

	<b>Scope of Work for Planning, Monitoring and Verification: Sivukile</b>	<b>Generation</b>
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### CONTROLLED DISCLOSURE

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## 1. INTRODUCTION

### 1.1 PROJECT BACKGROUND

Eskom is pursuing a multi-pronged approach to improve ambient air quality, including reducing emissions at the existing coal-fired fleet, investing in power generation from renewables and nuclear, and implementing air quality offsets programme in and around communities close to existing coal-fired power stations. Retrofitting abatement technology and diversifying the energy fleet come at higher cost and requires a longer period to implement. Air Quality Offsets (AQO) programmes on the other hand address emission sources directly within vulnerable communities, thus providing greater improvement in air quality that is experienced by communities. In addition, AQO programmes are more cost effective and result in meaningful improvement of air quality within a shorter time frame.

The requirement for implementing an AQO programme is a condition of the Atmospheric Emissions Licenses (AELs) for most Eskom coal-fired power stations. The AELs' requirements are similar to a condition in the National Air Quality Officer's decision (February 2015) on Eskom's power stations' application for postponement of the compliance timeframes with the National Environmental Management: Air Quality Act (Act No 39 of 2004) section 21 Minimum Emission Standards, which states that each power station is *'to implement an offset programme to reduce PM in the ambient/receiving environment. A definite offset implementation plan is expected from Eskom by 31 March 2016.'*

Eskom's Air Quality Offset Implementation Plan for Gert Sibande District Municipality was submitted to the National Air Quality Officer (NAQO) and the relevant Atmospheric Emission Licensing Authorities on 28 April 2016 (ENV16\_R017). Updated plans were submitted to Authorities in April 2021 (ENV21\_R052). The plan details the proposed offset interventions per selected settlement. It also details the approach followed in selecting the settlements, designing and implementing interventions and assessing the effectiveness of the interventions. The plan was approved by the NAQO in concurrence with the relevant Atmospheric Emission Licencing Authorities on 16 September 2016.

A number of areas in the Highveld (specifically within the Nkangala and Gert Sibande District Municipalities) are earmarked for rollout of AQO interventions by Eskom Generation Division on behalf of its respective power stations. Implementation of these interventions has commenced in Kwazamokuhle and Ezamokuhle as part of Phase 1 of the AQO programme. Phase 2 interventions are planned to commence early next year with rollout in Sivukile.

The AQO interventions for Highveld entail the following (Figure 1):

