

Research article

An Environmental Justice Perspective on Air Quality Offsets

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Abstract

Air quality offsets in South Africa are intended to counterbalance the harm caused by atmospheric emissions and deliver a net ambient air quality benefit in the affected airshed. In practice, they are implemented as a condition of leniency from compliance with the Minimum Emission Standards, and they focus on converting solid fuel burning households in low-income communities to cleaner forms of energy. Air quality offsets are not supported by all stakeholders, with non-governmental organisations in particular voicing vociferous objections. To date, there have only been very limited analyses of the ethical dimensions of air quality offsets. In this paper, air quality offsets and the Minimum Emission Standards are examined and compared from the perspective of three notions of environmental justice: distributive justice, which focuses on the distribution of environmental burdens and benefits; procedural justice, which considers inclusion and exclusion in decision- and policy-making processes; and justice as recognition, which focuses on the cultural and institutional processes that determine recognition, misrecognition and non-recognition of various groups. It is found that air quality offsets should guide action that promotes distributive justice because they are focussed on reducing polluting emissions in vulnerable, low-income communities that are exposed to the highest levels of ambient pollution. From a procedural justice perspective, South Africa's legislative processes provide for involving most stakeholders in decision-making processes. Air quality offset initiatives should be evaluated once they have been implemented at scale to determine whether they have indeed aided in redressing injustices. Assessment criteria could include whether the air quality-related health risk of vulnerable communities has been reduced, whether community members have participated in the design and implementation of interventions, and whether marginalised members of the community have benefitted from the interventions.

Keywords

air quality offsets, minimum emission standards, environmental justice.

Introduction

Air quality offsets are one of several measures introduced by the South African government to improve ambient air quality. In practice, they are implemented by polluting facilities as a condition of a postponement of compliance with the Minimum Emission Standards. They take the form of reducing emissions from domestic burning, waste burning and veld fires in low-income residential areas in close proximity to the polluting facilities.

Air quality offsets, as contemplated in the Air Quality Offsets Guideline, 2016 are unprecedented globally, in that the basis of equivalence is ambient air quality, and improvements in ambient

concentrations of one pollutant, for example particulate matter (PM), may be traded for emissions of another pollutant, for example sulphur dioxide (SO₂). Emission trading schemes in other parts of the world take the form of market-based schemes that allow facilities to trade in pollution reduction credits. These are usually for the same pollutant, and are intended to achieve a mandated reduction in emissions at least cost (Krupnick, Oates and van de Verg, 1983; Drury et al., 1999).

Despite the focus of air quality offset projects on improving air quality in dense low-income communities that are exposed to the poorest ambient air quality in South Africa, offsets have received severe criticism from non-governmental organisations

(NGOs). The Centre for Environmental Rights (2015), for example, has categorically stated that they and their clients ‘do not agree, in principle, with the use of offsets as a management tool to avoid compliance with legislation.’ Another NGO, groundWork, has reported that Eskom’s air quality offsets project ‘has created more problems than solutions’ (Molefe, 2018).

In light of the novelty and contentious nature of South Africa’s air quality offsets programme, this paper assesses air quality offsets from an environmental justice perspective. Environmental justice here is taken to mean the ways in which the environment and social difference are intertwined, and the justice of this interrelationship (after Walker, 2012). An analysis of this nature is perhaps premature, given that air quality offsets have not been implemented at scale yet, and so the promotion (or not) of justice through the offsets programme cannot be evaluated. However, ethical theory can be used both to guide action and to evaluate actions (Driver, 2007). Criticism of the air quality offsets programme in South Africa has largely been directed towards the policy, and not so much the implementation of interventions. As such, the purpose of this analysis is to offer assertions as to whether air quality offset policy is adequately designed to guide actions that promote environmental justice. Thereafter, suggestions are made for evaluating the offset implementations from an environmental justice perspective.

Materials and methods

To provide the necessary background for the evaluation of air quality offsets from an environmental justice framework, legislation pertaining to air quality offsets in South Africa is reviewed, and offset implementation programmes are discussed based on Eskom and Sasol’s plans, since between them they account for the majority of offsets initiatives. Environmental justice is introduced, drawing in particular on the work of Walker (2012), who identifies three concepts of justice – distributive justice, procedural justice and justice as recognition – which are discussed further in section 4.2. These three aspects of justice form the framework for the analysis in this paper. Use is made of Walker’s (2012) proposal that claims about environmental justice should comprise of three elements (Figure 1):

- i. an analysis of the evidence to determine the state of equality or inequality;
- ii. an explanation identifying why the inequalities and injustices exist. This reasoning on why the inequality fails to satisfy a justice principle is linked to:
- iii. a normative claim about justice/injustice.

Walker (2012) argues that the academic literature on environmental justice has tended to focus either on analysing justice concepts and theories, drawing on various philosophical and political traditions, or on the demonstration of patterns of inequality. An attempt is made in this study to explore both elements and the linkages between them in order to make a normative claim about what is just or fair.

The status of air quality on the South African Highveld is first

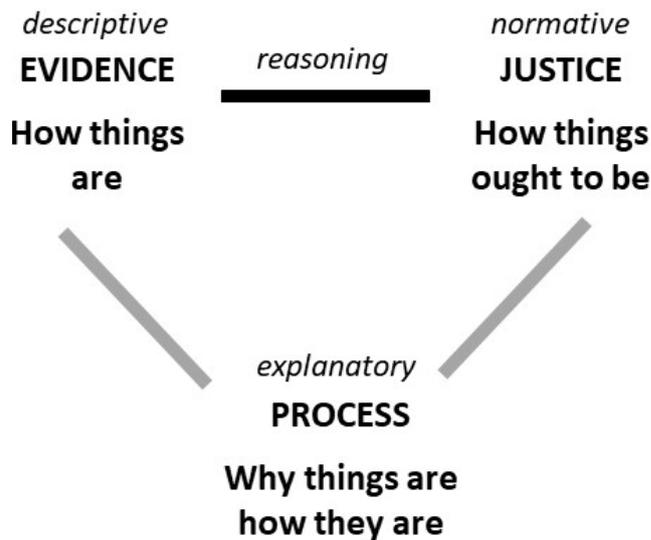


Figure 1: The three elements of environmental justice claims (after Walker, 2012)

assessed in terms of an environmental justice framework in order to provide context for the evaluation of air quality offsets. The term ‘Highveld’ is used here in the geographical sense, referring to the high-altitude plateau in the South African interior.

