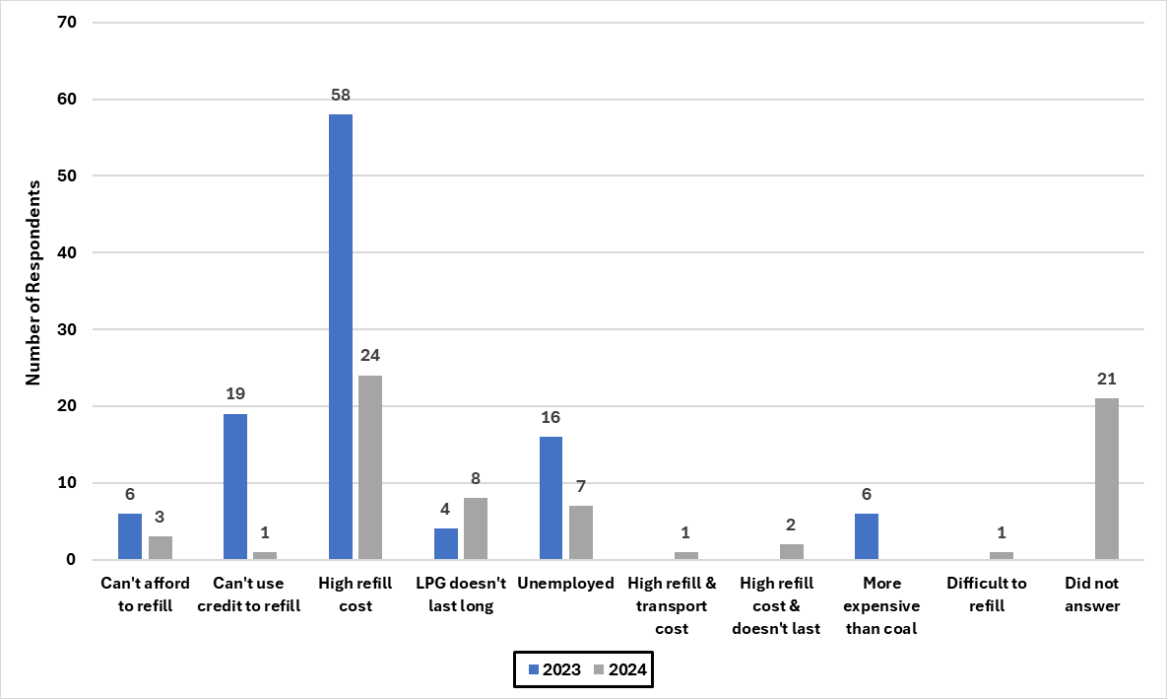


Figure 64: Why respondents view on why the LPG heater is expensive to use in 2023 and 2024

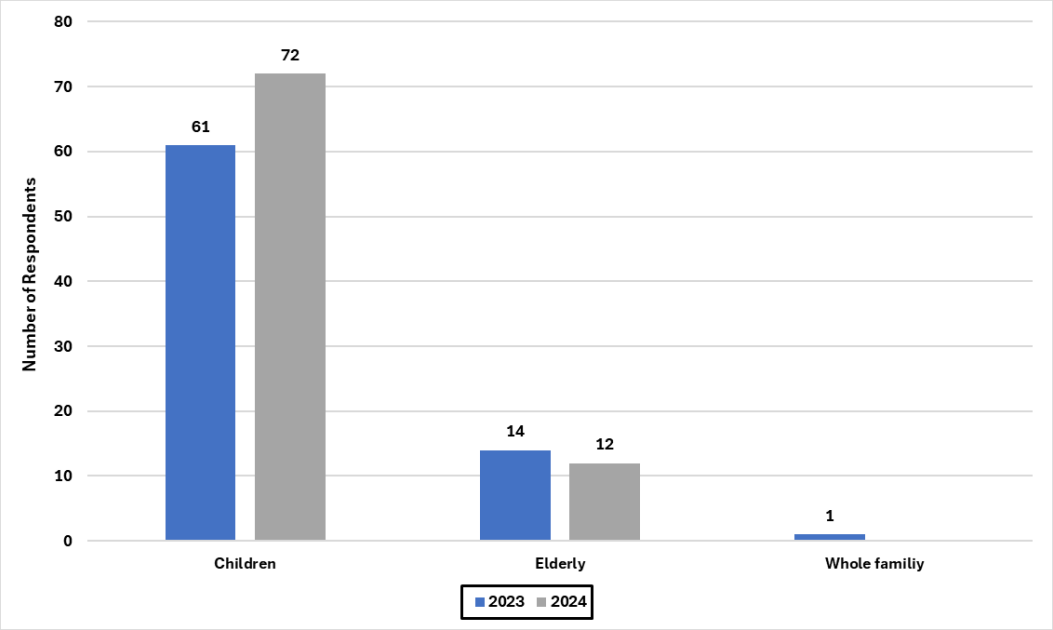


Figure 65: Household residents who are scared to use the heater in 2023 and 2024

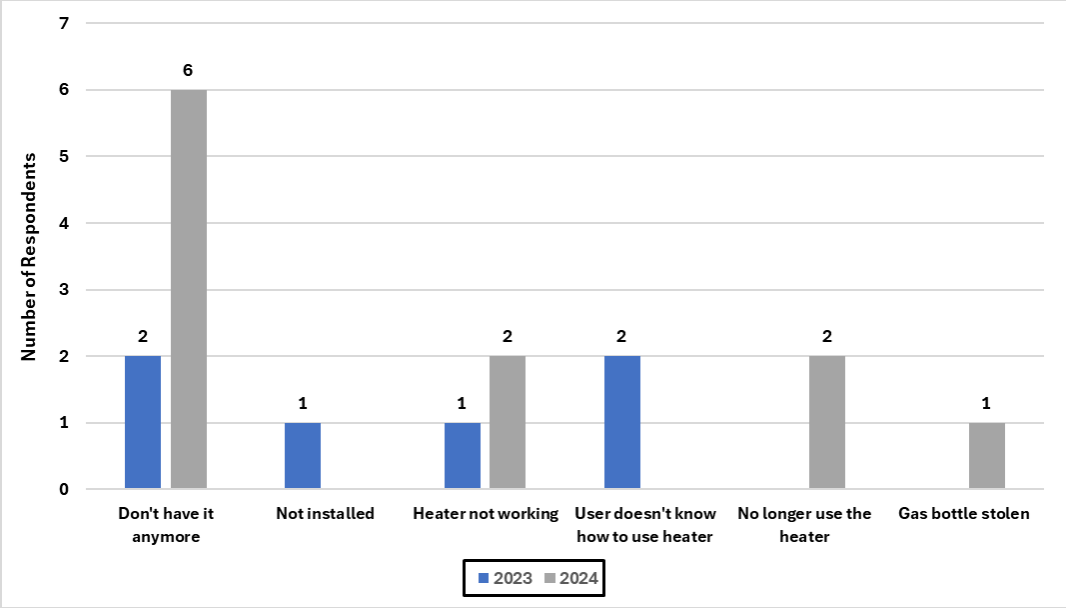


Figure 66: Why the household does not feel warm in 2023 and 2024

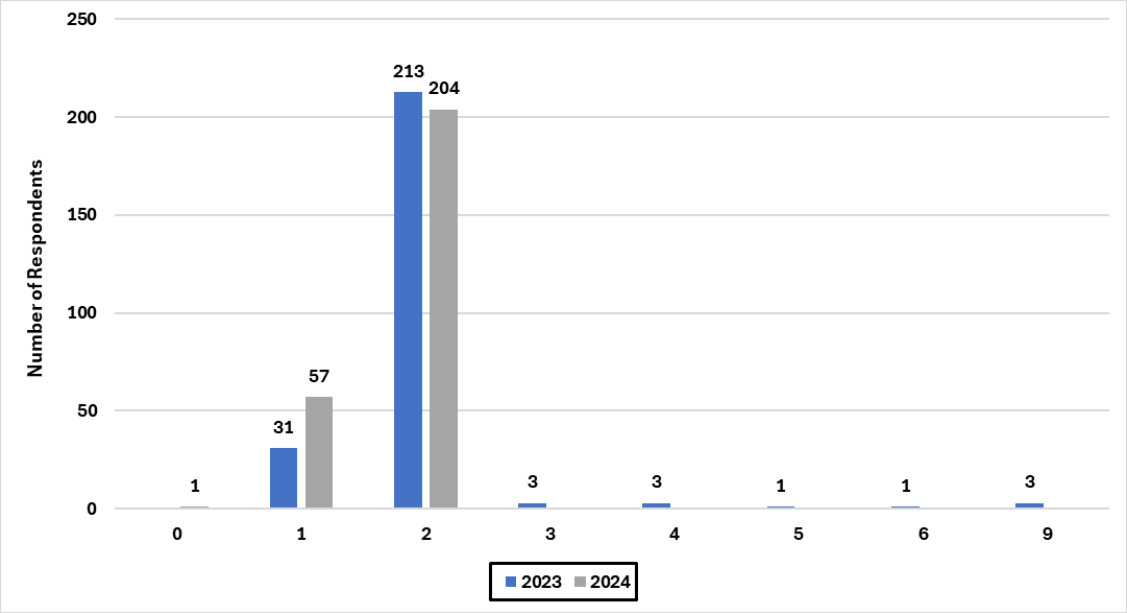


Figure 67:How many gas cylinders left in the house in 2023 and 2024

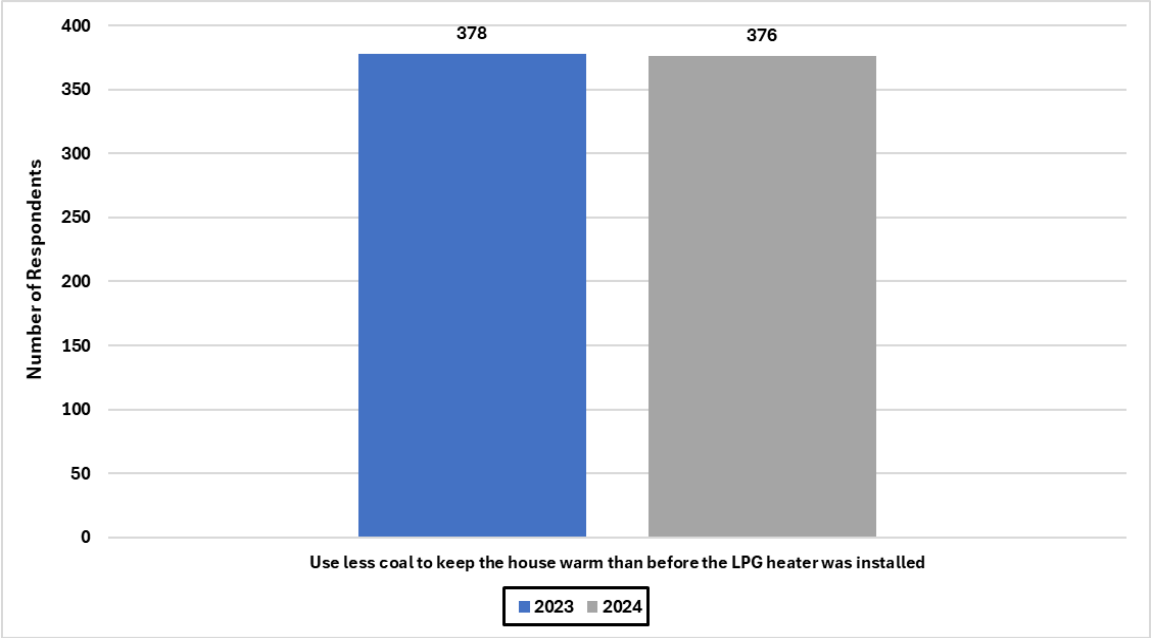


Figure 68:Households view on coal usage to keep their homes warm since the LPG Heater installation in 2023 and 2024

LPG Safety

As LPG technology is deemed as a safe alternative energy source, users have expressed safety concerns around the use of LPG based technologies due to poor installation or faulty cylinders[12]. Poor use, installation and maintenance can lead to incidents that could sway users away from LPG technologies.

In 2023, 370 of the respondents (95.1%) received training from the installation team, but it is important to note that only 265 (68.1%) respondents indicated that they knew what to do if they smelt gas when operating the LPG heater (Table 13). A concern to note is that despite the respondents indicating they do not know what to do when they smell gas, 285 respondents (75.8%) indicated that they would not want to receive training on how to use the LPG heater (Table 13). In 2024 367 of the respondents (95.1%) indicated that they received training from the installation team, but worryingly there were still respondents that indicated that they did not know what to do if gas is melt in when operating the LPG devices (Table 13), with a number of the respondents indicating that they would not want to receive training on how to use LPG cylinders.

During 2023 only 4 respondents (1%) reported their LPG heater being damaged or defective, stating that the devices have not worked since delivery. Of the 4 respondents, none attempted to fix the heater by themselves, with only 3 of the respondents reporting to Eskom of the issue (Table 13). The number of defective or damaged LPG heaters increased from the last survey, with 22 respondents in 2024 compared to 4 in 2023. Seven (7) of the respondents attempted to repair the heaters by themselves, with 14 houses reporting the issue to Eskom, five (5) of the respondents having their heater repaired (Table 13).

The 2023 survey highlighted that 381 respondents (97.9%) felt that the LPG Heater is not dangerous to use. One hundred and thirty-two (132) respondents (33.9%) have their windows and doors open when they utilise the LPG heater. For the 2024 survey 23 respondents view the LPG

[12] Urpelainen,J. “LPG as a Clean Cooking Fuel: Adoption, Use, and Impact in Rural India”. Energy Policy. 2018 November ; 122: 395–408. doi:10.1016/j.enpol.2018.07.042.

heaters as dangerous to use. One hundred and one (101) of (26.5%) respondents have their windows and doors open when they utilise the LPG heater for the main purpose of ventilation.

The 2023 survey indicate that compared to the responses regarding the ceiling repairs, 307 respondents (78.9%) indicated that they would repair the future damage to the LPG heater (Table 13). This could be due to lower cost involved in repairing the device compared to the larger task of sourcing materials and experienced labour to repair the ceiling. The same trend is seen in 2024 where 287 respondents indicated that they would repair the future damage to the LPG heater compared to repairing their ceiling indicating that respondents favour the lower cost of repairing the LPG heater than the ceiling

Figure 69 shows the respondents thoughts on why the LPG heater is not safe in 2023 and 2024.In 2023 respondents viewed the LPG heater as unsafe due to: 1) Children are around the devices; 2) the respondents feeling they are too old to know how to deal with the LPG heater; 3) that they are scared of using gas (Figure 69). In 2024 respondents felt that the LPG heater is unsafe as the respondents felt that they are too old to know how to deal with the LPG heater and of the smell

Figure 70 shows why the respondents would not fix their LPG heaters in 2023 and 2024. The respondents that indicated that they would not fix their LPG heaters stated affordability and viewing repairs as expensive as being their reason to not fix the LPG heaters in 2023 and 2024.

