MINIMUM EMISSIONS STANDARDS (MES)

OFFSET IMPLEMENTATION PLAN

SASOL SECUNDA

Table of Contents

List of Figures

Glossary

Air quality offsets guideline – the Air Quality Offset Guideline published in terms of section 24J(a) of the National Environmental Management Act, 107 of 1998 as GN 333 in Government Gazette 39833 of 2016. Refer to "Draft air quality offsets guideline" for more information. Since the publication of Sasol's draft offset implementation plan, the Air quality offsets guideline was published. Sasol's offset implementation plan has since also been informed by the Air quality offsets guideline.

Ambient standard – The maximum tolerable concentration of any outdoor air pollutant as set out in the National Ambient Air Quality Standards in terms of Section 9(1) of the NEM:AQA.

Baseline scenario - The baseline scenario is the reasonable, conservative scenario that would exist in the absence of the project.

Criteria pollutants – Section 9 of NEM:AQA provides a mandate for the Minister to identify a national list of pollutants in the ambient environment which present a threat to human health, well-being or the environment, which are referred to in the National Framework for Air Quality Management as "criteria pollutants". In terms of Section 9, the Minister must establish national standards for ambient air quality in respect of these criteria pollutants. Presently, eight criteria pollutants have been identified, including sulfur dioxide (SO2), nitrogen dioxide (NO2), ozone (O3), carbon monoxide (CO), lead (Pb), particulate matter (PM10), particulate matter (PM2.5) and benzene (C6H6). In this document, any pollutant not specified in the National Ambient Air Quality Standards (NAAQS) is called a "non-criteria pollutant".

Draft air quality offsets guideline – The draft air quality offsets guideline published in GN 597 in GG 38894 of 2015 sets out a draft guideline for the application of offsets during the implementation of the atmospheric emissions licensing system stipulated in Chapter 5 of the NEM:AQA, as well as guiding principles for the implementation of offsets.

Existing Plant – Any plant or process that was legally authorized to operate before 1 April 2010 or any plant where an application for authorisation in terms of the National Environmental Management Act 1998 (Act No.107 of 1998), was made before 1 April 2010.

GN 893 – Government Notice 893, 22 November 2013, published in terms of Section 21 of the National Environmental Management: Air Quality Act (Act No. 39 of 2004) and entitled '*List of Activities which Result in Atmospheric Emissions which have or may have a Significant Detrimental Effect on the Environment, Including Health and Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage'*. GN 893 repeals the prior publication in terms of Section 21, namely Government Notice 248, 31 March 2010. GN 893 deal with aspects including: the identification of activities which result in atmospheric emissions; establishing minimum emissions standards for listed activities; prescribing compliance timeframes by which minimum emissions standards must be achieved; and detailing the requirements for applications for postponement of stipulated compliance timeframes.

Hydrogen Sulfide (H_2S) – a colourless gas with the characteristic odour of rotten eggs. A by-product of oil refining and burning, as well as other sources including sewage treatment plants, and household solid fuel burning. Toxic at high concentrations.

Minimum emissions standards – Prescribed maximum emission limits and special arrangements for specified pollutants and listed activities. These standards are published in Part 3 of GN 893.

Nitrogen dioxide (NO_2) – one of a group of highly reactive gases known as "oxides of nitrogen," or "nitrogen oxides (NOx)." NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system, including airway inflammation in healthy people and increased respiratory symptoms in people with asthma.

Particulate matter (PM) – a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

The size of particles is directly and inversely linked to their potential for causing health problems, i.e. the smaller the particles, the more harmful they potentially are to one's health. Particles that are 10 micrometers in diameter or smaller generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. PM is generally placed into two categories:

- "Inhalable coarse particles" are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.
- "Fine particles" are 2.5 micrometers in diameter and smaller.

Point source – A single identifiable source and fixed location of atmospheric emission, and includes smoke stacks.

Postponement – A postponement of compliance timeframes for existing plant standards and new plant standards and their associated special arrangements, in terms of Regulations 11 and 12 of GN 893.

Priority area – means an area declared as such in terms of Section 18 of NEM:AQA.

Priority area air quality management plan – means a plan referred to in Section 19 of NEM:AQA.

Sulfur dioxide (SO_2) – one of a group of highly reactive gases known as "oxides of sulfur." SO_2 is linked with a number of adverse effects on the respiratory system, bronchoconstriction and increased asthma symptoms.

List of Abbreviations

AEL – Atmospheric Emissions Licence

CO – Carbon Monoxide

DEA – Department of Environmental Affairs

DOIP – Draft Offset Implementation Plan

H_2S – Hydrogen Sulfide

IPCC – Intergovernmental Panel on Climate Change

MES – Minimum Emissions Standards

NAAQS – National Ambient Air Quality Standards

NAQF – National Framework for Air Quality Management in the Republic of South Africa (2013)

NAQO – National Air Quality Officer

NEM:AQA – National Environmental Management: Air Quality Act

NO_2 – Nitrogen Dioxide

NOx – Oxides of Nitrogen

OIP – Offset Implementation Plan

PM – Particulate Matter

$PM_{2.5}$ – Particulate Matter with radius of less than 2.5 µm

PM_{10} – Particulate Matter with radius of less than 10 µm

SO_2 – Sulfur Dioxide

1 Introduction

Sasol is an international integrated energy and chemical company that employs more approximately 31 000 people working in 37 countries. In South Africa, Sasol owns and operates petrochemical and chemical manufacturing facilities in Secunda in Mpumalanga and Sasolburg in the Free State.

In 2013, the Department of Environmental Affairs (DEA) published revised Minimum Emissions Standards (MES), under the auspices of the National Environmental Management: Air Quality Act (NEM:AQA). The MES serves to define maximum allowable emissions to atmosphere for a defined range of pollutants and specific activities that can result in such emissions. The MES apply to many of Sasol's activities.

Sasol applied for postponement of the compliance timeframes contained in the MES which prescribe maximum emission limits for specified industrial activities. Decisions on these postponement applications were made in February 2015 by the National Air Quality Officer (NAQO) in concurrence with the Gert Sibande District Municipality licensing authority, and our Atmospheric Emissions Licences (AELs) were accordingly varied to align with those concurrent postponement decisions. The amended AEL for Sasol South Africa Pty (Ltd) (Sasol Synfuels) contains the following condition: '*The facility must implement an offset programme to reduce PM and SO_2 pollution in the ambient air / receiving environment and the implementation plan is to be presented to the NAQO and the licencing authority by 30 June 2015 after agreement, followed by an appropriate public participation process. The conditions associated with this will be included as an Annexure to the AEL'.* Sasol complied with this requirement by submitting a draft plan to local and national authorities. That plan has subsequently been refined in light of further discussion with authorities and other leadership structures and informed by the publication of the draft air quality offset guideline, to ensure consistency with that document. The offset plan has since also been informed and updated, as necessary, by the Air Quality Offsets Guideline (Government Notice No. 333), published on 18 March 2016. The difference between the Draft and gazetted guidelines has not resulted in material changes.

Further public consultation on this plan has been undertaken as required in terms of the postponement decisions above. Sasol values engagements with its stakeholders to ensure that the offset plan is fit for purpose and appropriately considers the needs of the eMbalenhle and Lebohang communities where the offset activities will be focused. The purpose of this document is to detail the offset implementation plan referred to above. The document is structured to:

- Present a rationale for offsets as a component of Sasol's air quality improvement roadmap (refer to Section 4 and Annexure 1);
- Outline Sasol's air emissions offset commitment (refer to Section 6);
- Share the outcomes of work done to date by Sasol at pilot scale to demonstrate learnings, potential benefits and challenges that could potentially be experienced through the implementation of community-based offsets (refer to Section 5 and Annexure 2);
- Describe the public participation process that was undertaken to obtain input on the draft offset implementation plan and the manner in which Sasol intends to consult with communities during implementation of this plan (refer to Section 7); and
- Introduce the proposed success criteria by which to measure offset performance (refer to Section 8).

It should be noted that Sasol has detailed the elements of the offset implementation plan to the extent possible, based on the level of current definition of proposed programme activities. Refinement and detailed scoping of programme activities will be ongoing, and will be shared

with, and informed by, stakeholders through an engagement approach that is described in Section 7.

2 Offset Implementation Plan in the Context of Postponements from the Minimum Emissions Standards

A Section 21 facility is an industry which operates one or more "listed activities", as described within the Listed Activities and Minimum Emission Standards (MES). The MES serves to define maximum allowable emissions to atmosphere for a defined range of pollutants and specify the listed activities that can result in such emissions. For example, the MES specify emission limits for emissions of sulphur dioxide (SO_2), oxides of nitrogen (NOx) and particulate matter (PM) arising from the combustion of fuels like coal and oil in power plants and furnaces. The MES apply to many of Sasol's listed activities.

Through environmental improvements implemented over the last decade, Sasol already complies with many of the MES. In 2013 and 2014, Sasol embarked on a process to apply for postponement of the 1 April 2015 compliance timeframe for some of the MES applicable to some of their listed activities. The postponement applications included motivation reports outlining the reasons for requesting postponements, Air Impact Reports (AIRs) and an extensive public participation process as documented in the form of Stakeholder Engagement Reports including Comment and Response Reports. The documents related to that process are available through the website of the independent consultant who facilitated the applications for Sasol (http://www.srk.co.za/en/za-sasol-postponements).

The National Air Quality Officer (NAQO) in concurrence with the Gert Sibande District Municipality licensing authority granted postponements to Sasol in February 2015, and stipulated conditions to be upheld for the period of postponement. One of the conditions of the postponements included the requirement to submit an offset implementation plan to reduce PM and SO_2 pollution in the ambient / receiving environment to the authorities by 30 June 2015. That condition has since been incorporated in Sasol's AEL and is therefore a legally binding requirement. As per the AEL condition, Sasol is also required to undertake an appropriate public participation process on its offset plan, prior to the plan's approval and inclusion as an Annexure to its AEL.

3 Sasol's Air Emissions Offset Objectives

The DEA's Air Quality Offsets Guideline defines air emissions offsets as "*an intervention, or interventions, specifically implemented to counterbalance the adverse and residual environmental impact of atmospheric emissions in order to deliver a net ambient air quality benefit within, but not limited to, the affected airshed where ambient air quality standards are being or have the potential to be exceeded and whereby opportunities and need for offsetting exist.*"

As part of Sasol's AEL amended following postponement decisions, a condition is included for Sasol to develop an offset implementation plan to offset particulate matter (PM) and sulfur dioxide (SO_2). Sasol identified opportunities to do so in respect of PM and SO_2 in the areas near its Secunda facility as guided by the draft Air Quality Offsets Guideline as it then was, as well as the HPA plan. Before this requirement for an offset implementation plan had been imposed, and informed by its own ambient air quality monitoring programme, Sasol recognised that high levels of PM in the ambient environment are prevalent, particularly in winter months. The levels exceed the NAAQS, meaning that human health is potentially at

risk. Non-industrial sources are known to contribute significantly to the exceedances of the NAAQS for PM, and hence Sasol began a programme of investigating the possibility that community-based offsets might achieve significant improvements in ambient PM levels. A pilot study in KwaDela, Mpumalanga has been undertaken, and results have been integrated across air quality and numerous other quality of life parameters.

More specific information regarding the scientific rationale for offsets is included in Annexure 1 and regarding the offset pilot study in KwaDela in Annexure 2.

3.1 Offset objective in terms of air quality outcomes

Sasol's offset plan seeks to demonstrate improvements in ambient levels of PM and SO2 in the areas where offsets are implemented. Ongoing monitoring of ambient PM and SO2 will be required to measure the improvements in these pollutant levels and the extent to which these can be directly attributed to the implementation of offsets by Sasol, over time.

3.2 Offset objective in terms of broader socio-economic outcomes

Sasol's position is that offsets may deliver sustainable and tangible ambient air quality improvements with socioeconomic benefits not always achievable through further point source abatement. To this end, ambient air quality improvement is not the sole measure of success. Rather they are one of a suite of measures or metrics aligned with the goal of "quality of life" or "well-being" improvement, which may also include other environmental improvements, such as greenhouse gas emission reductions.

3.3 Measurement of offset outcomes

Due to the early stage of knowledge and development of offsets, no quantified goals have been set for specific programme outcomes. Rather, the offset implementation plan outlines the various metrics along which Sasol will aim to quantify the beneficial impacts of its offset programme of activities. As knowledge, experience and data on offset performance evolves over time, the intent would be to gradually move toward definitive offset target setting for key metrics.

4 Air Emissions Offsets for Sustainable Air Quality Improvement

4.1 Offsets as a recognised air quality improvement mechanism

In the context of national policy development, Sasol has also advanced its policy thinking on environmental offsets generally, including air emission offsets. Within this arena, Sasol believes that formally recognised air emission offsets may represent a sustainable mechanism to improve ambient air quality with the potential to deliver other concurrent environmental and socioeconomic benefits, including greenhouse gas emission abatement and quality of life improvement, amongst others.

A formal offset mechanism will provide a credible basis for offsets, and ought to be informed by the sustainability principles contained in the National Environmental Management Act (NEMA). Such a mechanism would provide further investment certainty for offsets. Sasol also supports the principle that offsets be embedded in sound regulatory and environmental management governance to distinguish offsets from Corporate Social Investment. A

recognised mechanism would enable industry to broadly consider large-scale investments in offsets.

Sasol has submitted its views regarding development of a formal offset mechanism to DEA as part of its engagement process on environmental offsets. This includes views on air emission offset principles that should underpin rigorous offset projects, informed by an assessment of international practices and guidelines such as the Greenhouse Gas Protocol and Intergovernmental Panel on Climate Change (IPCC). Notwithstanding, Sasol's offset implementation plan is aligned with the principles outlined in the Air quality offsets guideline, as outlined below.

4.2 Application of the DEA's air quality offset principles

Sasol supports offsets as a mechanism which gives effect to the Constitution, the principles of NEMA, the objectives of the NEM:AQA, as well as the aspirations of the National Development Plan.

Since the first draft of this offset plan, the Draft air quality offsets guideline has been formalised. This offset plan is to be assessed, as necessary, by the authorities against the principles contained in the guideline. The offset principles contained in the guidelines have been paraphrased as necessary below.

4.2.1 Outcome based

Principle: The implementation, monitoring and evaluation of the air quality offset should be based on the outcome of improved ambient air quality.

How the principle will be applied: A comprehensive monitoring programme will be implemented to establish an ambient and indoor air quality baseline. Ongoing measurements will be conducted with a frequency which will be determined as part of the overarching programme, to confirm the arising air quality and other concurrent benefits. As explained in Section 3.3, due to the early stage of knowledge and development of offsets, no quantified goals have been set for specific programme outcomes. Rather, the offset implementation plan outlines the various metrics along which Sasol will aim to quantify the beneficial impacts of its offset programme of activities. As knowledge, experience and data on offset performance evolve over time, the intent would be to gradually move toward definitive offset target setting for key metrics. See Chapter 8 for an overview of metrics, and Annexures 3-5 for the specific metrics to be measured for the baseline campaign and immediate interventions.

4.2.2 No "like for like"

Principle: The proposed offset project(s) should address pollutant(s) whose ambient concentration is/are of concern in a particular area, and not necessarily the pollutant(s) whose emission from a facility is/are of concern.

How the principle will be applied: The offset condition included in the postponement decision, as reflected in Sasol's licence, stipulates the pollutants of concern as particulate matter and sulfur dioxide. These are therefore the focus of the offset interventions, while other pollutants (such as oxides of nitrogen, carbon monoxide, and greenhouse gases such as carbon dioxide, etc) may also be quantifiably reduced in the process.

4.2.3 Transparency and acceptability

Principle: Air quality offsets should be based on open, fair and accountable administrations by applicants and authorities, including the undertaking of a public consultation process to ensure public buy-in of offset projects.

How the principle will be applied: Chapter 7 outlines the public consultation process undertaken, and a detailed Stakeholder Engagement Report has been included as part of this submission. Chapter 7 also outlines that existing bi-annual consultation and information sessions will be used to report back to stakeholders on progress with implementation of all elements of the programme and results.

4.2.4 Complementarity

Principle: In administering offsets, authorities should take into account not only the impacts of offsetting, but also all other measures taken and/or to be taken by the proponent to reduce emissions within the applicant's facility.

How the principle will be applied: Sasol's postponement applications included air quality improvement roadmaps outlining the measures planned to be taken at their respective facilities to reduce emissions.