Air quality offsets are evaluated through an environmental justice lens, relative to the Minimum Emission Standards for Listed Activities Identified in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (henceforth referred to as the Minimum Emission Standards (MES)), since offsets are usually required as a condition of a delay in full or immediate compliance with the MES. This analysis focuses on South Africa’s air quality offsets policy and regulatory framework, as led by the national Department of Environment, Forestry and Fisheries (DEFF, previously the Department of Environmental Affairs), and the way in which air quality offsets have been conceived of in Eskom and Sasol’s implementation plans. Criteria for assessing the effectiveness of the implementation of offset projects from an environmental justice perspective are proposed.

This analysis takes place within the context of South Africa as ‘a society based on democratic values, social justice and fundamental human rights’ (according to the Preamble of the Constitution of the Republic of South Africa, 1996), and assumes political and societal views aligned with this.

Status of air quality offsets in South Africa

Air quality offsets are but one type of environmental offsetting in South Africa (Government of South Africa, 2015). Offsets are also employed for biodiversity, wetlands, water resources and carbon management. Environmental offsets are a response to the National Development Plan’s statement that ‘South Africa faces urgent developmental challenges in terms of poverty,

unemployment and inequality, and will need to find ways to “decouple” the economy from the environment, to break the links between economic activity, environmental degradation and carbon intensive energy consumption. In the past, resources were exploited in a way that was deeply unjust and left many communities excluded from economic opportunities and benefits while the natural environment was degraded. The country must now find a way to use its environmental resources to support an economy that enables it to remain competitive, while also meeting the needs of society’ (Government of South Africa, 2015).

Legal status of air quality offsets

The Air Quality Offsets Guideline was published on 18 March 2016 (Notice 333, Government Gazette No. 39833) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) section 24J (a). The Guideline provides ‘guidance on situations under which offsets can be applied during the implementation of the atmospheric emission licensing system...’ The Guideline establishes principles for air quality offsets including that they are outcome based (on ambient air quality improvements); an offset does not need to be ‘like for like’; there is transparency by the implementers and the authorities; receiving parties need to consent to participate; offsets projects should be sustainable in the long-term; and projects should be measurable and scientifically robust. It also stipulates that an offset programme should be subject to ‘detailed and transparent’ public participation.

The legal requirement to implement air quality offsets is stipulated in the atmospheric emission licences (AELs) of specific facilities, but there is almost no detail on what this entails. For example, the AEL for Sasol Synfuels issued on 31 March 2015 contains the condition that ‘The facility must implement an offset programme to reduce PM and SO₂ pollution in the ambient air / receiving environment and the implementation plan is to be presented to the NAQO [National Air Quality Officer] and the licencing authority by 30 June 2015 after agreement, followed by an appropriate public participation process.’ Duvha Power Station’s AEL issued on 28 June 2017 stipulates that ‘Eskom Duvha Power Station is required to provide and implement, a specific and time bound Atmospheric Emission Off-Set Plan to reduce PM in the ambient/receiving environment that must be approved by the Atmospheric Emission Licensing Authority annually.’ Importantly, these conditions requiring air quality offsets in facilities’ AELs were included as a requirement of an approved postponement of compliance with the MES.

Implementation of air quality offsets

Eskom and Sasol have published Air Quality Offset Implementation Plans for their facilities that are required to implement offsets. According to Sasol’s offset plans for Secunda (Sasol, 2017) and for the Sasolburg operations and Natref (Sasol, 2016), Sasol’s offset projects are implemented in Zamdela and eMbalenhle, the two large low-income residential areas in close proximity to their operations, and in Lebohang, which is a little further away, at the request of the Licencing

Authority. Sasol intends to insulate up to 7600 solid fuel-burning formal homes in eMbalenhle (5200 homes) and Lebohang (2400 homes). Sasol expresses intent to insulate and swap stoves for 1400 to 1800 serviced informal homes by June 2020 (provided a successful insulation solution for informal dwellings is found). Sasol is assisting with veld fire management around Secunda and has looked into measures to suppress dust on untarred roads (although since their contribution to ambient air quality is minimal, they will not be pursuing this further). In Zamdela and surrounds, Sasol is focussing on reducing emissions from veld fires, waste burning and vehicles. Education and awareness activities are undertaken in all three communities, with special focus on the schools.

As of June 2018, Sasol had insulated 500 formal RDP houses in eMbalenhle. They had also completed the insulation of 24 serviced informal dwellings with spray polyurethane foam and swapped their coal-burning stoves for a low emission coal stove or liquid petroleum gas (LPG) stove and heater in Lebohang. In Sasolburg, 20 staff members from the Fire and Traffic Departments were trained in vehicle emission testing to promote routine vehicle testing by the local authorities. 100 waste skips were placed in Zamdela in 2018, and approximately 10 000 tons of waste removed from the community (Sasol, 2018). Eskom proposes to reduce emissions from domestic burning in 40 000 households on the Mpumalanga Highveld by 2025 by insulating the dwellings and swapping the coal stoves for a cleaner alternative (probably electricity or LPG heaters and stoves) (Eskom, 2017c, 2017a). Communities are selected for offsets based on the following criteria:

- i. Communities exposed to highest ambient air quality impact from the facility are prioritised
- ii. Only communities where there is non-compliance with ambient air quality standards may be selected
- iii. Only communities where there is opportunity for offsets may be selected

In southern Gauteng near Lethabo Power Station, the focus is on reducing emissions from the burning of waste (Eskom, 2017b).

Eskom has completed a pilot study in KwaZamokuhle (adjacent to Hendrina town, Mpumalanga). Initially 120 households were insulated (60 with ceilings and 60 with ceilings and insulation on three walls) and each household received either an electricity subsidy (of R200 per month for the winter months) or their coal stove was swapped for a low emission coal stove, or their coal stove was swapped for an LPG heater and LPG stove (Langerman et al., 2018). Eskom subsequently insulated another 30 households and swapped their coal stoves for electric heaters and stoves. Eskom is currently busy with the contracting process to implement offsets on a larger scale.