Table 13: LPG safety in 2023 and 2024

eZmokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
LPG Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Safety	Receive training on LPG heater use	370	19	367	14
	Know what to do if gas is smelt	265	124	255	126
	Would you like to receive training on LPG Use	49	337	110	271
	LPG heater defective or damaged	4	385	22	359
	Tried to fix LPG heater by yourself	0	4	7	15
	Have you let Eskom know about the damaged/defective heater	3	1	14	8
	Eskom fixed the LPG heater	0	4	5	17
	It is dangerous to use the LPG heater	8	381	23	358
	Have windows and/or doors open when using LPG heater	132	257	101	280
	Will repair future damage on LPG heater	307	81	287	95

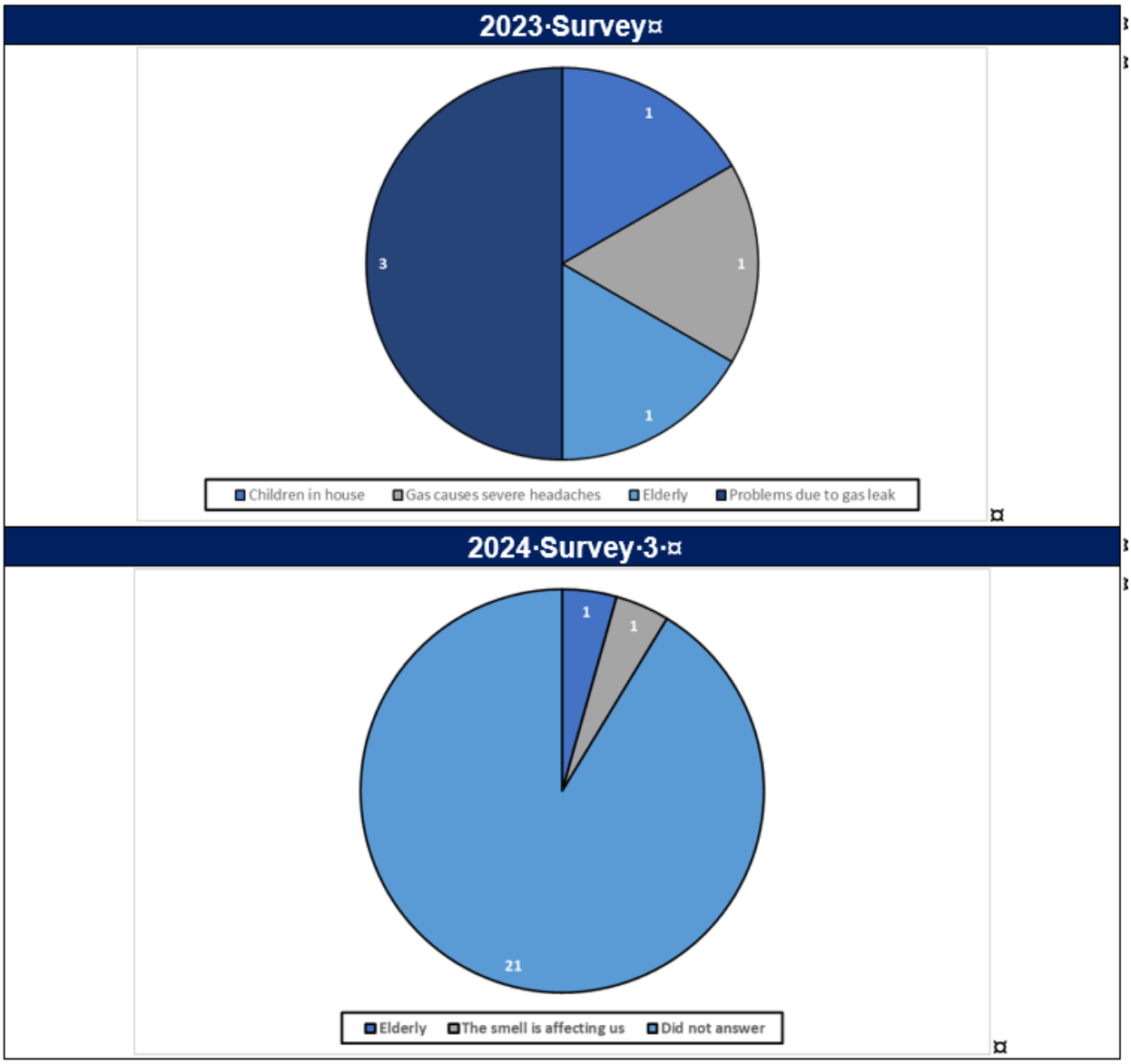


Figure 69: Thoughts on why the LPG heater is dangerous in 2023 and 2024

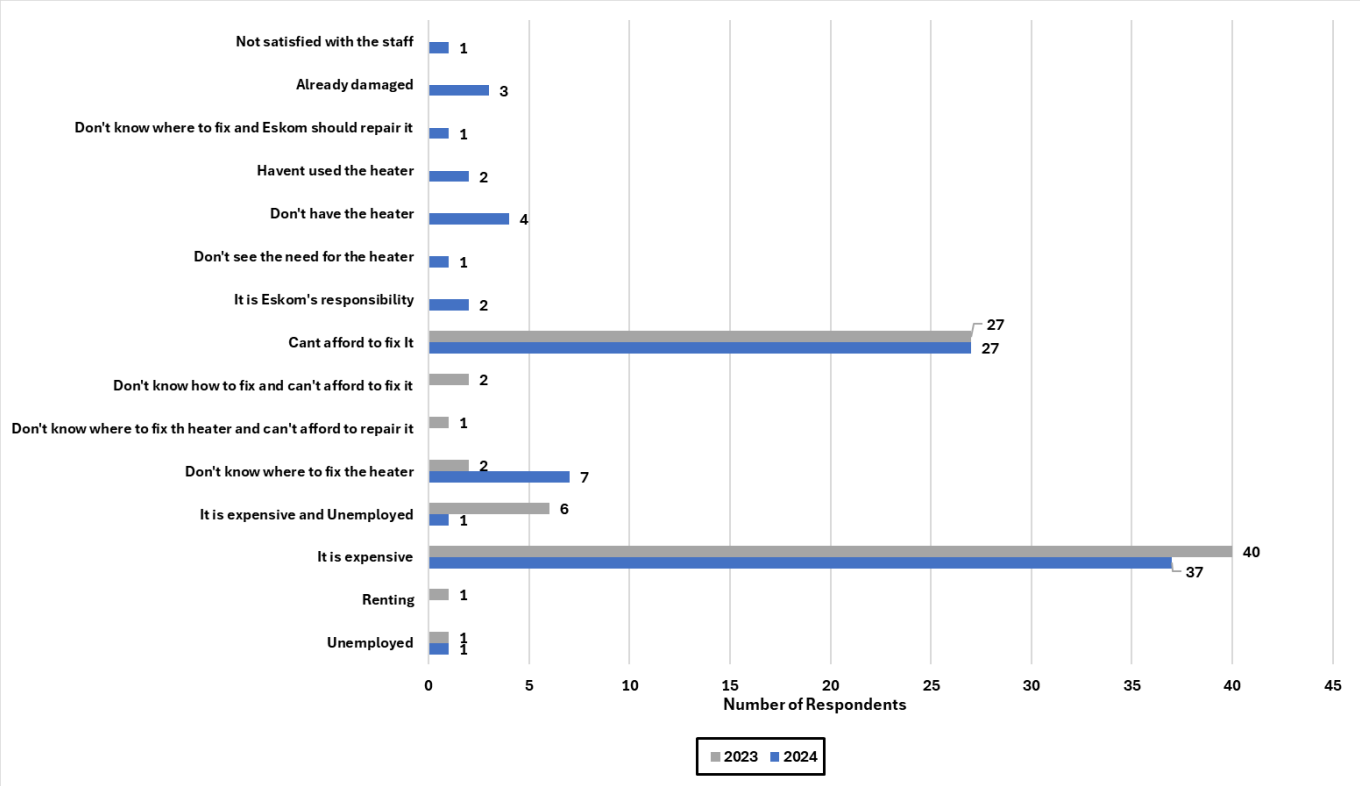


Figure 70: Why respondents will not fix the heater in 2023 and 2024

Respondents' Satisfaction with LPG Heater

Overall in 2023, 384 respondents (98.7%) indicated being happy with the LPG heater, with nearly all respondents (387 out of 389) recommending the LPG heater being installed in other households (Table 14), with the trend continuing in 2024 with 373 of respondents (97.1%) indicating that they are happy with the heater (Table 14). 383 respondents (98.5%) noted that their households are warmer after the LPG heater was installed in their household in 2023, and 368 respondents (96.5%) in 2024.

Figure 71 shows the respondents view on what can improved on the LPG heaters for 2023 and 2024. A majority of respondents had nothing to recommend for Eskom to improve regarding the LPG heaters in both 2023 (342 respondents) and 2024 (362 respondents) (Figure 71).

Table 14:Respondents' usage of LPG heater in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
LPG Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Usage of LPG	Happy with LPG Heater	384	5	370	11
	House is warmer after installation	383	6	368	13
	Would recommend LPG heater installation to other households	387	2	373	8

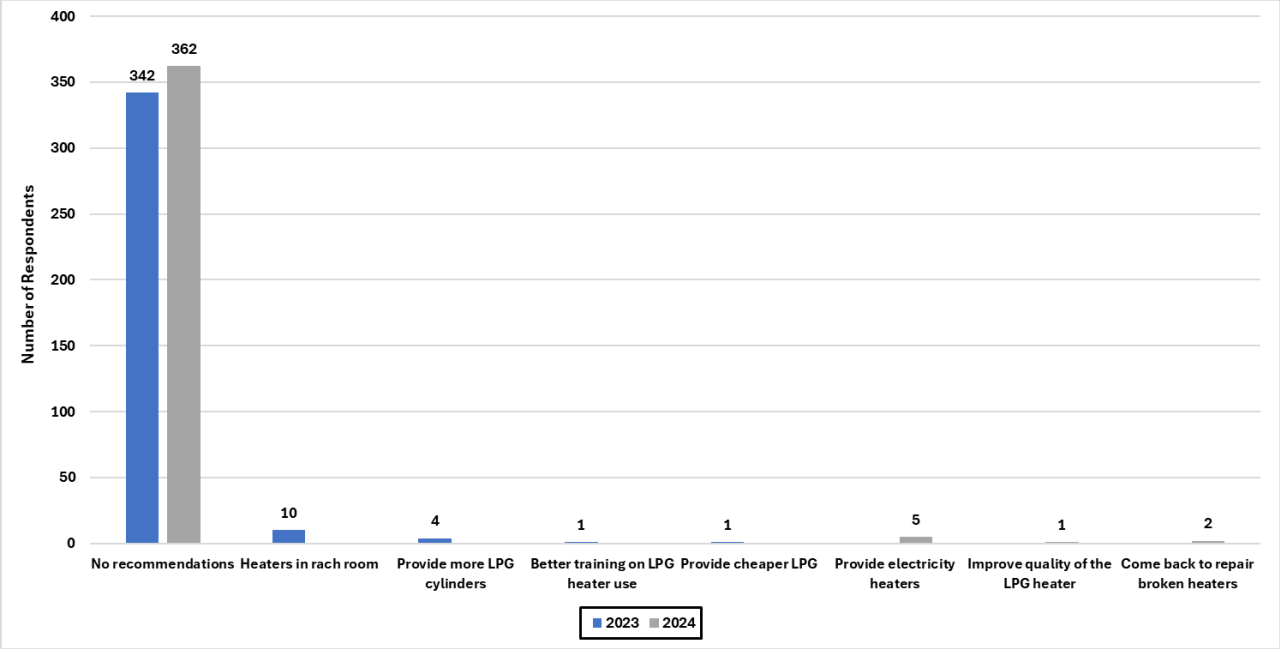


Figure 71:Respondents' view on how Eskom can improve on LPG heaters in 2023 and 2024

3.2.3 HYBRID GAS STOVE

Installation of Hybrid Stove

Of the 401 respondents interviewed, only 391 respondents had received the hybrid stove during the 2023 survey (Figure 72), 388 of respondents (99%) indicating they were happy with the quality of the hybrid stove. All the respondents indicated that the installation teams did not damage their homes during the installation (Table 15). In 2024, 372 respondents (97.6%) were happy with the quality of the stove, and none experienced the issue of the installation team damaging their household when installing the hybrid stove (Table 15).

Figure 72:Example of Installed Hybrid Stove

Table 15:Installation of hybrid stove in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Installation	Household has received the hybrid stove	391	10	N/A	
	Hybrid stove is of good quality	388	3	372	9
	Team damaged items when installing the hybrid stove	391	0	N/A	

Respondent Use of Hybrid Stove

The 2023 survey highlighted that since installation, 384 respondents' households (98.2%) hybrid stoves still look the same (Table 16). The 7 respondents (2.6%) that indicated that their stove did not look the same was due to malfunctions with the stove, or the stove being taken away from the property. Tables 16 to 18, summarise the hybrid stove faults for the 2023 and 2024 surveys respectively. The 2024 survey highlighted that a high number of respondents indicated that they do not have the stove, or the oven is no longer working (Table 18).

Two hundred and ninety-seven (297) respondents (76%) indicated that the hybrid stove was not more expensive to operate compared to the coal stove for 2023 (Table 25), whilst 335 respondents (87.9%) indicated that the hybrid stove was not more expensive to operate compared to the coal stove for 2024 (Table 26). Figure 73 is a graphical representation of why respondents find the hybrid stove more expensive to use than the coal stove for the 2023 and 2024 surveys. Both surveys indicate pricing of LPG refills, as well as the inability to buy gas bottles through a credit system as major reasons why the hybrid stove is more expensive to use than a coal stove.

In 2024, 366 of the respondents (96%) indicated that the stove still looks the same, with a majority of the remainder stating that the stove didn't look the same due to them not having the stove anymore

Only 4 respondents (1.3%) indicated in 2023 that their hybrid stove had become damaged or defective since delivery. Three hundred and eighty-two (382) respondents (97.7%) indicated that their stove and/or oven are operating properly since delivery. The respondents that do not have operating stoves/ovens indicated the following issues: 1) Buttons on the stove; 2) the burners not operating correctly; 3) Stoves tripping the electricity of the household when being operated (Table 16) for the 2023 survey. Sixteen (16) (1.3%) respondents indicated that their hybrid stove had become damaged or defective since delivery during the 2024 survey. Three hundred and sixty-four (364) respondents (97.7%) indicated that their stove and/or oven are operating properly since delivery (Table 26).

A barrier to transition from traditional fuels such as wood and coal to LPG technologies would be the desire to keep the taste of traditional foods the same[13]. Three hundred and eighty four (384) respondents (98,2%) indicated that the new hybrid stove cooked food faster than their traditional coal stove, and 377 respondents (98.2%) indicated that the food tastes the same (Table 16). Three hundred and eighty-two (382) respondents (99.2%) found the stove to be easy to use for the 2023 survey. In 2024, 373 respondents (97.9%) indicated that the new hybrid stove cooked food faster than their traditional coal stove, with 349 respondents (91.6%) indicated that the food tastes the same (Table 16).

[13] Urpelainen,J. "LPG as a Clean Cooking Fuel: Adoption, Use, and Impact in Rural India". Energy Policy. 2018 November ; 122: 395–408. doi:10.1016/j.enpol.2018.07.042.

Table 16: Respondents' use of hybrid stove in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Use	Hybrid stove still looks the same	384	7	366	15
	Hybrid stove became damaged or defective	4	387	16	365
	Does the stove and/or oven work properly	382	9	364	17
	Quicker to cook with new stove than coal stove	384	7	373	8
	Food tastes the same as food cooked on traditional coal stove	377	7	349	32
	New stove easy to operate	382	3	370	11
	More expensive to run hybrid stove than coal stove	94	297	46	335

Table 17 and Table 18 summarise the hybrid stove faults for the 2023 and 2024 surveys respectively. The 2024 survey highlighted that a high number of respondents indicated that they do not have the stove, or the oven is no longer working (Table 18).

Two hundred and ninety-seven (297) respondents (76%) indicated that the hybrid stove was not more expensive to operate compared to the coal stove for 2023 (Table 25), whilst 335 respondents (87.9%) indicated that the hybrid stove was not more expensive to operate compared to the coal stove for 2024 (Table 26).

Figure 73 is a graphical representation of why respondents find the hybrid stove more expensive to use than the coal stove for the 2023 and 2024 surveys. Both surveys indicate pricing of LPG refills, as well as the inability to buy gas bottles through a credit system as major reasons why the hybrid stove is more expensive to use than a coal stove.

Table 17: Hybrid stove faults in 2023

Hybrid Stove faults		
Issue	**Reason**	**Number of Respondents**
Why households' stove does not look the same	Broken button	2
	Electric plate is damaged	2
	Owner took stove	1
	The other plate is no longer working	1
Reason for stove being damaged or defective	Don't know the cause	1
	Electric plate is damaged	1
	One plate of the stove is damaged	1
	Stove is broken	1
Why respondents' stove/oven are not working	Electric plate damaged	1
	Not shown how to use stove	1
	Stove not installed	1
	We haven't used the stove	5

Table 18: Hybrid stove faults in 2024

Hybrid Stove faults		
Issue	**Reason**	**Number of Respondents**
Why households' stove does not look the same	Has stains and lid is broken	1
	Doesn't provide enough heat	1
	One plate is no longer working	1
	Given it to someone else	2
	They no longer have it	7
	It no longer has the grid for the pot	1
Reason for stove being damaged or defective	Electric plate is no longer working	2
	Never worked	1
	Stove is failing	1
	Switch off button doesn't work	1
	The other plate of the stove is no longer working	1
Why respondents' stove/oven are not working	Doesn't give enough heat anymore	1
	Haven't used it	2
	Never work	1
	Oven is not working	3
	The oven door can't be closed properly.	1
	They no longer have it	5
	Some of the plugs are not working	2

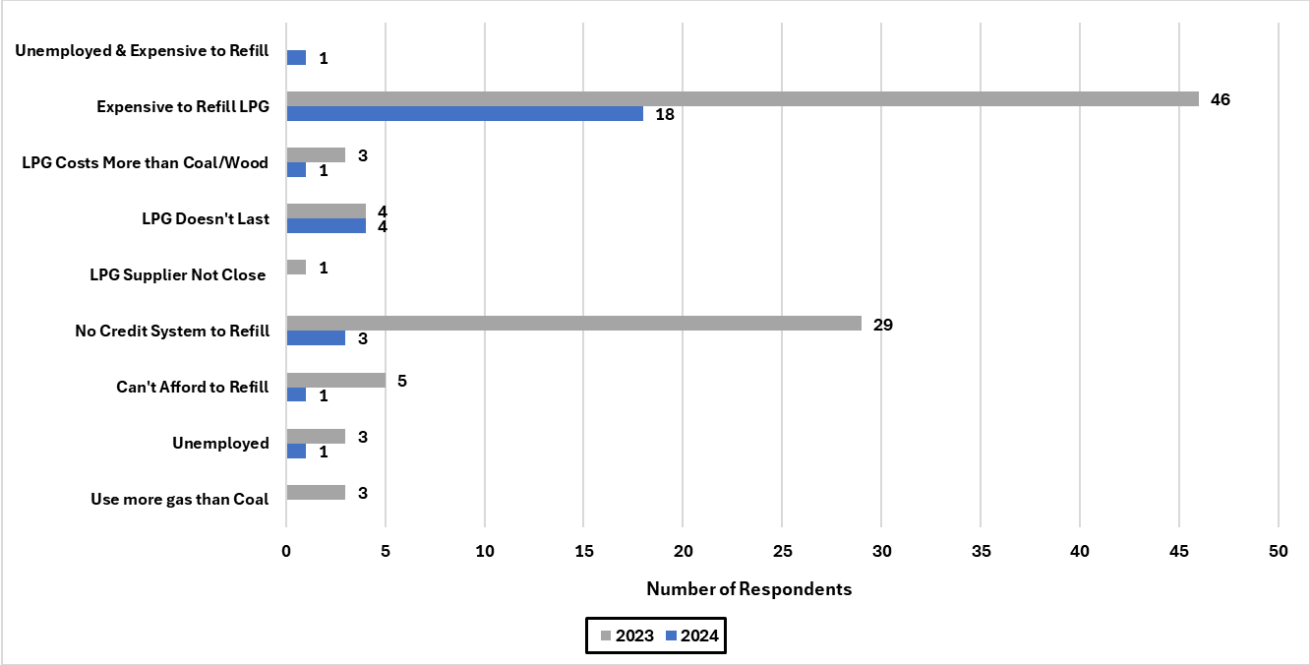


Figure 73: Why respondents find the hybrid stove more expensive to use than the coal stove in 2023 and 2024

Safe Use of Hybrid Stove

Three hundred and seventy-two (372) of the respondents (95.4%) received training on how to use the hybrid stove, but only 142 respondents (67.4%) know the safety protocol when gas is smelt in the house, whilst 50 respondents (12.8%) indicated that they would like to receive training during the 2023 survey (Table 19). It could be the case that the training received by the respondents was not as comprehensive as they needed, with a need for the installation contractors to identify where the possible gaps are in the training process. In 2024, 362 of the respondents (95%) received training on how to use the hybrid stove, but despite only 256 respondents (67.1%) indicated that they know the safety protocol when gas is smelt in the house (Table 19). One hundred and one (101) respondents (12.8%) indicated that they would like to receive training (Table 19). As stated before, it could be the case that the training received by the respondents was not as comprehensive as they needed.

