

Research article

Conceptualising air quality management instruments in South Africa

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Abstract

South Africa has developed a plethora of air quality management instruments as a means to address and mitigate air quality challenges. However, no holistic conceptualised understanding of these instruments exists to critically inform air quality management and governance. The aim of this paper is to identify existing air quality management instruments and conceptualise them in terms of three broad environmental management approaches, namely Command and Control-based (CaC), Fiscal-based and Civil-based. This allows for a critical understanding of the overall air quality governance framework in South Africa. A literature review methodology was followed to identify the different instruments. The research results suggest an over reliance on CaC, high levels of hybridisation, high level of complexity and an overall lack of synergy between instruments. The research notes that even amidst the plethora of instruments South Africa continues to face serious air quality challenges. We hope that the conceptualisation provided in this paper provides a basis towards a more detailed analysis of the strengths, weaknesses, and performance of different approaches and instruments to ensure more effective air quality governance and management in South Africa.

Keywords

air pollution, air quality management, instruments, environmental management, conceptualise, command and control (CaC), fiscal-based, civil-based, agreement-based.

Introduction

Internationally ambient air quality (AQ) has deteriorated significantly, in part due to human activities that release pollutants into the atmosphere (Kuklinska et al. 2015, Miranda et al. 2015, Sinha 2018). It is estimated that the global particulate matter (PM_{2.5}) concentrations have increased by 37.5% over the period 1960 to 2009 which were dominated by increases from China and India as a result of economic expansion and growth in emissions (Butt et al. 2017). In South Africa, poor local ambient air quality has become a major concern due to negative health impacts that directly affect mostly poorer communities relying on coal and wood burning for household fuel and who are also residing close to polluting industries (Dugard and Alcaro 2013).

In response to air pollution impacts, governments have been working with research institutions, industry and civil society to introduce efficient management measures (Ma et al. 2019). Many countries including China, United States (US) and the European Union (EU) have implemented a series of national control policies to reduce air pollution emissions (Wang et al. 2014, Kuklinska et al. 2015). At local level, European cities, where the majority of Europeans reside, have also developed various

policy instruments such as air quality plans. These plans include emission abatement measures designed and implemented by EU Member States (MS) in accordance with the Framework Directive 96/62/EC on ambient air quality assessment and management (Miranda et al. 2015).

The South African government has a long history of developing and implementing air quality management policies and legislation, dating back to the 1960s. These policies and legislations have over time introduced various regulating instruments to inform air quality governance decision-making (Emilson et al. 2004). Moreover, various air quality management approaches and instruments have been introduced by industry and civil society to improve their performance and protect their interests. The result has been a highly complex air quality management and governance context. However, despite a plethora of air quality management instruments, no integrated framework and/or conceptualisation of these instruments exists. Such a framework is needed to critically consider the overall air quality management and governance context in South Africa. Ideally, a management and governance system with high levels of hybridisation and subsequent redundancy

should be achieved. This will deliver an integrated and balanced approach to air quality management.

Therefore, the aim of this paper is to identify existing air quality management instruments and conceptualise them in terms of broader environmental management approaches (Nel and Alberts 2018) with a view to gain a critical understanding of the overall governance framework for air quality management in South Africa.

Methodology

To identify the different air quality management instruments, this research applied a literature review methodology. Air quality management cuts across various disciplines which means that a wide range of possible literature sources are potentially relevant. Snyder (2019) argues that literature review as a methodology is one of the best ways of engaging at a higher theoretical and conceptual level. Moreover, it also reveals areas where more research is required, which is an important component of creating theoretical frameworks and building conceptual models.