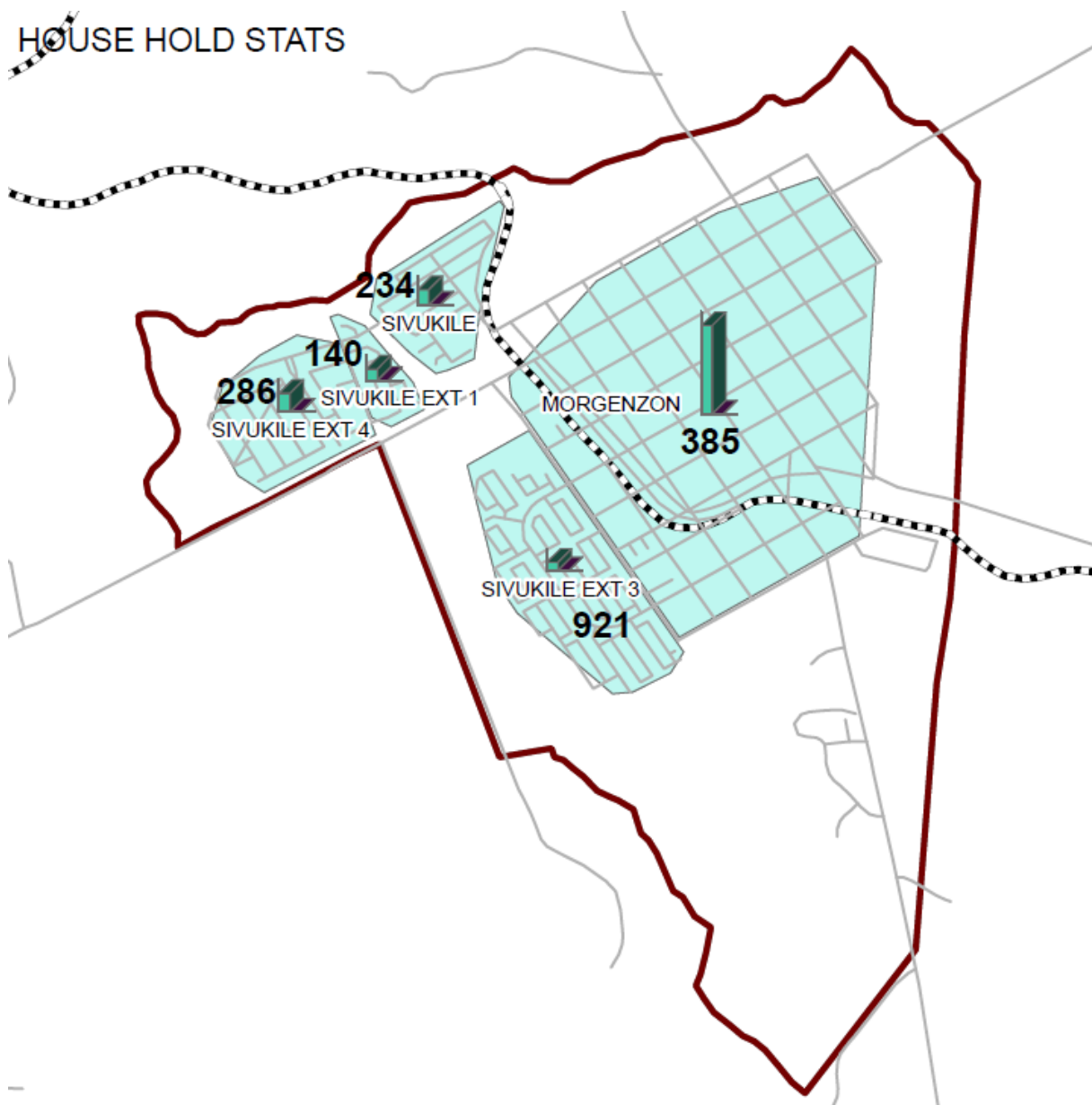
- Provision of a basic plus retrofit, which consists of:
  - o Insulation, entailing installation of a Spray Polyurethane Foam (SPF) ceiling system and draft proofing.
  - o Electrical rewiring and issuance of Certificate of Compliance (CoC).
- Stove swap, which entails:
  - o Provision of electricity based energy source with liquefied petroleum gas (LPG) backup. This will include a hybrid gas-electric stove, LPG heater plus 2x9 kg LPG cylinders and Compact fluorescent lamp (CFL) for energy efficient lighting.
  - o Removal and disposal of the coal stove



**Figure 1: Proposed AQO Interventions for Sivukile**

## 1.2 PROJECT IMPLEMENTATION SITE: SIVUKILE

As part of Phase 2 of the Eskom's AQO programme, Sivukile is proposed to be the main focus of Tutuka Power Station's AQO interventions. Sivukile has an estimated population of 5757 (based on 2011 census). The estimated number of households earmarked to receive interventions in Sivukile is 1160.



**Figure 1: Population mapping for Morgenzon and Sivukile**

Sivukile meets the site selection criteria for AQO programme i.e. power station impacts on the area, the area is in non-compliance with the national ambient air quality standards (NAAQS) and there exists an opportunity for offsets. A reference ambient air quality monitoring station (refer to Figure 2) has been in operation in Sivukile for over a year and the results indicate exceedances of the NAAQS for PM<sub>10</sub> (refer to Figure 3).



Figure 2: The reference ambient air quality monitoring station at Sivukile.