Seven (7) respondents (1.8%) found the hybrid stove dangerous to use compared to the traditional coal stove for 2023, whilst 11 respondents (2.8%) found the hybrid stove dangerous to use compared to the traditional coal stove in 2024 (Tables 29 and 30).

The respondents in 2023 follow the same pattern as with the LPG heater with 312 respondents (79.8%) indicating that they would repair any future damage to the LPG stove, but 293 respondents (75.1%) indicated that Eskom should fix the damage. In 2024 the respondents follow the same pattern as the 2023 survey with 301 respondents (79%) indicating that they would repair any future damage to the LPG stove, but 230 respondents (75.1%) indicated that Eskom should fix the damage. (Table 19)

Figure 74 illustrates why respondents find the hybrid stove more dangerous to use in 2023 and 2024. A main reason is more care is needed when utilising LPG devices (not leaving the gas open).

Figure 75 highlights the reasons why respondents open windows and/or doors when using the hybrid stove in 2023 and 2024. One hundred and thirty-three 133; respondents (34%) (Table 19) open their windows and doors when using the hybrid stove for ventilation in 2023. Ninety-seven (97) respondents (34%) open their windows and doors when using the hybrid stove for ventilation and clearing the smell of the LPG in 2024.

Figure 76 highlights why respondents will not fix their damaged hybrid stove. In 2023 respondents that will not repair the damage cited the main reason to not fix the damage was the inability to afford the repairs or they find the repair process quite expensive and would not spend the money. In 2024 respondents that will not repair the damage cited the main reason to not fix the damage was the inability to afford the repairs or they find the repair process quite expensive and would not spend the money.

Table 19: Hybrid stove safety in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Safety	Receive training on how to use the hybrid stove	372	18	362	19
	Will you like to receive training on how to use the hybrid stove	50	341	101	280
	Is it dangerous to use the hybrid stove than a coal stove	7	382	11	370
	Know safety protocol when gas is smelt	263	127	256	125
	Windows and/or doors open when using hybrid stove	133	258	97	284
	Will you repair any damage in the future	312	79	301	80
	Should Eskom fix the damage	293	97	230	151

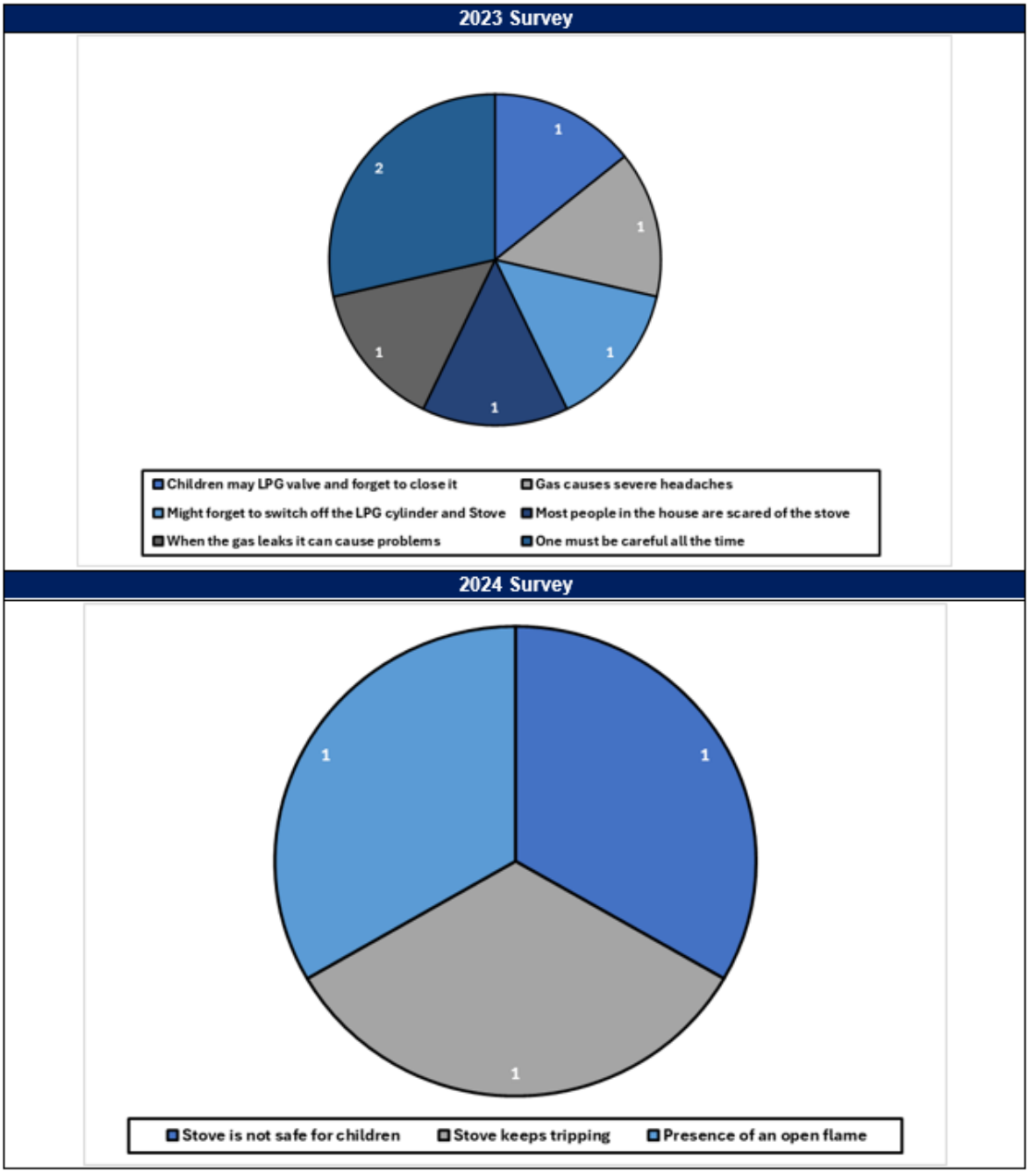


Figure 74: Why respondents find the hybrid stove more dangerous to use in 2023 and 2024

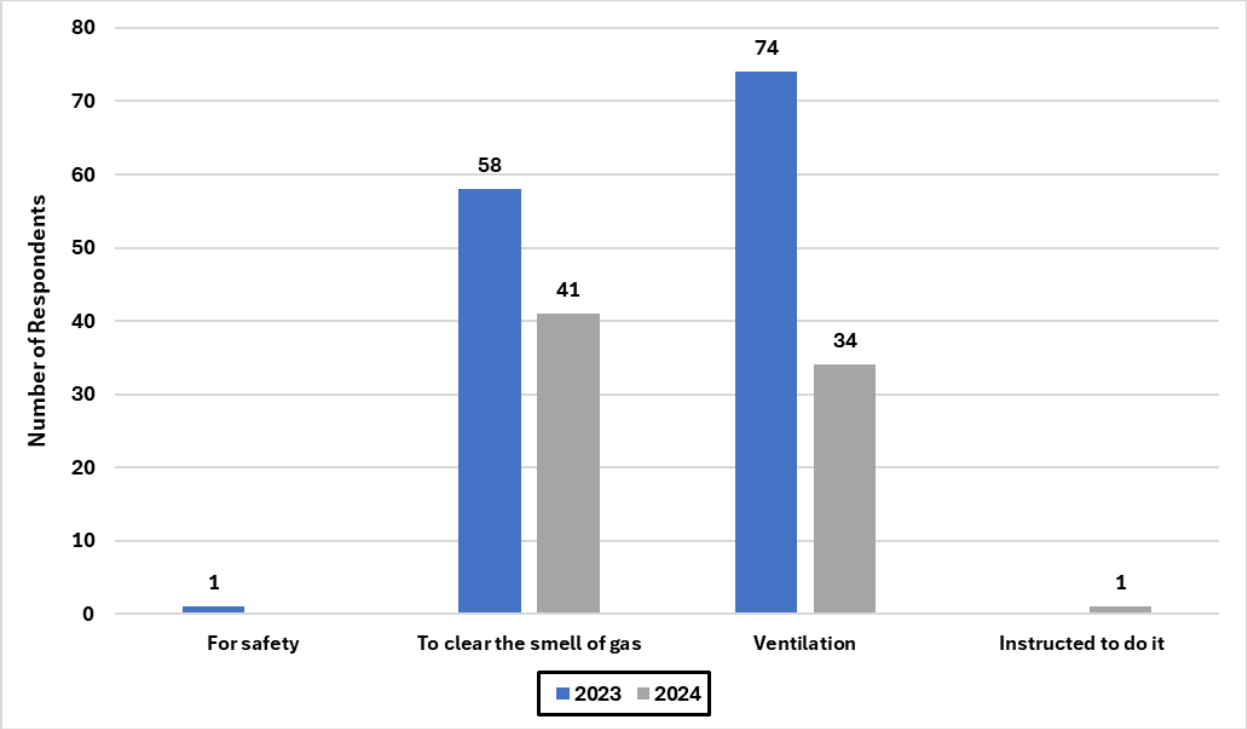


Figure 75:Why respondents open windows and/or doors when using the hybrid stove in 2023 and 2024

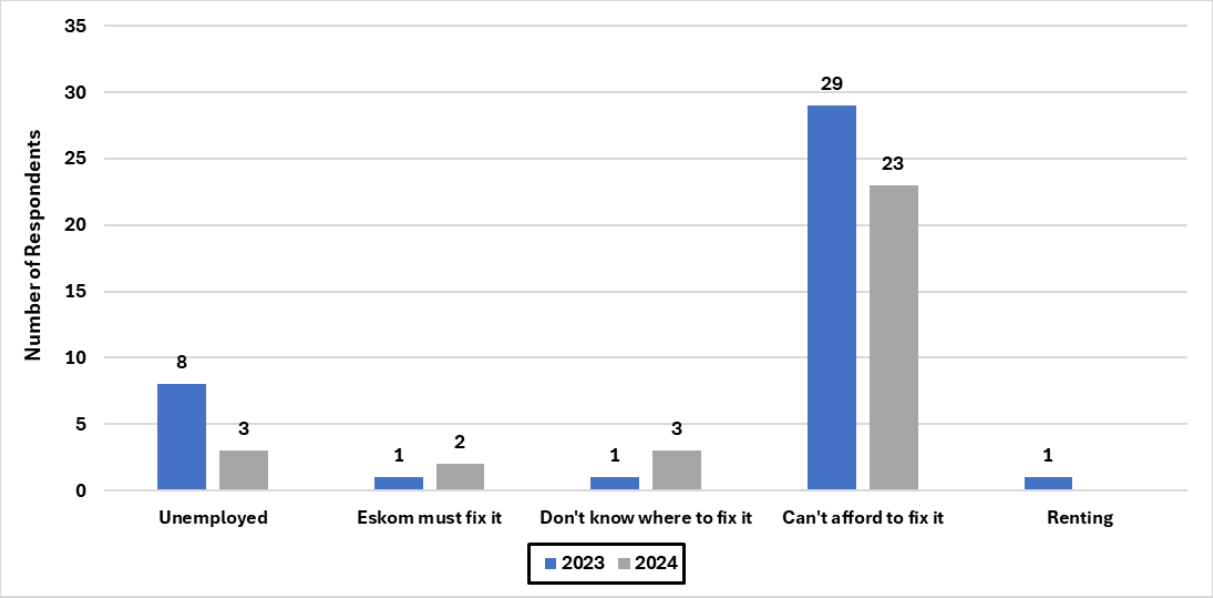


Figure 76: Why respondents will not fix the damaged stove in 2023 and 2024

Respondents' Satisfaction With Hybrid Gas Stoves

Overall, respondents were happy with the installed hybrid stove in 2023 and 2024 , with 386 respondents (98.7%) in 2023 and 375 respondents in 2024 (98.4%) (Table 20)

All the respondents in the 2023 survey recommended the installation of the hybrid stove, whilst 377 respondents (98.2%) in 2024 recommended the installation of the hybrid stoves(Table 20) in 2024.

Figure 77 shows the respondents recommendations on the hybrid stove can improved by Eskom in 2023 and 2024. When inquired as to how Eskom can improve the hybrid stove, a majority of respondents said nothing needed to be change, but some respondents recommended that the stoves have 2 electric plates and 2 gas plates for both surveys.

Table 20:Satisfaction with hybrid stove in 2023 and 2024

Ezamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Satisfaction	Happy with Hybrid stove	386	5	375	6
	Would Recommend Installation of Hybrid Stove in Other Homes	390	0	377	4

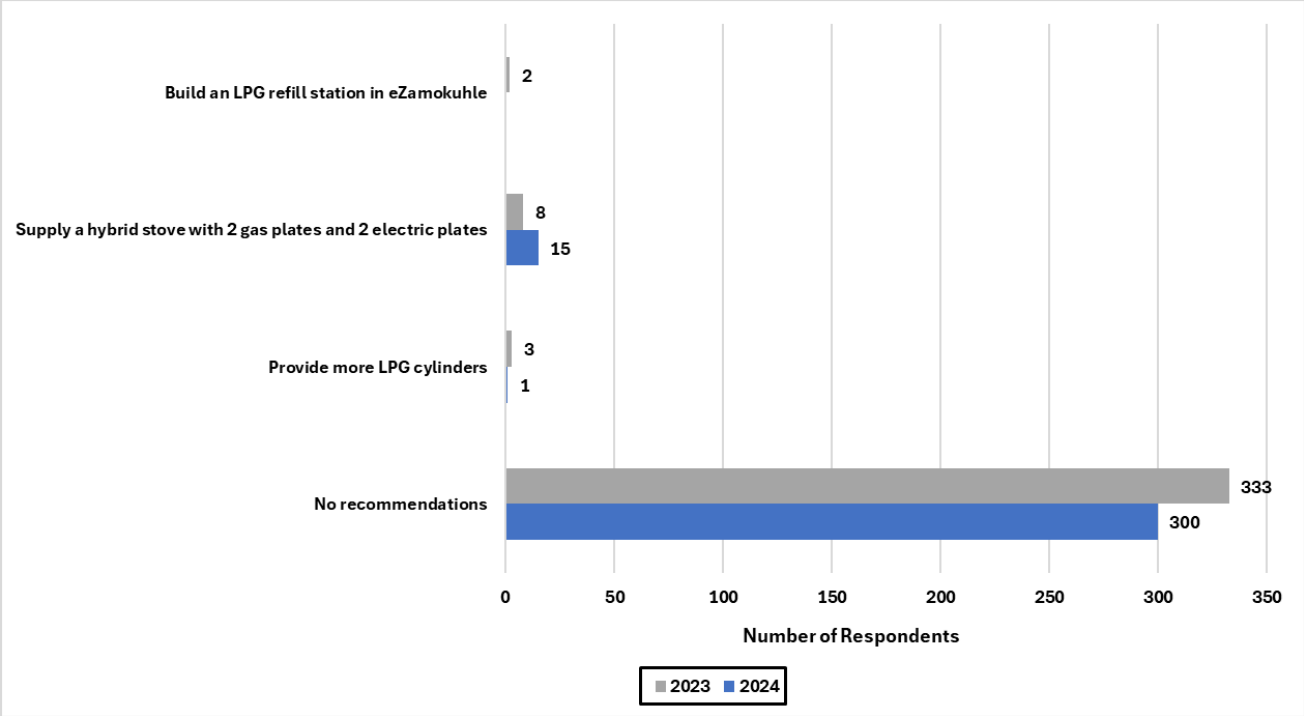


Figure 77:Respondents recommendations on how to improve the provided hybrid stove in 2023 and 2024

3.2.4 REWIRING INTERVENTION

In 2023, 399 respondents had received the wiring intervention as of December 2023 (Figure 78). Of the 399 respondents, 384 (96.2%) reported receiving wiring of good quality, whilst in 2024, 362 respondents (95%) reported receiving wiring of good quality. Only 3 respondents (0.8%) reported having the wiring team damage the household whilst completing the rewiring intervention in 2023.