Arguments for and against air quality offsets

Air quality offsets have been embraced by implementing industries and government. The Air Quality Offsets Guideline states that ‘offsets are required to assist in sustaining required standards of environmental quality while achieving sustainable

rates of economic growth'. Eskom emphasizes the need to reduce exposure to air pollution at least cost, and propounds that 'household or community offsets are a more effective way of reducing human exposure to harmful levels of air pollution, than is retrofitting power stations with emission abatement technology at exorbitant costs'(Eskom, 2019).

Air quality offsets are vehemently opposed by NGOs, however. Their arguments against offsets are summarised in the submissions made by the Centre for Environmental Rights and their clients on the draft Air Quality Offsets Policy published in 2014, and on the draft Air Quality Offsets Guideline published in 2015 (Centre for Environmental Rights, 2014, 2015), and expanded on in Life After Coal's submission on Eskom's 2019 application for leniency from the MES (Centre for Environmental Rights, 2019). The NGOs 'do not agree, in principle, with the use of offsets as a management tool to avoid compliance with legislation', in particular the MES. Offsets themselves are perceived to have 'no overarching legislative or policy framework' (Centre for Environmental Rights, 2014). Furthermore, the design of offsets is considered to be flawed because a relaxation of SO₂ emissions from power stations, for example, may be traded for a reduction in ambient PM concentrations. They feel that 'offsets must result in a balancing of losses and gains in the same attribute or variable of concern,' (Centre for Environmental Rights, 2019), and that 'determining a reliable and defensible basis for determining equivalency between the impacts of regulatory relaxation and the offset effort is fundamental to any system of offsets' (Centre for Environmental Rights, 2014).

The NGOs also contend that the benefits of offsets are distributed unfairly. Air quality offsets are not a valid substitute for compliance with the MES, because the measures operate at different scales ('offsets could endorse higher levels of regional pollution while reducing pollutants at a localised level' (Centre for Environmental Rights, 2019)). They refer to 'implications for equity and justice' arising because 'offset activities may unfairly favour some communities at the expense of others (e.g. where electricity or gas subsidies are provided, or improvements/retrofits to houses are made)' (Centre for Environmental Rights, 2014). In addition, 'the implications of offsets for public health will be affected by the timeframes permitted for implementing offsets and attaining required air quality standards' (Centre for Environmental Rights, 2014). For example, Eskom has not progressed beyond the pilot stage of their programme. Lastly, some polluting facilities may be unfairly advantaged over others by offsets because 'offsets represent a subsidy to pollution-generating activities' (Centre for Environmental Rights, 2014).

The NGOs purport that the responsibility for the implementation of offset-type projects should lie with the state, rather than with polluting industries. The CER perceives of air quality offsets as 'outsourcing government's responsibility toward human settlements in need of alternative forms of clean energy' (Centre for Environmental Rights, 2019) and proposes rather that 'the responsibility for tackling the problems of domestic

air pollution would best be placed at the local authority and/or community health level, supported by national policy' (Centre for Environmental Rights, 2014).

The views of households who have received offset interventions are not well known. The implementation is reported on favourably from research conducted by the offset project teams (most of the internal reports assessing the effectiveness of the pilot projects have not been published, but Eskom's 2017 progress report indicates that 80% of households who were approached to trade their coal stove for either a low emission coal stove or an LPG heater and stove agreed to participate, and of those more than 90% elected to keep their new stoves rather than swapping back to their old coal stoves after one winter (Matimolane, 2017)). However, a report by groundWork alleges that they 'discovered a number of challenges that the community is facing. From the way the project was presented and communicated, to the financial implication of replacing coal stoves with electric ones, to shoddy workmanship on ceilings and walls, to commitments and promises that were never fulfilled.' The two households that were interviewed in KwaZamokuhle reported a leaking roof, being unable to afford electricity for the electric stove that replaced their coal stove, insulation peeling off the walls, and being unable to open windows due to the wall insulation (Molefe, 2018).

The notion of justice

Environmental justice has been conceived within the much larger field of social justice.

Social justice

There are two schools of thought on justice that developed during the European Enlightenment. One approach focuses on identifying ideal institutions and associated rules of behaviour for a perfectly just society. This approach has been called "transcendental institutionalism" and has been led by the work of people such as Thomas Hobbes, Jean-Jacques Rousseau, Immanuel Kant and John Rawls.

Rawlsian justice is underpinned by the conception of 'justice as fairness.' Fairness can be seen as a demand for impartiality, where evaluations avoid bias, take note of the interests and concerns of others, and avoid being influenced by vested interests or prejudices. Rawlsian justice is concerned with setting up 'just institutions' that constitute the basic structure of society, and requires that people's behaviour complies entirely with the proper functioning of these institutions (Rawls, 1971). Rawls (1993) proposes two principles of justice:

- i. Each person has an equal right to a full scheme of basic liberties which is compatible with a similar scheme of liberties for all.
- ii. Social and economic inequalities are to be arranged so that they are attached to offices and positions open to all under conditions of fair equality of opportunity, and so that they are to the greatest benefit of the least advantaged members of society.

The second approach to justice is comparative rather than concentrating on ideals, and focuses on social realizations resulting from actual institutions and actual behaviour. This ‘realization-focused comparison’ has been elucidated by Adam Smith, Mary Wollstonecraft, Karl Marx and Amartya Sen, among others. Sen (2009) argues that an assessment of justice requires a focus on the lives that people are able to lead, not on just the institutions and behaviour compliant to these institutions.

Environmental justice draws from both schools of thought. The principle of ‘justice as fairness’ is frequently invoked. Environmental government departments are designed to be ‘just institutions’ and they pass legislation to ensure that society’s behaviour complies with the requirements of their departments. In conceiving of environmental legislation, however, government is also very cognisant of the realities of vulnerable and marginalised people, and the need to find a balance between preventing environmental harm and supporting economic development.

Environmental justice

Environmental justice has been defined by the United States Environmental Protection Agency as ‘the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.’ Environmental justice takes place at different scales: for people, for communities and for non-human species and ecosystems. Inherent in environmental justice is the idea that disadvantaged people should not be subjected to disproportionate environmental impacts.