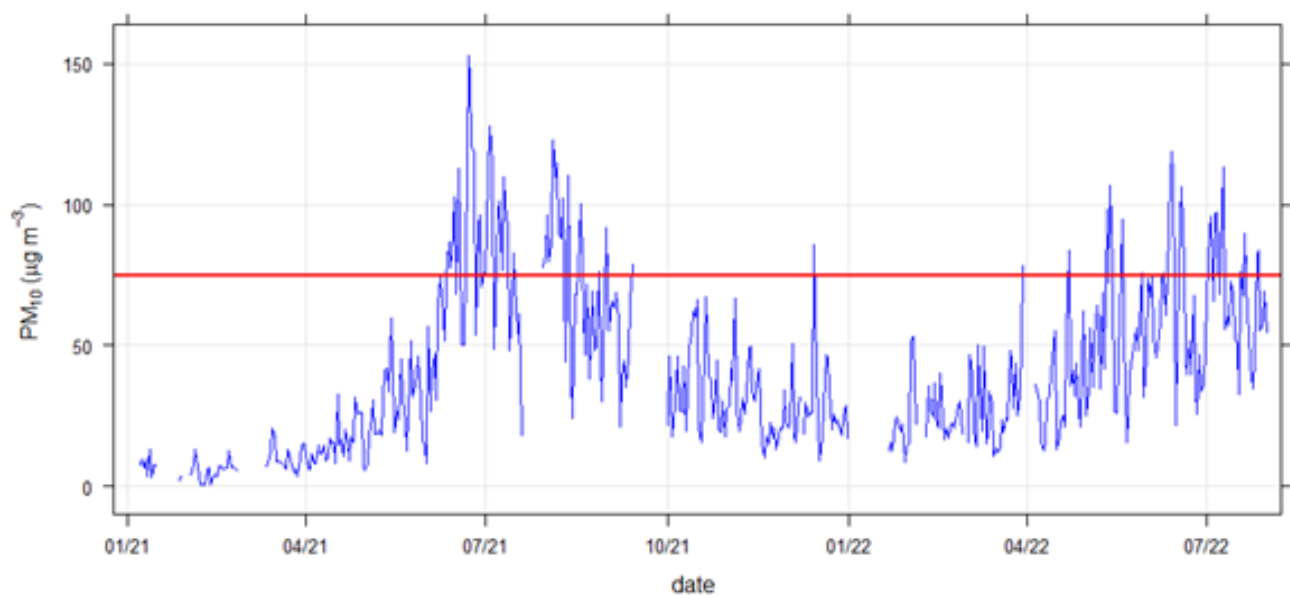
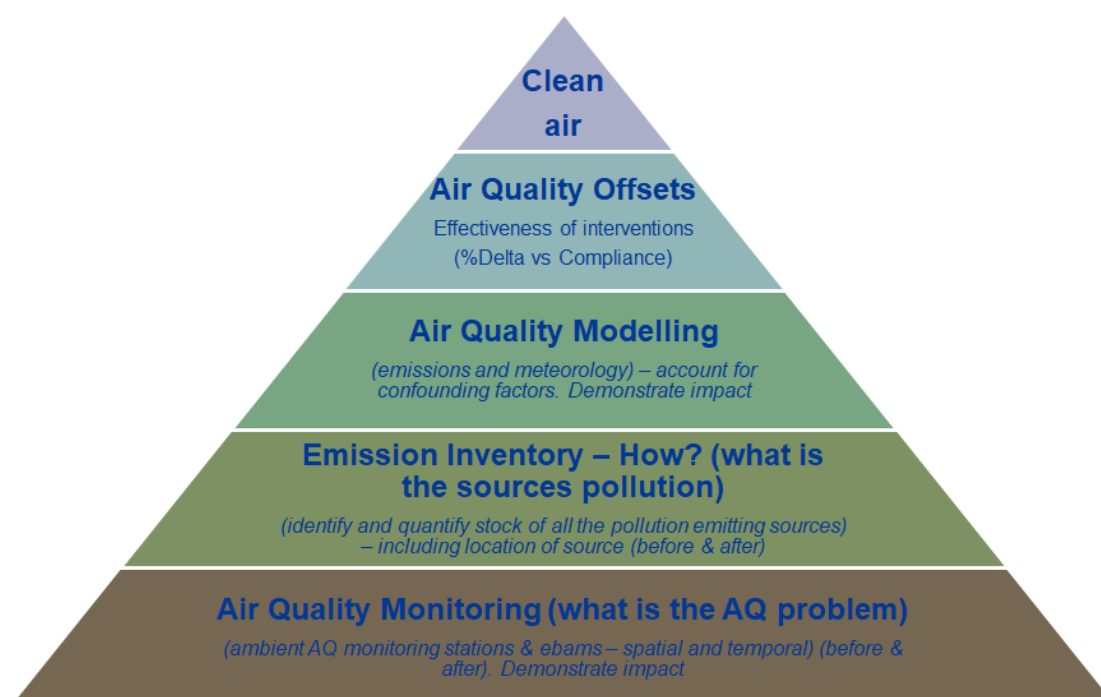