4.2.5 Sustainability

Principle: The offsets projects should be based on long-term air quality improvement without impeding on other socio-economic and environmental objectives. Offsets that provide for short-term solutions should not be considered.

How the principle will be applied: Sasol's projects are being scoped to try and build sustainability into the outcomes, so that the longevity of benefits extends beyond the period of investment. This involves, amongst others, partnering through existing structures and institutions, the use of service level agreements, and capacity building. Where ongoing investment (e.g. through provisions for maintenance) may be necessary, Sasol will provide funding for the period of the offset programme, linked to postponement decisions.

4.2.6 Measurable and scientifically robust

Principle: An approved offset must have measurable air quality outcomes. Offsets should represent actual reduction of atmospheric emissions from various sources and not incomplete or inaccurate accounting of emissions, and therefore should cater for good understanding of emission sources. A realistic baseline in the absence and presence of the offset project should be understood.

How the principle will be applied: A comprehensive baseline campaign forms part of the offset plan, as detailed in Annexure 3. Key metrics will be measured over time as the programme progresses, to assess benefits arising from the offset activities.

5 Sasol's Air Emissions Offset Investigations to date

5.1 Overview

Sasol continues to investigate offsets and to consider the policy framework, the mechanisms and other guiding tools required to bring about a credible, justifiable and meaningful offset regime. To this extent, Sasol has engaged and continues to engage with the DEA and other stakeholders to share learning and views, to contribute towards the creation of a common understanding of how the risks posed by airshed non-compliance with the PM NAAQS can most effectively be addressed, so that NEM:AQA objectives are ultimately met. In the Section that follows Sasol's ongoing KwaDela pilot study is summarised. More detail on the pilot study is included in Annexure 2. The KwaDela study, which was initiated in 2012, is Sasol's most in-depth investigation of offsets to date.

5.2 The KwaDela pilot study

Sasol initiated one of the first comprehensive pilot scale studies on ascertaining the domestic solid fuel use and associated emissions reduction benefits of interventions that would limit heat loss from Reconstruction and Development Programme (RDP) houses. Reduced heat loss would imply less domestic fuel required for at least space heating, during cold winter months. The pilot study, which is already far progressed, is being conducted in KwaDela, a residential area of some 1,000 households in Mpumalanga, where the interventions took the form of three different configurations of RDP home insulation, on all willing and eligible households:

- Basic retrofit: The ceiling and draught proofing (window sill and door insulation) retrofit (on 396 homes);
- Intermediate retrofit: The ceiling and draught proofing plus a Trombe wall[1] on the north façade (on 20 homes); and,
- Full retrofit: The full retrofit comprises the Basic retrofit plus outside wall insulation on the east, south and west façade and a Trombe wall on the north façade (89 homes).

In order to conduct this detailed study, Sasol has partnered with independent experts in community quality of life and air emissions research, namely the Nova Institute and North West University, respectively. Sasol has also shared knowledge, learning and best practice with Eskom, which is also implementing a pilot study. A comprehensive monitoring programme was established to measure and establish a baseline of among others, coal use, fire cycles, indoor and ambient air temperature, and indoor and outdoor air quality. A broad range of household well-being indicators was also collected.

[1] *A Trombe wall is a sun-facing wall originally developed by the French engineer Félix Trombe in 1956. It is built from material that can act as a thermal mass combined with an air space, insulated glazing and vents to form a large solar thermal collector. For the KwaDela study the design was adjusted to exclude extra building mass and air vents. A single layer of polycarbonate sheeting is mounted on a treated wooden frame and fixed to the northern facade of test houses. The wall is also painted black. Solar heat is trapped in the space between sheet and wall, is then absorbed by the wall from where it radiates into the living space over a period of several hours. In summer the acute sun angle limits the heat collection of the Trombe wall and thus does not cause excessive heating.*

5.3 Results

In the first year after implementation, promising positive results, including statistically significant improvements in indoor household temperatures, were recorded. A significant proportion of households also reported that they discontinued solid fuel use in winter. The full retrofit is clearly more effective in eliminating coal use. Approximately 18% of coal using households who received a basic retrofit discontinued coal use while 42% of those who received the full retrofit stopped using coal. The impact at ambient level is less clear. There is a small yet measurable year-on-year reduction in daily ambient $PM_{2.5}$ concentrations especially during the morning and evening PM peaks typically linked to domestic fuel burning. Detailed feedback was obtained from households who received the retrofits. The overwhelming majority of respondents were satisfied with the intervention.

The results of the pilot study present important learnings for the manner in which Sasol has prepared this offset implementation plan:

- The complexity of various sources impacting on ambient air quality is not to be underestimated. Multiple factors outside of the project implementer's control could be at play – therefore, no commitment to an outcome-based target is possible at this stage, although Sasol does commit to detailed monitoring to see whether impacts are visible, and furthermore, projects proposed are informed by the Highveld Priority Area Air Quality Management Plan, which highlights the main air quality challenges for the region;
- Given the complexity and number of emission sources, it is unlikely that a single offset intervention will meaningfully improve ambient air quality. For this reason, Sasol have proposed a programmatic approach, to allow for learning and adaptability as time progresses, to respond to measured results on key outcome metrics;
- Interventions dependent on behavioural changes for successful outcomes (for example linked to solid fuel burning and waste burning) are necessarily complex; and
- The establishment of a comprehensive emissions baseline and emission source inventory is critical to explaining offset performance over time within a potentially very variable year-on-year baseline. For this purpose, extra components have been included in the baseline campaign to increase robustness.

5.4 Quality of life survey

Importantly, a quality of life survey was also conducted in eMbalenhle, Lebohang and KwaDela between August and October 2013. The purpose of the survey was to provide a baseline for measuring the impact of any single or combined interventions in the communities for potential quality of life improvement. The survey investigated perceived well-being, self-reported health and standard of living. In general, respondents tend to be more satisfied with life domains related to relationships (closest partner, household members, neighbours, trust, sensation, motivation, communication) than with their environment (terrain, air, house, light, sounds). The ratings for satisfaction with work and education (discovery) are conspicuously low and satisfaction with air quality in eMbalenhle was the lowest satisfaction score of all.

These survey results for a quality of life baseline provide further support for the possibility that community-based offset programmes could contribute meaningfully to various sustainable development imperatives, including air quality improvement.

6 Sasol's Offset Plan (2015-2020)

6.1 Context

Over the past three years, Sasol has invested considerably in social projects to deliver quality of life improvements linked to improved environmental management outside the Secunda factory fence, through its Corporate Social Investment programmes. These initiatives include

providing infrastructure for improved municipal waste management, waste recycling, municipal sewage plant improvements, and, more recently, water leak management as a demand reduction intervention in response to the drought. Several of these projects have either directly or indirectly contributed to improving ambient air quality. These projects focused on the 'lower hanging fruits', and were relatively straight forward interventions, not requiring significant research and piloting. The focus of the offset programme as outlined below, is now targeting more complex challenges for non-industrial pollution sources, and for this reason, retains ongoing testing of solutions as a pivotal component of a successful and sustainable offset programme.

6.2 Programme of activities approach

Sasol's air emissions offset interventions are structured as a programme of activities. The aim is to show progressive implementation of interventions, building knowledge and experience, towards increasing improvements in quality of life outcomes, including ambient air quality. Since knowledge of solutions to effect ambient air quality improvements through community-based offsets is relatively nascent, the programme is inherently intended to grow and adapt over time as experience, successes, shortcomings and learnings are obtained. The sequencing and staggering of activities is mindful of the current state of knowledge, and how this will grow over time.

This phased approach seeks to balance the vital continued gathering of detailed scientific data on quality of life and air quality baselines and feasible solutions to inform more effective longer-term activities of a more complex nature, with the need to demonstrate visible activities on the ground in the short term.

Successfully driving ambient air quality improvements, particularly where these involve investments much more directly impacting on communities, cannot be achieved by Sasol's actions alone. Sasol strives for a collaborative, constructive relationship where all parties play a meaningful role toward the successful execution of the offset implementation plan. For this reason, much emphasis is placed on ongoing stakeholder engagement and community participation as part of this plan.

At a high level, the programme of activities comprises:

- **Ongoing stakeholder consultation**, for the purposes of awareness creation around the implementation plan; educating communities about air quality and their role in diminishing pollution as well as personal exposure; reporting progress on offset implementation and addressing challenges.
- **A detailed quality of life and air quality baseline campaign** in eMbalenhle and Lebohang to identify the key opportunities for air quality improvement, against which holistic quality of life improvements will be tracked.
- **Implementation of specific projects** aimed at improving air quality are as follows:
    - Veld Fire Management in Secunda
    - Insulation of solid fuel burning RDP homes in eMbalenhle and Lebohang
    - Testing of innovative solutions in Lebohang with the intent of full scale roll-out if successful and demonstrated to significantly improve ambient air quality. Section 6.4.2 C outlines these tests and what will be done in the event these tests prove unsuccessful
- **Air quality education and awareness campaigns** which involve developing a programme to educate the community on sources of air pollution and measures that can be taken to improve the air quality in the targeted communities.

It should be noted that Sasol has detailed the elements of the offset implementation plan to the extent possible, based on the level of current definition of proposed programme activities. Refinement and detailed scoping of programme activities will be ongoing, and will be shared

with, and informed by, stakeholders through an engagement approach which is described in Section 7.

6.3 Geographical scope

The AEL condition specifies that the offset implementation plan must address PM and SO_2. In light of the offsets guideline and aligned with the HPA plan, which requires interventions to be targeted near the facility in areas with identified opportunities for offsets, as confirmed through consultation with authorities, the focus areas for the implementation plan has been identified as eMbalenhle, a large community close to the Secunda facility and Lebohang, a mid-sized community adjacent to Leandra.

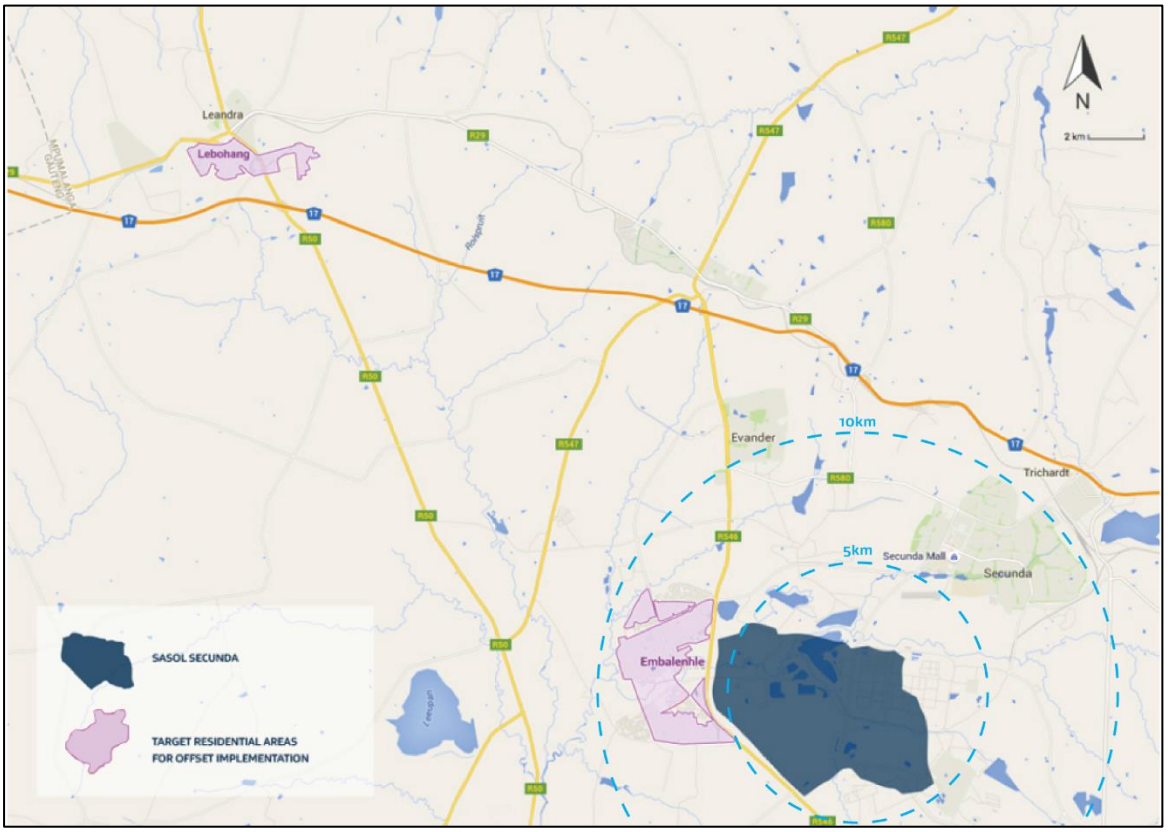

Figure 1: Location of eMbalenhle and Lebohang communities in relation to Sasol Secunda facility

The Atmospheric Impact Report (AIR) prepared as part of Sasol's postponement applications (available from http://www.srk.co.za/files/File/South-Africa/publicDocuments/Sasol_Postponement/SOGS_/ANNEXURE_A_SYNFUELS_Atmospheric_Impact_Report.pdf) confirms that the area within a 10 km radius of the facilities is where the majority of ambient impacts from Sasol materialise. While these concentrations lie well within the NAAQS, offsets are nevertheless logically focused in eMbalenhle, confirming the guidance received from authorities and aligned with the process which informed decisions on the areas to implement offsets in.

Considering the impact of activities at neighbouring communities on ambient air quality and guidance from the local authority, Lebohang was strategically selected as a testing ground for piloting further offset solutions, as detailed below.

6.4 Sasol's commitment

Sasol commits to implementing an offset programme, targeting low-income communities near its Secunda facility, informed by guidance provided by authorities, its own research and sustainable development objectives and importantly, also the inputs of the targeted communities and other stakeholders.

The envisaged components of the "programme of activities" for advancing offsets within the next five years are outlined hereunder, comprising a pipeline of initiatives at various stages of development.

6.4.1 Detailed quality of life and air quality baseline

A detailed baseline is a crucial component of any credible offset programme, since:

- It establishes the key emission sources contributing to ambient concentrations of pollutants, thereby pointing to the types of offset interventions which are necessary to effect a meaningful change in ambient air quality;
- It sets the starting point, against which improvements resulting from the offset activities can be measured, against defined and measurable success criteria.

Details of the components of the baseline campaign applicable to eMbalenhle and Lebohang are presented in Annexure 3. The careful planning and sound execution of the baseline campaign is essential to meet Sasol's offset principles of completeness and accuracy.

Commencing in the course of 2016, a comprehensive ambient and indoor air quality monitoring campaign will be conducted in eMbalenhle by an independent and appropriately qualified party. This will be followed by a similar campaign in Lebohang in the second quarter of 2017. Historical data on the air quality in Lebohang will be gathered from other industries' ambient monitoring stations to get some information in support of a baseline. The nature and extent of both baselines will include the measurement and quantification of various pollutant species in both the ambient environment and indoor domain (including PM and SO_2), all relevant meteorological data, as well as the sophisticated profiling of sources through chemical source apportionment. As part of the baseline campaign, household energy use surveys have commenced within Lebohang in July 2016 and will extend until October 2017. An attempt will also be made to quantify the possible greenhouse gas footprint of the significant sources in the area through energy profiles and mass balance calculations. From an indoor household perspective, temperature measurement will be taken, together with chimney temperatures to monitor fire making activity. Moreover, activities undertaken that could influence both indoor and ambient air quality will be determined through amongst others the conducting of comprehensive surveys in the area. As discussed in Section 5, a quality of life baseline was already established in 2013. This will now be supplemented with gathering of detailed information regarding household energy consumption patterns and the extent of household understanding / education regarding air pollution and air quality. The survey will be supplemented by direct measurements consisting of a combination of stove temperature measurements, coal-use logbooks kept by the household and the periodic weighing of coal containers.

A coal merchant survey will be done at a number of local coal merchants to obtain information on the origin, price and format in which coal is sold. A sample of coal bags (or tins) will be weighed.

A community source survey will investigate relatively small, distributed non-household sources within the residential area. Regional and local dust sources will be investigated through a GIS land-use assessment.

The gathering of this data will allow for the compilation of an emission inventory for eMbalenhle and Lebohang and for the integration of air quality, quality of life, energy consumption patterns and air quality education information to draw insights regarding how to best give effect to ambient air quality improvements in ways that also achieve significant co-benefits, including socioeconomic outcomes.

A baseline survey on energy consumption patterns and air quality education will also be conducted in Lebohang. These will supplement the quality of life baseline that was also gathered there in 2013.