Three concepts of environmental justice have been elucidated by Walker (2012):

- i. Distributive justice focuses on the distribution of environmental resources (positive) and harms (negative).
- ii. Procedural justice is concerned with the way decisions are made, who is involved and has influence, and who has access to the formal justice system. It looks at inclusion and exclusion in decision-making processes around environmental and social issues.
- iii. Justice as recognition emphasises who is given respect, and who is or is not valued, which is related to prejudice and discrimination.

The analyses that follow consider each of these three notions of environmental justice.

Environmental justice applied to ambient air quality on the South African Highveld

The environmental justice framework is first applied to ambient air quality on the South African Highveld (where offset programmes are currently targeted), in order to provide a context for the assessment of air quality offsets that follows. A distributive justice framework is adopted, in line with Walker’s (2012) suggestion that it is most relevant when considering air quality.

Many of South Africa’s mines, coal-fired power stations, smelters, other industries and a coal-to-liquids plant are clustered on the Highveld. A large portion of South Africa’s population resides in the large metropolitan centres located there (26% of South Africa’s total population resides in Gauteng alone (StatsSA, 2019)). The air pollution produced by the mining, industrial and urban activities has resulted in the declaration of two inter-provincial Priority Areas (the Highveld Priority Area in eastern Gauteng and Mpumalanga, and the Vaal Triangle Airshed in the northern Free State and southern Gauteng), where special management measures have been put in place to address the poor air quality.

The following three questions posed by Bell (2004) are examined when considering a distributive justice claim for air quality on the Highveld:

- i. Who are the recipients of environmental benefits and burdens?
- ii. What is to be distributed?
- iii. What is the principle of distribution?

Firstly, the “community of justice” that matters when considering the environmental burdens and benefits of air quality on the South African Highveld are all people that breathe the air, which is all people living or working on the Highveld (and indeed, beyond).

Secondly, the environmental burden of poor air quality is often measured in terms of ambient air quality concentrations and compliance with ambient standards, but can perhaps be better quantified in terms of personal exposure. These measures are surrogates for an increase in the risk of contracting or dying from a number of diseases due to exposure to air pollution. It is crudely estimated that there are over 7 000 premature deaths in South Africa each year due to an increased incidence of stroke, ischemic heart disease, lung cancer, acute lower respiratory disease and chronic obstructive pulmonary disease (in order of decreasing significance) (WHO, 2016). Increased incidence of negative health outcomes (for example premature deaths or hospital admissions) provide a useful indication of the costs of poor air quality, because they also account for the vulnerability of those being exposed. These metrics point to the type of evidence needed to make judgements about justice in air quality matters.

Lastly, Bell (2004) has identified three principles that are generally applied in environmental justice scholarship to determine the right principle of distribution. These are first, a ‘principle of equality’, which in the case of air quality would mean that everyone should breathe air of uniform quality; second, a ‘principle of equality plus a guaranteed standard’, where there is no inequality and also a minimum standard ensured for all; and third, ‘a guaranteed minimum with variation above that minimum according to personal income and spending choices’, in which, beyond an ensured minimum, people can reasonably express their preferences. The ambient air quality management approach followed in South Africa, and indeed

in many countries, adopts the third principle of distribution, by legislating and then attempting to enforce ambient air quality standards (published in 2009 and 2012 by the Department of Environmental Affairs in South Africa).

Walker (2012) proposes that the focus of his environmental justice claim-making framework (Figure 1) used for a distributive justice analysis for air quality should be on patterns of exposure, vulnerability and responsibility. Claims regarding exposure to air pollution on the South African Highveld are made in Table 1, assuming that justice requires a guaranteed minimum standard of air quality (the National Ambient Air Quality Standards), with variation above that minimum according to preference.

There is widespread non-compliance with ambient PM standards across the Highveld. In 2018, there was non-compliance with the annual PM₁₀ standard of 40 µg/m³ at 14 of the 20 operational ambient air quality monitoring stations on the Highveld, and non-compliance with the ambient PM_{2.5} annual standard at 8 of the 9 operational monitoring stations in the Vaal Triangle Airshed and the Highveld Priority Areas (Khumalo, 2019). PM_{2.5} is monitored at very few urban sites in South Africa, so more monitoring is needed for conclusions to be drawn about air quality levels in cities.

Highest levels of PM are measured in low-income residential areas where domestic burning occurs (Hersey et al., 2015) (Figure 2). Ambient PM₁₀ concentrations in the major urban areas are on average slightly higher than PM₁₀ levels in industrial areas, although concentrations in industrial areas are usually higher than in urban areas in the summer. The actual levels of particulate pollution to which people are exposed are significantly higher than the ambient levels in communities that practise domestic burning, as demonstrated by Wernecke (2018)

for KwaZamokuhle and Kwadela, coal-using communities on the Mpumalanga Highveld (Figure 2; Table 3).

Highest exposure levels among lower socio-economic groups is also widely found in North America and Europe, where it has been consistently shown that lower-income communities and minority groups are more exposed to air pollution from both point and mobile sources (Morello-Frosch and Jesdale, 2006; Tian, Xue and Barzyk, 2013; Taylor, 2014; Bullock, Ard and Saalman, 2018; Barnes, Chatterton and Longhurst, 2019; European Environment Agency, 2019). Similarly, in the Korba region in India, where coal mines and coal-fired power stations are clustered, marginalised social groups (the officially-designated Scheduled Caste (lowest caste) and Scheduled Tribe (indigenous people)) are disproportionately exposed to the environmental risks associated with coal extraction (Oskarsson and Bedi, 2018).