Figure 3: Daily time series of  $PM_{10}$  concentrations at Sivukile ambient air quality monitoring station. The red line represents the daily limit value for  $PM_{10}$ .

### 1.3 OBJECTIVE OF PLANNING, MONITORING AND VERIFICATION (PMV)

The overall objective of PMV is depicted in Figure 4 below. The effectiveness of the offsets interventions and roll-out thereof will be tracked through the PMV entity, and reported on annually to the Gert Sibande

District Municipality and NAQO. A contract will be established with a PMV contractor to undertake this task.



**Figure 4: Objective of the AQO PMV activities.**

Three (3) indicator domains will be monitored before and after the offsets implementation, namely, *the state of ambient air, emissions and quality of life*. Over the monitoring period, the project scenario (as it actually took place) will be compared to a credible baseline scenario (i.e. the situation that would have been the case if the project was not implemented).

**Table 1: Parameters to be monitored**

Ambient air quality	Hourly, daily and annual PM and SO <sub>2</sub> concentrations within the implementation area
	Spatial and temporal distribution of ambient air quality within the implementation area
Household emissions	Number of solid fuel using households within the project boundary per fuel type
	Average solid fuel use per household per season per fuel type
	Number of households at which the offset has been successfully implemented
Quality of life	Demographic factors such as age and sex distribution, which is important to monitor the level of vulnerability due to exposure to air pollution in a community
	Health and well-being such as poverty lines and employment, as well as perceptions regarding air quality and the desirability of the air quality offset project.
	Services and infrastructure such as water, waste removal and sanitation, as well as housing with particular emphasis on measuring temperature inside homes, in order to determine the appropriate indoor thermal range which, influence domestic energy usage patterns
	Education, safety and security aspects as far as it relates to and could be impacted by the offset project

The relationship between the emissions from households and the state of ambient air will be established through modelling (dispersion modelling and receptor modelling). Any confounding factors will be accounted for. Model validation will form an important part of this task.

The offset project impact is the difference between the baseline scenario and the project scenario. The principal indicator for the success of the intervention will be related to a change in exposure to air pollution. This can be expressed as a reduction in the ambient concentration of PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>x</sub> and SO<sub>2</sub>, or as a reduction in standards weighted pollution intake or a reduction in inhalation related health risk or a reduction in the expected burden of disease from air pollution.

Changes in key parameters (i.e delta in ambient air quality, number of coal stoves, energy use pattern, etc.) will mainly be reported before and after implementation of the AQO interventions. The ambient air quality in the area and details of the project implementation should be monitored continuously and the data recorded in the project database.

## 2. PROJECT ACTIVITIES

The following project activities, which are in line with the objective outlined above, are included in the scope of work for contractor to be appointed to undertake the PMV works.