This study followed a similar data collection approach as Olagunju et al. (2019) in which a literature review was done through a broad systematic search of popular academic electronic databases such as Google Scholar, and Scopus. Other non-peer reviewed literature such as relevant legislations were located from general Google searches, textbooks and specific databases such SAAQIS and Center for Environmental Rights (CER) library databases. These databases were searched using the keywords ‘air quality management’ AND ‘South Africa’ AND ‘Environmental management instruments’. Ultimately a saturation point was reached where the authors could not find any new relevant literature from their searches. An earlier version of this paper was presented at the National Association of Clean Air (NACA) Conference in November 2020 and was published in its Proceedings.

Environmental Management policy instruments

Internationally, researchers from different countries have classified environmental policy instruments into several different categories. Kemp (1995) categorises them into command, market, and communication types, while Hamilton et al. (1997) categorises them into market-utilised, market-established, environmental regulation, and public mobilisation types. Howlett and Ramesh (2009) categorised the policy instruments by the required level of government involvement as mandatory, hybridised, and voluntary policy instruments. According to Liang et al. (2018) the classification by Howlett and Ramesh (2009) is internationally the most widely accepted and adopted within the field of environmental management.

In South Africa, environmental management and governance instruments are generally classified according to the following broad approaches: a) Command and Control-based approaches

(CaC), b) Fiscal/Market-based approaches, c) Civil-based approaches as shown in figure 1 (Nel and du Plessis 2001; Nel and Alberts 2018). However, many instruments reflect characteristics of more than one approach. In such instances these instruments are referred to as hybridised instruments. An example would be environmental taxes that are based in law (CaC) but might also present a fiscal incentive (Fiscal-based).

Sometimes so-called ‘Agreement based approaches’ are included as a separate classification. However, for this paper we have opted to integrate agreement-based approaches with the other three approaches (as shown in figures 1 and 4 letter D). Because of the high level of hybridisation, we consider this to be a more accurate conceptualisation as will be discussed in the following sections. The different instruments are employed by both government and private sector to achieve environmental policy goals and/or typically more sustainable outcomes.

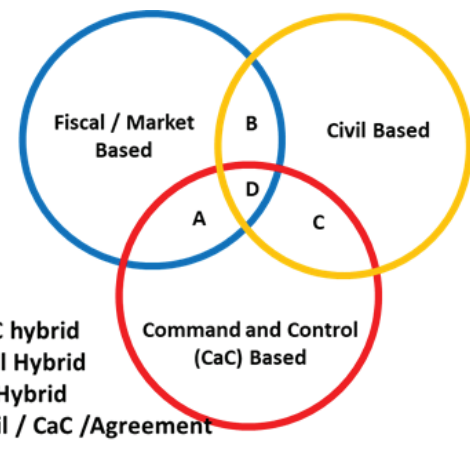


Figure 1: Environmental management instruments in South Africa including hybrid approaches (A-D).

The following sections provide a more detailed discussion of each approach.

Command and Control-based approach

These approaches include instruments that are mandated through policy and legislation. These instruments are typically refined through regulations and environmental standards designed to achieve specific environmental objectives (Kostka 2016). The legislation and regulations are set by governmental authorities to regulate activities and human interaction with the environment towards minimising potential impacts on the receiving environment (Malloy 2010). Command and Control instruments regulate industries by enforcing universally applicable environmental laws and therefore often face criticism from industry for being inflexible (Stavins 2000; Kirschke and Newig 2017).

The CaC instruments dealing with air quality in South Africa emanate from different pieces of legislation within the South African legal framework starting with section 24 of the Constitution of the Republic of South Africa which is the

supreme law in the country that informs all other legislation (see figure 2). The constitution makes provision for the citizen’s rights to an environment that is not harmful to their health or well-being. The National Environmental Management Act (NEMA) is the next level framework legislation that provide for cooperative environmental governance as well as defining the principles for decision-making on matters affecting the environment. NEMA provides that reasonable legislative (CaC) and other measures (Fiscal and Civil based) be implemented to address environmental issues including air quality.