In 2023 Three hundred and eighty-eight (388) respondents (97.2%) reported having their wiring looking the same as when installed, but sixteen (16) respondents (4%) reported having their wiring become damaged or defective mostly due to poor installation (Table 22). In 2024 367 respondents (96.3%) reported having their wiring looking the same as when installed, but 18 respondents (4.7%) reported having their wiring become damaged or defective mostly due to poor installation (Table 23).

Three hundred (300) respondents (75.2%) received a certificate of compliance (COC),with 164 respondents (Table 21) indicating that they did not know that they are supposed to receive a COC (Figure 79). This is concerning for households without the certificate, as households will not be able to claim from their insurance where issues arise from the installed wiring. It would be beneficial for Eskom to ensure that the households receive this certificate and do a check with the installation teams to ensure that these certificates are distributed to the completed households. An increase in respondents that received a certificate of compliance is noted, with 356 respondents in 2024 (93.4%) (Table 21)

Three hundred and ninety-two (392) respondents (98.2%) recommended having the wiring redone in other houses in 2023 (Table 21). The other 7 respondents wouldn't recommend the installation due to their negative experiences with the installation in their households, mostly of the installation team not completing the work. Three hundred and sixty-five (365) respondents (95.8%) recommended having the wiring redone in other houses in 2024 (Table 21). The other 18 respondents wouldn't recommend the installation due to their negative experience with the installation in their households, mostly due to the poor installation of the plugs.

Figure 80 shows respondents view on what Eskom can do to improve on the rewiring intervention in 2023 and 2024. Respondents mostly had no recommendations, other than the installation of double plug points in the households rather than the single plug points that were installed in this campaign.

Figure 78:Example of wiring installed in households

Table 21:Wiring installation in 2023 and 2024

eZamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No	Yes	No
Installation	Received wiring intervention	399	2	401	
	Wiring is of good quality	384	15	362	12
	Did you receive a certificate of Compliance	300	99	356	18
	Installation team damaged household	3	396	N/A	N/A
	Does electrical wiring look the same as when installed	388	11	367	7
	Electrical wiring became damaged or defective	16	383	18	356
	Recommend rewiring to be done at other households	392	7	365	9

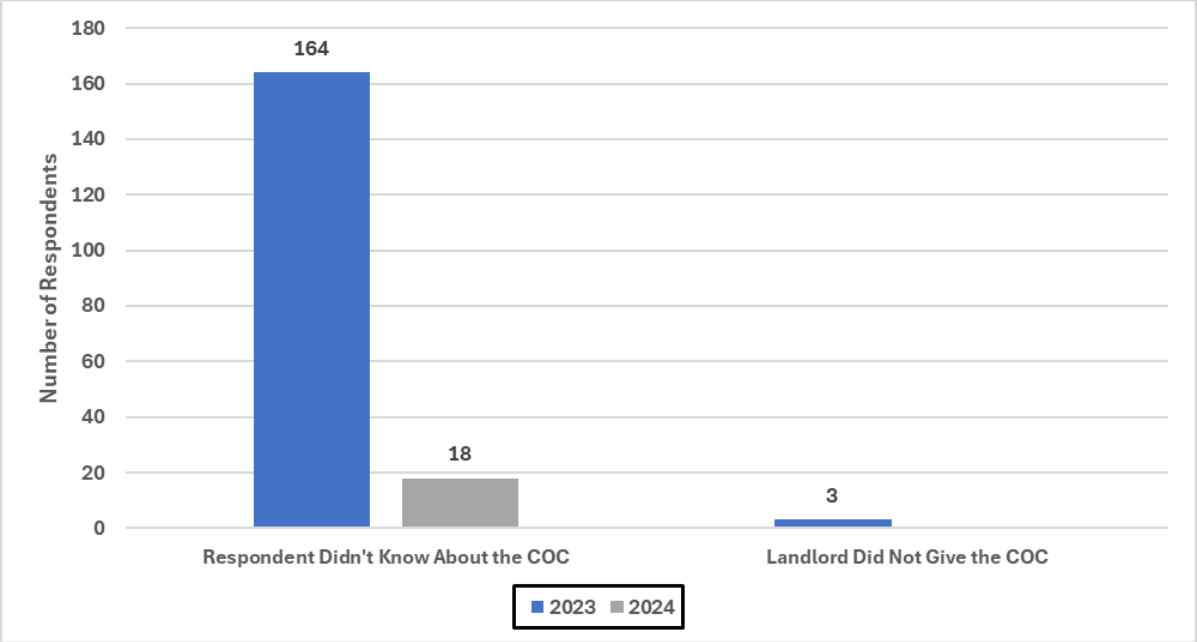


Figure 79:Reason respondents did not receive a Certificate of Compliance (COC) in 2023 and 2024

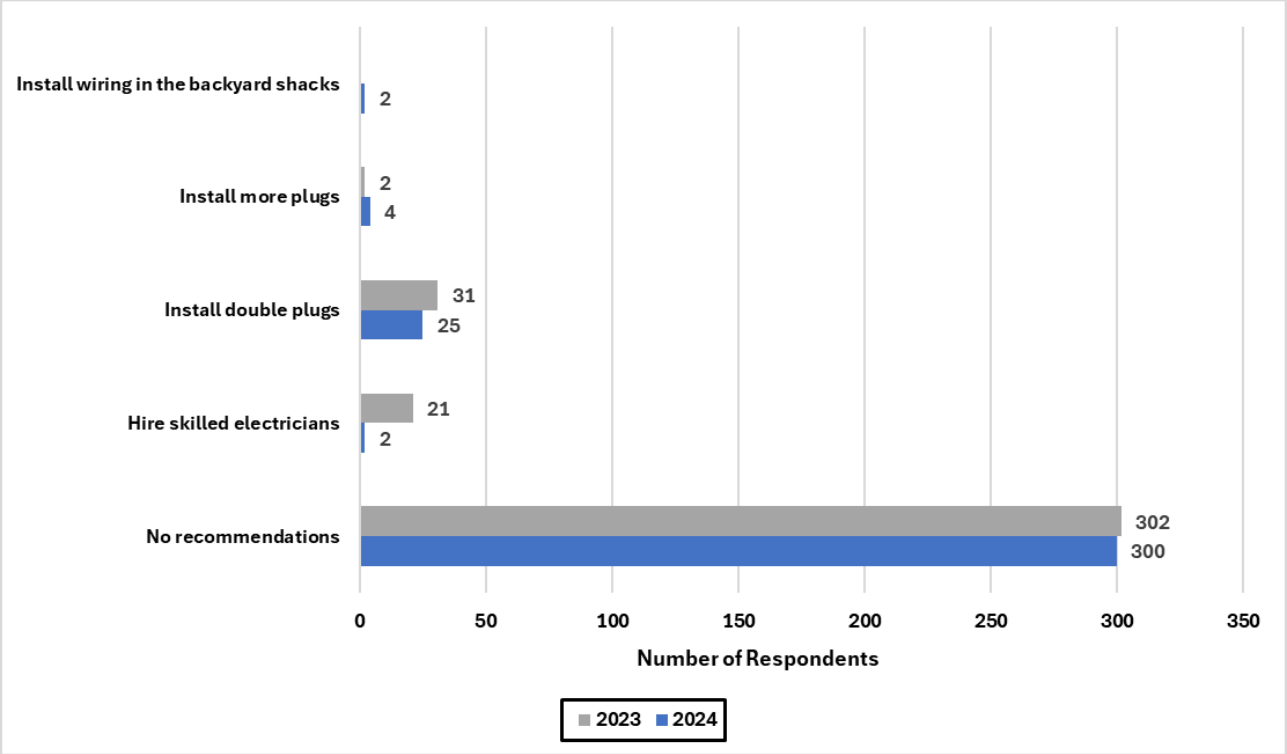


Figure 80: Respondents' recommendations on how to improve the rewiring interventions

Table 22:Faulty wiring in household feedback in 2023

Faulty Wiring in Household		
Issue	**Reason**	**Number of Respondents**
Why wiring is not of good quality	Db not connected	1
	It is more exposed	1
	Lights don't work properly	1
	No proper connection	1
	Only 1 pipe is not good	1
	Other switches were not installed	1
	The plugs are not working	2
	There is a fault	1
	Unfinished job	6
Cause of Defective Wiring	Didn't install it properly	1
	Don't know	2
	incomplete installation	3
	It just stopped working	1
	Never worked since installation	1
	Kettle	1
	Light problem	2
	Poor installation	5

Table 23:Faulty wiring in household feedback in 2024

Faulty Wiring in Household		
Issue	**Reason**	**Number of Respondents**
Why wiring is not of good quality	DB box is not good	1
	Electricity meter not working	1
	It trips every time	2
	Some lights don't work after installation	4
	The rewiring	1
	There are lose wires	2
Cause of Defective Wiring	Cable fault	1
	Don't know	5
	Loose nails	1
	Poor wiring	3

3.2.5 REGRESS

In 2023, three hundred and ninety-seven (397) respondents (99.2%) viewed electricity subsidies as a necessary incentive to keep households from regressing back to coal stoves and abandoning their new hybrid stoves (Table 24). In 2024, 373 respondents (97%) viewed electricity subsidies as a necessary incentive to keep households from regressing back to coal stoves and abandoning their new hybrid stoves (Table 24).

No respondents indicated they have purchased another coal stove in 2023, with only 1 household indicating they have another coal stove that they use. Only 5 respondents (1.2%) indicated they would give back the hybrid stove or LPG heater for a brand-new coal stove in 2023. Four (4) respondents indicated they have purchased another coal stove in 2024, with three (3) respondents indicating they have another coal stove that they use (Table 24). Only 13 respondents (3.4%) indicated they would give back the hybrid stove or LPG heater for a brand-new coal stove in 2024.

In 2023, 361 respondents (91.4%) preferred to use the LPG heater as the preferred method to warm the home compared to coal. Three hundred and sixty-four (364) respondents (95%) preferred to use the LPG heater as the method to warm the home compared to coal in 2024. (Table 24)

Three (3) respondents (0.8%) will be moving away in 2023, with 2 respondents moving due to high rent and the other respondent having their lease lapse at the end of 2024 (Table 24). Seven (7) respondents (1.8%) will be moving away in 2024 with 2 respondents moving due to high rent and the other respondent having their lease lapse at the end of 2024 and some seeking to move to their own property.

Figure 81 shows which intervention respondents thought made the biggest difference to them. In 2023 respondents found the ceiling (190; 47.5%) as their most preferred intervention, followed by the hybrid stove (127; 31.8%) and then the LPG heater (83; 20.8%). In 2024 206 respondents (54.1%) found the ceiling as their most preferred intervention, followed by the hybrid stove (121; 31.8%) and then the LPG heater (54;14.2%).

Figure 82 shows respondents' satisfaction with the interventions in 2023 and 2024. It is positive to note that in 2023 342 of the respondents (85.5%) are satisfied with the interventions, and only 4 respondents (1%) being somewhat unsatisfied. In 2024 294 of the respondents (77%) are satisfied with the interventions, and 30 respondents (7.8%) being somewhat unsatisfied. The increase in unsatisfied respondents could be related to the increased issues experienced with the ceilings leaking due to the heavy rains

Figure 83 shows the reasons as to why respondents would give back their hybrid stove or LPG heater for a brand-new coal stove. In 2023 and 2024 respondents who indicated they give back their hybrid stove stated the main reason being that they find coal to be cheaper than LPG and electricity

Figure 84 shows respondents' responses when asked what they view as future threats to the Eskom offsets project in eZamkouhle in 2023 and 2024. In 2023 respondents viewed the burning of fuels such as coal and wood to be the biggest threats to the offsets project, whilst in 2024 respondents would view the burning of coal and wood, and the informal dumping sites in eZamokuhle to be threats to the project.

Table 24: Intervention regress in 2023

Ezamokuhle Post Eskom AQO Intervention Roll-out		Number of Respondents			
Hybrid Stove Intervention					
		2023		2024	
Section	Question	Yes	No		
Regress	Electricity subsidy will promote use of stove	397	3	373	7
	Have you purchased another coal stove	0	401	4	377
	Would you give back the hybrid stove or LPG heater for a brand-new coal stove	5	396	13	368
	Which one do you prefer to heat your home: LPG heater or coal?	361	34	364	17
	Will you be moving away from this house in 2024	3	398	7	374
	Do you have another coal stove in your home	1	400	3	378

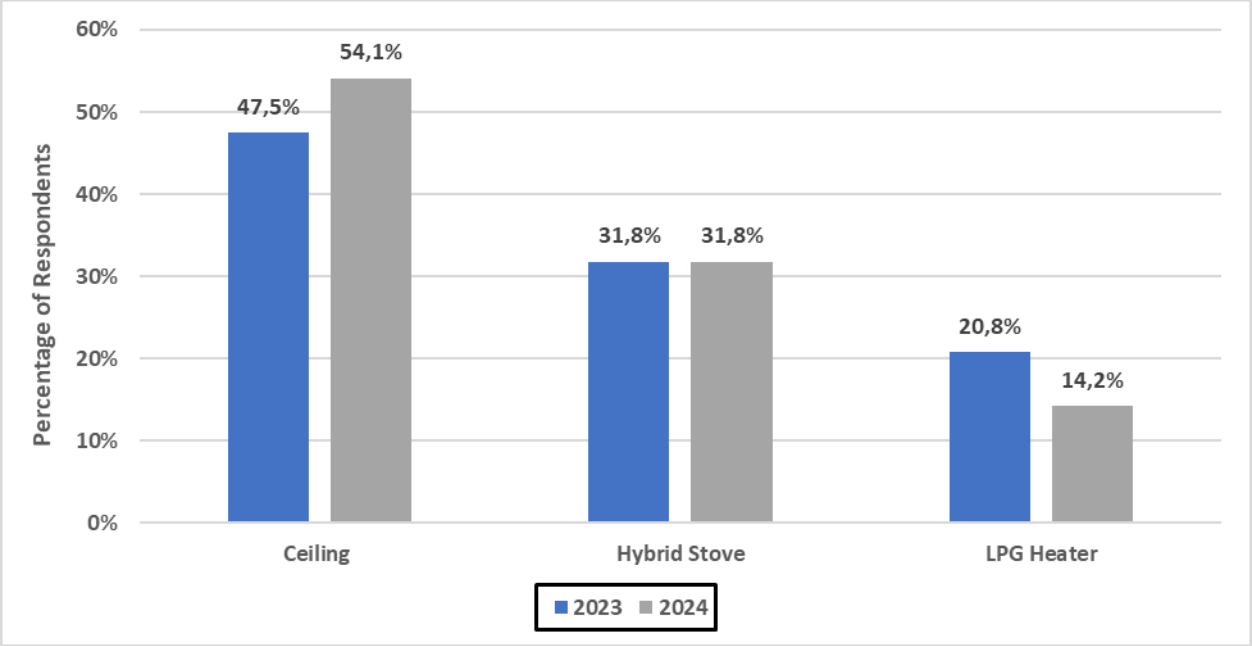


Figure 81: Which intervention the respondents view made the biggest difference to them in 2023 and 2024