The high levels of exposure on the Highveld can be accounted for by the emissions of pollutants from a multitude of sources, the proximity of people to these emission sources, poor dwelling quality, and meteorology. Tall stack sources disperse pollutants effectively, which means that plumes are considerably diluted before they come to ground level, but they affect a large area. Emissions from surface sources such as domestic burning, waste burning, veld fires and vehicles are much lower in quantity, but a much higher fraction of the emissions is inhaled (called inhalation intake fraction) (Humbert et al., 2011). The poor quality of housing in low-income areas, which usually takes the form of uninsulated (i.e. no ceilings) formal RDP homes or poorly constructed informal dwellings, often built out of highly conductive materials, increases the energy demand for heating. Clean energy is often inaccessible or unaffordable for these communities. For example, around 22% of households

Table 1: Environmental justice claims about air quality on the South African Highveld, based on the framework of Walker (2012)

	Exposure	Vulnerability	Responsibility
Exposure	Widespread non-compliance with ambient PM standards. Highest exposure for low-income, solid/ liquid fuel-burning communities.	People living in low-income communities, children, the elderly, and people with pre-existing conditions are particularly vulnerable to air pollution.	Almost everyone is responsible for air pollution in some way. Greatest responsibility rests with large industries and power stations that emit highest quantities of pollutants, and solid/liquid fuel-using households who are responsible for emissions causing highest exposure.
Process	Exposure levels are high on the Highveld because of the multitude of sources, the high intake fraction of surface emissions and unfavourable dispersion conditions, especially in winter.	Low-income communities are highly vulnerable because of their poorer baseline health status, lower quality dwellings, inability to afford cleaner energy and an inferior standard of health care provided. Low-income communities are partly a legacy of South Africa's past.	Large industries and power stations are in many cases unable/unwilling to comply with emission standards. Energy poverty and no access to cleaner energy results in domestic use of 'dirty fuels'.
Justice	Exposure levels (including to indoor air) should not exceed National Ambient Air Quality Standards.	There should be monitoring of air to which the most vulnerable are exposed. There should be an adequate minimum standard of health care accessible to all.	Emission reduction should be financed by those most responsible for causing air pollution.

in Gauteng and 8% of households in Mpumalanga are not connected to the national electricity grid (StatsSA, 2019). Pollution is exacerbated by the sub-tropical climate on the Highveld. Low wind speeds result in stagnation of pollutants, frequent nocturnal temperature inversions trap air pollutants near the surface, recirculating air flow brings pollution back into the area after it has exited, and the lack of rain in the winter means the atmosphere is not effectively cleansed in these months (Tyson and Preston-Whyte, 2000).

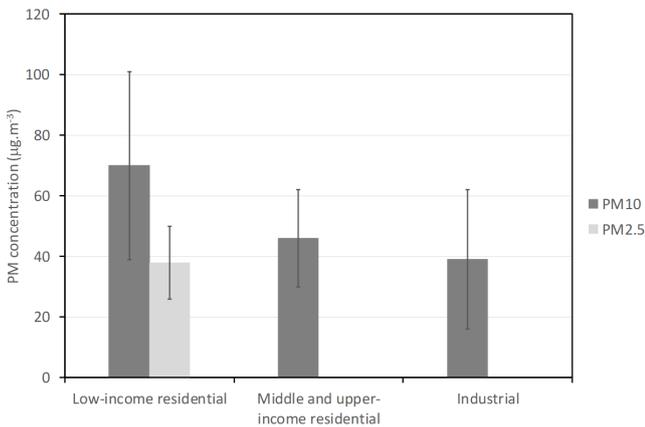


Figure 2: Annual average PM₁₀ and PM_{2.5} concentrations (µg/m³) measured at the surface monitoring stations at different site types in South Africa’s five major urban areas, the VTAPA and the HPA (after Hersey et al., 2015)

Table 2: Average daily particulate matter concentrations (µg/m³) for indoor air, outdoor air and personal exposure levels in two coal-using communities on the Highveld (Wernecke, 2018).

Kwadela	Winter 2013 & 2014	Summer 2014 & 2015
Indoor PM ₄	166	99
Personal PM ₄	70	38
Ambient PM _{2.5}	36	18
KwaZamokuhle	Winter 2016	Summer 2016
Indoor PM ₄	193	65
Personal PM ₄	161	53
Ambient PM _{2.5}	70	42

The widespread non-compliance with ambient air quality standards on the Highveld is considered undesirable by all who reside in these areas. There is widespread agreement between almost all interested parties, from government to NGOs to industries and communities, on the need to achieve ambient air quality standards.

With regards to the vulnerability of people exposed to air pollution on the Highveld, health studies show that children, the elderly, and people with existing medical conditions are most vulnerable to the effects of poor air quality (Royal College of Physicians of London, 2016). In particular, gestation, infancy and early childhood are vulnerable times because organs are

developing. The heart, brain, hormone systems and immunity can all be harmed by air pollution.

In addition to being exposed to higher levels of pollution, communities of lower economic status generally have compromised health status (CSDH, 2008) (because of limited access to sufficient healthy food, among many other factors). Furthermore, there appears to be an amplified “triple jeopardy” health impact, beyond the additive effect of higher exposure levels and compromised health status (Buzzelli, 2018). In South Africa, lower income communities are reliant on public health services, which are often inferior to the private health services available to higher income individuals. This further compounds the vulnerability of lower socioeconomic communities to health risks from air pollution.

A just society requires that specific measures are put in place to protect those who are more vulnerable to the effects of poor air quality. For example, an adequate minimum standard of health care should be available to all, with additional health care available to children and the elderly. Ambient air quality monitoring networks should ensure there is adequate coverage in low income communities so that the authorities are aware of the severity of the air quality in these areas and can take appropriate steps to manage the situation.

Lastly, there are different opinions as to how the responsibility for poor air quality should be allocated. Responsibility is typically assigned on the basis of quantities of emissions, but an argument could also be made for assigning responsibility based on contribution to ambient air quality or exposure (which depends not just on source strength but also on the proximity of people breathing the air to the source). Moreover, responsibility is usually assigned to the owner of a facility producing emissions, but responsibility could also be allocated to the consumer of the goods/services produced (except perhaps to consumers of electricity in South Africa, since there is a statutory monopoly on the generation, transmission and sale of electricity). In the case of the South African Highveld, almost everyone is responsible for the poor air quality in some way, but the greatest responsibility rests with large industries, power stations and related activities such as mining (DEA, 2011), high income individuals who own their own vehicles and consume a lot of electricity and other commodities, and solid/liquid fuel-burning households (who in some cases contribute the greatest amount of pollution to ambient levels in areas that experience the worst air quality in the country (e.g. Chidhindi et al., 2019)).

Emissions are usually linked to economic factors. Large industries and power stations are often unable or unwilling to comply with the MES because of the large costs associated with retrofitting abatement technology (Eskom, 2019). Low-income households are unable to afford cleaner sources of energy and so resort to using dirty fuels like coal, wood and paraffin (Pauw et al., 2008).