- Activity 1: Ethical clearance (updated annually or as and when required)
- Activity 2: Area intelligence (updated annually)
- Activity 3: Household survey (before and after)
- Activity 4: Emission inventory (before and after)
- Activity 5: Air quality modelling (before and after)
- Activity 6: Project effectiveness review (before and after)
- Activity 7: Database and reporting (as and when required)

The contractor shall submit a comprehensive inception report outlining the approach to be followed in executing each activity. A detailed programme shall be provided during the Inception Phase of the project that will detail the various milestones and their delivery dates. The inception report shall be approved by the employer prior to the commencement of the works.



The contract for this work is for three (3) years, covering the period before, during and after the implementation of the proposed interventions. The scope of activities to be undertaken by the PMV contractor is detailed in the next section. Note that the work related to these activities will be released through a task order process.

The PMV contractor shall provide the necessary project management services to co-ordinate the PMV scope of work. This includes meetings, project planning, quality control, scheduling, reporting and invoicing.

## 2.1 ACTIVITY 1: ETHICAL CLEARANCE

The contractor shall obtain ethical clearance or permit from relevant institutions for all the offset project activities which require ethical clearance or permission (including but not limited to conducting household surveys). The process will include finalising “permits”, survey tools (questionnaire and sampling plan), preparation of research protocols and completion and submission of the required documentation. Different universities, institutions or governance structures have their own internal rules governing the process of ethical clearance and/or permission to execute the scope. The contractor shall comply with all the relevant rules. The ethical or permit application documentation shall be submitted to the employer for approval prior to submission to the relevant institution.

Ethical clearance shall be *updated annually or as and when required*.

### Key tasks:

- Detailed method statement (to be approved by the employer prior to commencement of the activity)
- Confirm requirements for ethical clearance / permit
- Obtain relevant documentation
- Finalise tools e.g. questionnaire and sampling plan
- Prepare a research protocol
- Complete documentation
- Obtain authorisation / permit (e.g. permission to fly drones and/or aviation permits / licenses)
- **Deliverable: Approved ethical clearance (permits/licenses where applicable)**

## 2.2 ACTIVITY 2: AREA INTELLIGENCE

The contractor shall gather intelligence about Sivukile. This includes (but is not limited to) gathering relevant high level regional, social and geographical information including past studies in the area.

Obtain and evaluate government plans / documents on the area (including the Integrated Development Plan and other spatial planning documentation). The contractor shall undertake a macro assessment of the information obtained and report the results in the form of a high level intelligence snapshot report to be submitted to the employer for approval.

The contractor shall undertake a ground-based and aerial-based in-situ assessment of Sivukile to assist the project team in getting clear orientation of the area in order to evaluate and correct oversights in the project plan. The purpose of the in-situ assessment is to provide a detailed, expert, objective perspective on the area. This task shall include a dawn to dusk drive-through and fly-through (drone survey) of Sivukile to document all potential pollution sources including active and historic small, distributed air pollution sources in public spaces.

The aerial-based in-situ assessment shall be used to determine 1). types and number of different house structures, 2). number of houses with coal stoves (using chimney as a proxy) and number of house with asbestos roofs. Ariel survey (using drones) shall also be used to monitor any changes in Sivukile over time including the proliferation of informal dwellings.

The contractor shall identify sources and suppliers of various fuels (energy sources) supplied and in use in Sivukile. The contractor shall investigate the supply chain of each of the fuel / energy source and estimate the quantity and cost of fuel to the households. The fuels to be investigated include, but not limited to, electricity, coal, dung, wood, LPG, paraffin, etc. The following should be determined with regard to each fuel supplied to Sivukile;

- Who are the fuel merchants (identify all role players and their profiles)
- Origin or source of the fuel (describe its supply chain to the household)
- Describe their business model (mode of operation)
- Format in which the fuel is sold
- Price of the fuel (pricing dynamics and cost structure)
- Profit margins

Particular emphases should be given to investigating the business model and supply chain of coal supply business in Sivukile (coal merchants).