It is important to note that during the planning of the baseline work, attention was particularly given to the priority area improvement plans to guide the establishment of the monitoring regime.

Approximate timeframe of activities: on the ground activities for baseline data gathering commenced in May 2016 in eMbalenhle and similar activities will commence in the second quarter of 2017 in Lebohang. The components of the baseline that will be prioritised are air quality measurements, with all related surveys to follow. Activities will take approximately 18 months to complete. Various aspects of the baseline campaign will be ongoing throughout implementation, to track progress on the impacts of the offset projects. Where results of the baseline studies become available sooner, Sasol will review such results against the current interventions and where necessary, adjust the offset plans should the results reveal other sources which are not necessarily accommodated in the current interventions.

6.4.2 Interventions

While it is clear that there is still much to be done in order to establish the community acceptance of specific offset interventions, as well as to reliably quantify their effectiveness over time as a measure of sustainability, it is also clear that there is not unlimited time in which to continue research. Sasol therefore proposes a dual focus on implementing some visible offset activities in the immediate term (targeting the secondary area of the Sasol Secunda facility and Sasol Mining areas; see (A) below), while ongoing baseline (targeting eMbalenhle initially) and research work (targeting Lebohang; see (C) below) lays a solid foundation for offset activities over the medium to longer term. To commence during 2017, is the implementation of a large scale rollout of insulation in solid fuel burning RDP homes (targeting eMbalenhle and Lebohang in a staggered manner; see (B) below).

Sasol engaged with the Gert Sibande District Municipality to discuss the nature of offset interventions that might be considered, in light of the Highveld Priority Area Air Quality Management Plan.

Although it is not yet possible to confirm the extent of the improvements expected Sasol is reasonably satisfied that the interventions identified will contribute adequately towards improved ambient air quality, based on the outcome of the KwaDela pilot study. The actual impact of the contribution can only be assessed through the detailed baseline campaign which will be done in parallel. Therefore, as part of the implementation, Sasol proposes to assess the effectiveness of the interventions through quantifiable metrics specified in the

relevant sections below and in the annexures. The intent is for the outcome of the detailed baseline campaign (in particular the source apportionment activities) to inform the extent to which the identified interventions are rolled out, or to support the implementation of new initiatives to address any new sources that are identified. The proposed interventions are briefly described below although the statement in Section 6.1 is reiterated that Sasol has detailed the elements of the offset implementation plan to the extent possible, based on the level of current definition of proposed programme activities. Refinement and detailed scoping of programme activities will be on-going, and will be shared with, and informed by, stakeholders.

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A. Reduced smoke (PM) emissions from veld fires

Veld fires are a significant source of PM emissions on the Highveld during the winter months and also contribute to secondary ozone formation. Sasol plans to implement best practices in veld fire management to reduce PM emissions arising from preparation of firebreaks by reducing the amount of grass available for burning, within its secondary area and around coal conveyer belts.

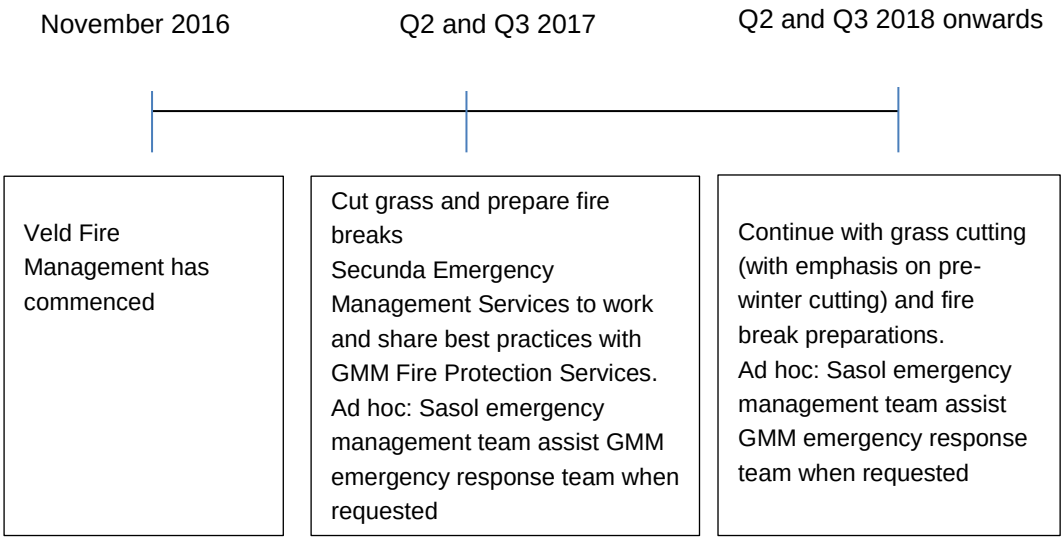
Secunda Emergency Services who are undertaking the fire management practices, plans to work together with the Fire Protection Association (FPA) of Govan Mbeki Municipality (GMM) in sharing best practices to facilitate the prevention of veld fires by cutting the grass around the Secunda facility and conveyer belts and baling it for animal feed, burning of fire breaks and extinguishing fires where they do occur, as quickly as possible. A plan for the preparation of fire breaks for the year gets developed and a decision is made by parties involved (emergency management, working on fire, Sasol Mining and FPA) on the specific requirements for the season. Weather conditions impact adherence to the schedule. High risk areas are highlighted in the plan to be addressed first (if weather permits, and the FPA agrees that the fire breaks can be done). After the high risk areas are completed, the rest of the plan will be addressed. The fire breaks for the Sasol Secunda's secondary area is scheduled to be completed by end of May each year, with the rest of the Sasol land (conveyor belts and at mines) to be completed by end of August each year. The FPA meets annually in May, followed by monthly meetings in June, July and August. Best practices are shared at the meeting on methods to prepare fire breaks, e.g. burning, scraping or grading. For example, a best practice shared by Sasol at a previous FPA meeting was the use of herbicide along conveyor belts to suppress the growth of the grass and therefore avoiding the burning of the grass.

Uncontrolled veld fires are high risk events, therefore it is attended to as soon as possible, to prevent it from spreading to surrounding areas. The Sasol emergency management team will assist the GMM emergency response team when requested.

The reduction in number and duration of fire events will be assessed by comparing ambient monitoring data from Sasol's existing air quality monitoring network prior to this activity, with those afterward. Detail on the intervention is included in Annexure 4.

Sustainability of intervention: This activity, lying within the Sasol sphere of control, in collaboration with the Fire Protection Association of Govan Mbeki Municipality, is considered to have a high likelihood of longer-term successful impact.

Timeframe of activities: The work on veld fires has begun already and will continue on a yearly basis (see summary of plan in section 6.3.3). This activity will be undertaken yearly, however efforts will be concentrated particularly from May to end of August, where there is known to be an abundance of dry grass, to cut the grass in order to reduce the amount of fuel available to prevent burning and burn-spread.



Metrics to measure the impact of the initiative:

Sasol will monitor and report:

- the number of fire events
- impacts associated with fire events on ambient air quality
- geographical areas of grass cut
- area of grass cut

B. Insulation of Solid Fuel burning RDP Homes

Based on the test work conducted on insulating RDP houses in KwaDela, a similar approach will be adopted to implement an insulation solution in RDP houses in eMbalenhle and Lebohang.

The approximate number of RDP and serviced informal houses in eMbalenhle and Lebohang that burn solid fuels (based on Nova's 2013 survey) are given in Table 1 below.

Table 1 : An approximate number of solid fuel burning households in eMbalenhle and Lebohang

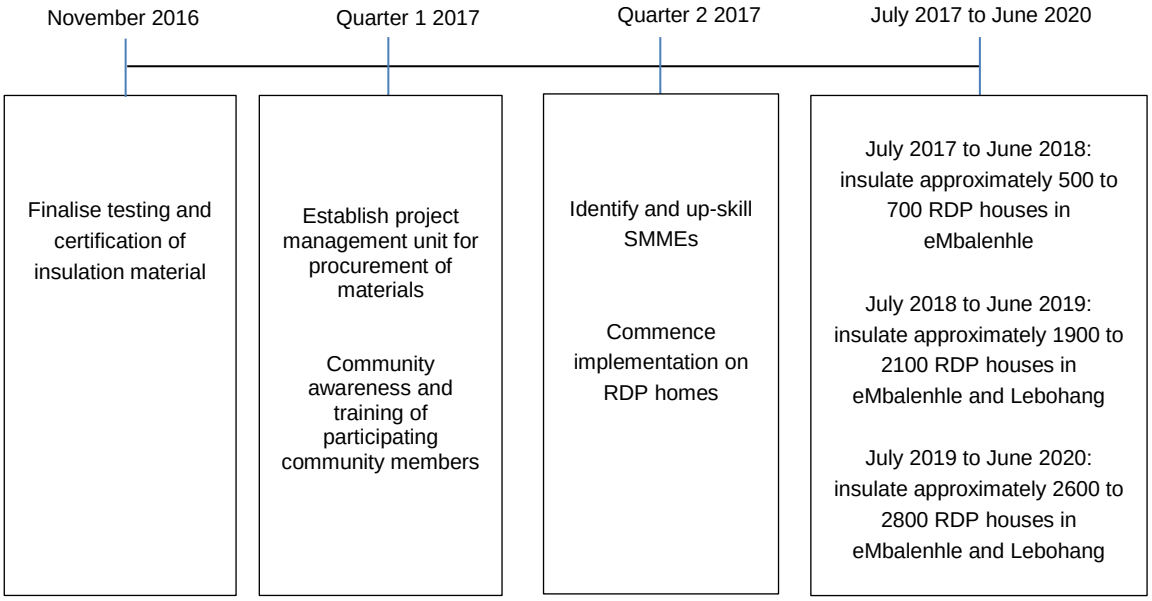
Township	House Type	
	RDP	**Serviced Informal**
eMbalenhle	5200	8000
Lebohang	2400	2200
Total	**7600**	**10200**

The approach toward the implementation schedule and scale outlined below is based on the concept of a Local Management Unit (LMU) for implementation. The LMU includes a coordinator, assistants, construction manager and logistics. Based on experience at KwaDela, the first year is constrained by learning and experience. The plan would be to focus on establishing one LMU in eMbalenhle which should be able to implement up to 700 houses in year 1 – with very close attention paid to the quality of implementation for sustainability purposes. It is estimated that this team could then ramp up to doing 1400 houses in year 2. In parallel, in year 2 a second LMU would be established in Lebohang, but which would again go through the learning and quality control process, limiting implementation of the second LMU to 700 houses. The total number of houses insulated in year 2 would therefore be 1400 (LMU 1) + 700 (LMU 2) = 2100 (eMbalenhle / Lebohang). From year 3, both LMUs would be able to insulate at a rate of 1400 houses a year, hence the scale of 2800 houses a year.

It should be noted that the insulation intervention will be offered to the number of households referred to below. The uptake is dependent on the number of qualifying households, as well as the household's willingness to voluntarily participate in the project.

The approximate schedule of activities intended for this phase of the programme is as follows:

- **1st quarter of 2017:** Establishing a project management unit for procurement of materials and training of community members participating in implementation
- **2nd quarter 2017:** Sasol Enterprise and Supplier Development activities (SMMEs)
- **For the year July 2017 to June 2018:** insulation of approximately 500 to 700 RDP houses in eMbalenhle
- **For the year July 2018 to June 2019:** insulation of approximately 1900 to 2100 RDP houses in eMbalenhle and Lebohang
- **For the year July 2019 to June 2020:** insulation of approximately 2600 to 2800 RDP houses in eMbalenhle and Lebohang
- The remainder 25% of RDP houses (2000 houses) will be completed from **July 2020 to June 2021**



In terms of the plan, by June 2020, 75% of solid fuel burning RDP homes (as per the 2013 numbers presented in Table 1) in both Lebohang and eMbalenhle will be insulated, with the remaining 25% to be completed in the subsequent 12 months.

The insulation of solid fuel burning serviced informal houses in Lebohang and eMbalenhle will be considered based on the results from the Lebohang trial tests (see Section C on next page). Pending no unforeseen outcomes, the test is planned to be completed by June 2018.

Sustainability of intervention: A limited time series of data is available on the durability of installed insulation in RDP homes, and the resultant impact on household members' solid fuel burning patterns. Sasol has, through its KwaDela and Lebohang test programmes, now landed on the third – and hopefully – final – technology solution and will take appropriate measures to ensure successful installation of RDP home insulation. To bolster the chance of success with change management in household behaviour towards desired outcomes, the education and awareness campaign outlined in (D) below together with the bi-annual consultation and information session described in Chapter 7, are important underpinning and supporting sustainability enhancement mechanisms.

Metrics to measure the impact of the initiative:

As outlined in Annexure 2 for the KwaDela pilot study and in Section 8.2, a number of metrics will be monitored and reported on with varying appropriate frequency, including the following monitoring activities:

- Pre-implementation energy and house type census to confirm that households included by the project boundary are indeed using solid fuels for domestic purposes and that they have been using solid fuels before exposure to the project activity. It is further necessary to inspect all structures in the target area to ascertain their eligibility for project participation;
- Project database to keep record and capture data of all interactions between the project implementation team and the participating household;
- Continuous ambient air quality monitoring to monitor the state of the ambient air in the project area and to validate the annual air quality modelling of the baseline and project scenarios;

- Annual household level surveys and measurements to determine the extent to which the project measures continue to be used by households. From these results the retention rate and benefits to households can be deducted, as well as savings in solid fuel use and improvement in indoor temperature;
- Annual air quality modelling to estimate the impact of the project, the baseline and project scenario; and
- Incidental benefits (economic benefits accruing to the community through payment for services rendered, implied savings on energy costs as a result of reduced fuel consumption, greenhouse gas emission savings)

C. Testing of Innovative Solutions in Lebohang

The various types of sources contributing to ambient air pollution are detailed in the Highveld Priority Area Air Quality Management Plan (AQMP). These include, for example, industrial emissions, veld fires, vehicle emissions, domestic fuel burning emissions, wind-blown dust from unsurfaced areas and mine dumps, etc. Goal 3 of the HPA AQMP is that by 2020, air quality in all low-income settlements is in full compliance with ambient air quality standards.

Opportunities to identify and evaluate innovative technical solutions lie in the following objectives of Goal 3 of the AQMP:

- Clean fuels and technology that are affordable and easily available:
  - Clean combustion technologies such as stoves
  - Clean fuels such as anthracite coal and gas
- Improvement of service delivery to low-income communities:
  - Electrification
  - refuse removal
  - Greening
  - Road surfacing
- Low-income and informal households are energy efficient:
  - Solar water heating and other energy efficient devices

As explained in Section 6.1, given that lower hanging fruits for community sources of emissions are believed to have been addressed in eMbalenhle, further efforts are required to research and test new solutions for more complex emissions challenges. More work needs to continue to identify further solutions to reduce ambient pollution sources that are both effective and supported by community members, on the back of the KwaDela pilot study. A test programme was proposed in Lebohang, to contribute towards Goal 3 through the piloting of a suite of potentially promising innovative solutions that, if successful, could be incorporated into the medium to longer-term programme of activities.

Further detail on the approach to this programme is detailed in Annexure 5.

The outcome of the pre-feasibility study identified two innovative concepts that were to be taken forward to the feasibility phase:

- Evaluating solutions for dust suppression of unsurfaced roads (Annexure 5),
- Evaluating insulation and stove swop solutions for serviced informal houses (Annexure 5)

Sustainability of interventions: Limited information is available on the technical feasibility, performance and community acceptance of these solutions, which is why on-going test work is proposed. Where significant concerns with sustainability are identified, these may present

insurmountable obstacles to advancing implementation. This is why testing of the solutions is necessary in the first instance.

The detail and schedule for the activities to be undertaken in evaluating the two solutions is provided below.

1) Lebohang I: Evaluating solutions for dust suppression of un-surfaced roads

FEASIBILITY FOR ROAD SURFACING

PURPOSE

Surfacing of dirt roads using fine and coarse ash from Sasol's processes to suppress dust

Stakeholder Support	
Technical Solutions	
Schedule	

PROGRESS

Innovative solutions have been tested by CSIR but has proven to be unsuccessful due to the clay type soil in Govan Mbeki Municipality.