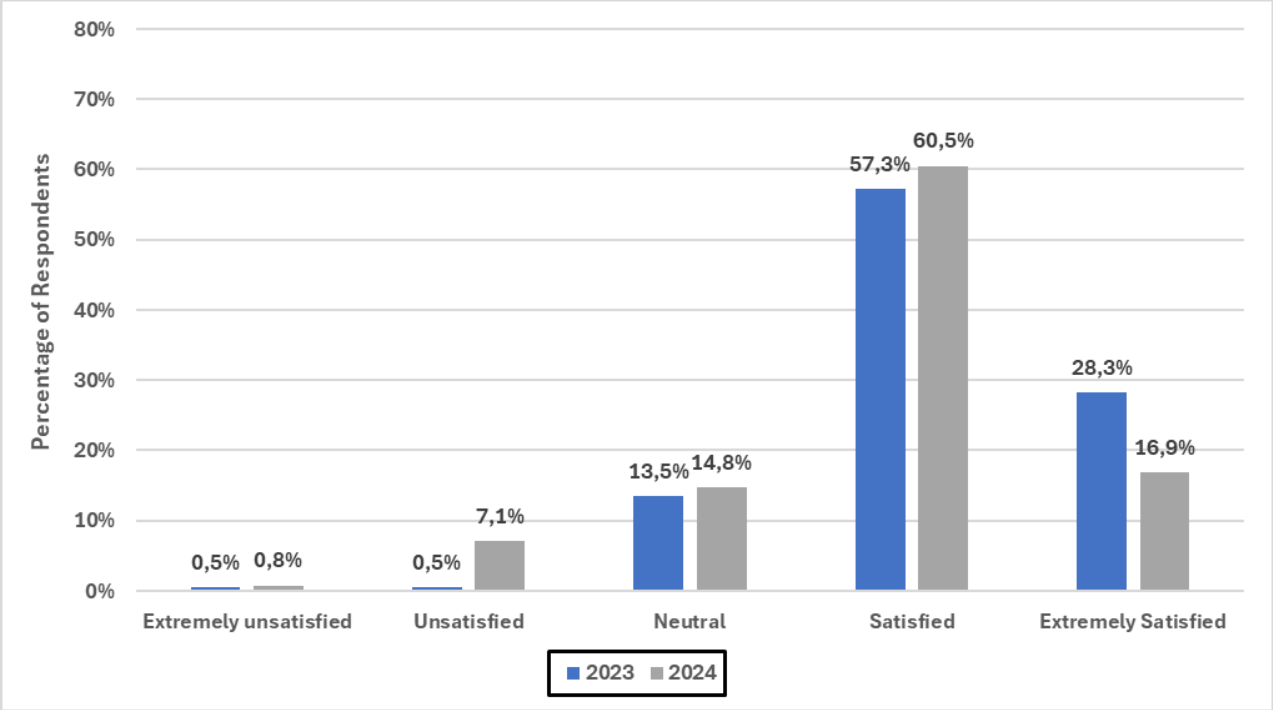


Figure 82:Respondents satisfaction with interventions in 2023 and 2024

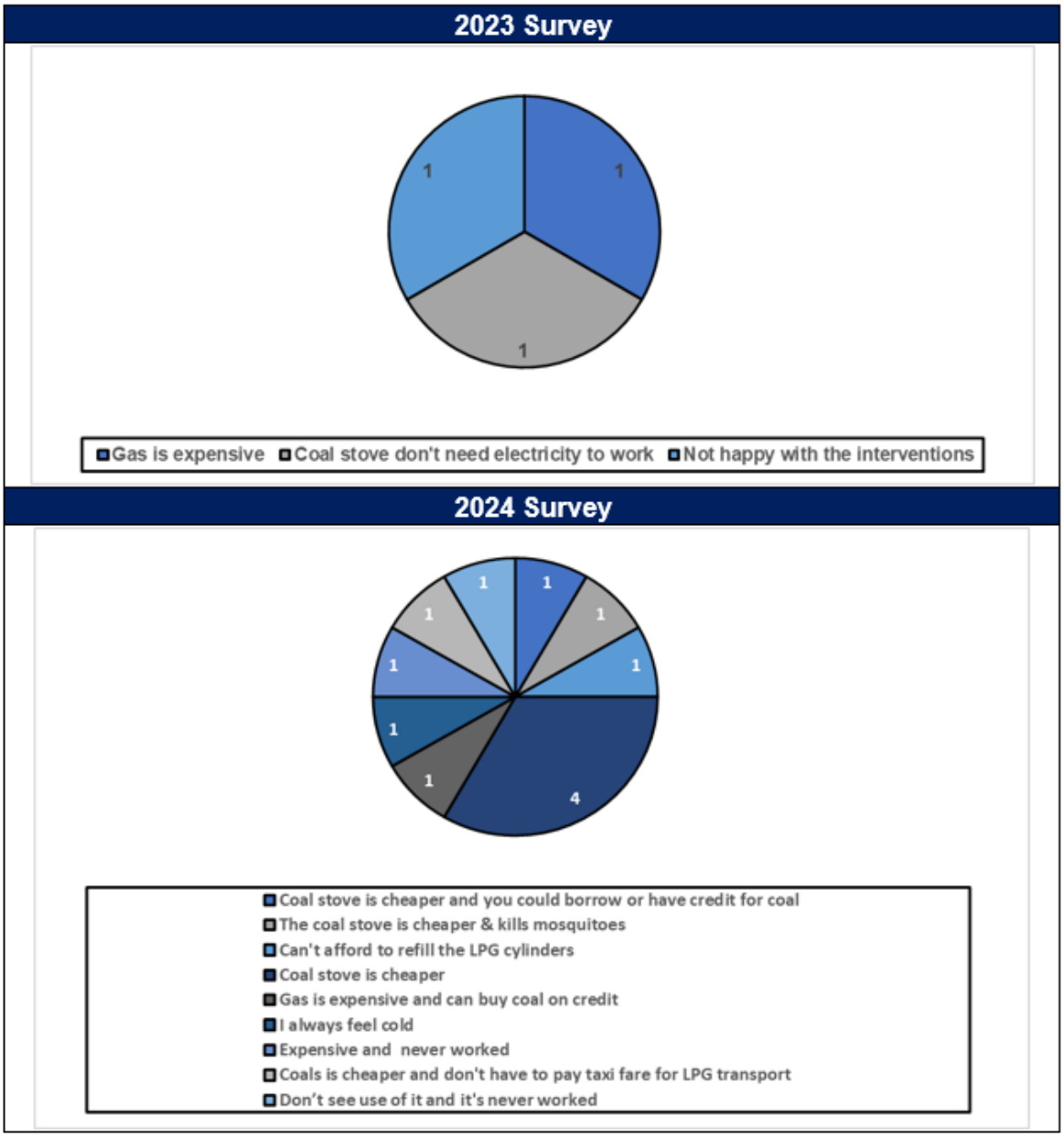


Figure 83: Why respondents would give back the hybrid stove for a brand-new coal stove in 2023 and 2024

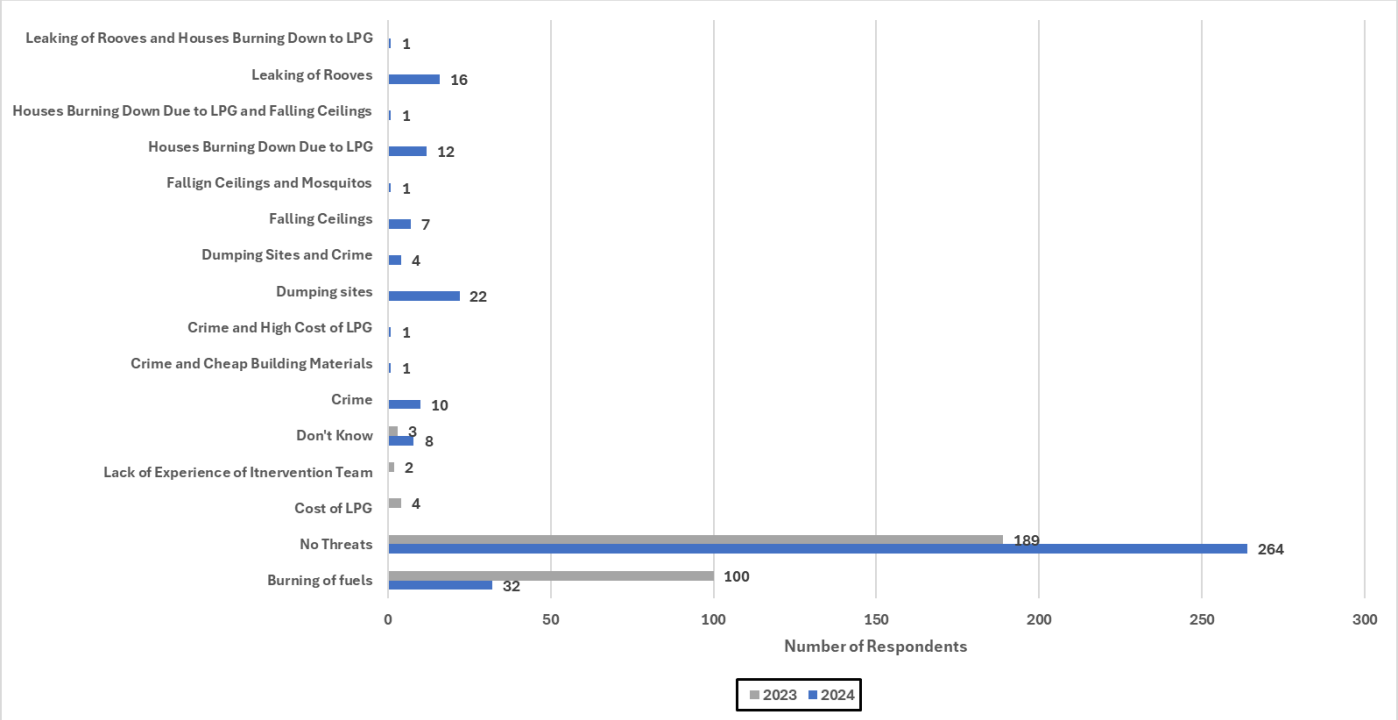


Figure 84: Respondents views on what they see as the biggest threats to Eskom's air quality offset in 2023 and 2024

3.2.6 Focus Group Interviews

3.2.6.1 Activation & Registration Process (2023)

The interviewed respondents viewed the sign-up process as an easy process but indicated that they had communication issues. The communication issue was that the installation teams had not indicated when they would be coming to commence the indoor retrofits and the subsequent installations of the gas devices. This would force households to make rushed arrangements to prepare the household for disturbances to their daily schedule and living arrangements. Another problem was that the teams created a misunderstanding with the respondents as to what the teams will be doing at that particular home e.g. will SPF be done. As such, they recommended that the installation teams utilise an SMS system to notify households of: 1) When the team is installing the ceiling and applying the spray foam,2) when they will be installing the gas devices, 3) Time to be spent at the household with timelines for each process. The participants also highlighted that the teams would not complete the job and would be halfway with one task and only come back later to finish the task at a much later time or not at all.

3.2.6.2 Project execution (2023)

As noted from the project effectiveness questionnaire in the previous section, the households were generally happy with the work done by the installation teams, but not the case for the participants. The participants noted that the installation teams were not professional with the work that was completed, with the DB boxes left incomplete and ceilings half finished. The respondents also felt that the teams could not be approached to assist in fixing the major issues or to complete the unfinished work.

With regards to the wiring work done by the installation teams, the focus group was generally not happy with the installation. The group did indicate that one aspect that could be improved is to communicate with the household if they would like to have the plugs installed or not. As the homes have limited space, the households would have a set arrangement for appliances and furniture to

be placed in specific areas of the house. As such, new plug placements executed without the homeowners input add further limitations to how the occupants can place their belongings. The participants suggested that uniformity is needed with the plug points as some households had different sized plug points installed. The group concluded that Eskom must run checks on the work done and be stricter on the qualifications of the teams selected to do the work.

3.2.6.3 Interventions (2023 & 2024)

- **Hybrid stove and heater in 2023**

An important aspect of the households receiving the hybrid stove and gas heater, is for the households to receive a form of safety training on how to utilise the new technologies. The focus group did indicate that they had received the needed training to use the gas devices, along with the needed safety guidelines for safe operation. They did indicate that an education campaign targeted at the elderly community members would assist in easing the older age groups into using gas technologies. They also suggested that a better way to transport the gas bottles for the elderly be introduced.

The participants indicated that delivery of the gadgets has been major challenge for them when it comes to the introduction of the gas technology. Despite the participants finding the gas heaters more expensive to use, they find that they use the heaters less due to the better insulation of the ceiling.

- **Hybrid stove and heater in 2024**

In the 2024 FGI, the interviewees indicated that after a year of using the hybrid stove, they are satisfied with the cooking time and how much easier it is to manage the heat when cooking compared to the coal stove, as they had to babysit their meals to prevent them from burning their food.

As the focus group has now experienced a winter season with the LPG heaters, they have noted that the heaters are an intervention they greatly appreciate as it has been easier to keep the rooms warmer than an umbaula, One suggestion from the group was for the heaters to come as a hybrid heater with the option for electricity or LPG use as the current pricing for LPG makes the heater still quite expensive to use.

- **Ceiling (2023)**

The households were overall happy with the ceiling and found their households were warmer after the installation was concluded.

- **Ceiling (2024)**

Some ceilings were reported as still being in good condition and keeping their homes warm, but some reported having leaks that have resulted in some households removing the lighting fixtures when heavy rains started. The group also indicated a large number of residents have reported having issues with their ceilings such as holes forming from the leaks due to the heavy rains experienced between December 2024 and January 2025.

3.2.6.4 Sustainability

When asked if the members of the focus group would utilise the hybrid stove and gas heater for five to ten years and past that. A point that they raised for both the 2023 and 2024 FGI was regarding the maintenance of the gadgets and ceiling. They viewed the ceiling as something Eskom would have to be responsible for maintaining the roof and would not want Eskom to financially compensate the homeowners as they find it difficult and time consuming to find reliable and reasonably priced contractors to do that work.

In 2023 the focus group indicated that a major threat to the offsets project's sustainability is the lack of a local gas distributor. At the time, the households were paying R380 for gas refills in Standerton and at the local Total garage. The local Bhyat Mica only exchanges gas bottles, which the residents prefer not to do in case they receive defective or old gas bottles. As gas refills were a challenge in the area, some residents have been assisted by others to refill gas bottles in nearby

towns, but that method has led to some being targets of scammers who take the gas bottle and the residents' money. In 2024 the focus group indicated that the number of suppliers has not changed, with the exception of a local supplier being present in eZamokuhle, who is able to deliver to residents who have made orders beforehand. The group still reiterated that more local suppliers should be present in eZamokuhle, with the coal merchants being integrated as part of the energy supplier ladder as distributors of LPG.

In 2023 the group viewed the ceilings as sustainable, but for the AQO intervention to be successful, Eskom would have to assist with maintenance of ceilings if issues arise. This is further supported by the results noted in the 2023 annual household survey where 76.5% of respondents indicated Eskom should be liable to fix any leaks or damage to the roof. In 2024 the group indicated that the ceiling is currently unsustainable due to the large number of households experiencing problems with leaks,as well as those that are collapsing.

3.2.6.5 Perception of Air Quality

When asked about the air pollution situation in the eZamokuhle area in the 2023 FGI, the focus group indicated that the air is cleaner for them within the community and the homes, and that the project has assisted in cleaning the air in the community. When asked what they viewed as the main contributor to air pollution in eZamkuhle, they indicated that other people in the area who burn coal and also burn shoes for utilizing the material for other activities.

In 2024 the focus group indicated the same feedback as above but added that the mosquitos have become a problem I the area. Waste burning is viewed as the current air quality threat to the area but have noted that the community is policing the waste burning areas by preventing waste burning from occurring in random locations close to residents.

4. RECOMMENDATIONS

It's evident from the results that the residents are overall satisfied with the current project interventions and view the interventions as a positive influence for the community. However, certain areas of the project have been identified to have hurdles that can prove to be an issue in the future for this community and future communities that will be involved with the next phase of the offsets project.