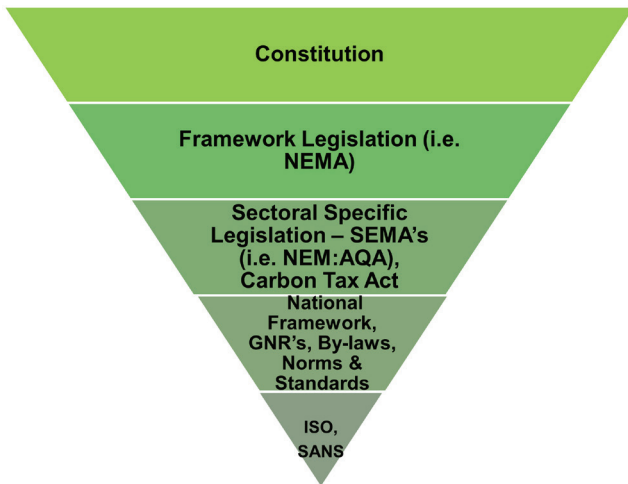


Figure 2: South African air quality legal framework.

The next level of legislation is sectoral specific acts or the so-called ‘Specific Environmental Management Acts’ (SEMA’s) related to specific areas of concern such as air quality. Although air quality CaC instruments originated from the Atmospheric Pollution Prevention Act no. 45 of 1965 (APPA) which made provisions to control certain industrial processes (Scorgie 2012),

the APPA became outdated after 1994, particularly relating to assigning of roles and responsibilities to the different spheres of government (Engelbrecht & Kornelius 2015). The National Environmental Management Air Quality Act No. 39 of 2004 (NEM:AQA) came into effect in 2005 as sector-specific legislation for managing and governing air quality by all relevant spheres of government. NEM:AQA consists of nine chapters which provides several governance instruments or measures that were not previously included in the APPA such as ambient air quality standards (see table 1) (Naiker et al. 2012).

The main objective of NEM:AQA is “To protect the environment by providing reasonable measures for the protection and enhancement of the quality of air; the prevention of air pollution and ecological degradation; and securing ecologically sustainable development while promoting justifiable economic and social development, and to give effect to section 24(b) of the Constitution”.

Furthermore, there are several other pieces of national legislation, as shown in appendix A, that are directly or indirectly linked to the management of air quality. The 2017 National Framework for Air Quality Management in the Republic of South Africa is an important policy document that also provides for various CaC interventions.

Engelbrecht and Kornelius (2015), further denotes that municipal air quality management by-laws are also an important regulatory instrument in the context of air quality. Chapter 7 of the constitution read with section 13(a) of the Municipal Systems Act and section 11(1) of NEM:AQA, specifies that at a local level, municipalities must adopt air quality by-laws (Engelbrecht & Kornelius 2015). Appendix A includes additional municipal acts and policies such as the Municipal Systems Act and Carbon Tax Act with relevance to air quality management.

Table 1: Command and control instruments for air quality management with relevant examples.

Command & Control Instrument	Source/Example
Air quality law	See Figure 2 and Appendix A
Inspections	NEM:AQA Chapter 5
Requests for more information	NEM:AQA Chapter 2 s.7 ss. 2
Audits	NEM:AQA s. 45
Prosecutions	NEM:AQA s. 52
Authorisations, permits, licences, etc.	NEM:AQA Chapter 5 s.37 & s.38
Directives, Interdicts, Restraining orders, Liability reforms	NEM:AQA s. 51
Orders and Penalties	NEM:AQA s. 51 and 52
Statutory record-keeping and reporting	NEMA s.30
Environmental/Air Quality standards	National Ambient Air Quality Standards
Model bylaws	Constitution Section 156(1)(a)(e.g. Cape Town Air Quality Management By-law, 2016)
Environmental restoration orders	NEMA s28