CRITICAL NEXT STEPS:

The source apportionment study will facilitate the decision to consider any further work on the road surfacing option

If the source apportionment results confirm that the impact of dust from unsurfaced roads is minimal, this option will not be considered further. If this is the case, then the number of solid fuel burning RDP homes to be offered to be insulated in Sasol's Financial Year 19 (July 2018 – June 2019) will increase by approximately 500 to 700. This is also indicated in Figure 2B in Section 6.4.3.

Informed by the AQMP, consideration was given to the possibility that vehicles driving on unsurfaced roads are a source of dust (particulate matter) that could be materially contributing to high ambient particulate matter levels. For this reason, the pre-feasibility study conducted in 2016 highlighted the potential opportunity to find novel road surfacing materials that could more cost-effectively reduce dust than traditional bitumen applications.

The Centre for Scientific and Industrial Research (CSIR) then conducted feasibility studies on various composite materials incorporating ash, as well as laboratory tests for performance. The schedule of activities conducted is outlined below.

- 1st quarter of 2016: pre-feasibility studies to identify innovative solutions
- 2nd quarter of 2016: feasibility studies of road surfacing solutions
- 3rd quarter of 2016: laboratory testing for the road design mix
- 4th quarter 2016: feasibility study for the proposed road design was completed and the innovative solutions assessed proved to be unfeasible. The results of the source apportionment study will facilitate the decision to consider any further work on the road surfacing option.
- **If the source apportionment results confirm that the impact of dust from unsurfaced roads is minimal, this option will not be considered further. If this is the case, then the number of solid burning fuel RDP homes to be offered to the community for insulation in Sasol's Financial Year 19 (July 2018 – June 2019) will increase by approximately 500 to 700. This is also indicated in Figure 2B in Section 6.4.3.**

The results of the feasibility study, however, led to a conclusion that the road design materials are not feasible for implementation, since the underlying clay soil structure which makes conventional road surfacing prohibitively expensive in the Govan Mbeki municipality also drives significantly higher costs than anticipated for alternative road surfacing materials. As per the last bullet point above, it is considered ill-advised to continue further work on the road surfacing option unless the results of the baseline campaign (the source apportionment study specifically) demonstrate that material ambient air quality benefits would arise. Therefore, the decision has been to place the test work on hold until such time as the baseline information proves otherwise.

2) Lebohang 2: Evaluating insulation solutions for serviced informal houses

INFORMAL HOUSING INSULATION

PURPOSE

Reduce solid fuel burning

Developing and testing insulation solutions and swopping of stoves

Stakeholder Support	
Technical Solutions	
Schedule	

PROGRESS

Studies and community engagements completed
Shortlisted solutions to include insulation of homes, stove swops and surfacing of roads
Testing of solutions in progress

CRITICAL NEXT STEPS

Testing alternative safer material for insulation
Finalise alternatives, obtain costs and SANBS approval

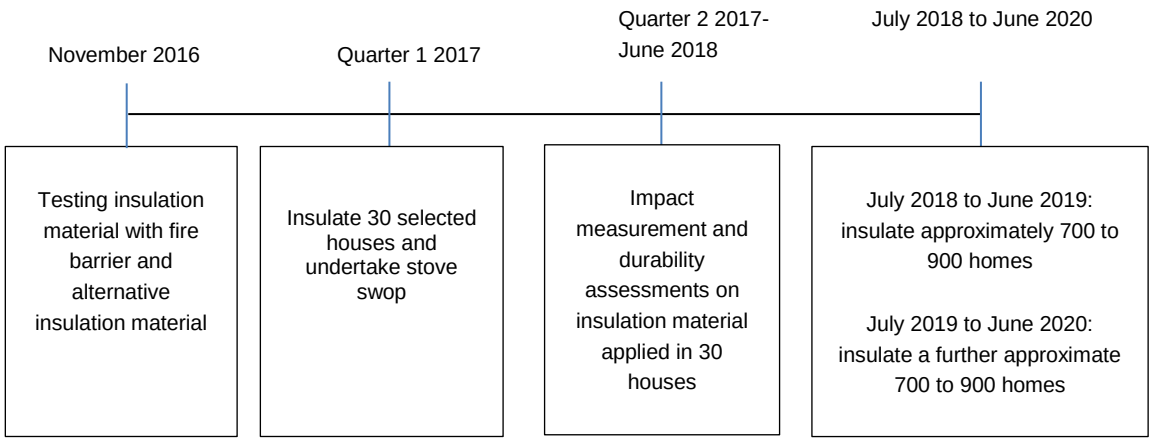
Since serviced informal houses form a significant percentage of homes for the targeted communities, Sasol's priority is to find a sustainable solution in order to achieve a reduction in PM emissions in ambient air quality. Pending the results and recommendations from the pilot study, Sasol may undertake additional work to address the effectiveness and durability of the insulation material to achieve the sustainable results. This might impact the full scale implementation of this specific activity. Should the results show no sustainable solution, then Sasol will adjust the plan to offer insulation to approximately 400 more solid fuel burning RDP homes from Financial Year 19.

Informed by the AQMP's identification of domestic fuel burning as a significant source of ambient pollution, coupled with the substantial proportion of serviced informal houses in eMbalenhle and Lebohang for which no solutions have been developed and the initial successes of the KwaDela pilot study on insulation of RDP houses, the development of insulation solutions for informal houses was highlighted as a potential priority.

The schedule of activities to be conducted is outlined below.

- 1st quarter of 2016: pre-feasibility studies to identify innovative solutions
- 2nd quarter of 2016: laboratory fire tests to assess risk of insulation material
- 3rd and 4th quarter 2016: testing insulation material with fire barrier, as well as assessing alternative insulating material
- 1st quarter 2017: insulate approximately 30 selected serviced informal houses, together with an LPG stove or more efficient stove swop, subject to successful identification of a fire barrier
- 2nd quarter of 2017 to 2nd quarter 2018: measure impact by assessing effectiveness and durability of insulation material
- If successful and pending no unforeseen obstacles impacting on schedule, implement at scale:
    - July 2018 to June 2019 insulate approximately 700 to 900 houses
    - July 2019 to June 2020 insulate a further approximately 700 to 900 houses.

- **Since serviced informal houses form a significant percentage of homes for the targeted communities, Sasol's priority is to find a sustainable solution in order to achieve a reduction in PM emissions in ambient air quality. Pending the results and recommendations from the pilot study, Sasol may undertake additional work to address the effectiveness and durability of the insulation material to achieve the sustainable results. This might impact the full scale implementation of this specific activity. Should the results show no sustainable solution, then Sasol will adjust the plan in figure 2B in Section 6.4.3 to offer insulation to approximately 400 more solid fuel burning RDP homes from Financial Year 19.**



The hurdles faced with the laboratory fire tests emphasise the importance for ongoing rigorous research and test work. Through ongoing efforts of the project team, a suitable fire barrier has been identified. Based on these results, Sasol is committed to implementing the pilot, which includes a stove swop for additional exploration of the heating energy patterns and demands of households living in informal (serviced) homes.

Until the pilot study is completed, and pending successful results thereof, Sasol is not yet in a position to confirm any rollout – the principles of sustainability and community acceptability will guide an informed decision. Since serviced informal houses form a significant percentage of homes for the targeted communities, Sasol's priority is to find a sustainable solution in order to achieve a reduction in PM emissions in ambient air quality. Pending the results and recommendations from the pilot study, Sasol may undertake additional work to address the effectiveness and durability of the insulation material to achieve the sustainable results. This might impact the full scale implementation of this specific activity. Should the results show no sustainable solution, then Sasol will adjust the plan to start implementing alternative activities (i.e. offer to insulate more RDP homes or start with stove swop) from Financial Year 20.

D. Education and awareness on air quality

Education and awareness campaigns aimed at the broad sector of the public in the areas of intervention will be implemented as per the schedule in 6.3.3 to support the effective execution of the interventions referred to herein. Throughout this process, Sasol will also engage with the community to establish effective means of engagement for this purpose.

In order to reach the community as a whole in the intervention areas, various mediums of communication will be utilised to execute the activities planned for this initiative. These activities include the development of booklets and pamphlets on air quality and the various air pollutants, which will be used as educational tools for both young and old community members.

To make the process fun for the community, art will be used as an instrument to promote air quality awareness. Stage plays on the subject will be enacted while participatory videos will be utilised as social tools for communicating the message. Air quality awareness-building actions, such as a

Cycling Rally for environmental awareness will be conducted. This rally will be used as a conduit to educate the community on various air pollutants and waste management, promoting a change of attitude, as well as fostering the habit of disposing of waste in the right place, valuing recycling and discouraging domestic waste burning. Alongside these activities, a media awareness-raising campaign will conducted through local media, such as radio spots and newspaper articles on topics related to air quality and educating local journalists on air quality. The existing bi-annual consultation and information sessions that Sasol hosts will also provide an on-going avenue to build knowledge and dialogue around air quality management.

Sustainability of intervention: Previous pilot studies on technologies such as improved coal fire cooking methods have revealed that human behavioural factors are not to be underestimated in contributing to the success, or failure, of the longevity of benefits arising from offset projects. Driving behavioural change, for example to convince households to buy less coal in winter after their indoor temperatures significantly improve, or to consider cleaner fuels, is key to achieving the desired outcomes, regardless of whether the implemented technologies perform in accordance with expectations. Only through on-going education and awareness campaigns, can these messages be reinforced.

Metrics to measure the impact of the initiative:

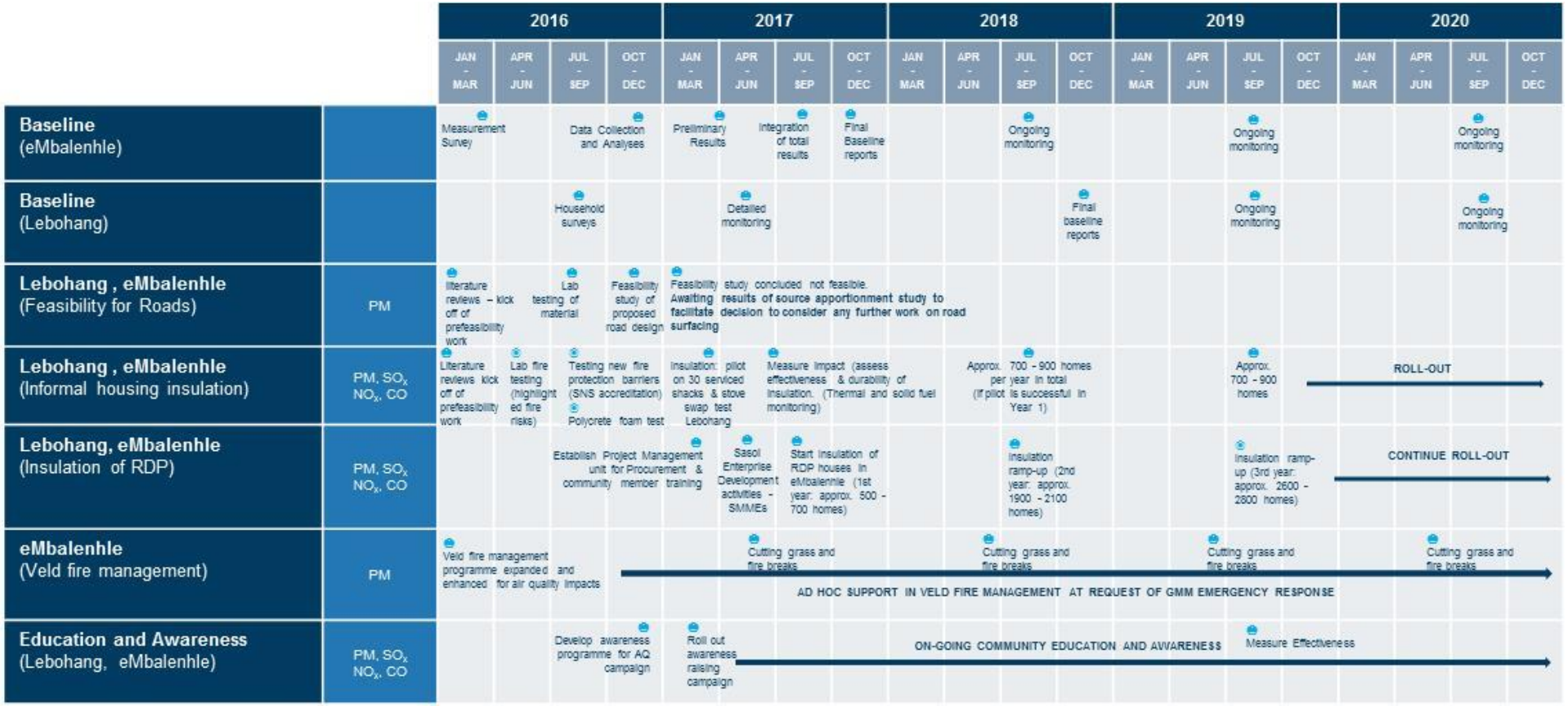
Questions will be built into the energy survey questionnaire which will be repeated over time. The response on these specific questions will indicate the growth of air quality awareness in the community.

6.4.3 Summary of the plan

The implementation plan as described above is summarised in the timeline graphic in Figure 2A and 2B.

It should be noted that the insulation intervention will be offered to the number of households referred in the plan below. The uptake is dependent on the number of qualifying households, as well as the household's willingness to voluntarily participate in the project.

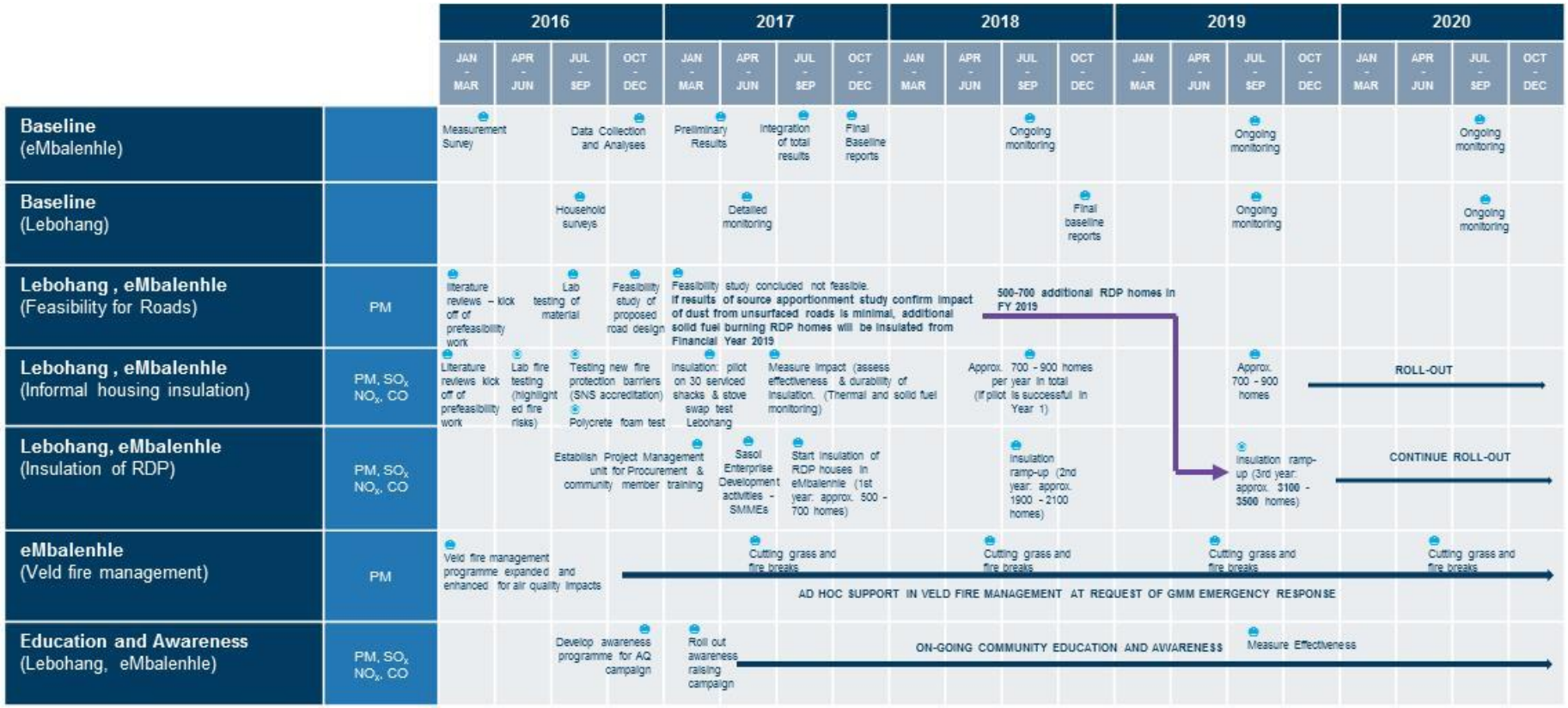
Figure 2A: Secunda Offset Implementation Schedule



Dates are indicative and may change

It should be noted that the insulation intervention will be offered to the number of households referred in the plan below. The uptake is dependent on the number of qualifying households, as well as the household's willingness to voluntarily participate in the project.