Taking the above into account, its ARM's recommendation that the following areas are considered:

1) Ceiling interventions need to be sustainable for the households:
    - It is recommended that inspections are carried out immediately after implementation has been concluded and a time period after the installation is completed
2) Hybrid stoves:
    - It's recommended a well-established LPG distribution provider is needed for the community to prevent the possibility of regress due to difficulties in obtaining LPG locally
3) Wiring interventions:
    - It's recommended that certificates of compliance are made mandatory for insurance purposes
    - Better communication lines between the sub-contracting team and the residents need to be established to keep a healthy relationship with Eskom and the community

Through the household surveys, households were approached about their views on what they would recommend Eskom do to improve the interventions:

1) Ceiling interventions:

- It's recommended that Eskom ensures the sub-contractors hire more skilled/experienced people
- It's recommended that better building quality materials are used, especially for the cornices

- It's recommended that the teams take more care into the finish of the interior (better painting, better glue and better ceiling finish) Installations of the different aspects of the roof (cornice, metal roofing, ceiling) need to be inspected after the work is done

2) LPG heaters:
    - Respondents want more gas cylinders to be provided for the heaters
    - It's recommended that heaters are provided per room of a household

3) Hybrid stoves:
    - Majority of respondents requested that the stoves have 2 plates that use electricity and 2 plates that use gas.
    - Respondents recommended that more gas cylinders are provided to the households
4) Wiring interventions:
    - It's recommended that double plug points are installed instead of the single point plugs
    - It's recommended that Eskom ensures the sub-contractors hire more skilled/experienced people

ARM held a FGI with the selected households that had participated in the Eskom AQO project (section 3.7). The recommendations from the respondents included the following:

- ✓ Teams need to complete the work done in each household
- ✓ It's recommended a better way to transport gas bottles for the elderly is introduced
- ✓ It's recommended that an education campaign targeted at the elderly community members would assist in easing the older age groups into using gas technologies
- ✓ It's recommended a better way to transport gas bottles for the elderly is introduced
- ✓ Participants suggested that uniformity is needed with the plug points as some households had different sized plug points installed
- ✓ It's suggested that the sub-contractors communicate with the household as to whether plug points can be installed or not

Table 25:Summary of Recommendations from the Household Survey

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
1. Ceiling intervention	▪ It is recommended that inspections are carried out immediately after implementation has been concluded and a time period after the installation is completed	▪ It's recommended that Eskom ensures the sub-contractors hire more skilled/experienced people ▪ It's recommended that better building quality materials are used, especially for the cornices ▪ It's recommended that the teams take more care into the finish of the interior (better painting, better glue and better ceiling finish)	▪ Teams need to complete the work done in each household

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
2. LPG Heater	5. A targeted awareness and safety training in terms LPG to the old female (60 to 99) adult segment may plausibly result in a higher uptake herein.	6. Respondents want more gas cylinders to be provided for the heaters 7. It's recommended that heaters are provided per room of a household	8. It's recommended a better way to transport gas bottles for the elderly is introduced

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
3. Hybrid stove	9. A well-established LPG distribution provider is needed for the community to prevent the possibility of regress due to difficulties in obtaining LPG locally	10. Majority of respondents requested that the stoves have 2 plates that use electricity and 2 plates that use gas. 11. Respondents recommended that more gas cylinders are provided to the households	12. It's recommended that an education campaign targeted at the elderly community members would assist in easing the older age groups into using gas technologies 13. It's recommended a better way to transport gas bottles for the elderly is introduced
4. Wiring Intervention	14. The ARM team recommends that certificates of compliance are made mandatory for insurance purposes 15. Better communication lines between the sub-contracting team and the residents need to be established to keep a healthy relationship with Eskom and the community	16. It's recommended that double plug points are installed instead of the single point plugs ▪ It's recommended that Eskom ensures the sub-contractors hire more skilled/experienced people	17. Participants suggested that uniformity is needed with the plug points as some households had different sized plug points installed 18. It's suggested communicate with the household be open to allow for plug points to be installed or not

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
19. Other	20. Eskom to develop suitable financing models (such as credit) with local retailers & fuel merchants for the supply and access to gas in the community. 21. Given the rising cost of living, we propose offering 5kg and 9kg LPG cylinders instead. The more affordable 5kg cylinder will contribute to long-term sustainability of Eskom's AQO Project. 22. Eskom to establish a network of community technicians capable of offering both repairs and replacement parts for the provided stoves. 23. Eskom consider replacing any rusted components of the roof prior to application of the SPF celling. 24. Implementing dust suppression/solutions of unpaved roads in low-income settlements 25. Implementing veld fire management solutions 26. Eskom evaluates the feasibility of mini and micro grids in appropriate locations 27. Eskom in conjunction with local municipalities assess the potential for biogas generation from Waste and Sewage treatment plants. 28. Eskom to consider the feasibility and viability of paving the unpaved roads. 29. Rollout of carpets to households to aid in improving the thermal	31.	32.

Recommendations proposed for consideration			
Theme	**ARM**	**Respondents**	**Focus Group Interviewees**
	comfort of the homes in winter 30. Fruit and vegetables are not grown nor sold on the properties except for a few exceptions. An opportunity could exist to promote the development of subsistence market gardens which may directly help to reduce fugitive dust emissions in the area.		

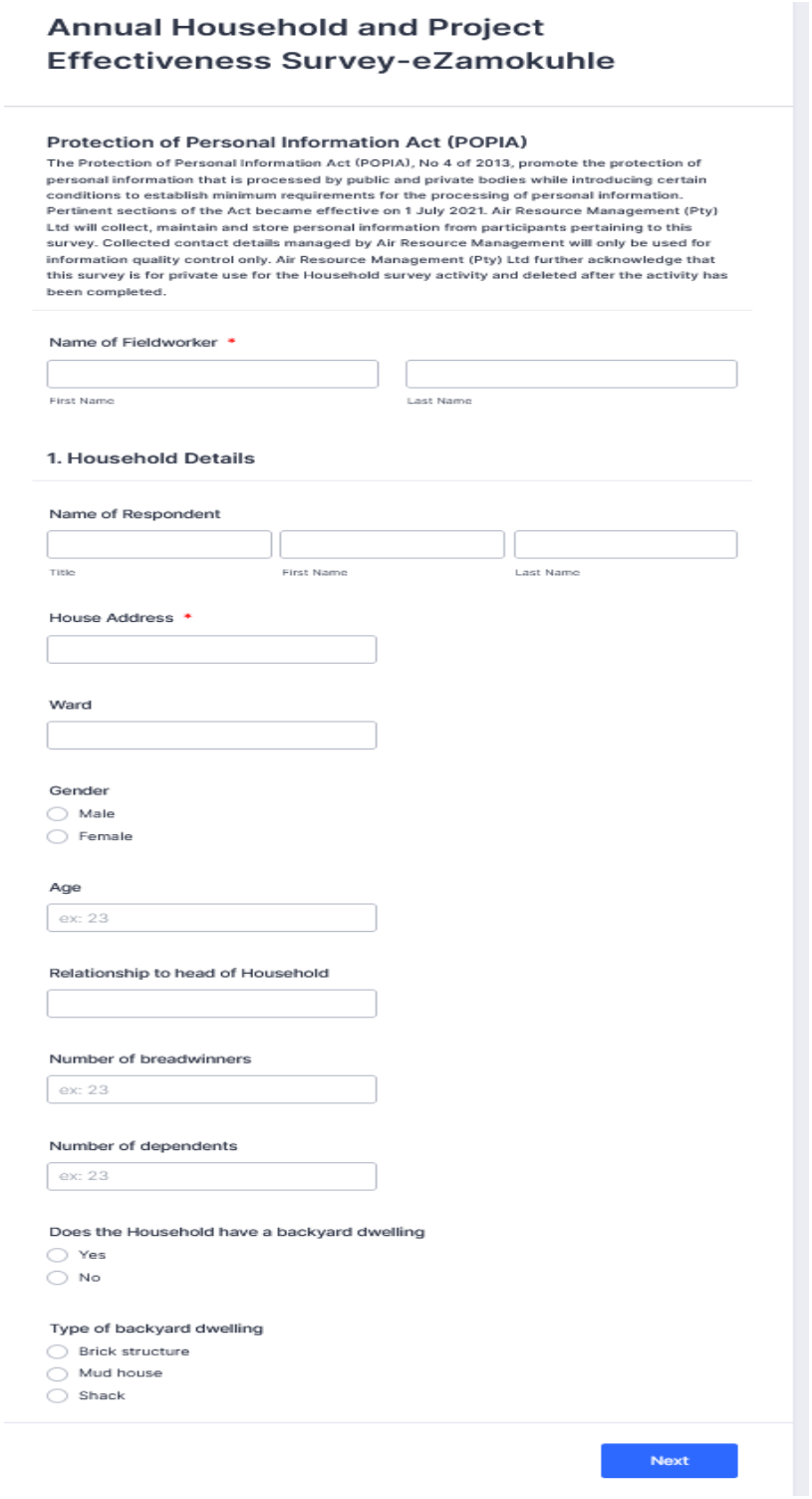
5. CONCLUSION

One of the key metrics for Eskom is to ascertain the improvement in the quality of life for the communities wherein the Eskom AQO intervention is rolled out. ARM conducted an Annual Household and Monitoring of Project Effectiveness Survey on 400 households (2023) and 381 households (2024) in eZamokuhle. All households that were sampled received the full Eskom AQO intervention suite.

It was clear from the Project Effectiveness Survey that both in 2023 and 2024, the households in eZamokuhle viewed the Eskom provided AQO interventions (stove, LPG heater, rewiring and celling) as of a good quality. The feedback from participants reveals a remarkable increase in warmth post Eskom's AQO ceiling installations, with an extraordinary 99.8% satisfaction rate in 2023, slightly declining to 99.2% in 2024, while overall contentment also increased from 97% to 97.6%. Satisfaction with the Eskom provided AQO LPG heaters was exceptionally high, with 98.7% of 384 respondents expressing their approval in 2023, a sentiment that carried over to 2024, where 97.1% reported continued satisfaction. Furthermore, 98.5% of respondents in 2023 felt their homes were noticeably warmer with the LPG heater use, supported by 96.5% in 2024. Approval for the Eskom AQO hybrid stoves remained substantial across both years, with nearly universal endorsement in 2023 and continued strong recommendations in 2024. Additionally, 98.2% of respondents in 2023 advocated for Eskom to continue rewiring other homes in the community, a trend that persisted in 2024.

This transition above not only reflects an improvement in the quality of life for the eZamokuhle participants but also underscores the effectiveness of Eskom's AQO interventions in eZamokuhle. Eskom's AQO interventions can thus provide an option for achieving improvements in participants quality of life while promoting a sustainable benefit to the community.

ANNEXURE 1: ANNUAL HOUSEHOLD & PROJECT EFFECTIVENESS QUESTIONNAIRE



Annual Household and Project Effectiveness Survey-eZamokuhle

Protection of Personal Information Act (POPIA)

The Protection of Personal Information Act (POPIA), No 4 of 2013, promote the protection of personal information that is processed by public and private bodies while introducing certain conditions to establish minimum requirements for the processing of personal information. Pertinent sections of the Act became effective on 1 July 2021. Air Resource Management (Pty) Ltd will collect, maintain and store personal information from participants pertaining to this survey. Collected contact details managed by Air Resource Management will only be used for information quality control only. Air Resource Management (Pty) Ltd further acknowledge that this survey is for private use for the Household survey activity and deleted after the activity has been completed.

Name of Fieldworker *

First Name

Last Name

1. Household Details

Name of Respondent

Title

First Name

Last Name

House Address *

Ward

Gender

- Male
- Female

Age

ex: 23

Relationship to head of Household

Number of breadwinners

ex: 23

Number of dependents

ex: 23

Does the Household have a backyard dwelling

- Yes
- No

Type of backyard dwelling

- Brick structure
- Mud house
- Shack

Next

2. Main Dwelling characteristics

Total Number of People in Household

ex: 23

Type of Dwelling

- Standard RDP Housing
- Extended RDP Housing
- Self-Built

Number of Rooms

ex: 23

Floor Type

- Tiles
- Carpet
- Wooden Floor
- Cement
- Other

Ceiling

- Ceiling
- No Ceiling

Ceiling Condition

- Excellent
- Good
- Average
- Poor

Roof Type

- Concrete
- Tile
- Thatched
- Wood
- Metal Sheet

Interior Wall Condition

- Excellent
- Good
- Average
- Poor

The house our household occupies is:

- Rented
- Owned(built by ourselves)
- Owned (bought)
- Owned (inherited)

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3.1 Eskom AQO Project Interventions Effectiveness (Ceiling)

Was a ceiling installed at this household?
- ◯ Yes
- ◯ No

Photo of ceiling

Take Photo

When the ceiling was installed in your home,was it of a good quality?
- ◯ Yes
- ◯ No (Explain below)

Why ceiling is not of good quality

Did the team who installed the ceiling in your home damage any items inyour home?
- ◯ Yes (Please explain)
- ◯ No

Team damaged items in home explanation

Did the team who installed the ceiling in your home leave your home in amess after they were done?
- ◯ Yes (Please Explain)
- ◯ No

Explanation of mess left by team

Does the ceiling condition now, look the same as when Eskom has installed it?
- ◯ Yes
- ◯ No (Please explain)

Explanation of ceiling condition

Are there any stains on the ceiling?

- ◯ Yes (Please indicate colour of stains and possbile cause)
- ◯ No

Colour of stains and cause

Photo of stains

Take Photo

Has there been any water leaks through the ceiling?

- ◯ Yes (Please indicate cause of leak)
- ◯ No

Possible cause of leak

Did you let try to fix the Leak yourself?

- ◯ Yes
- ◯ No

Did you let Eskom know about the leak?

- ◯ Yes
- ◯ No

Did they fix the leak?

- ◯ Yes
- ◯ No

Has the cornice become loose from the wall or ceiling?

- ◯ Yes (Please indicate cause)
- ◯ No

Cause of loose cornice on wall or ceiling

Loose cornice

Take Photo

Did you try to fix the loose cornice?

- ◯ Yes
- ◯ No

Did you let Eskom know of the loose cornice?
- Yes
- No

Did they fix the loose cornice for you?
- Yes
- No

Do you currently conduct any maintenance on the ceiling?
- Yes (Please indicate why)
- No (Please indicate why)

Why maintenance is done

Why maintenance is not done

If there is any future water leaks or damage to the celing, will you fix it?
- Yes (Please indicate why)
- No

Why will you fix the ceiling?

Will you not fix the future water leaks or damage due to high cost?
- Yes
- No

Should Eskom fix the future water leaks or damage?
- Yes
- No

Is the ceiling safe?
- Yes
- No (Please specify why)

Why the ceiling is not safe

Why the ceiling is not safe

Since the ceiling has been installed do you find your home warmer?

- Yes
- No (Please specify why)

Why the home does not feel warmer

Since the ceiling has been installed, how much coal do you now use inwinter than before it was installed?

- Use the same amount of coal than before the ceiling was installed
- Use less amount of coal than before the ceiling was installed
- Use more coal than before the ceiling was installed

Are you happy with the Eskom ceiling installed in your home?

- Yes
- No (Please specify why)

Why you are not happy with the installed ceiling

Would you recommend to other households to have the Eskom ceiling installed in their homes?

- Yes
- No (Please specify why)

Why would you not recommend to other households to have the Eskom ceiling installed in ther homes

What would you recommend to Eskom to improve this celing?

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3.2 Eskom AQO Project Interventions Effectiveness (LPG Heater)

Has the household received the LPG heater?
- ◯ Yes
- ◯ No

Photo of LPG Heater

Take Photo

Is the LPG heater installed in your home of a good quality?
- ◯ Yes
- ◯ No (Please explain)

Why LPG heater is not of good quality

Did the team who installed the LPG Heater in your home damage any items in your home?
- ◯ Yes (Please explain)
- ◯ No

How the team damage items in your home

Does the LPG Heater condition now, look the same as when Eskom has installed it?
- ◯ Yes
- ◯ No (Please explain)

Why the LPG Heater is not in the same condition as when installed

Did you receive training on how to use the LPG Heater?
- ◯ Yes
- ◯ No

Will you like to receive training on how to use the LPG Heater?
- ◯ Yes
- ◯ No

Has the LPG heater become damaged or defective since you received it?
- ◯ Yes (Please explain)
- ◯ No

What is the reason the LPG heater was damaged or defective

Damaged LPG Heater

Take Photo

Did you try to fix the LPG heater yourself?

- Yes
- No

Have you let Eskom know?

- Yes
- No

Have they fixed it for you?

- Yes
- No

Eskom provided 2 9kg LPG cylinders with the LPG heater. Do you still have any gas from these 9kg cylinders ?

- Yes
- No

How many cylinders do you have left?

- 1
- 2
- Other

Is there a place you can go to refill these cylinders?

- Yes (Please indicate where below)
- No

Where you refill gas cylinders

Is it expensive to use the LPG heater?

- Yes (Please indicate why)
- No

Why it is expensive to use the LPG Heater

Is it dangerous to use the LPG heater ?

- Yes (Please indicate why)
- No

Why it is dangerous to use the LPG heater

Is there anyone in your home who is scared to use the LPG heater ?

- ◯ Yes (Please indicate who below)
- ◯ No

Who is scared in the home to use the LPG heater

- ◯ Children
- ◯ Elderly
- ◯ Other

Do you know what to do if you smell gas from the LPG heater?

- ◯ Yes (Please indicate who knows and what to do below)
- ◯ No

If yes,who knows what to do if you smell gas and what to do

Do you have your windows and/or doors open when you use the LPG heater?

- ◯ Yes (Please explain)
- ◯ No

Why windows and/or doors are open

If there is any damage to the LPG heater in the future,will you fix it?

- ◯ Yes
- ◯ No (please explain)

Why will you not fix the LPG heater?

Should Eskom fix the damage?

- ◯ Yes
- ◯ No

Since the LPG Heater has been installed do you find your home warmer?

- ◯ Yes
- ◯ No (Please specify why)

Why does the home not feel warmer with the LPG heater

Should Eskom fix the damage?

- ◯ Yes
- ◯ No

Since the LPG Heater has been installed do you find your home warmer?

- ◯ Yes
- ◯ No (Please specify why)

Why does the home not feel warmer with the LPG heater

Since the LPG Heater has been installed, how much coal do you now use in winter than before it was installed?

- ◯ Use the same amount of coal than before the LPG Heater was installed
- ◯ Use the less amount of coal than before the LPG Heater was installed
- ◯ Use more coal than before the LPG Heater was installed

Are you happy with the Eskom LPG Heater installed in your home?

- ◯ Yes
- ◯ No (Please specify)

Why you are not happy with the LPG heater installed in your home

Would you recommend to other households to have the Eskom LPG Heater installed in their homes?

- ◯ Yes
- ◯ No (Please specify)

Why you would not recommend other households have the Eskom LPG heater installed in their homes

What would you recommend to Eskom to improve this LPG heater?

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3.3 Eskom AQO Project Interventions Effectiveness:Hybrid gas-electricity stove

Has the household received the hybrid stove?