Fiscal-based approach

The fiscal-based instruments, also known as market-based instruments, focus more on the market or price mechanism to change behaviour and or support environmental management through for example, taxes, subsidies, and permits (Wessesls and Mkhari, 2007; Pirard 2012). These instruments rely heavily on incentives and disincentives and aims to attach economic value to environmental services such as clean air. This approach

encourages organisations and consumers to consider more environmentally friendly and cost-effective measures in their operations and products (Munda et al. 1994; Stavins, 2010). Previous studies have shown that companies are more willing to partake in environmental initiatives that incentivise certain goals and are willing to alter certain aspects and behaviour of the business to meet these goals (Frondel et al. 2008). Fiscal based instruments are more flexible than the traditional CaC

Table 2: Policy matrix of interventions to correct for environmental market failure (Source: National Treasury 2006)

Using markets (using existing prices)	Creating markets (forming new markets and marketable goods)	Environmental regulations	Engaging civil society
<ul style="list-style-type: none"> • Elimination of perverse subsidies; • Environmentally related taxes; • Deposit-refund systems; • User charges; and • Targeted subsidies 	<ul style="list-style-type: none"> • Property rights and decentralisation; • Tradable Permits and rights; and • International offset systems 	<ul style="list-style-type: none"> • Product and process standards; • Bans / prohibitions; • Non-tradable permits and quotas; • Zoning; and • Liability and performance bonds 	<ul style="list-style-type: none"> • Public participation; • Information disclosure; and • Voluntary agreements

Table 3: Fiscal-based instruments for air quality management with relevant examples:

Fiscal-based Instrument	Examples
Incentives and awards	<ul style="list-style-type: none"> • Clean Development Mechanism (CDM) projects e.g. Beatrix mine methane project for electricity generation. • General Fuel Levy (petrol, diesel, biodiesel), Aviation Fuel Levy. • Carbon emission tax for vehicles that produce more than 120g/km and are taxed at a rate of R75 + VAT for every g/km in excess of the 120g/km threshold. • Green procurement strategies for the City of Cape Town and Nelson Mandela Bay metropolitan municipalities. • RECSA is the association of Voluntary REC market participants in South Africa. All active producers, traders and consumers of RECs in South Africa are automatically members of RECSA.
Information disclosure programmes	
Demand-side management	
Disincentives	
Tradable Renewable Energy Certificate (TREC)/ Tradable/marketable permits	
Depository return schemes	
Security deposits	
Air Quality charges/levies	
Emission Trading Schemes/ Cap and Trade Instruments including restrictions	
Pricing policies	
Differential indirect taxes	
Tax concessions	
Subsidies (investment, research and development, activity)	
Product charges/taxes	
Resource charges/taxes	
Emission charges	
Process charges/taxes	
Two-tier tariffs	
Deposit-refund system	
Green purchasing	
User fees	
National environmental fund/account	

Table 4: Civil based instruments for air quality management with relevant examples.

Civil-based Instrument	Examples
Education	<ul style="list-style-type: none"> • Basa njengo Magogo project; • South Durban Community Environmental Alliance campaign; • Tree planting and rooftop gardens campaigns (e.g. Arbor Week) • Centre for Environmental Rights (CER) • GroundWork and the Vukani Environmental Justice Movement V Government case for the Highveld Priority Area (HPA); • Richards Bay Clean Air Association (RBCAA) • The case of Tergniet and Toekoms Action Group v Outeniqua Kreosootpale (Pty) Ltd; • Uzani Environmental Advocacy CC and BP Case; • Labelling schemes - such as energy efficiency labels on electrical appliances or organic farming produce; • Information disclosure programmes - such as the Toxic Release Inventory in the United States or Indonesia’s PROPER initiative; • Rating and ranking - where the environmental performance of a firm is ranked or rated according to certain criteria and publicly made available through the stock exchange for example.
Public awareness	
Carbon sequestration	
Public participation	
Improved access to information: – Requests for more information – Statutory record-keeping and reporting	
Air quality Monitoring Committees/Forums	
Increased <i>locus standi</i>	
Environmental justice organisations	
Class action, improved access to courts	
Private prosecution	
Beneficial cost awards	
Protection of workers	
Protection of whistle blowers	
Green rights	
Eco-labelling	
Public waste and pollution inventories	
Information disclosure programmes	

instruments in that they provide organizations and individuals the opportunity to react quickly to financial incentives and disincentives (Toxopeüs and Kotzé, 2017). For example, in the US more flexibility and greater financial incentives resulted in air pollution reduction beyond what clean air laws and traditional CaC rules require (Lurmann et al. 2015).