Figure 2B: Secunda Offset Implementation Schedule if feasibility studies are not successful



Dates are indicative and may change

6.4.4 Refinements to the offset plan in light of stakeholder engagement process

The stakeholder engagement process is summarised in Chapter 7, from the detailed Stakeholder Engagement Report incorporating the Comments and Responses Report which was prepared by SRK Consulting. Sasol has considered the comments received, and on that basis, notes and emphasises the following important elements of the plan that support the community's comments:

- Requests were received for Sasol to assist in increasing community awareness around air quality issues. Sasol believes the implementation of the offset programme to be a valuable opportunity to facilitate knowledge sharing through the ongoing bi-annual consultation and information session, which will be the stakeholder engagement platform for Sasol's offset plan, as described in Chapter 7;
- Various suggestions were made for potential solutions that could contribute to reduced air emissions in the community (e.g. dust from roads, vehicle emissions). The baseline campaign as outlined in Section 6.3.1 and Annexure 3 serves to construct a comprehensive understanding of the quality of air, and its key drivers, to confirm the most significant community sources of pollution to be addressed in the medium to longer term activities;
- The Lebohang programme of activities as outlined in Section 6.3.2 and Annexure 5 was well supported, with suggestions received on what kinds of solutions should be considered. All ideas directly related to air quality improvements (obtained from not only the Secunda related offset meetings, but also the Sasolburg ones) will be considered as potential opportunities for testing in the Lebohang programme;
- Numerous requests for job opportunities linked to the offset programme were received. Sasol re-emphasises that the primary aim of the offset plan is to reduce ambient pollutant levels. Where job opportunities arise from the programme, a concerted effort will be made to employ locally.

7 Stakeholder Engagement

The stakeholder engagement approach for this offset implementation plan is informed by Sasol's AEL, the offset licence condition contained therein, Sasol's offset principle of transparency, the principles of consultation contained in the Environmental Impact Assessment Regulations (Government Notice No. 982, 04 December 2014) published under NEMA and guidance provided in the Air Quality Offsets Guideline.

Figure 3 outlines the process that was followed, and the timeframes along which the activities took place.

Prior to engaging other stakeholders, an agreement on the draft offset implementation plan was required with the licensing authority. Various existing engagement platforms have been used to inform the Municipality and the community on the process that will unfold in the implementation of offsets, for example during Monthly and Quarterly Meetings with community structures and the Municipality.

7.1 Public Participation

Chapter 6 of the Air Quality Offsets Guideline indicates the requirement for offset programmes to be subjected to a “detailed and transparent public participation programme”. The guideline goes on to require that a public meeting be held to which the public and authorities are invited. The guideline also indicates that the public participation process can be undertaken in terms of the National Environmental Management Act 107 of 1998 or a separate process.

The guideline provides direction regarding the public participation process to be undertaken as part of an air quality offset programme. Although the guideline was in draft at the time the public participation process was undertaken, in order to meet the requirements of the draft guideline as it then was, and ensure effective stakeholder engagement the scope of work was informed by the requirements of Chapter 6 of the EIA Regulations. These regulations meet all the requirements of the Air Quality Offsets Guideline and go a little further in specifying the steps required as part of the participation process. The final guideline has not impacted the process followed.

Public participation with communities and other registered Interested and Affected Parties included opportunities to comment on the draft plan, a stakeholder consultation meeting to facilitate comments and notification of the updated plan’s submission and authority decision. This process is being facilitated by SRK, an independent Environmental Assessment Practitioner. Meetings took place in eMbalenhle, Secunda and Lebohang, where the content of the draft offset implementation plan was shared for public comment. A key objective of these meetings was to ensure that the reasons for, and principles underpinning the offset proposal are well understood by the community and that the community had an opportunity to inform the contents of the proposal.

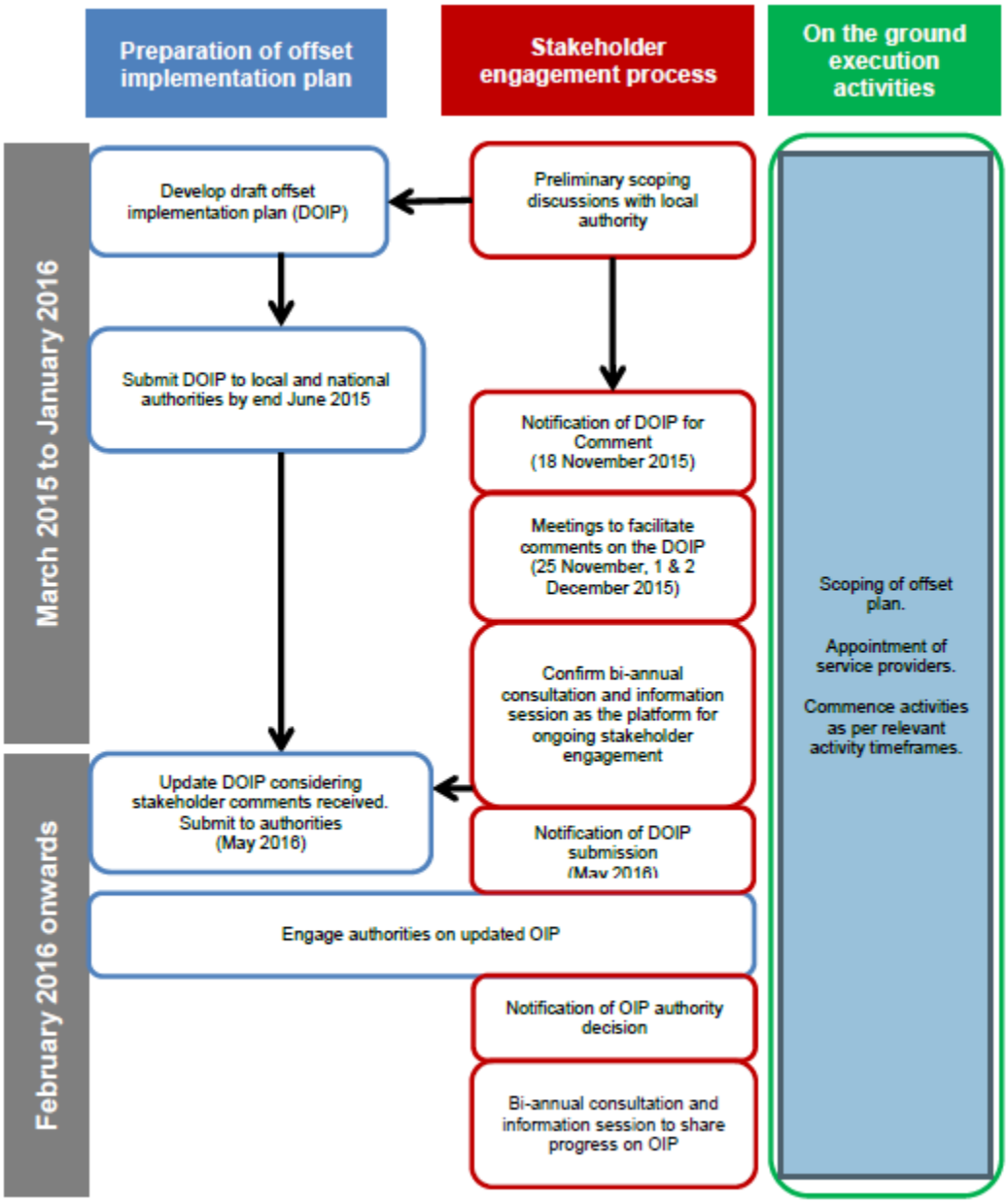


Figure 3: Technical and stakeholder engagement process

A period of 50 days was allowed for comment on the draft offset implementation plan, and working with SRK, Sasol has considered comments received, in a Comment and Response Report (CRR), making any necessary updates to the draft plan. Due to the importance of stakeholder involvement in this programme, Sasol's existing bi-annual consultation and information session will be used as the key platform where stakeholders will receive progress updates on implementation of the programme of activities, where successes can be shared, challenges and concerns be highlighted and resolved, and questions can be raised.

Approximately 1,000 community members attended the public meetings on Sasol's offset plans in the Secunda and Sasolburg regions.

7.2 Offset plan approval process

The key compliance requirement was submission of the draft offset implementation plan to authorities by 30 June 2015. This version, which has now been updated, has been submitted to authorities on 18 May 2016, considering comments received.

It is now envisioned that further discussions may take place with relevant authorities and that the plan will formally undergo consideration for approval. The offset implementation plan will be appended to the AEL. The plan will need to be executed and monitored as per its commitments. Stakeholder engagement thereafter will principally take place via the bi-annual consultation and information session emphasising the importance of the directly affected communities in the execution of the offset implementation plan.

8 Success Criteria

8.1 Overview

Ambient air quality manifests as a result of multiple complex parameters that are highly variable in space and time. Within that complexity, measuring ambient air quality is similarly challenging, especially within residential areas where a small, localised source such as the burning of waste or a veld fire can significantly influence the measurements over short timeframes. In addition, ambient air quality, which falls to be safeguarded by government, is dependent on so many external factors that a single emitter or entity cannot alone take accountability and responsibility for its improvement. To this end, Sasol will measure its offset programme of activities using a 'basket of measures' to characterise "improved well-being" aligned with Section 24 of the Constitution and the sustainability principles contained in the NEMA and that would unambiguously indicate a successful offset, rather than just improved air quality.

The principle of a basket of measures is illustrated in Figure 4. The range of performance parameters under the offsets regime is illustrated, highlighting the manner in which they all contribute to reduced risk of adverse human health effects, as a result of poor air quality, and thereby contribute to improving the Constitutional well-being imperative. The culmination of the offset is to reduce the risk of adverse health effects to the same extent or better than the equivalent reduction in industrial emissions. It is important to use a 'basket of measures' approach, which assesses the holistic contribution of an offset to well-being, incorporating dispersion modelling and monitoring tools.

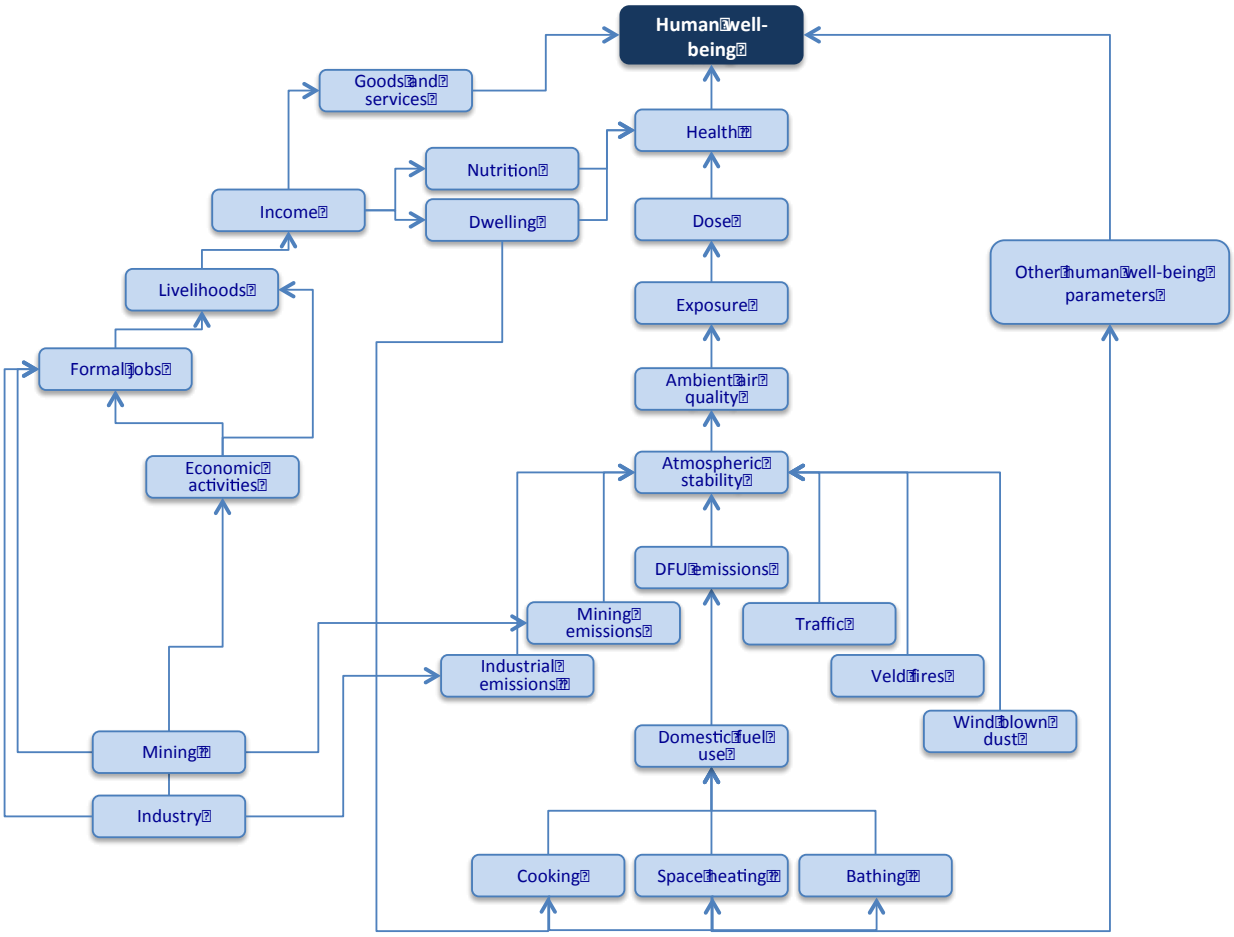


Figure 4: Schematic illustration of the key performance parameters within an offset regime, contributing to the Constitutional right to an environment not harmful to human health or well-being

8.2 A basket of measures

This basket of measures is intervention-dependent and must include the various elements that present potential compromises to acceptable health and well-being, including ambient air quality. By way of example, in the KwaDela pilot study that undertook the insulation of RDP homes, the measures identified by Sasol and the project team to be important include:

- The extent of ambient air quality improvement in the targeted communities, directly attributable to the intervention and excluding the influence of external factors on baseline variations;
- Measurement of the reduction in solid fuel consumption;
- Reductions in personal exposure of household occupants in the targeted communities on the basis of indoor and ambient pollution exposure;
- Environmental co-benefits, such as avoided greenhouse gas emissions;
- Material improvement in a range of human well-being indicators in the targeted communities, including:
    - Economic benefits accruing to the community through payment for services rendered (linked to job opportunities created and procurement of services from local businesses);
    - Economic benefits accruing to the community through savings on energy costs;

- Thermal comfort improvement for household occupants better shielded from temperature extremes;
- Sense of well-being arising from improvements to people's homes, including the reduction in dust ingress

Establishing success criteria is important to the principle of sustainable offsets because there must be a measurable set of outcomes defined prior to the offset that can be used to determine what has been achieved after the offset intervention. the basket of measures chosen for each intervention will reflect risk reductions to human health and well-being as well as additional sustainable development benefits that may accrue.

9 Conclusions

Sasol's AEL includes the requirement for an offset implementation plan to be presented to authorities by 30 June 2015, and thereafter subjected to an appropriate public consultation process. This document records that updated draft plan, following conclusion of the public participation process.

The offset plan, once approved, will be implemented in conjunction with the ongoing focus on the implementation of the air quality improvement roadmap outlined in Sasol's postponement applications.

Progress on the implementation of this offset plan will be shared through the bi-annual consultation and information session, and reported back to applicable authorities.

Annexures

Annexure 1: The Rationale for Offsets

THE RATIONALE FOR OFFSETS

This annexure sets out the context for offsets in the present air quality policy framework, as well as the scientific rationale for advancing offsets within this air quality policy regime.

The terms in this annexure are as defined in the glossary of the main document.

1. The objective of the NEM:AQA

Ultimately, the objective of the NEM:AQA is to give effect to the Constitutional right of South Africans to an environment that is not harmful to human health or well-being, and that is protected for the benefit of present and future generations, in respect of air pollution.