The area intelligence study shall be undertaken twice i.e. *before and after* implementation of the interventions.

Key tasks:

- Detailed method statement (to be approved by the employer prior to commencement of the activity)
- Obtain authorisation as required (from local leadership if required).
- Obtain all relevant information about Sivukile (documents, interviews, etc.).
- Undertake ground-based and aerial-based in-situ assessment of Sivukile.
- Identify community sources of pollution (quantification to be done as part of activity 4: emission inventory).
- Identify fuels (energy sources) used in Sivukile and investigate their supply chains.
- Synthesize information into an intelligence report
- Identify any risks and opportunities to the AQO project in Sivukile
- **Deliverable: Area intelligence and in-situ assessment report**

### 2.3 ACTIVITY 3: HOUSEHOLD SURVEY

Information from the household survey together with observations shall be used to gather information to household emissions activities which will be used to develop a comprehensive household emission inventory (refer to section 2.5). The information shall also help understand and explain the effects the AQO interventions on key variables i.e. the efficacy of the AQO intervention (refer to section 2.7) and any confounding factors at play.

The contractor shall conduct household surveys on a statistically significant number of households (approximately 25% of households) in Sivukile to establish baseline information on socio-economic conditions, energy use patterns, household emission sources, perceptions of air pollution and quality of life in the communities, prior to the implementation of interventions. A similar survey exercise shall be repeated after the interventions have been implemented to help understand the resultant changes. The contractor must identify and implement a method that represents the best practice standard in conducting such a survey. Members of the local community must be recruited and trained to conduct the surveys. The surveys including the recruitment and training of surveyors must be done in conjunction with the local project management organisation (PMO).

**Household emission sources:** The purpose of this data is to understand and better quantify the harmful emissions that originate from the households in the area with particular emphasis on domestic fuel burning. The contractor must develop and use a questionnaire that includes (but not limited to) the following recommended proxy indicators:

- Potential sources of air pollution
- Energy use patterns (type of fuels, frequency of use, quantity used, devices used, energy cost, etc.)
- Ownership of durable energy appliances
- Perception of indoor and outdoor air quality and improvement thereof as a result of implementing the interventions
- Satisfaction with the AQO interventions (experience with installation and use of interventions)
- Performance of the AQO interventions
- Sustainability of interventions

**Quality of life:** The survey shall also determine the quality of life in the affected community. For this purpose, the contractor must develop and use a questionnaire that includes (but not limited to) the following recommended proxy indicators:

- Household income
- Overall satisfaction i.e. with living conditions; house as well as with cooking and heating
- Perception of health
- Illnesses experienced
- Days of absenteeism
- Type of housing structure (size, quality, roof type, ceiling etc),
- Number of people per household

**Economic activities:** The survey will also identify and quantify the economic activities in the affected areas. For this purpose, the contractor must develop and use a questionnaire that includes (but not limited to) the following recommended proxy indicators:

- Employment profile
- Education profile
- Household income profile
- Spending patterns
- Expenditure elasticity
- Income spent on energy (energy cost of household)
- Health costs
- Gross domestic product (GDP) contributions

Note that a few of the proxy indicators are only applicable for surveys conducted after implementation of interventions. The surveys must include interviews with selected household supplemented by detailed

observations by the surveyors. The contractor shall submit a detailed survey plan and questionnaire to the employer for approval prior to commencement with the survey.

Household survey shall be undertaken *before* (to establish baseline) and *after* the implementation of interventions.

Key tasks:

- Detailed method statement (to be approved by the employer prior to commencement of the activity)
- Develop survey plan including questionnaire and checksheet (submit to employer for approval)
- Employ and train surveyors (local employment)
- Conduct surveys
- **Deliverable: Comprehensive survey report (synthesis of results of surveys/observations)**

## 2.4 ACTIVITY 3: AMBIENT AIR QUALITY MONITORING

Eskom has established an ambient air quality monitoring station (reference station) at Sivukile (refer to Figure 2) and has operated it since 2020. The monitoring station is equipped with continuous monitors to monitor SO<sub>2</sub>, NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and meteorology. The employer (Eskom) will continue to operate and maintain the monitoring station, verify the data and compile monthly reports. The air quality data will be made available to the contractor.