This approach does however also receive criticism due to environmental services not necessarily matching the economic value which is attached to them in taxes and subsidies (Pirard, 2012). Generally, any country’s market (particularly concerning environmental goods and services) can be subjected to failure at any given time which usually leads to the inconsideration of environmental issues in everyday market activities (National Treasury 2006). Under such circumstances, the South African government has developed several environmental policy interventions in an attempt to correct for environmental market failures which are dominated by regulatory instruments such as standards, bans on the use of certain goods or technologies, liability payments (such as the mining rehabilitation fund) and non-tradable permit systems as shown in table 2. It is however evident that many of the fiscal-based instruments exist as a hybrid with other approaches, particularly CaC, which are further discussed in the following sections – see table 3 for a summary.

Lastly, a number of stand-alone instruments have been identified in the literature review such as the Clean Development

Mechanism (CDM) and Green Infrastructure projects which aim to, through the market mechanism and incentives, reduce emissions in developing cities and encourage green building developments.

Civil-based approach

Civil-based instruments are used to empower civil society to become key stakeholders in environmental governance and active participants in the decisions that may impact the environment and people’s health and well-being (Toxopeüs and Kotzé, 2017). Toxopeüs and Kotzé, (2017) further point out that civil-based instruments enable and empower civil society, particularly the disadvantaged, to pursue environmental justice by raising their environmental concerns to be considered in decision making by government and the private sector. Civil-based instruments aim to as a minimum inform and educate communities on the relationship between them and their environment (Keen et al. 2005). This social learning approach creates opportunities for building of partnerships and implementation of joint programmes between communities, government and industry (Keen et al. 2005). Civil-based instruments require success factors such as access to information and education, public awareness raising, legal empowerment and access to courts as well as public information inventories on for example AQ and pollution (Cooke and Corbo-Pekins, 2018).

In South Africa however, the civil-based approach is often difficult to implement mainly due to formal education being

limited in most communities which then limit the potential for environmental education (Wessels and Mkhari, 2007). Also, air quality issues are very costly and complex which makes civil instruments difficult to implement.

Similar to market-based instruments, Civil-based instruments are also designed as hybrids with other approaches particularly the CaC approach. Various sections in NEMA (CaC) require public participation (Civil) to be conducted for activities that require environmental authorisations (i.e. atmospheric emission licenses) before commencement. This process is used to help incorporate public concerns and promote environmental justice in development projects and decision making (Viljoen 2007).

As shown in table 4, several air quality-related civil based instruments in South Africa rely heavily on access to information, justice campaigns, awareness and carbon sequestration campaigns.

Non-government organizations such as the Centre for Environmental Rights (CER) also play a significant role in the implementation of civil-based instruments in South Africa. The CER is comprised of a group of activist lawyers who assist communities and civil society organisations realise their Constitutional right to a healthy environment by advocating and litigating for environmental justice.

Agreement-based approach

Agreement based instruments (also known as voluntary agreements - VAs) are collaborative arrangements between the private sector, regulators, and other interested and affected parties where parties voluntarily commit to goals and actions that improve environmental performance (Delmas and Terlaak, 2001). Agreements can be used by organisations as a strategic instrument to adhere to their compliance obligations, develop new air quality management competencies ahead of competition, and communicate their responsible performance to their interested and/or affected parties (Delmas & Terlaak, 2001).