The way in which air pollutants result in potentially significant detrimental effects on human health and the environment is through the concentrations of these pollutants at ground level. The severity of the detrimental effects is a function of the concentrations that occur together with the exposure to those concentrations by both people and the environment. Accordingly, National Ambient Air Quality Standards (NAAQS) have been promulgated to define tolerable ambient air quality concentrations for selected pollutants.

2. Recognition for the role of offsets within air quality policy

The NAQF, which provides the medium- to long-term plan for the practical implementation of the NEM:AQA, identifies various mechanisms for the implementation of air quality improvement objectives, including the setting of standards for various sources, such as the MES, which prescribe maximum emission limits for specified industrial activities, and many of which apply to Sasol's activities. The NAQF further notes the consideration of an offset policy for air pollution as a future focus area, linked to the identification of offsets as a means to channel private sector efforts toward reducing community sources of air pollution in the DEA's Strategy for addressing air pollution in dense, low-income settlements (2013).

All these various mechanisms are aimed at achieving the objective of the NEM:AQA, which can, for practical purposes, be defined as ambient air which does not exceed the NAAQS.

Sasol's main facilities in Secunda, Mpumalanga and Sasolburg, Free State, are located in the Highveld Priority Area (HPA) and the Vaal Triangle Airshed Priority Area (VTAPA) respectively. These areas were declared by the Minister since NAAQS for PM are being exceeded. The priority area air quality management plans for both priority areas contemplate offsets as necessary mechanisms to achieve compliance with the NAAQS, as briefly outlined below.

The VTAPA Air Quality Management Plan (2009; 2013 mid-term review) records that "particulate emissions from domestic coal and wood burning have been identified as the major cause of poor ambient air quality in urban areas such as the Vaal Triangle, and have a significant adverse impact on human health." Accordingly, this plan sets objectives to address domestic fuel burning emissions, including:

- By 2015 an evaluation is undertaken of household emission reduction options including but not limited to the rollout of new stoves, retrofit of houses, energy efficient RDP houses, fitment of ceilings, LPG rollout and subsidy and a household emission reduction action plan is developed; Effective interventions, research, awareness raising and education are major aspects in achieving the goal. The role of economic development, technological improvements in combustion equipment and emissions offsetting are also critical;
- By 2017 household emission reduction plan is rolled out by government and assisted by industry through offsetting;

The VTAPA Air Quality Management Plan also seeks to implement offsetting to address veld fires, setting a goal that "by 2017 [a] veld burning emission reduction action plan is rolled out by government and assisted by industry through offsetting."

The HPA Air Quality Management Plan (2012) similarly states that "all residential areas where wood and coal are combusted experience high concentrations of particulates and [carbon monoxide], particularly those that are densely populated. Here, exposure can be particularly high." The plan sets a goal that by 2020, air quality in all low-income settlements is in full compliance with ambient air quality standards, and calls for research institutions and organisations to motivate research on domestic fuel use, particularly emission reduction measures.

This state of affairs is acknowledged in the DEA's 2014 State of air quality report and National air quality indicator, which concludes that "it is clear that PM_{10} is still the greatest national cause for concern in terms of air quality… Continued and increased national provincial and local action is required in order to bring particulate concentrations down to acceptable levels… Many South Africans may not be breathing air that is not harmful to their health and well-being".

Sasol's conclusion is that there is widespread recognition of the significant contribution of community sources to non-compliance with NAAQS, and that it is recognised by the DEA that facilitating private sector investment through a formal offset mechanism, may be the most effective way to address these sources.

3. Scientific rationale for air emission offsets

As described in the main body of this implementation plan, Sasol was granted postponements from compliance timeframes for meeting some of the MES applicable at its industrial facility in Secunda. As part of its postponement applications, Sasol outlined its air quality improvement roadmaps, which included a commitment to offsets. Sasol's view is that offsets may prove to be a more effective alternative means of achieving compliance with the NAAQS than a solitary focus on compliance with the MES, particularly where it is demonstrated to be challenging.

Sasol's pilot investigations into community-based offsets are described elsewhere in this document, as an alternative way to achieve the same risk reduction benefits (or better), that the MES are designed to achieve. The principle of an offset in terms of air quality management, is thus to reduce the source of risk to receptors, by reducing sources other than emissions from Sasol's activities. The principle is illustrated diagrammatically in Figure A1. The air quality to which people and the environment are exposed is a function of Sasol (and other industrial) emissions as well as multiple other emission sources including those from domestic fuel use, veld fires, wind-blown dust, etc. Sasol contends that by reducing other sources, a similar or greater benefit could potentially be achieved than by solely focusing on reductions of Sasol's emissions.

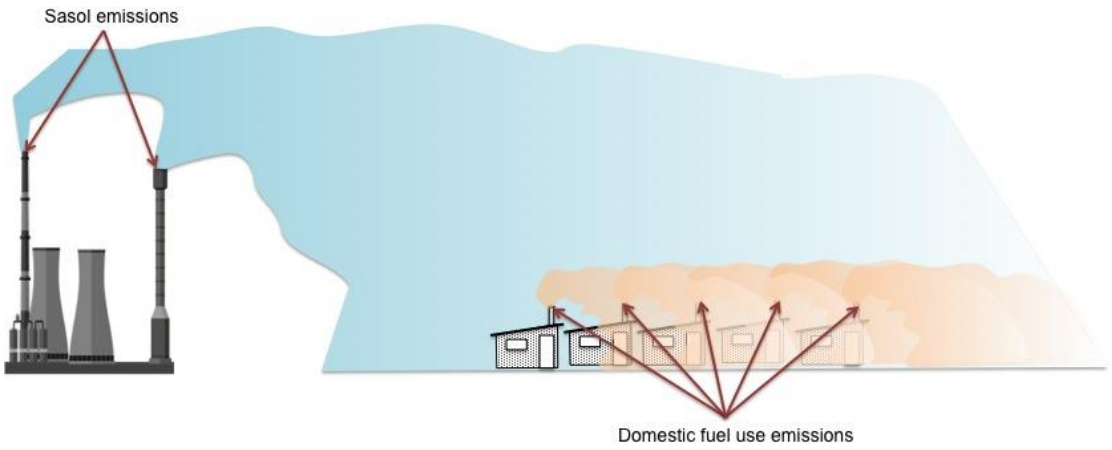


Figure A1: Schematic illustration of an air emissions offset

4. Relative contributions to ambient concentrations

For this offset principle to be credible, it is necessary to examine the contribution made to ambient air quality where people are exposed from Sasol emissions and from the multiple other contributing sources. These other sources include other industries, biomass burning, dust from agricultural activities, motor vehicle emissions and domestic fuel use. Emissions from domestic fuel use are significant for ambient air quality not in terms of mass but in terms of the fact that the emissions are generated where people are directly exposed, as acknowledged in the priority area air quality management plans.

Under stable atmospheric conditions, which occur frequently on the South African Highveld, emissions from domestic fuel use are typically trapped at ground level and do not disperse readily. As a result of this poor dispersion, people living in those areas are exposed to the full mass of what is emitted without any significant dilution.

While emissions from sources such as Sasol are significant in terms of mass, the emissions are substantially diluted before they come to ground where they affect ambient or ground-level air quality. Under stable atmospheric conditions the emissions from industry are often prevented from coming to ground because inversion conditions provide a barrier to the pollution being mixed and transported downwards to ground level. These patterns are well illustrated in measured ambient air quality where average hourly concentrations exhibit the diurnal cycle (the pattern that unfolds during the day and the night) typically experienced in terms of concentrations of SO_2, NO_2 and PM_{10}. The measured diurnal pattern is a function of pronounced atmospheric stability, which is driven at both synoptic scale (continental anti-cyclone) and local scale (rapid cooling of the earth's surface leading to surface temperature inversions, where temperature increases rather than decreases with height).

The atmosphere is at its most unstable during the day and at its most stable during the night, especially in the early hours of the morning when the earth's surface is at it's coolest. As the sun rises the surface starts to heat up and this has the effect of initiating turbulence in the atmosphere, which renders the atmosphere progressively more turbulent (unstable) as the day progresses. During the afternoon, heating from the sun starts to reduce, the surface starts to cool and with the cooling of the surface the atmosphere gets progressively more stable. The cooling continues throughout the night until the rising sun the following day again initiates surface warming and turbulence. An unstable atmosphere is one where mixing (diffusion and dispersion of pollutants through the atmosphere) occurs freely, whereas a stable atmosphere is one where mixing is strongly inhibited.

Measured concentrations of pollutants are shown in Figure A2 and can be seen to exhibit the following broad patterns as the day unfolds:

- SO_2 concentrations display a peak during mid-afternoon;
- PM_{10} concentrations peak during the early morning and early evening;
- The peak NO_2 concentrations occur in the early morning and early evening;

These patterns are explained by the sources of the pollutants and more specifically whether they are emitted to atmosphere at some height above the ground or whether they are emitted at the surface. Under stable atmospheric conditions (with very little mixing) pollutants emitted at the surface will largely remain at the surface while pollutants emitted at height above the ground simply cannot come to ground. It is only when the atmosphere becomes unstable that pollutants emitted at ground level can start to diffuse and disperse away from the ground and when pollutants emitted at height above the ground are mixed towards ground level.

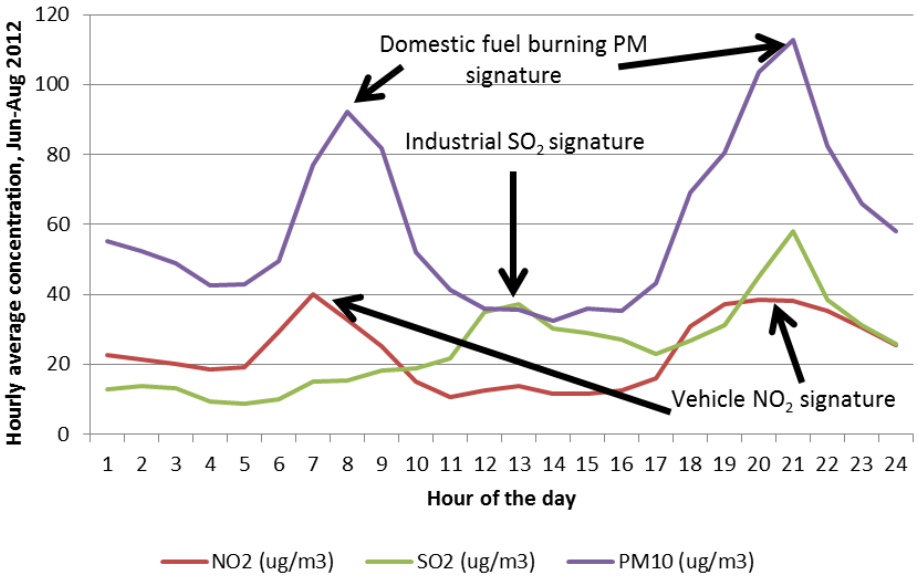


Figure A2: Average hourly SO2, NO2 and PM10 concentrations at the Langverwacht monitoring station calculated over the period June – August 2012 (winter)

This is why the PM_{10} concentrations peak at night, because the primary source of the elevated PM_{10} concentrations is from sources at ground level when there is very limited mixing in the atmosphere. In a similar vein this is also the reason why a SO_2 concentration peak is visible during the day, because the primary source of the elevated SO_2 concentrations at this time of the day are industrial emissions from tall stacks. The industrial emissions can only come to ground when the atmosphere is unstable and the emission plumes are brought to ground. In these terms it can be argued that the dominant contribution of measured ambient SO_2 derives from industrial emissions, whereas most measured PM_{10} derives from emissions at ground level with a significant contribution from domestic fuel burning, and other sources.

Analysis of measured ambient air quality and how this changes over time, supplemented by dispersion modelling studies shows that emissions from domestic fuel use are anticipated to constitute a significant source. If the air quality to which people are exposed is to be managed to ensure that such people are not exposed to concentrations of pollution that would potentially threaten their health, then small reductions in domestic fuel use

emissions would be expected to result in far more significant improvements in localised air quality than large scale reductions of industrial sources where these emissions occur well above ground level.

5. Concluding remarks

Carefully designed and well implemented offsets may have significant potential to reduce personal exposure to air pollution. South Africa has a high prevalence of chronic obstructive pulmonary disease (COPD). COPD is "a disease state characterised by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases"[2]. By definition reductions in personal exposure to such noxious particles and gases is key to reducing the risk of COPD. Offsets present an opportunity for affected communities to have quality of life improved by meaningful reductions in air pollution exposure and associated disease risk. It is to this end that Sasol is working with leading academics and others to investigate various interventions that could be implemented in residential areas that would serve to reduce atmospheric emissions at ground level.

[2] *Pauwels RA, Buist AS, Calverley PMA, Jenkins CR, Hurd SS, GOLD Scientific Committee. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. NHLBI Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop summary. Am J Respir Crit Care Med 2001;163:1256-1276.*

Annexure 2: Overview of KwaDela pilot Offset Study

OVERVIEW OF KWADELA PILOT OFFSET STUDY

1. Emission sources contributing to ambient air pollution near Secunda

National Ambient Air Quality Standards (NAAQS) have been set for criteria pollutants which have known health impacts. The permissible levels of these pollutants in ambient air have been informed by the World Health Organisation guidelines. Where ambient air for a specified pollutant exceeds its NAAQS, health is potentially compromised. Below these levels, ambient air is deemed to be of permissible quality.

As part of its applications for postponement of some MES, Sasol appointed independent specialists to prepare atmospheric impact reports (AIRs) which model its contribution to ambient pollution levels near the Secunda and Sasolburg facilities. The AIRs highlight particulate matter (PM, comprising smoke, dust and other solid-phase chemical compounds) as significantly exceeding the applicable NAAQS. Further, the emission signature of the sources contributing to exceedances of the NAAQS is distinctly non-industrial in origin (Figure 1), a phenomenon described in Annexure 1.

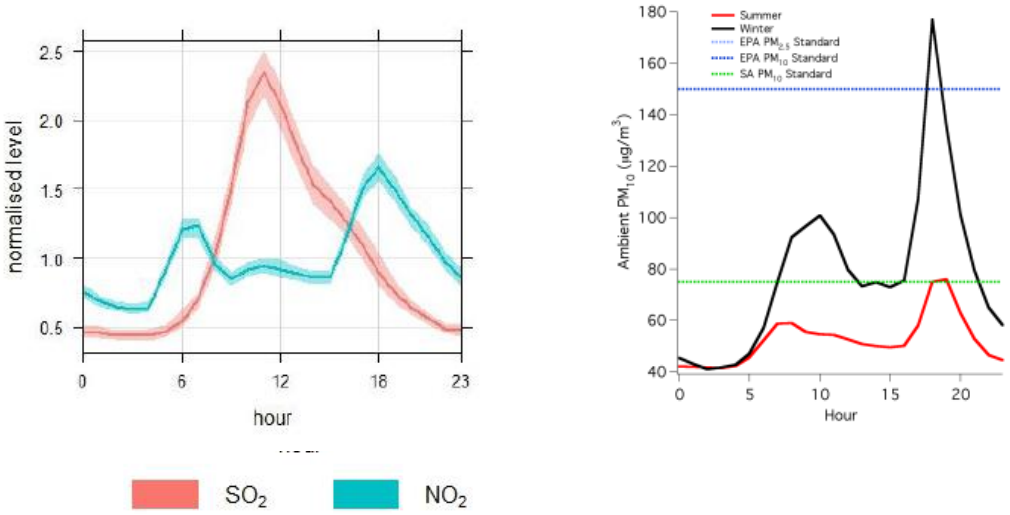


Figure B1: normalised hourly ambient concentrations of SO_2 and NO_2 at a monitoring station near the Sasol Secunda plant (left) and hourly ambient concentrations of PM_{10} for winter and summer at KwaDela, a small community ~50 km from Secunda (right)

The emission signature of industrial pollution is well documented, with ambient peaks in concentration occurring around midday, as clearly exhibited by SO_2 in the left graph. NOx concentrations are a function of both industrial activity (midday concentrations would reflect the maximum industrial impact) and domestic activity, in the form of vehicle emissions, peaking during main traffic hours in the morning and early evening. These dual contributors are evident for NO_2 in the graph at the left as well. The graph at the right shows absolute concentrations of PM_{10} measured in KwaDela, a town fairly far removed from any industrial activity. The ambient concentrations exhibit a clear domestic activity signature, which is much exacerbated during winter months. The emission signature for high ambient PM levels closer to our Secunda plant follows the same patterns, and therefore appears to be linked to winter domestic fuel burning patterns.