From a normative perspective, it is generally agreed that the

‘polluter pays’ principle should apply and action should be financed by those most responsible for causing air pollution.

An environmental justice analysis of air quality offsets

Air quality offsets are now considered from distributive justice, procedural justice and justice as recognition perspectives. Since air quality offsets are often implemented as a substitute for full compliance with the MES, the two pieces of legislation are contrasted.

Distributive justice

For an analysis of how air quality offsets fare in terms of distributive justice, we again answer the questions posed by Bell (2004) (Table 3), and then use Walker’s (2012) claim-making framework, focusing on patterns of exposure, vulnerability, responsibility and access to resources.

Table 3: The benefits, costs and principle of distribution for air quality offsets versus the Minimum Emission Standards

	Air quality offsets	Minimum Emission Standards compliance
What is distributed?	Benefits: Reduced health risk, improved dwellings, greater cooking convenience?, greater indoor thermal comfort? Costs: Smaller increase in cost of production	Benefits: Reduced health risk Costs: Greater increase in cost of production, higher electricity tariff
Recipients of benefits/ burdens	Benefits: Usually low income communities	Benefits: Everyone in the (large) airshed Costs: Electricity users, consumers and shareholders
Principle of distribution	Communities selected for offsets based on ambient air quality impact of implementing facility, non-compliance with ambient standards, and opportunities for offsets	MES apply stricter standards to newer facilities than to older facilities. MES postponement applications adjudicated by the NAQO and Licencing Authorities.

Firstly, with reference to distributed benefits, both air quality offsets and the MES are designed to improve ambient air quality and reduce the health risk of exposed communities. Air quality offsets implemented at household level have other benefits that can favourably influence the quality of life of the household members, for example improved dwelling quality, more comfortable indoor temperature, and more convenient

cooking facilities. The installation of emission abatement retrofits creates business and employment opportunities. The costs of the emission reductions are borne by the polluting facilities in both cases, and these in turn reduce the profits of the companies and/or are passed through to the consumers. Eskom estimates that the full cost of compliance with the MES is capital costs of R182 billion (in 2018 real terms) and annual operating costs of at least R5.9 billion per annum. This translates to the electricity tariff being 7-10% higher than it would be in the absence of emission abatement retrofits. Eskom has instead opted for a reduced emission reduction plan estimated to cost R67 billion (in 2018 real terms) over the next 10 years, with annual operating costs of R0.9 billion, and the implementation of air quality offsets (Eskom, 2019). In this case, air quality offsets as a substitute for full compliance with the MES avoid a 4-8% increase in the electricity tariff.

Secondly, the health benefits of emission reductions achieved due to reduction of industrial emissions are received by all who live in the airshed (often at a regional scale), while the benefits of offset projects are confined to the communities where the offsets are implemented.

There are several possible principles of distribution when selecting communities for air quality offset interventions. Eskom has prioritised communities primarily on the basis of impact of the polluting facility on ambient air quality, and then on need and feasibility (i.e. where opportunities for offsets exist). It would perhaps be more equitable to prioritise communities based on need (i.e. those experiencing the worst ambient air quality levels), irrespective of their location relative to the implementing facility (but this would be less palatable to communities who are impacted by the emissions from facilities). With regards to distributing the responsibility for reducing emissions between facilities, the MES applies stricter limits for facilities that were constructed after the standards were published, than for those that were constructed before the standards were published. Applications for postponement of compliance with the MES are adjudicated by the NAQO together with the Licencing Authorities.

I offer the following distributive justice claims about air quality offsets and the MES, with respect to exposure, vulnerability, responsibility and access to resources:

Apropos exposure to air pollution as a result of the implementation of air quality offsets, the evidence suggests that there will be large reductions in exposure to PM, and potentially also SO₂ and NO_x, but the reductions will be limited to recipient communities. Conversely, all people residing on the South African Highveld will experience small reductions in PM_{2.5} exposure due to MES compliance. Communities close to large facilities that reduce their emissions will experience larger reductions in SO₂ exposure. Atmospheric dispersion of pollutants and the resulting differences in inhalation intake fraction are the processes that account for the differences in magnitude and geographical location of the reductions in

exposure. Sources addressed by offsets emit lower quantities of pollution almost directly into the air that people breathe, and pollutants may be trapped near the surface. Emissions from these ground-level sources usually have a high inhalation intake fraction (Humbert et al., 2011). Facilities targeted by the MES emit much higher quantities of pollutants from tall stacks, and these pollutants are transported to a large area. Because the pollutants are greatly dispersed before they reach the surface, the emissions from the facilities have an intake fraction several orders lower in magnitude than indoor emissions. From a normative perspective, as the NGOs point out, a basis for equivalence between emission reductions achieved through air quality offsets and the MES is required (Centre for Environmental Rights, 2014). This author is of the opinion that a 'like for like' equivalence will not be the most effective way of achieving exposure reductions through offsets, since polluting facilities are often unable to comply with SO₂ emission standards, for example, while the main pollutant of concern in low-income communities is PM. Instead, it is proposed that an equivalent reduction in health risks should be achieved by the offset project to that that would have been achieved through MES compliance, taking into account the entire domain influenced by emission reductions brought about by each of the two measures.

With regards to vulnerability, offsets specifically target emission reduction in low-income communities that are both exposed to the worst air quality (Hersey et al., 2015) and are more vulnerable to the effects of the air pollution because of their generally poorer health status and inferior health services provided. In particular, children and the elderly, who are particularly vulnerable to air pollution (Royal College of Physicians of London, 2016), often spend more time indoors than adults in formal employment, and will particular benefit from a reduction in domestic burning emissions. There is unfortunately a real danger of neglecting some of the most vulnerable households in the communities when implementing offsets, such as households residing in informal dwellings. Informal dwellings are non-uniform and often poorly constructed, and so cannot easily be insulated with the any of the methods used by Eskom and Sasol for formal houses. The difficulty in insulating these households may result in them being neglected entirely. Immigrants are also particularly vulnerable because they are less able to access state services like housing and health care.

In terms of the implications for justice, then, air quality offsets promote actions to redress injustices to vulnerable groups. Some of the most vulnerable households, like immigrants and those that reside in informal dwellings, should also receive offset interventions.