- ◯ Yes
- ◯ No

Photo of Hybrid stove

Take Photo

Is Hybrid gas-electricity stove installed in your was it of a good quality?

- ◯ Yes
- ◯ No (Please explain)

Why the hybrid stove was not of good quality

Did the team who installed the Hybrid gas-electricity stove in your home damage any items in your home?

- ◯ Yes (Please explain)
- ◯ No

How the team damaged items in your home

Does the Hybrid gas-electricity stove condition now, look the same as when Eskom has installed it?

- ◯ Yes
- ◯ No (Please explain)

Why the hybrid stove does not look the same as when Eskom installed it

Did you receive training on how to use the Hybrid gas-electricity stove?

- ◯ Yes
- ◯ No

Will you like to receive training on how to use the Hybrid gas-electricity stove?

- ◯ Yes
- ◯ No

Has the gas-electricity stove become damaged or defective since you received it

- ◯ Yes (Please explain)
- ◯ No

Please indicate the possible cause of damage or why it is defective

Damaged hybrid stove

Take Photo

Have you tried to fix the hybrid stove yourself?

- Yes
- No

Have you let Eskom know about the issue of the stove?

- Yes
- No

Have they fixed it for you?

- Yes
- No

Does the stove and/or oven work properly?

- Yes
- No (Please explain)

Why the stove and/or oven are not working

Is it quicker to cook food now with the new stove?

- Yes
- No (Please explain)

Why the stove is not quicker to cook food

Does the food have the same taste as the food cooked on a traditional coal stove?

- Yes
- No (Please explain)

Why the food does not taste as the food cooked on a traditional coal stove

Is the new stove easy to operate?

- ◯ Yes
- ◯ No (Please explain)

Why the stove is not easy to operate

Is it more expensive to use the Hybrid gas-electricity stove than a coal stove ?

- ◯ Yes (Please explain)
- ◯ No

Why it is more expensive to use the hybrid gas-electricity stove

Is it dangerous to use the gas-electricity stove than a coal stove ?

- ◯ Yes (Please explain)
- ◯ No

Why the stove is more dangerous to use

Do you know what to do if you smell gas from the gas-electricity stove?

- ◯ Yes (Explain below)
- ◯ No

Who knows what to do if gas is smelt and what do if gas is smelt

Do you have your windows and/or doors open when you use the gas-electricity stove?

- ◯ Yes (Please explain)
- ◯ No

Why windows and/or doors are open when using stove

If there is any damage to the gas-electricity stove in the future, will you fix it?

- ◯ Yes
- ◯ No (Please explain)

Why you will not fix the damaged stove

Should Eskom fix the damage?

- ◯ Yes
- ◯ No

Since the gas-electricity stove has been installed do you find your home warmer?

- ◯ Yes
- ◯ No (Please specify why)

Why you do not feel that the home is warmer

Since the gas-electricity stove has been installed, how much coal do you now use in winter than before it was installed?

- ◯ Use the same amount of coal than before the Hybrid gas-electricity stove was installed
- ◯ Use the less amount of coal than before the Hybrid gas-electricity stove was installed
- ◯ Use more coal than before the Hybrid gas-electricity stove was installed

Are you happy with the Eskom gas-electricity stove installed in your home?

- ◯ Yes
- ◯ No (Please explain)

Why you are not happy with the stove installed in your home

Would you recommend to other households to have the Eskom gas-electricity stove installed in their homes?

- ◯ Yes
- ◯ No (Please explain why)

Why you would not recommend the stove being installed in other households

What would you recommend to Eskom to improve this gas-electricity stove?

3.4 Eskom AQO Project Interventions Effectiveness:Electrical rewiring by Eskom contractors

Has the household had the rewiring done by Eskom?

- ◯ Yes
- ◯ No

Photo of wiring

Take Photo

Is electrical rewiring that was done in your home of a good quality?

- ◯ Yes
- ◯ No (Please explain)

Why the rewiring is not good quality

Did the team who installed the electrical rewiring in your home damage any items in your home?

- ◯ Yes (Please explain)
- ◯ No

How team damaged home when doing electrical rewiring

Does the electrical rewiring condition now, look the same as when Eskom has installed it?

- ◯ Yes
- ◯ No (Please explain)

Why the rewiring condition now does not look the same as when Eskom installed it

Has the electrical rewiring become damaged or defective since you received it?

- ◯ Yes (Please indicate possible cause)
- ◯ No

Photo of damaged electrical wiring

Take Photo

Cause of damage or defective wiring

Did you receive a certificate of competence for the electrical rewiring that was done in your home?

- ◯ Yes
- ◯ No (Please explain)

Reason for not receiving certificate of competence for the electrical wiring done in your home

Would you recommend to other households to have the Eskom electrical rewiring installed in their homes?

- ◯ Yes
- ◯ No (Please explain)

Why you would not recommend the electircal wiring to be done in other houses

What would you recommend to Eskom to improve the electrical rewiring?

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3.5 Eskom AQO Project Interventions Effectiveness:Regress

Will you be moving away from this house in 2024?

- ◯ Yes (Plese explain why)
- ◯ No

Why you are moving away from your current home

Have you purchased another coal stove?

- ◯ Yes (Please explain why)
- ◯ No

Why you purchased another coal stove

Do you have another coal stove in your home that you use?

- ◯ Yes (Please explain how often you used it below)
- ◯ No

How often you used the coal stove

If you were able to give Eskom back the hybrid stove and/or LPG heater for a brand new coal stove, will you?

- ◯ Yes (Please explain why)
- ◯ No

Why you would give Eskom back the hybrid stove for a brand new coal stove

Does the LPG heater provide enough heat for you?

- ◯ Yes
- ◯ No (Please explain)

Why the LPG does not provide enough heat for you

Which one do you prefer to heat your home: LPG heater or coal?

- ◯ LPG heater
- ◯ Coal

From all of Eskoms interventions (new hybrid stove, LPG heater and celing), which one makes the biggest difference for you?

- ◯ Ceiling
- ◯ LPG Heater
- ◯ Hybrid stove

Will an electricity subsidy promote more use of the hybrid electricity gas stove?

- ◯ Yes
- ◯ No (Please explain)

Why an electricity will not promote more use of the hybrid stove

How satisfied are you with Eskoms interventions (new hybrid stove, LPG heater and celing) that were provided to you on a scale of 1 to 5. 1 been extremely unsatisfied and 5 been extremely satisfied

- ◯ 1. Extremely unsatisfied
- ◯ 2. Unsatisfied
- ◯ 3. Neutral
- ◯ 4. Satisfied
- ◯ 5. Extremely Satisfied

What would you recommend to Eskom to improve the Eskom interventions?

What is the biggest threat to Eskoms Air Quality Offset Project?

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Pre-Intervention Energy Usage

Which of the energy sources were used in your home?

- ☐ Electricity from grid
- ☐ LPG
- ☐ Firewood
- ☐ Coal
- ☐ Candle
- ☐ Electricity from isolated system
- ☐ Solar
- ☐ Animal dung
- ☐ Generator
- ☐ Other

Which one of the following was the main energy source?

- ○ Electricity
- ○ LPG
- ○ Firewood
- ○ Coal
- ○ Candle
- ○ Solar
- ○ Animal Dung
- ○ Generator
- ○ Other

Which one of the following was the main energy source for cooking?

	Mainly	Sometimes	Rarely	Never
Electricity	○	○	○	○
LPG	○	○	○	○
Firewood	○	○	○	○
Coal	○	○	○	○
Candle	○	○	○	○
Solar	○	○	○	○
Animal Dung	○	○	○	○
Generator	○	○	○	○
Battery	○	○	○	○

Which one of the following is the main energy source for heating?

	Mainly	Sometimes	Rarely	Never
Electricity	○	○	○	○
LPG	○	○	○	○
Firewood	○	○	○	○
Coal	○	○	○	○
Candle	○	○	○	○
Solar	○	○	○	○
Animal Dung	○	○	○	○
Generator	○	○	○	○
Battery	○	○	○	○

Which one of the following is the main energy source for lighting?

	Mainly	Sometimes	Rarely	Never
Electricity	○	○	○	○
LPG	○	○	○	○
Firewood	○	○	○	○
Coal	○	○	○	○
Candle	○	○	○	○
Solar	○	○	○	○
Animal Dung	○	○	○	○
Generator	○	○	○	○
Battery	○	○	○	○

Does your home have an electricity meter?

- ○ Yes
- ○ No

If your home does not have an electricity connection,please indicate if the statement is major,minor or no reason

	No reason	Minor reason	Major reason
Electricity is not available in my area	○	○	○
Our household can't pay the connection fee	○	○	○
Our household cant pay the cost of housewiring	○	○	○
Our household cant affford the monthly payment	○	○	○
Our household can't afford to buy electircal equipment	○	○	○
We are satisfied with present energy source	○	○	○

How many days per month do you utilise electricity?

- ○ 1-5
- ○ 6-10
- ○ 11-20
- ○ 20-29
- ○ Whole Month

What is your cost of electricity (Rands)

- ○ 1-200
- ○ 200-500
- ○ 500-1000
- ○ 1000-2000
- ○ More than 2000

Type of lighting

	Yes	No	Does not know
Incandescent light bulb	○	○	○
Fluorescent tubes	○	○	○
Energy saving light bulbs	○	○	○

Post-Intervention Energy Usage

Which of the energy sources were used in your home?

- ☐ Electricity from grid
- ☐ LPG
- ☐ Firewood
- ☐ Coal
- ☐ Candle
- ☐ Other
- ☐ Electricity from isolated system
- ☐ Solar
- ☐ Animal dung
- ☐ Generator

Which one of the following is the main energy source?

- ○ Electricity
- ○ LPG
- ○ Firewood
- ○ Coal
- ○ Candle
- ○ Solar
- ○ Animal Dung
- ○ Generator
- ○ Other

Which one of the following is the main energy source for cooking?

	Mainly	Sometimes	Rarely	Never
Electricity	○	○	○	○
LPG	○	○	○	○
Firewood	○	○	○	○
Coal	○	○	○	○
Candle	○	○	○	○
Solar	○	○	○	○
Animal Dung	○	○	○	○
Generator	○	○	○	○
Battery	○	○	○	○

Which one of the following is the main energy source for heating?

	Mainly	Sometimes	Rarely	Never
Electricity	○	○	○	○
LPG	○	○	○	○
Firewood	○	○	○	○
Coal	○	○	○	○
Candle	○	○	○	○
Solar	○	○	○	○
Animal Dung	○	○	○	○
Generator	○	○	○	○
Battery	○	○	○	○

Which one of the following is the main energy source for lighting?

	Mainly	Sometimes	Rarely	Never
Electricity	○	○	○	○
LPG	○	○	○	○
Firewood	○	○	○	○
Coal	○	○	○	○
Candle	○	○	○	○
Solar	○	○	○	○

Does your home have an electricity meter?

- Yes
- No

If your home does not have an electricity connection,please indicate if the statement is major,minor or no reason

	No reason	Minor reason	Major reason
Electricity is not available in my area			
Our household can't pay the connection fee			
Our household cant pay the cost of housewiring			
Our household cant affford the monthly payment			
Our household can't afford to buy electircal equipment			
We are satisfied with present energy source			

How many days per month do you utilise electricity?

- 1-5
- 6-10
- 11-20
- 20-29
- Whole Month

What is your cost of electricity (Rands)

- 1-200
- 200-500
- 500-1000
- 1000-2000
- More than 2000

Type of lighting

	Yes	No	Does not know
Incandescent light bulb			
Fluorescent tubes			
Energy saving light bulbs			

In case of power failure,what do you use as a backup?

	Yes	No
Candles		
Gas lamp		
Generator		
Car/motocycle battery		
Other		

Other backup power

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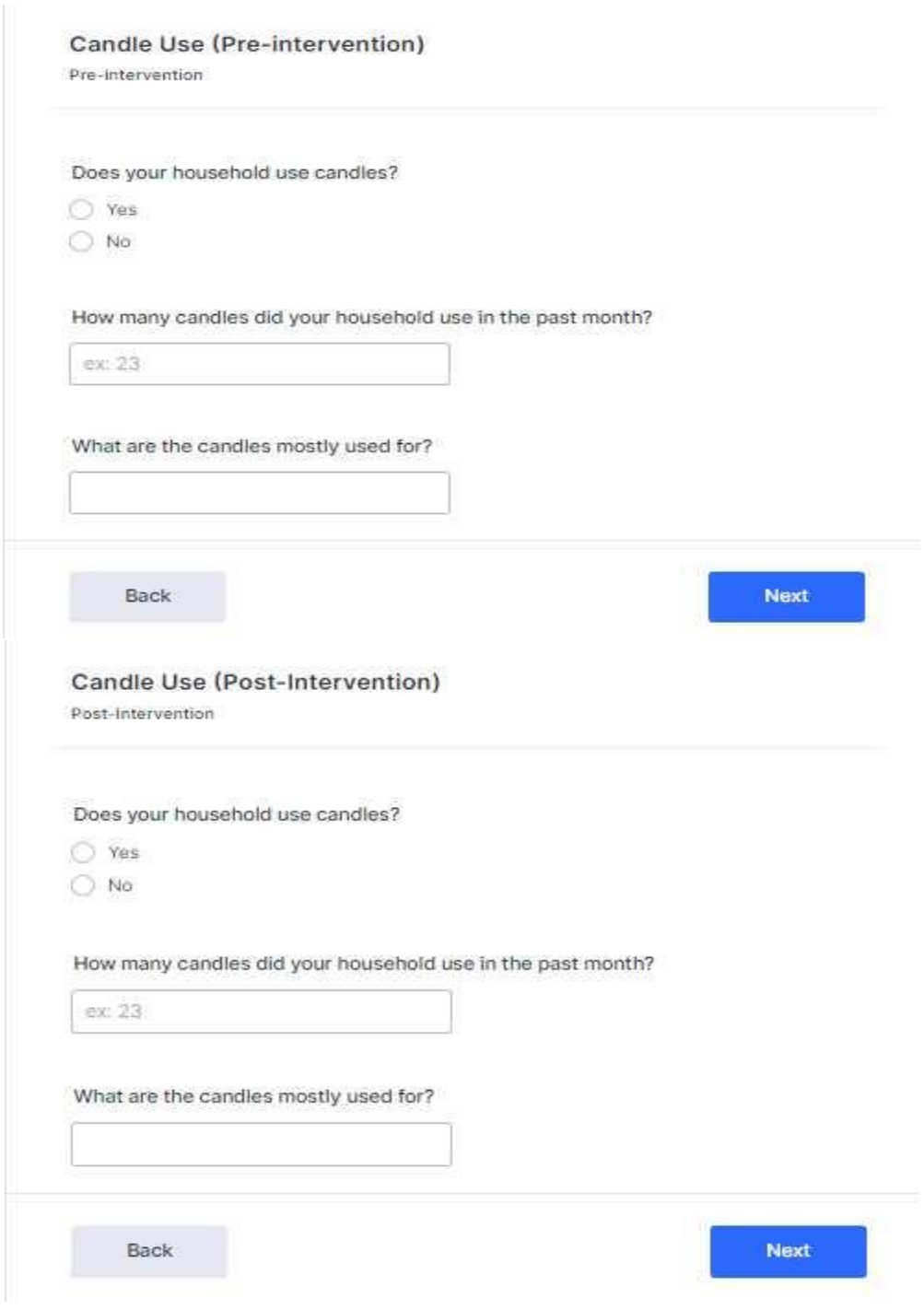

Candle Use (Pre-intervention)

Pre-intervention

Does your household use candles?

- Yes
- No

How many candles did your household use in the past month?

ex: 23

What are the candles mostly used for?

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Candle Use (Post-Intervention)

Post-Intervention

Does your household use candles?

- Yes
- No

How many candles did your household use in the past month?

ex: 23

What are the candles mostly used for?

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Use of LPG (Pre-intervention)

Pre-intervention

Does your household use LPG?

- ○ Yes
- ○ No

What size of gas cyclinder/tank does your household use?

	Yes	No
5kg cylinder	○	○
9kg Cylinder	○	○
12kg cylinder	○	○
14kg cylinder	○	○

Does the household use the following gas appliance?

	Yes	No
Gas Lamp	○	○
LPG stove	○	○
LPG stove and oven	○	○
LPG heater	○	○

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Use of LPG (Post-Intervention)

Post-Intervention

Does your household use LPG?

- ○ Yes
- ○ No

What size of gas cyclinder/tank does your household use?

	Yes	No
5kg cylinder	○	○
9kg Cylinder	○	○
12kg cylinder	○	○
14kg cylinder	○	○

Does the household use the following gas appliance?

	Yes	No
Gas Lamp	○	○
LPG stove	○	○
LPG stove and oven	○	○
LPG heater	○	○

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Firewood (Pre-Intervention)

Pre-intervention

Does your household use firewood?

- ◯ Yes
- ◯ No

How does your household obtain firewood for domestic use?