These trends are identical to those seen near Sasol's facility in Sasolburg, too.

Further work is underway to confirm the contribution of various emission sources to ambient PM concentrations in KwaDela.

2. Sasol's investigations into community-based interventions for ambient PM reduction

Mindful of the on-the-ground realities described above, through Sasol's Corporate Social Responsibility (CSR) programmes and university research partnerships, various investigations have been conducted over the years to better understand the possibility of beyond-the-factory-fence initiatives to reduce high ambient PM concentrations. These include, among others, the development of the *Basa Magogo* cleaner cooking method and most recently, the KwaDela pilot study to quantify the potential for RDP home insulation to improve indoor and ambient air quality.

The rationale for Sasol's investigations into these beyond-the-factory-fence air quality improvement opportunities has been to inform a view on the extent to which such interventions could constitute sustainable measures to improve ambient air quality in line with the objectives of the NEM:AQA. This is to inform Sasol's positions and engagements regarding the development of a formally recognised air quality offset mechanism which would provide a clear business incentive to invest in such programmes at a scale beyond CSR.

The KwaDela pilot study is briefly described here. During 2015, the pilot study will have been concluded and final reports prepared which quantify the potential of the RDP home insulation for beneficial air quality, health and socio-economic impacts, along with other positive environmental benefits, at large scale.

The study was undertaken for the following reasons:

- To investigate the efficacy of RDP house insulation (3 configurations) on all eligible and willing homes in a community, as a solution to achieve indoor and ambient air quality improvements. (Effectively, this pilot study constitutes a full-scale offset implementation in a small community).
- To understand practical aspects regarding implementation of successful offset projects, along with their risks and limitations.
- To establish the impact of community-based offsets on other sustainable development parameters, including quality of life and environmental parameters such as greenhouse gases.
- To inform Sasol's inputs to air quality offset policy development.

3. Results of KwaDela pilot study

The three phases of the pilot study entailed:

1 the establishment of a detailed pre-implementation baseline of winter and summer ambient and indoor air quality in KwaDela, along with detailed surveys to capture quality of life baseline parameters;

2 the implementation of the RDP insulation intervention; and

3 the repeat of the winter and summer ambient and indoor air quality baseline measurement in order to determine the benefits realised.

The insulation technology is an expanded polystyrene sheet attached to the exterior wall, covered with a plastic mesh for increased flexibility, followed by a plain layer of plaster, and then with a pigmented plaster, which holds its colour even when chipped. The value of one of the surveys conducted during the initial baseline phase was to confirm the acceptability of the proposed technology, and to understand how social value creation could be enhanced in small ways. An example relates to the insight that people feel powerless to make improvements to

their homes to individualise them, due to financial constraints. It was this insight which led the project team to seek various pigmented plaster options, to afford households some choice in the upgrades to their homes.

The three phases have been completed, and currently quality control processes and integration of all findings has been undertaken. Further work is ongoing to assess the durability of the insulation installation over a successive winter period (phase 4). A final study report for phase 3 will be issued during 2015.

Some photos documenting the study are included at the end of this report.

Findings of the study are presented below.

4. Indoor temperatures

RDP homes are in the region of 50 m^2 in area, comprising an open-plan kitchen and lounge area, and two separate bedrooms. Ablutions are often outside. RDP homes are not designed or constructed with thermal efficiency and temperature control in mind: where homes are north-facing this is by chance and not design; doors and windows are not well installed, ineffectively sheltering against draughts and ingress of dust; most homes have corrugated iron roofs without a ceiling, through which most of the heat escapes, and significant dust ingress also occurs.

Temperature measurements were taken on the four walls of the home and the chimney, during summer and winter periods. Indoor temperatures are thought to be a potential useful proxy for air quality predictors, since the comfort provided by less extreme cold in winter is anticipated to link directly to the amount of solid fuels consumed for fire making for space heating purposes.

While not an air quality benefit, it should be noted that lower temperatures in summer are also a social benefit, linked to comfort and therefore quality of life.

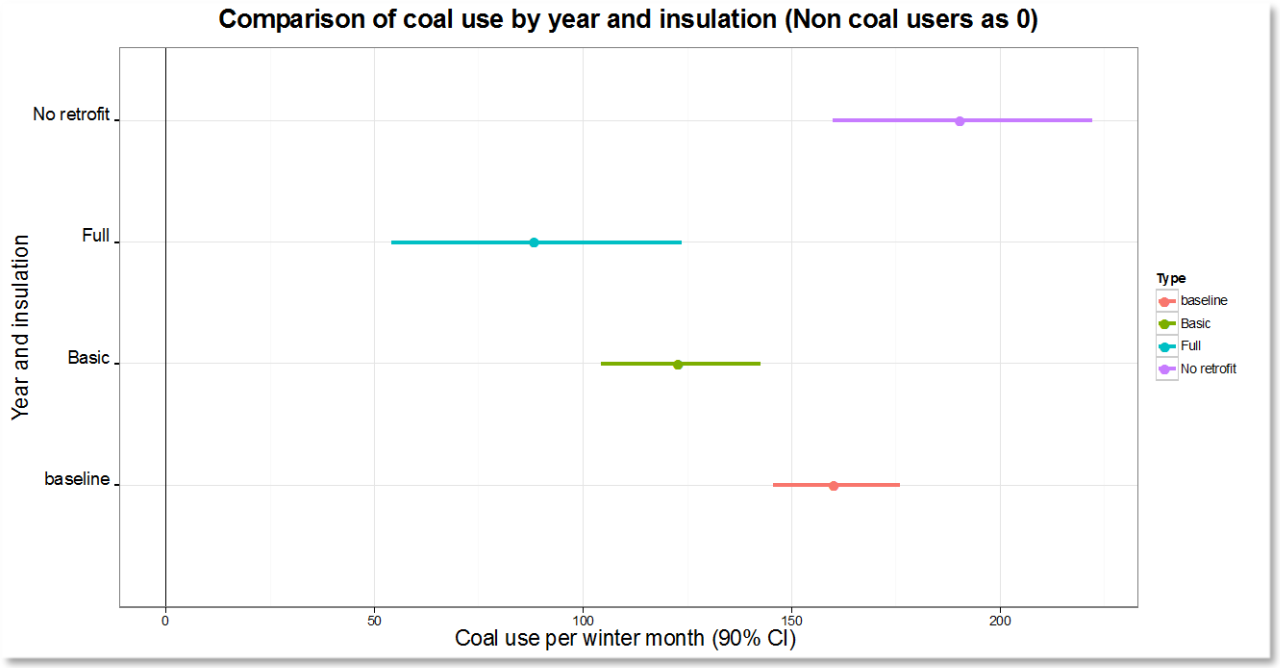
Month	Retrofit type	Minimum temp recorded	First quartile temp	Mean temp	Third quartile temp	Maximum temp recorded
Jul-13	None	2.1	10.0	13.9	17.6	34.3
Jul-14	Basic	-2.3	12.7	15.8	19.0	31.1
Jul-14	Full	10.5	15.5	18.3	21.0	30.6
Aug-13	None	1.0	10.5	15.0	19.5	40.3
Aug-14	Basic	-2.8	14.0	16.9	20.0	31.2
Aug-14	Full	9.5	17.0	19.3	21.5	37.7
Sep-13	None	0.0	15.0	19.3	24.0	49.5
Sep-14	Basic	-0.8	16.7	20.3	24.4	38.6
Sep-14	Full	12.0	19.5	22.4	25.4	49.4

From the temperature quartiles per month above it is clear that the basic and full retrofit both have a positive temperature stabilisation effect which is particularly dramatic in the case of the full retrofit for protection against low temperatures. From a quality of life perspective, the number of winter indoor hours recorded falling with a range defined as fit for humans, increased by 155% in houses receiving a full retrofit – despite many of those households foregoing the use of coal.

5. Energy consumption patterns

An energy consumption survey was an integral part of the study, and the before and after implementation comparison highlights the extent to which energy demand is favourably influenced by the insulation intervention and its associated impact on winter indoor temperatures, for the first winter after implementation. Households purchase coal and also use significant quantities of wood where available, to start their fires. An interesting finding from KwaDela was the significant use of dung as a (free) heating fuel. Electricity is not typically used for heating purposes, due to its comparatively high cost. Electricity theft may have occurred but was not investigated or measured. These observations point to the important socio-economic linkages between household selection of energy carriers and affordability of the various options available.

The following graphical presentation of the household energy survey results shows the relative stepped coal use improvement of the basic and full retrofit interventions. The mean coal consumption for households who received the full retrofit is significantly lower than the 2013 baseline as well as for households who did not receive any retrofits in 2014.



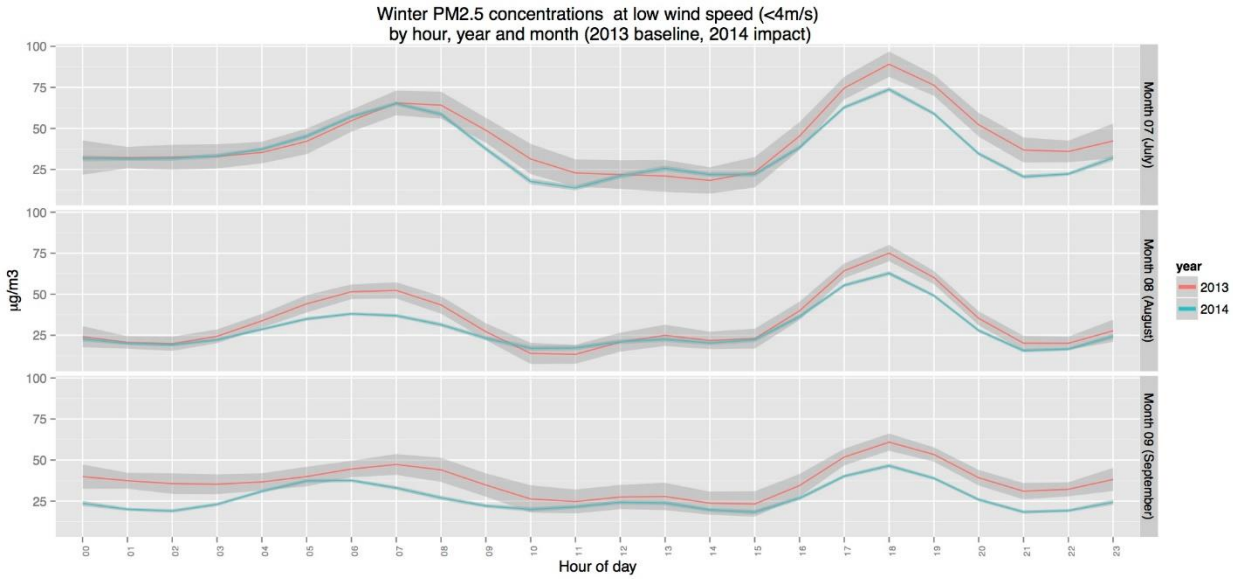
Having received full retrofits, after 1 year, 42% of coal-using households report completely ceasing to use coal in winter, versus the control group reporting a 9% discontinuation of coal use. The basic retrofit was less effective, with and 18% reported discontinuation of coal use.

6. Indoor and ambient air quality

As expected, high ambient concentrations of PM are measured in winter (refer to Figure 1 of this annexure). Significantly, concentrations in the regions of one to two orders of magnitude higher were measured inside people's homes in the morning and evening, directly linked to fire-making and fire-refuelling activities. These are coupled with high concentrations of carbon monoxide (CO) from incomplete combustion.

Examples of challenges faced by households include the use of old cracked stoves and cracked chimneys, resulting in much of the smoke escaping into the home. When measured without any energy sources being used for space heating purposes, indoor RDP home temperatures are not significantly different than ambient temperatures, implying household members are inadequately protected from the cold.

While measured after just one winter cycle post implementation of the intervention, the following results were recorded for each winter month:



A reduction in peak $PM_{2.5}$ corresponding to the evening fire making period is apparent.

7. Social benefits arising from the pilot study

The air quality-related benefits are the primary driver for offsets which will dictate the extent to which such projects are deemed as successes or failures in the eyes of many stakeholders. However, Sasol believes that the social co-benefits are not insignificant.

Apart from some of the qualitative social benefits arising (e.g. empowering home owners to individualise the outcome through choice of plaster colours, thermal comfort in the form of less extreme indoor temperatures and the reported visible reduction of dust ingress from external sources), the quantifiable benefits include:

- Skills development and temporary job creation for 17 interviewers conducting the initial surveys period (16 of whom were women, not previously employed, aged 25-35). A week of certified training was conducted on the cellphone-based survey tool.
- The implementation phase trained and employed 51 construction workers organised as 15 teams under team leaders (all from the community). The team leaders received certified training at the training facility of a leading RDP construction firm. Wages of R1 million were paid to these workers over the implementation period.
- The 15 sets of tool kits purchased for the project were donated to the team leaders at the end of the implementation phase.
- The average saving in fuel costs per household is +/- 50 kg in winter months. At R1.50/kg in KwaDela this amounts to R75/month.

	Mean coal use per winter month (kg)	
Insulated?	**2013**	**2014**
Yes	111.36	94.07
No	118.92	143.75

8. Conclusion and way forward

Research at KwaDela continued during the 2015 winter period to confirm winter 2014 results as well as to investigate the durability of the retrofit installations one year later.

The sustainability of reduced solid fuel use is further investigated, as it is hoped that the solid fuel burning practices may reduce further as inertia of established habits decreases.

It is re-emphasised that these are preliminary findings, in the sense that endurance of the benefit over a longer period of time is not quantified.

The learnings extracted from all phases of the study have been, and will continue to be used to inform the design and implementation of the medium to longer-term component of the offset programme of activities linked to Sasol's licence condition.

SOME PHOTOS DOCUMENTING THE PILOT OFFSET STUDY IN KWADELA

Figure B2 – baseline monitoring, clockwise from top left: installation of mobile ambient monitoring station; a household's stockpile of wood for the winter; example of poor condition of household stoves – cracked; indoor air monitoring equipment installed in a household's kitchen area

Figure B3 – training of team leaders on insulation and plastering techniques at construction company facilities in Midrand

Figure B4 – insulation implementation in KwaDela, clockwise from top left: installation of ceilings requires precision and fit-for-purpose solutions for chimneys; attaching insulation to exterior walls; completed ceiling; completed exterior insulation, covered in pigmented plaster in the colour selected by the household

Annexure 3: Details on the Quality of life and Air Quality baseline measurement Campaign

The baseline campaign is the pivotal starting point for the longer-term offset programme of activities, since it establishes the air quality and quality of life benchmark values for a range of parameters, against which the impact of all future offset interventions will be measured.

The campaign design is refined and enhanced based on learnings from the KwaDela study.

The diagram below depicts the holistic overview of the baseline campaign for both the Sasolburg and Secunda areas. The holistic overview divides the indoor and ambient air quality activities between macro, meso and micro scale, and also provides content on the quality of life studies. The overall deliverables and what they aim to inform is also indicated to the right of the diagram.