The responsibility for reducing emissions at facilities in order to comply with the MES clearly lies with the facilities themselves. The responsibility for implementing offsets currently also rests with the facilities, since the offsets are a condition of the facilities' AELs, and also with the recipients of the offset interventions (who are required to alter their cooking habits or maintain their new ceilings, for example). However,

responsibility for some of the interventions being undertaken, including facilitating recycling and refuse removal, insulating dwellings and switching households to cleaner sources of energy usually lies with local authorities, government departments responsible for housing and those responsible for energy, respectively, and with households themselves. Indeed, section 26 (2) of the Constitution of the Republic of South Africa assigns the responsibility for the realisation of the right for everyone to have adequate housing to the state. Using existing departments to implement offsets would theoretically benefit from expertise and economies of scale that are already in place. However, then facilities could not be held responsible for offsets that do not deliver the expected improvement in ambient air quality. There is probably value in exploring different models of implementing offsets through government departments or another central agency.

Eskom and Sasol have tried to very carefully navigate the issue of disputed responsibility for service provision by not taking over any of the state functions of providing housing, removing refuse or testing vehicles, but have rather supported the state functions by insulating the dwellings, providing waste skips and training officers in vehicle emissions testing. The provision of cleaner energy is a function of both the state (through providing connections to the national electricity grid) and the market (through distributing fuels like LPG, coal, paraffin and wood). Eskom and Sasol have more aggressively intervened in this space in their attempts to switch fuels used by households.

From a normative perspective, then, according to the 'polluter pays' principle, facilities (and their customers) should be required to pay for their own emission reductions (which essentially is internalising the full costs of production). Since air quality offsets are a substitute for emission reduction at the facilities themselves, they should also be funded by the facilities. Polluting facilities should not perhaps take over responsibility for providing state services, but they can definitely support the state.

Large facilities obviously have access to more resources than low-income communities. Indeed, it could be argued that poverty is the main reason for poor air quality in low-income communities due to the lack of affordability of cleaner fuels, the poor quality of housing that necessitates a lot of energy for heating in winter, and even payment of low rates means basic services like refuse removal are inadequately funded. However, many polluting facilities also claim that they are unable to finance full compliance with the MES. The economic burden of emission reduction is minimised if reductions in exposure to poor air quality are achieved at least cost.

Procedural justice

Procedural justice is a second conception of environmental justice that complements distributive justice, and focuses on the procedure of justice rather than just the outcome of justice. Procedural justice is concerned with inclusion and exclusion in decision-making processes (Walker, 2012). The processes

Table 4: Information publicly available on Air Quality Offsets and the Minimum Emission Standards

Information provider	Information	Location
South African Air Quality Information System (SAAQIS)	All air quality acts, regulations and notices, strategies, policies, guidelines and municipal by-laws	https://saaqis.environment.gov.za
	Ambient air quality	
Parliamentary monitoring group	Summary of decisions on MES postponement applications by 31 March 2015	http://pmg-assets.s3-website-eu-west-1.amazonaws.com/171107Postponements_Report.docx
Sasol	2019 MES Postponement applications	https://www.srk.co.za/en/za-sasol-2019-mes-postponement-applications
	Previous applications for postponement of the MES, decisions issued and air quality offset implementation plans	https://www.srk.co.za/en/za-sasol-postponements
	Integrated Report/Sustainability Report provides annual summary of the status of offsets and postponement applications	e.g. http://www.integratedreport.sasol.com/sustainability/driving-sustainable-air-quality.php
Eskom	2019 MES postponement applications	http://www.naledzi.co.za/public-documents-naledzi.php
	Annual emission reports for 2017/18	http://www.naledzi.co.za/public-documents-naledzi.php
	Air quality offset implementation plans	http://www.eskom.co.za/AirQuality/Pages/PlansReports.aspx
Centre for Environmental Rights	CER's submissions on the offsets guidelines to the DEA	https://cer.org.za/programmes/pollution-climate-change/submissions-on-draft-regulations-guidelines-and-declarations
	Challenges to MES postponement applications by Eskom and Sasol	https://cer.org.za/programmes/pollution-climate-change/litigation
	Appeal of power stations' AELs	https://cer.org.za/programmes/pollution-climate-change/litigation
	Eskom's 2017 and 2018 MES applications and CER's objections.	

of scrutiny here are the formulation of the air quality offsets guideline and the Minimum Emission Standards, the decision on who is required to implement offsets, the decision on what the AEL requirements regarding offsets are, and the formulation of the facilities' air quality offset implementation plans.

The following aspects can be the subject of procedural justice claims (Stephens, Bullock and Scott, 2001; Schlosberg, 2007):

- i. The availability of environmental information that is required for effective participation.
- ii. Inclusion in environmental decision-making and policy-making processes in terms of who is able to participate and the respect given to participants.
- iii. Access to legal processes for challenging decision-making and protecting environmental rights.
- iv. Inclusion in community-based participatory research in which scientists collaborate with community members.

Again, Walker's (2012) framework for environmental justice claim-making (Figure 1) is followed, considering the evidence for inequality, an explanation as to why the inequality occurs and a normative claim about justice, with reference to these four points.

Most information pertaining to air quality offsets and the MES is available online (see Table 4 for a list). The internet and South Africa's laws, including the requirement for public participation in environmental processes and the Promotion of Access to Information Act, 2000, greatly facilitate the provision of information. There are, however, several key pieces of information that are not currently available but should be, including the scientific and economic studies underpinning the formulation of the MES, the documents from the MES standards setting process, and the reports on progress and effectiveness of offset implementation. The Eskom air quality offsets website has not been updated since 2017.

Environmental decision-making and policy development processes are generally inclusive. Industries and NGOs were well represented at the SABS standard-setting process for the MES. Unfortunately other affected parties like Labour were less well represented. The SABS process was eventually abandoned because consensus could not be reached by all parties. A period of public comment was given for the draft Air Quality Offsets Guideline and its preceding draft Air Quality Offsets Policy. Public participation is a legal requirement for industries when applying for postponement of compliance to the MES and developing air quality offset implementation plans. Public meetings on MES postponement applications and offset implementation plans are usually held by facilities in affected low-income communities to facilitate participation of more vulnerable people. The NGOs have made lengthy submissions on the major postponement applications and have challenged the wording of offset conditions in facilities' AELs (for example, the appeals lodged by the CER on behalf of their clients against the AELs of four power stations in 2016, available at <https://cer.org.za/programmes/pollution-climate-change/litigation>). Illiterate people, who comprise around 21% of South African adults between the ages of 35 and 64 (Statistics South Africa, 2017), still struggle to participate.