Eskom has at its disposal Portable Environmental Beta Attenuation Monitors (E-BAMS) that are earmarked for deployment at various Eskom AQO sites. The portability of the E-bams allow for the monitors to be placed at different locations (spatial deployment) in the area and hence enable the development of a better air quality profile for the area. The E-bams are equipped with PM<sub>10</sub>/PM<sub>2.5</sub> monitors.



**Figure 5: Portable Environmental Beta Attenuation Mass (E-BAM) Monitor**

The contractor shall deploy at least 4 E-Bams ( two  $PM_{2.5}$  monitors and two  $PM_{10}$  monitors) at suitable locations across Sivukile. The E-Bams shall be deployed for a three-month period per season. The winter campaign will be from June to August and the summer campaign will be from December to February. The contractor shall arrange for permission to site the E-BAMs, establish and operate them for the monitoring campaign period, log, verify and report on the data, and decommission the E-BAMS at the end of the campaign. Maintenance and repairs of E-BAMS will be conducted by the contractor. The selection criteria that should be used to determine an appropriate location for the siting of the E-BAMS at Sivukile should include *inter alia*:

- Electricity supply;
- representativeness of the site;
- no site obstructions that will interfere with the sampling inlet flow of the instruments probe;
- monitors must be at least 2m from walls, barriers and other significant structures
- presence of trees (trees can scavenge pollutants and can be a source of particulates)
- meteorology;
- climatology;
- source receptor relationships;
- the emission sources;
- dispersion modelling and

- on security and logistical considerations.

Theft and vandalism of the E-BAMs placed at Sivukile is an inherent risk. The contractor shall conduct a risk assessment and develop and implement a security plan (together with a security checklist) to ensure safe deployment of E-bams. The security plan needs to be approved by the employer before it's implemented. Eskom will be liable for the deployment of E-bams (not insured).

The contractor shall integrate data from the Eskom reference air quality monitoring station and from the E-bams, to document and report on the ambient air quality in Sivukile *before (baseline), during (as and when required) and after* the implementation of the AQO interventions.

Key tasks:

- Detailed method statement (to be approved by the employer prior to commencement of the activity)
- Synthesis of ambient air quality data / reports (from Eskom)
- E-Bams deployment security plan
- Deployment of E-bams and continuous monitoring (including spatial variation profiling)
- Baseline assessment of ambient air quality in Sivukile (integrated)
- Continuous air quality monitoring and reporting (integrated, seasonal reports)
- **Deliverable: Integrated Ambient Air Quality Monitoring Reports for Sivukile**

## 2.5 ACTIVITY 4: EMISSIONS INVENTORY

The contractor shall use information and data gathered as part of this study (PMV SoW) to calculate / estimate emissions (i.e. PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> & NO<sub>x</sub>) from all major sources (household, community, etc.), and use that information to develop a comprehensive emissions inventory for Sivukile. The emissions inventory shall be developed *before (baseline) and after* the implementation of the AQO interventions.

The results from the emissions inventory shall be presented in pie-charts, which show the percentage contribution of all major pollution sources to PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> & NO<sub>x</sub> released into the area. Of specific interest is the contribution of domestic solid fuel burning to PM released into the area.

Key tasks:

- Develop an emissions inventory (quantities, emissions rates and location of the sources)
- **Deliverables: Emission Inventory and the associated report**

## 2.6 ACTIVITY 5: AIR QUALITY MODELLING

A dispersion model will be used to complement air quality monitoring data from both the reference air quality stations and the E-Bams. The contractor shall perform appropriate dispersion modelling to predict ambient PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>x</sub> levels in Sivukile to an acceptable level of accuracy. Consideration shall be given to both primary and secondary PM. The model shall comply with the Department of Forestry, Fisheries and the Environment's (DFFE) "*code of practice for air dispersion modelling in air quality management in South Africa*".