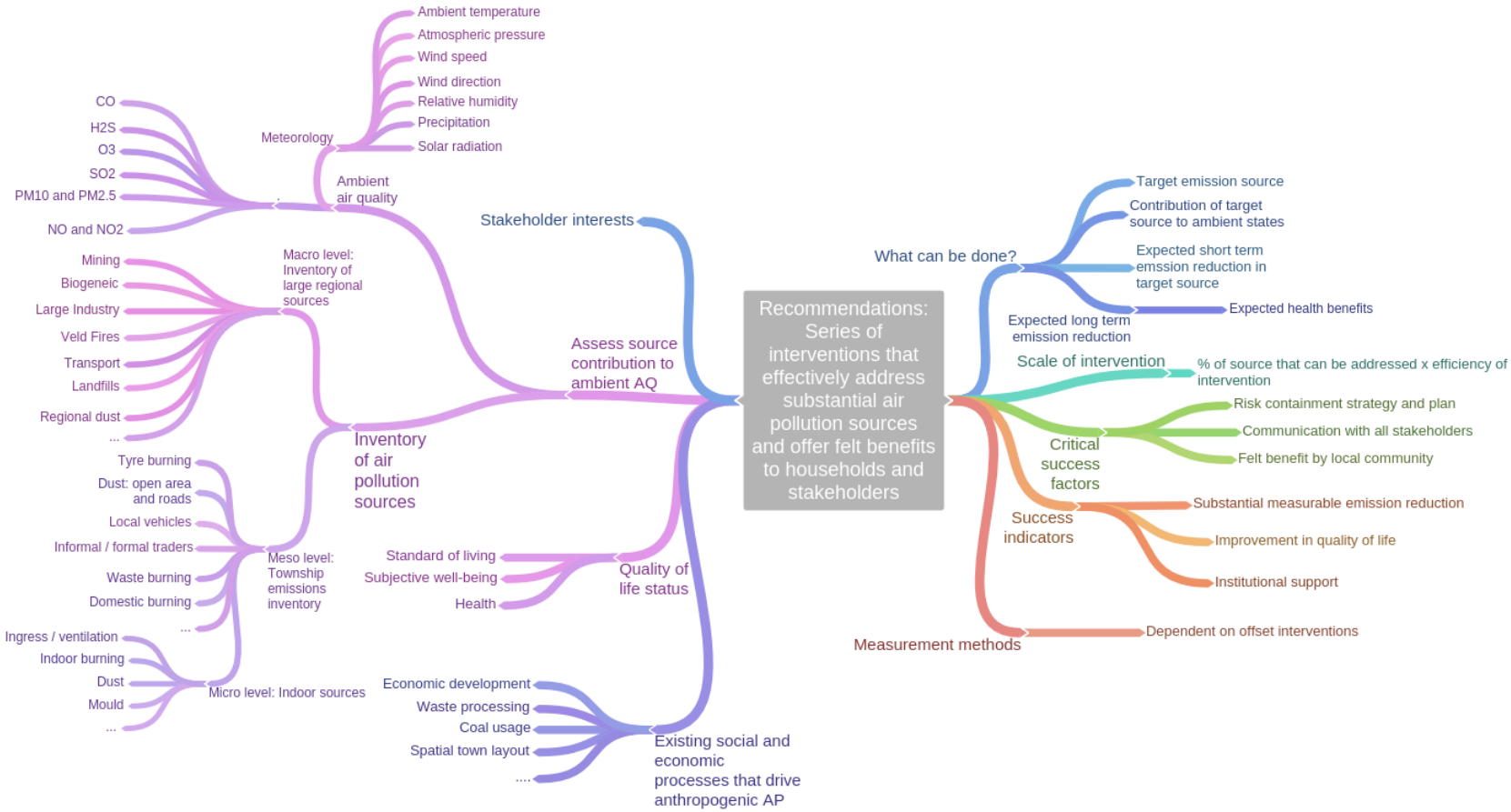


Figure C1 – conceptual overview of quality of life and air quality baseline campaign

The table below provides more detailed information on the activities. The air quality measurement activities are described under the Activity categories: Chemical source apportionment, ambient air quality measurements, and Indoor air quality measurements. This component of the baseline will therefore establish the concentration of various pollutants in ambient and indoor air, and will chemically analyse samples of ambient particulates to confirm the sources of these pollutants. The source apportionment will be critical to informing the key sources of community-based pollution to be targeted for offsetting over the longer term.

The quality of life activities are described under the Activity categories General household survey, Community source survey, GIS land use assessment, Rapid *in situ* assessment, Household fuel consumption measurement, Coal merchant survey and Focus group interview. These surveys aim to better understand, at a detailed level, household quality of life and the extent to which that is affected through air pollution impacts. They will also seek to establish an air quality education baseline, and drivers behind household energy consumption and energy carrier choices.

Activity	Parameter measured	Description	#observations Embalenhle	#observations Zamdela	#observations Lebohang
Chemical source apportionment	PM10	28 8-hour samplesper season (winter & summer) per location	56	56	0
	Background PM10	14 24 hour samples per season (winter & summer) per location	28	28	0
	Elemental Carbon Organic Carbon	14 8 hour samples per season (winter & summer) per location	28	28	0
Ambient air quality measurements	SO2	Continuous measurement, logged at 1 minute intervals for 12 months	12 months	12 months	0
	CO		12 months	12 months	0
	NO & NO2		12 months	12 months	0
	O3		12 months	12 months	0
	PM10 & PM2.5		12 months	12 months	0
	H2S		12 months	12 months	0
	Solar radiation				
	Ambient temperature		12 months	12 months	0
	Relative humidity		12 months	12 months	0
	Wind speed				
	Wind direction				

	Precipitation				
	Atmospheric pressure		12 months	12 months	0
Indoor air quality measurements	PM4	Dustrak	7d each in 28hh	7d each in 28hh	0
	CO	High events	7d each in 28hh	7d each in 28hh	0

Activity	Parameter measured	Description	#obs Embalenhle	#obs Zamdela	#obs Lebohang
General household survey	Demographic variables	Structured interview with an adult household representative	0	800-1000	200
	Subjective well-being		0	800-1000	0
	Services and standard of living		0	800-1000	0
	Energy use		0	800-1000	200*
	experience and perceptions of air quality		0	800-1000	200*
	Experience and perceptions on safety and security		0	800-1000	0
Community source survey	Small emission sources like waster burning, informal food vendors, dust etc.	Systematic sample of public areas to log local sources of pollution	1	1	1
GIS land use assessment	Potential sources of wind-blown dust	Existing land use data and on-the-ground verification	1	1	0
Rapid in situ assessment	All visible pollution sources	Structured site visit to visually assess different air pollution sources	1 day, sunrise to sunset	1 day, sunrise to sunset	0
Household fuel consumption measurement	Household solid fuel consumption	fuel logs; container measurements; fire ignition times	20	20	0

Coal merchant survey	Coal origin, format weights and prices	Structured interview with coal merchants	1	1	1
Focus group interview	Experience and perceptions of air quality	Focus group interviews			
Focus energy use surveys	Domestic energy use and emission from domestic sources	In-depth structured interview on a comprehensive range of energy applications and fuel use practices	0	0	4
			200	200	200
In-depth QOLA interviews	Quality of life in the households including basic necessities, localisation, basic activities, relationships, consciousness and body structure	Three in-depth interviews per household adult representative including open ended and structured interviewing techniques	0	40 – 50	0
Focus group interviews	QoL perceptions and issues in the community	Four group interviews: two with men and two with women	0	4 x (6-10)	0

Annexure 4: Immediate interventions in eMbalenhle: Veld fire management

1. Background

This intervention considers the reduction of smoke (PM) emissions from veld fires by implementing preventative measures in the Sasol areas (secondary area, and Sasol Mining areas) and sharing of best practices with the Fire Protection Association of Govan Mbeki Municipality.

2. Project objective

The purpose of the veld fire management program in the Sasol's fire protection officer's jurisdiction is to reduce the risk of veld fires (preventative measures) and the impact whenever it occurs (corrective measures). The aim is to reduce PM_{10} emissions which originate during a veld fire (smoke).

Figure 1 provides an example of the typical impact of veld fires on ambient air quality. In the secondary area of Sasol's Secunda facility (which includes a game park with large tracts of veld), a fire occurred on 28 August 2014 at 13:00 during which 500 hectares burnt, and again on 29 August 2014 during which 900 hectares burnt. This veld fire originated from the municipal camp and spread to the Sasol secondary area. The Sasol Club ambient monitoring station data illustrates the impact of the fire on ambient PM_{10} levels, visible as a sharp spike.

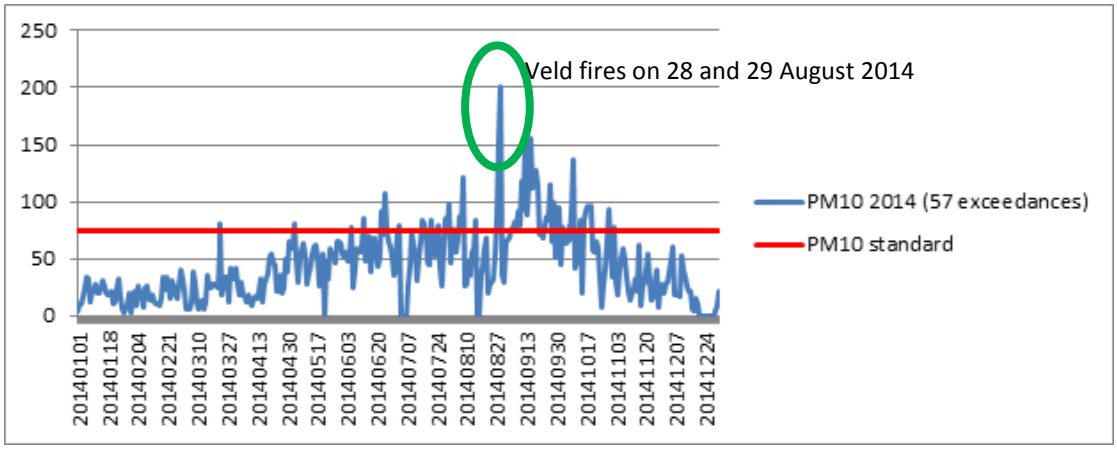


Figure D1: PM_{10} emissions measured at Sasol club ambient monitoring station

3. Project overview

PM_{10} emissions emanate from veld fires. The overview of the project to reduce veld fire burning is the following:

- Cutting and bailing of grass over a 271 hectare area;
- Burning of fire breaks at boundaries during acceptable atmospheric conditions (to reduce impact on ambient air quality) by trained personnel (total area of firebreaks is 200,5 hectares with disc cultivation of 10 meters wide strips);
- Responding to veld fires by trained personnel to limit the total area burned and possible further spread of the fire to surrounding residential areas. Veld fires are high risk events and are attended to as soon as possible to prevent it spreading to surrounding areas;
- A best practice planned to be implemented is to reduce the PM emissions from preparing firebreaks alongside Sasol's coal conveyor belts by reducing the amount of grass available for burning. This will be done by cutting of grass alongside the conveyor belts (in excess of 100 km) covering 50 meters on both sides of the conveyor belts which translates to an area of 10 square kilometres, and applying a growth suppressant to limit regrowth;

- Checking conveyor belt protectors to prevent fires originating from possible friction of the conveyor belt rollers; and
- Sharing of best practices with the Fire Protection Association of Govan Mbeki (Chief Fire Officer of Govan Mbeki, farmers, etc.).

4. Project Scope and Milestones

The project scope covers the Sasol's fire protection officer's jurisdiction. Any external veld fire threats that could impact on the Sasol areas will also be attended to, in order to proactively address the risk.

The emergency management team has the personnel and equipment to implement the fire breaks. Two additional veld fire appliances and one 8 000 litre water tanker have been procured recently to strengthen the response capacity of Sasol Emergency Management, bringing the total number of response appliances specifically for veld fire management to eight. As part of the offset plan, further tractors will be procured for cutting of grass.

Major Milestone
Project schedule for cutting of grass and fire breaks
Two tractors already purchased and in use
Yearly update on project schedule for cutting of grass and fire breaks

5. Project Success Metrics

The impact of the project will be measured by:

- Reduction in number of veld fires in the Sasol's fire protection officer's jurisdiction (two veld fires in 2014); or
- Reduction in the severity of veld fires that originate in the Sasol's fire protection officer's jurisdiction.

Ambient air quality will be assessed to determine the impact of PM_{10} concentrations whenever a veld fire occurs.

6. Partners

- Sasol emergency management responds to veld fires in the Sasol areas, as well as veld fires approaching Sasol areas.
- Sasol Emergency Management responsible for cutting grass alongside the Sasol conveyor belts and applying growth suppressant.
- Continuous communication between Govan Mbeki fire department and Sasol emergency management, as well as implementing shared best practices at Fire Protection Association sessions.
- Our communities, in reporting veld fires as soon as they are detected, to activate an effective response

The proposed role of each partner is outlined below:

Partner	**Role to be played**
Secunda SHE team	Cutting and bailing of grass; and Sharing of best practices with the Fire Protection Association of Govan Mbeki
Secunda Public Affairs	Communication with community
Sasol emergency management	Cutting of grass alongside Sasol conveyor belts and applying growth suppressants; Burning of fire breaks; Responding to veld fires in the Sasol areas, as well as veld fires approaching Sasol areas; and Sharing of best practices with the Fire Protection Association of Govan Mbeki
Fire Protection Association (Chief Fire Officer of Govan Mbeki)	Sharing of best practices with farmers and industry in Govan Mbeki municipality area
Community	Contact Govan Mbeki fire department whenever a veld fire is observed
Local authorities	Note

Annexure 5: Evaluation of innovative solutions to potentially improve ambient air quality, to be piloted in Lebohang

1. Background

Lebohang was selected to run further pilot studies to advance knowledge on ambient air quality improvement through offsets, informed by previous survey work conducted there as well as guidance provided by the Licensing Authority.

The Highveld Priority Area (HPA) Air Quality Management Plan (AQMP) identifies some of the expected significant contributors to air pollution levels in a low-income community such as Lebohang as domestic solid fuel burning (for space heating, cooking and water heating) and dust from unsurfaced roads, among others.

This proposal aims to contribute to Goal 3 of the AQMP whereby by 2020, air quality in all low-income settlements is in full compliance with ambient air quality standards, through identifying a suite of solutions which present promising opportunities for ambient air quality improvement, but need further testing to confirm their merit and feasibility before taking to large-scale rollout.

Opportunities to identify and evaluate innovative technical solutions lie in the following objectives of Goal 3 of the AQMP:

- Clean fuels and technology that are affordable and easily available:
    - Clean combustion technologies such as stoves
    - Clean fuels such as anthracite coal and gas
- Improvement of service delivery to low-income communities:
    - Electrification
    - refuse removal
    - Greening
    - Road surfacing
- Low-income and informal households are energy efficient:
    - Solar water heating and other energy efficient devices

2. Feasibility study programme objective

The objective is to identify, prioritise and test a diverse set of innovative solution(s) at small scale, informed by the requirements of the HPA AQMP and community consultation, in order to assess whether any of the solutions are sufficiently promising to be taken to larger scale under the medium to longer-term offset programme (refer to Section 6 of the main document for an explanation).

The programme goal is to demonstrate the potential of these interventions assessed in terms of:

- Confirming that they show promise in ultimately leading to an improvement in ambient air quality, through contribution to Goal 3 of the AQMP;
- Consideration of community perceptions / experience of the solutions;
- Ability to take to scale in a manner which can deliver sustained benefits;
- Socioeconomic value co-creation opportunities, in line with other of Sasol's sustainability objectives (e.g. job creation, enterprise and supplier development)

3. Project Scope

A formal, impartial and consultative process is proposed in order to identify a suite of prioritised innovative solutions to test at small scale in Lebohang that could be translated into offset programmes in other communities.

The process proposed includes the following sequential steps:

- Conduct a literature review of possible innovative solutions, informed by Goal 3 of the AQMP;
- Develop a decision matrix to evaluate and prioritise the proposed solutions, informed by the goals described in section 2 above, encompassing air quality improvement potential and other factors;
- Using the decision matrix, propose a short list of potential technologies for consultation and confirmation with the community, through focus group interviews to gain understanding of end-user requirements in order to select final candidate technologies;
- Feasibility test of final candidate solutions;
- Design a Sustainability measure for each identified and implemented solution;
- As an output of the process, prepare recommendations on whether any of the solutions should be considered for inclusion in the medium to longer-term programme of activities in relation to their performance in terms of the goals described in section 2 above.

This process will be managed by an external vendor for impartiality and expert detailed community consultation (e.g. through one-on-one surveys). Nova Institute has been appointed as the vendor.

4. Programme Success Metrics

The success metrics will be aligned with the criteria included in the decision matrix, as informed by the goals described in section 2 above.

While through the process outlined in section 3 above, it is intended to identify solutions which can be indeed be incorporated into the medium to longer-term programme, it cannot be guaranteed that any individual solution implemented will be successful in achieving the overarching goals. Through community engagement as the process unfolds, updates on progress, obstacles, learnings and improvement opportunities will be integral to improving the chances of identifying successful further solutions.

5. Partners

The success of these pilot programmes is dependent on the coordinated planning and interaction of a variety of partners. The role of partners will have to be carefully agreed upon during the planning phase for implementation of the pilot studies.

The role of each partner is outlined below:

Partner	Role to be played
Sasol Secunda SHE team	Provide environmental expert inputs into the programme.
Sasol Secunda Public Affairs	Engaging with the applicable authorities, community leadership and the community to support and enable this programme. Provide stakeholder expert inputs into the programme.
Consultant(s) supporting with community engagement and market acceptance surveys	Facilitation of the process outlined in Section 3 of this Annexure. Nova Institute has been appointed as the consultant.
Community	Participation in the process.
Govan Mbeki Municipality	Provide guidance and support on the innovative solutions identified for pilot implementation.