Industries frequently access legal processes, for example when requesting postponement of compliance to the MES, but access to legal processes by members of the public is generally hampered by the high cost of legal fees. Here NGOs, like the CER, groundWork and many others, play a vital role in giving a voice to marginal communities. There is a concern, however, that the interests of communities will not be represented if they conflict with the interests of the NGOs. In a just society, all would have equal access to legal processes, regardless of income or education level.

Detailed community-based research has been conducted in support of the air quality offsets programmes, including the conducting of quality of life assessments prior to and after implementation of the intervention, and a comprehensive assessment of the effectiveness of the interventions. Not only have households been the subject of rigorous research, but members of the communities have participated in the research through conducting household surveys and operating ambient air quality monitoring instrumentation sited in the community, for example. (This information has been directly communicated to the author by members of the implementation team in KwaZamokuhle). Unfortunately, most of this research has only been published in confidential industry reports, and needs to be published in the public domain.

Justice as recognition

Justice as recognition is concerned with who is respected or valued and who is discriminated against (Walker, 2012). Schlosberg (2004) argues that misrecognition is fundamental to the production of distributional inequalities. Misrecognition may occur by institutions of the state or more subtly through social norms and the way in which people interact with each other.

While South African environmental legislation has come a long way in recognising all individuals, everyone is certainly not recognised equally. Studies show that, in many instances, racism and gender discrimination apply just as much to air quality issues as to general societal issues (Drury et al., 1999; Siddiqui et al., 2005 for example). There are a few other groups of people who should be mentioned. The illiterate are often invisible. In addition, immigrants are often maligned or disparaged. They also do not have access to all the services that South Africans do, such as health care (even if legally entitled to it) (Lepodise, 2018) and housing. Undocumented migrants are particularly marginalised because of their insecure legal status. An estimated four million migrants are hosted in South Africa currently (United Nations, 2017).

Evaluating air quality offset implementation

The environmental justice implications of air quality offsets can, of course, only properly be evaluated once offset interventions have been executed on a large scale. Some principles for evaluating the roll-out of offset projects from an environmental justice perspective are proposed here. Exact metrics still need to be developed, preferably in consultation with a larger group of affected parties. These metrics should ideally be incorporated into an air quality offsets standard which regulates offset planning, implementation and reporting requirements.

The promotion of distributive justice will depend on whether the air-quality related health risk of vulnerable communities has been reduced through the implementation of an offset initiative. Health risk depends on susceptibility (which depends on things like nourishment, age and pre-existing health conditions of community members), exposure to air pollution, and access to health care. Air quality offsets specifically target reducing exposure through reducing emissions (although the awareness programmes may also reduce exposure through encouraging people to avoid particularly smoky environments, for example), but they may also indirectly reduce susceptibility of people to air pollution-related illnesses through means such as improving the thermal comfort of dwellings.

The simplest metric to measure the effectiveness of air quality offsets is avoided emissions (relative to the baseline). Distributive justice is served if inequalities in exposure between lower income communities and higher income communities is reduced. Changes in quality of life of community members affects vulnerability and susceptibility to air quality-related health risks, so metrics also need to take into account indirect costs and benefits of an intervention, such as changes to housing quality and thermal comfort, training provided and jobs created. Certainly, an offset intervention should not result in a net decline in quality of life.

The question then arises as to what a sufficient offset for a facility is. If air quality offsets are viewed as a strict substitute

for compliance with the MES, then the equivalence could be determined in terms of ambient air quality levels, exposure levels, or health risk. Impact on health risk is the most complete metric, but the most difficult to measure.

The principles of the Air Quality Offsets Guideline encourage procedural justice in air quality offset programmes. Specific requirements for a procedurally just community intervention could include that community members participate meaningfully in the design and implementation of an intervention; that the community has access to information about their exposure and their participation in the project (such as ambient air quality measurements and results of community-based research); and that their participation is voluntary. Consultation should be at household level, and not just with community leaders.

To advance justice as recognition, interventions should be designed to be as inclusive as possible of groups who are particularly vulnerable or who tend to be marginalised, such as immigrants, the illiterate, people who live in informal dwellings, the unemployed and even women. The inclusion of under-recognised people could be promoted through the development of criteria upfront regarding who is to receive offset interventions. These criteria should favour the most marginalised communities and community members, as far as technical considerations allow.

Conclusions

Air quality offsets have been assessed from an environmental justice perspective, considering the context of ambient air quality on the South African Highveld where low-income communities are exposed to the highest air pollution levels. The potential of the Air Quality Offsets Guideline to guide environmentally just action has been compared with that of the MES, since offsets are usually implemented as a condition of postponement of compliance with the MES.

In summary, air quality offsets, as conceived in the Air Quality Offsets Guideline (2016) and the industries' offset implementation plans, have the potential to be used to promote environmental justice. From a distributive justice perspective, air quality offsets focus air quality improvements on vulnerable communities that are exposed to highest concentrations of pollution. In terms of procedural justice, decision-making and policy formulation processes are generally inclusive, but lower socio-economic groups are still somewhat disadvantaged in their access to legal processes and information like evaluations of offset effectiveness. Offsets can play a role in achieving the Sustainable Development Goals, particularly goals 3 (good health and well-being), 7 (affordable and clean energy), 10 (reduced inequalities) and 11 (sustainable cities and communities).

The realisation of the potential of offsets to promote environmental justice can only be determined once offsets have been implemented at scale. Such an assessment of the results of

offset interventions should holistically consider the many factors that influence the effects of poor air quality on illness (including the underlying vulnerability and quality of life of members of a community), as well as the air quality in the community relative to the baseline air quality in the absence of the interventions, and relative to nearby higher income communities. It should also consider the effective participation of the community in the offsets project design and implementation, and be as inclusive as possible in terms of which households are selected to participate.

Note

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