- ◯ Purchase
- ◯ Collected/gathered
- ◯ Purchase and Collected/gathered

Following Questions are for purchased Firewood

What is the cost of the purchased firewood? (Rands)

- ◯ 1-10
- ◯ 11-30
- ◯ 31-50
- ◯ 51-70
- ◯ 71-100
- ◯ More than 100

How long does it take to travel one way to purchase?

- ◯ 1m-50m
- ◯ 50m-100m
- ◯ 100m-500m
- ◯ 500m-1000m
- ◯ More than 1km

How many days will the bundle last?

- ◯ 1-5
- ◯ 6-10
- ◯ 11-20
- ◯ 20-29
- ◯ Whole month
- ◯ More than a month

Following questions are for collected firewood

Where did you collect your firewood?

How far did you travel to collect the firewood?

- ◯ 1m-50m
- ◯ 50m-100m
- ◯ 100m-500m
- ◯ 500m-1000m
- ◯ More than 1km

How many days did the previous collected firewood last?

- ◯ 1-5
- ◯ 6-10
- ◯ 11-20
- ◯ 20-29
- ◯ Whole month
- ◯ More than a month

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Firewood (Post-Intervention)

Post-Intervention

Does your household use firewood?

- Yes
- No

How does your household obtain firewood for domestic use?

- Purchase
- Collected/gathered
- Purchase and Collected/gathered

Following Questions are for purchased Firewood

What is the cost of the purchased firewood? (Rands)

- 1-10
- 11-30
- 31-50
- 51-70
- 71-100
- More than 100

How long does it take to travel one way to purchase?

- 1m-50m
- 50m-100m
- 100m-500m
- 500m-1000m
- More than 1km

How many days will the bundle last?

- 1-5
- 6-10
- 11-20
- 20-29
- Whole month
- More than a month

Following questions are for collected firewood

Where did you collect your firewood?

How far did you travel to collect the firewood?

- 1m-50m
- 50m-100m
- 100m-500m
- 500m-1000m
- More than 1km

How many days did the previous collected firewood last?

- 1-5
- 6-10
- 11-20
- 20-29
- Whole month
- More than a month

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Use of charcoal (Pre-intervention)

Pre-intervention

Does your household use charcoal?

- ◯ Yes
- ◯ No

How many KGs of charcoal do you use in one month?

- ◯ 1-5
- ◯ 6-10
- ◯ 10-20
- ◯ 30-40
- ◯ 50-100

How far do you travel to purchase charcoal?

- ◯ 1m-50m
- ◯ 50m-100m
- ◯ 100m-500m
- ◯ 500m-1000m
- ◯ More than 1km

How many days does the charcoal last for?

- ◯ 1-5
- ◯ 6-10
- ◯ 11-20
- ◯ 20-29
- ◯ Whole month
- ◯ More than a month

What is the average cost of the charcoal? (Rands)

- ◯ 1-10
- ◯ 11-30
- ◯ 31-50
- ◯ 51-70
- ◯ 71-100
- ◯ More than 100

How reliable is your source of charcoal?

- ◯ Very reliable
- ◯ Fairly reliable
- ◯ Unreliable

Do you use more than one source for your charcoal?

- ◯ Yes
- ◯ No

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Use of Charcoal (Post-intervention)

Post-intervention

Does your household use charcoal?

- ◯ Yes
- ◯ No

How many KGs of charcoal do you use in one month?

- ◯ 1-5
- ◯ 6-10
- ◯ 10-20
- ◯ 30-40
- ◯ 50-100

How far do you travel to purhcase charcoal?

- ◯ 1m-50m
- ◯ 50m-100m
- ◯ 100m-500m
- ◯ 500m-1000m
- ◯ More than 1km

How many days does the charcoal last for?

- ◯ 1-5
- ◯ 6-10
- ◯ 11-20
- ◯ 20-29
- ◯ Whole month
- ◯ More than a month

What is the average cost of the charcoal? (Rands)

- ◯ 1-10
- ◯ 11-30
- ◯ 31-50
- ◯ 51-70
- ◯ 71-100
- ◯ More than 100

How reliable is your source of charcoal?

- ◯ Very reliable
- ◯ Fairly reliable
- ◯ Unreliable

Do you use more than one source for your charcoal?

- ◯ Yes
- ◯ No

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Use of Coal (Pre-intervention)

Pre-intervention

Does your household use coal?

- Yes
- No

How many KGs of coal do you use in one month?

- 1-5
- 6-10
- 10-20
- 30-40
- 50-100

How far do you travel to purchase coal?

- 1m-50m
- 50m-100m
- 100m-500m
- 500m-1000m
- More than 1km

How many days does the coal last for?

- 1-5
- 6-10
- 11-20
- 20-29
- Whole month
- More than a month

What is the average cost of the coal? (Rands)

- 1-10
- 11-30
- 31-50
- 51-70
- 71-100
- More than 100

How reliable is your source of coal?

- Very reliable
- Fairly reliable
- Unreliable

Do you use more than one source for your coal?

- Yes
- No

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Use of Coal (Post-intervention)

Post-intervention

Does your household use coal?

- ◯ Yes
- ◯ No

How many KGs of coal do you use in one month?

- ◯ 1-5
- ◯ 6-10
- ◯ 10-20
- ◯ 30-40
- ◯ 50-100

How far do you travel to purchase coal?

- ◯ 1m-50m
- ◯ 50m-100m
- ◯ 100m-500m
- ◯ 500m-1000m
- ◯ More than 1km

How many days does the coal last for?

- ◯ 1-5
- ◯ 6-10
- ◯ 11-20
- ◯ 20-29
- ◯ Whole month
- ◯ More than a month

What is the average cost of the coal? (Rands)

- ◯ 1-10
- ◯ 11-30
- ◯ 31-50
- ◯ 51-70
- ◯ 71-100
- ◯ More than 100

How reliable is your source of coal?

- ◯ Very reliable
- ◯ Fairly reliable
- ◯ Unreliable

Do you use more than one source for your coal?

- ◯ Yes
- ◯ No

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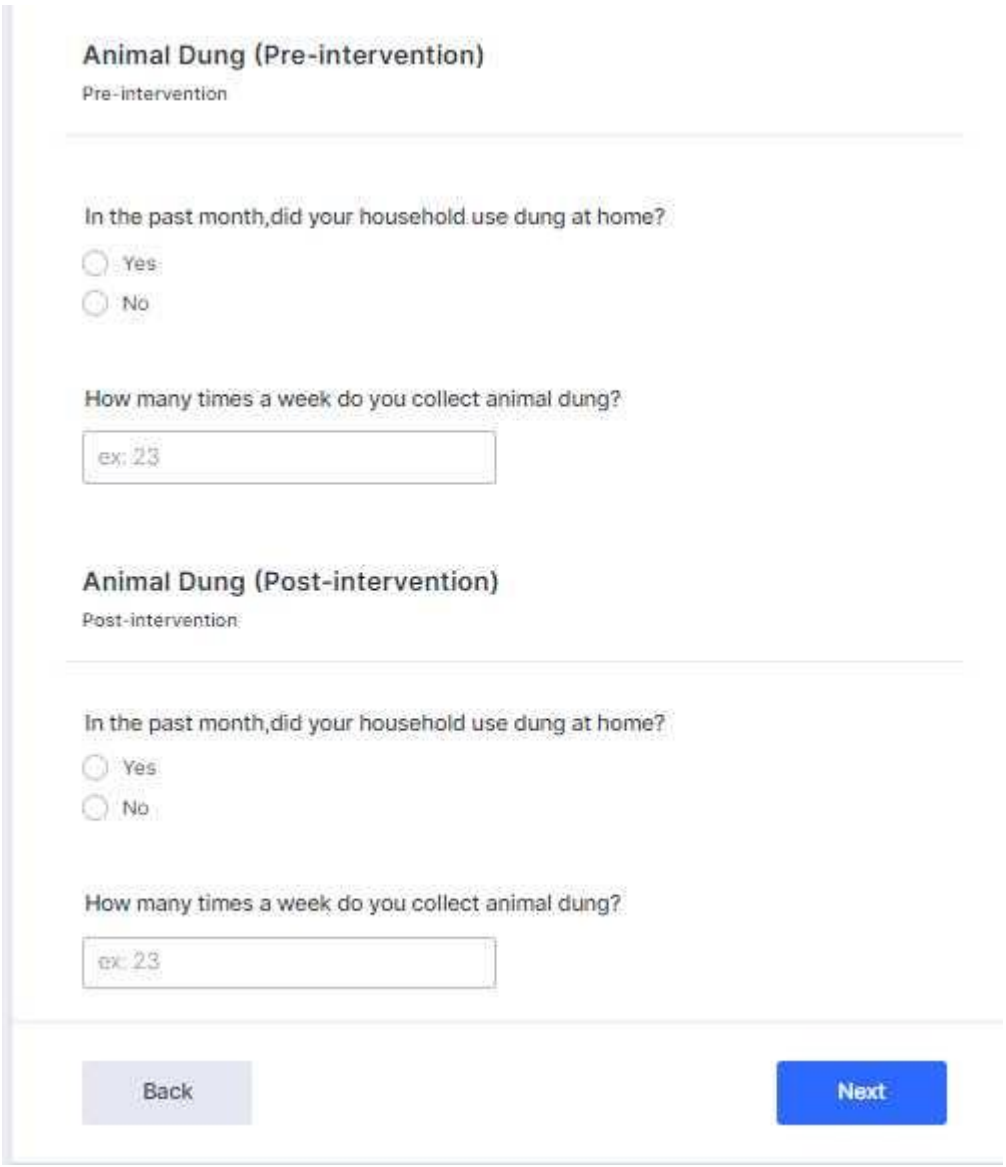

Animal Dung (Pre-intervention)

Pre-intervention

In the past month,did your household use dung at home?

- Yes
- No

How many times a week do you collect animal dung?

ex: 23

Animal Dung (Post-intervention)

Post-intervention

In the past month,did your household use dung at home?

- Yes
- No

How many times a week do you collect animal dung?

ex: 23

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Cooking devices (Pre-intervention)

Pre-intervention

What is the main stove that your household uses for cooking pre-intervention?

- [ ] Open fire
- [ ] Traditional stove no chimney
- [ ] Traditional stove with chimney
- [ ] Gas stove
- [ ] Electric stove

Where is the stove located?

- [ ] Outdoors
- [ ] Semi-enclosed
- [ ] Separate kitchen
- [ ] In living area

Is there a vent or window in the cooking area?

- ( ) None
- ( ) One only
- ( ) Two or more

What type of fuel does your household use for cooking?

- [ ] Firewood
- [ ] Coal
- [ ] Charcoal
- [ ] LPG
- [ ] Electricity
- [ ] Dung cakes

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Cooking Devices (Post-Intervention)

Post-Intervention

What is the main stove that your household uses for cooking pre-intervention?

- [ ] Open fire
- [ ] Traditional stove no chimney
- [ ] Traditional stove with chimney
- [ ] Gas stove
- [ ] Electric stove

Where is the stove located?

- [ ] Outdoors
- [ ] Semi-enclosed
- [ ] Separate kitchen
- [ ] In living area

Is there a vent or window in the cooking area?

- ( ) None
- ( ) One only
- ( ) Two or more

What type of fuel does your household use for cooking?

- [ ] Firewood
- [ ] Coal
- [ ] Charcoal
- [ ] LPG
- [ ] Electricity
- [ ] Dung cakes

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Health (Pre-Intervention)

Pre-Intervention

Are you satisfied with your health?

- ○ Greatly unsatisfied
- ○ Unsatisfied
- ○ Neutral
- ○ Satisfied
- ○ Greatly Satisfied

How many members of your household smoke?

ex: 23

How often do you or a member of your household experience eye diseases or irritation?

- ○ Never
- ○ Occasionally
- ○ Frequently
- ○ All the time

How often do you or a member of your household experience an illness with a cough?

- ○ Never
- ○ Occasionally
- ○ Frequently
- ○ All the time

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Health (Post-Intervention)

Post-Intervention

Are you satisfied with your health?

- ○ Greatly unsatisfied
- ○ Unsatisfied
- ○ Neutral
- ○ Satisfied
- ○ Greatly Satisfied

How many members of your household smoke?

ex: 23

How often do you or a member of your household experience eye diseases or irritation?

- ○ Never
- ○ Occasionally
- ○ Frequently
- ○ All the time

How often do you or a member of your household experience an illness with a cough?

- ○ Never
- ○ Occasionally
- ○ Frequently
- ○ All the time

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Standard of living

What is the main source of water supply for the household?

- [ ] Outside tap
- [ ] Indoor taps
- [ ] Borehole/Well
- [ ] Neighbour
- [ ] Rain water

How many days has your water supply been available in the past month?

- ( ) 1-5
- ( ) 6-10
- ( ) 11-20
- ( ) 20-29
- ( ) Whole month
- ( ) More than a month

How much do you pay for water?

- ( ) 0
- ( ) 1-R500
- ( ) R500-1000
- ( ) R1000-R2000
- ( ) More than R2000

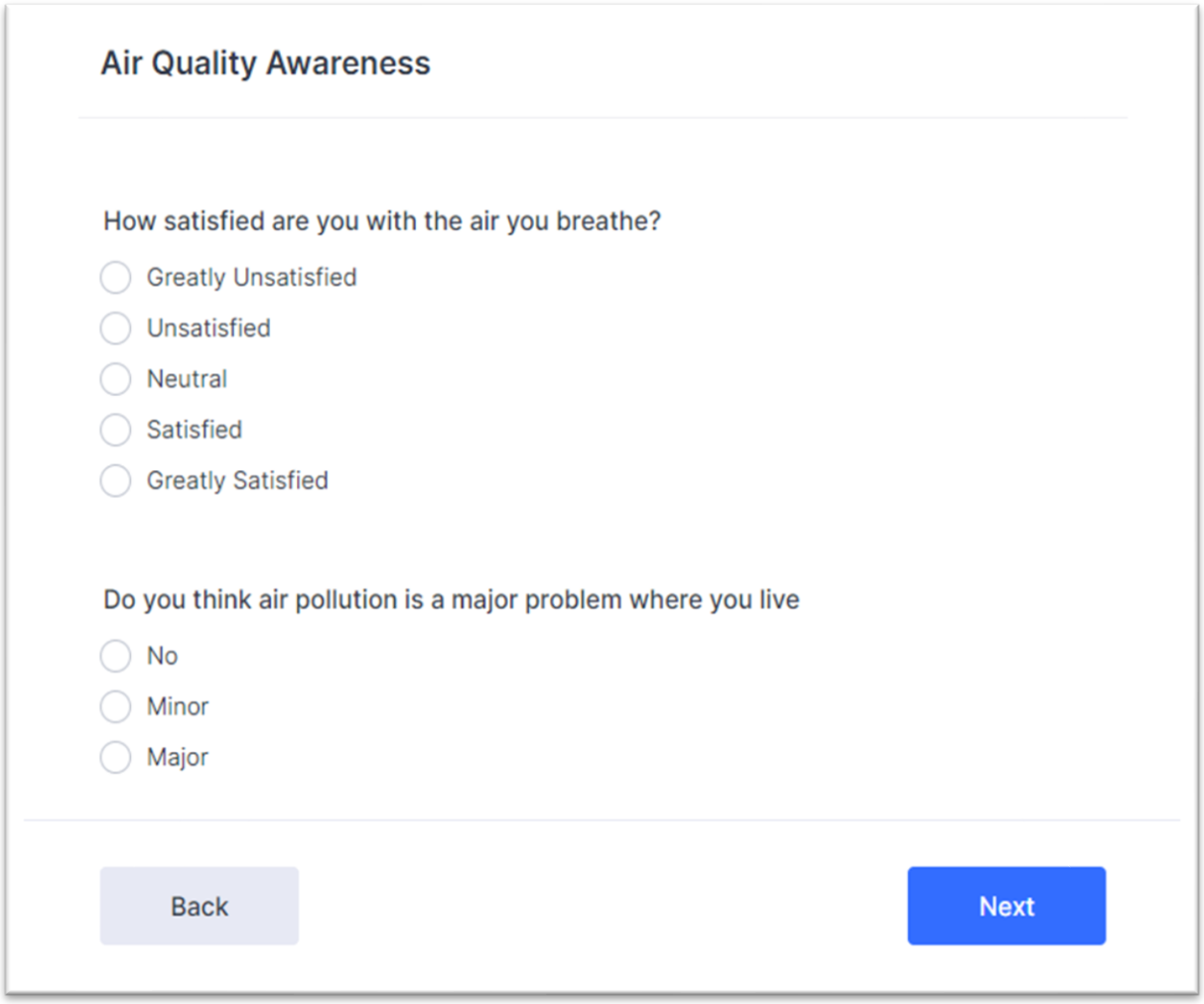
Do you have to walk away from your home to fetch water?

- ( ) Yes
- ( ) No

How far do you have to walk to fetch water ?

- ( ) 1m-50m
- ( ) 50m-100m
- ( ) 100m-500m
- ( ) 500m-1000m
- ( ) More than 1km

What type of container do you use to fetch water?


Air Quality Awareness
How satisfied are you with the air you breathe?
Greatly Unsatisfied
Unsatisfied
Neutral
Satisfied
Greatly Satisfied
Do you think air pollution is a major problem where you live
No
Minor
Major
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