The contractor shall perform the dispersion modelling to determine the ambient air quality status *before (baseline)* and *after* implementation of the offset interventions.

### Key tasks:

- Perform dispersion modelling (before and after)
- Model validation
- **Deliverables: Dispersion modelling reports**

## 2.7 ACTIVITY 6: PROJECT EFFECTIVENESS REVIEW

The contractor shall conduct a review of the AQO project effectiveness. The main purpose of the review is to determine the extent to which the project measures continue to be used by the households and to determine their effectiveness in meeting the project objectives. The review must include an assessment of the following aspects:

- Improvements in ambient air quality
- Improvements in indoor air quality
- Number of coal stoves removed from circulation
- Retention rate (continued use of gadgets)
- Rate of regress (back to use of solid fuels)
- Performance of the interventions (hybrid stove, LPG heater and ceiling)
- Satisfaction with interventions (including user experience with both installation and use)
- Localisation (business opportunities – local vs broader)
- Community empowerment
- Skills development (gender and youth)

The contractor shall conduct the AQO project effectiveness review *annually* and the results of which will be included in the annual report to the authorities.



Key tasks:

- Undertake annual project effectiveness assessment
- **Deliverables: Project effectiveness report**

**2.8 ACTIVITY 7: DATABASE AND REPORTING**

The contractor shall establish and maintain a project database to store;

- All the air quality monitoring data / reports (ambient air quality monitors and E-bams)
- Survey data / results
- Emissions inventory (including pollution sources, frequency, duration, magnitude, location, seasonality etc).
- AQO Implementation information (number, type, location, intervention, date of implementation, employment data, local spend, etc.).
- All the project documentation and reports (produced by all AQO contractors including PMV)
- Any other documentation of relevance to the project

Eskom shall be trained on the use of the project database, and the database shall be accessible to Eskom for the duration of the project and thereafter. The database shall be handed over to Eskom at the end of the contract.

The contractor shall compile monthly project status reports. The contractor shall compile an Integrated AQO implementation report, annually, for submission to DFFE and the licensing authorities. The report shall synthesize all the information on the AQO project.

The contractor shall establish a project dashboard to monitor key project factors including, but not limited to, the following;

- Ambient air quality in Sivukile (vs NAAQS)
- Number of households that received interventions / coal stoves removed (vs target)
- AQO intervention rollout rate (vs target)
- Number of jobs created (local, gender, youth, etc.) (vs target)
- Local spend (vs target)

The establishment and maintenance of the database and dashboard will require close interface and co-ordination with the employer, the Eskom project manager and the site project implementation team. This is the responsibility of the contractor.

Key tasks:

- Monthly AQO project reports
- Comprehensive annual AQO project reports
- Maintain an up-to-date dashboard
- **Deliverables: Up-to-date database, dashboard, monthly and yearly reports**

### 3. SCHEDULE OF PMV ACTIVITIES

The schedule of activity will be aligned to the project implementation schedule and it will cover period before, during and after the implementation of interventions. The plan is to commence with the implementation of the interventions in Sivukile in January 2023. The implementation period is estimated to be 18 months. Thus, the planned completion of the rollout in Sivukile is June 2024. The scope of this work will extent to 2025 to allow for evaluation of the interventions one year after rollout.

**Table 2: Schedule of PMV activities**

Activity no.	Description	Year 1 - 2023	Year 2 - 2024	Year 3 - 2025
1.	Ethical clearance	Annual update (as & when required)	Annual update (as & when required)	Annual update (as & when required)
2.	Area intelligence	Before (baseline)		After
3.	Household survey (baseline)	Before (baseline)		After
4.	Emission inventory	Before (baseline)		After
5.	Air quality modelling	Before (baseline)		After
6.	Project effectiveness review	Annual review	Annual review	review
7.	Database and Reporting	Monthly / annually	Monthly / annually	Monthly / annually