According to Farina 2001, Agreement-based instruments can be divided into self-regulation where industry will choose to set their own environmental objectives and indicators, as well as co-regulation where the environmental objectives and methods of achieving the objectives are defined through interaction between government and industry. Nel & Wessels, (2010) further argue that the adoption of VAs as self-regulation may be entirely voluntary meaning that performance is never verified by anybody, while others may need to be regularly verified (co-regulation) by independent and competent third parties. Such verifiers could also be either entirely independent such as accredited certification bodies or even enforcement agencies themselves. The verifiers could also be public watchdog bodies or enforcement surrogates appointed by the regulated (Nel and Wessels, 2010). A good example of co-regulation is the agreements organisations have with government on the collective efforts to minimise air quality impacts. These goals are

put in air quality management plans (AQMP) implementation plans and are monitored. Another co-regulation agreement is the partnership between IBM with CSIR and the City of Johannesburg municipality to use the Internet of Things (IoT) to curb air pollution in the city by analysing historical and real-time data from environmental monitoring stations across the Gauteng Province. The objective was to uncover greater insight about the nature and causes of air pollution and model the effectiveness of intervention strategies. In this project, scientists are using historical and real-time data from environmental monitoring stations and machine learning and cognitive models to provide insight about air pollution, ground level ozone, and air quality to model the effectiveness of intervention strategies (IBM 2016).

Essentially agreement-based instruments exist in hybrid with other instruments in dealing with air quality issues and do not exist as a stand-alone approach as shown in figure 4 letter D. This approach helps to not focus on air quality impacts in isolation but on the interplay between all environmental impacts of an organisation which then helps to avoid duplication of impacts mitigation and saving costs.

In South Africa, the hybrid approach between voluntary agreements and CaC instruments is required under section 35 of NEMA in which an environmental management cooperative agreement (EMCA) may be entered into between the government and any person or community in order to give effect to the NEMA principles (Farina, 2001). These agreements may be entered either as negotiations between an industrial sector and government or as a result of interaction between individual polluters and affected parties such as local communities and NGO's (Farina, 2001).

It is often difficult to have a single coordinated management approach with agreement-based instruments as different companies have adopted different instruments that suit their business needs. Some of these organisations may sometimes not want to disclose their agreements to the public or to other organisations for various reasons. However, for those organisations that adopt agreement-based instruments, there are general key benefits associated with this approach. This includes: to encourage a proactive cooperative approach from the industry which can reduce conflicts between regulators and industry; allows greater flexibility and freedom to find cost-effective solutions that are tailored to specific conditions, and the ability to meet environmental targets more quickly due to decreased negotiation and implementation lags (CSIR, 2016).

The most commonly used voluntary self-regulation agreement instruments in South Africa especially in the private sector and internationally are the ISO series guidelines developed by the International Organization for Standardization (ISO) (see Figure 3). The ISO standards are adopted by various organizations including some regulations as best practice guidelines for air quality and environmental management. The ISO 14000 family of standards provide a guideline or framework for organizations

that need to synchronize their disparate mini functions within the organization into a single, integrated and functional one to enhance their environmental and air quality performance. Although it is a self-regulatory instrument, ISO standards are able to pull-in or work in combination with other instruments in their application. An example to this is the ISO 14001:2015 environmental management system (EMS) standard clauses 4.2 and 6.1.3. Clause 4.2 deals with understanding the needs and expectations of interested parties where all the relevant stakeholders (which include the civil society) must be identified as well as their relevant (environmental) needs which is primarily a civil-based approach. Clause 6.1.3 requires the organization to determine and have access to the compliance obligations related to its environmental aspects as well as taking them into account when implementing and improving the EMS system. This compliance obligations clause is primarily relating to the command-and-control instruments.

Other agreement-based instruments include the carbon disclosure project (CDP) which is a global initiative where the Johannesburg Stock Exchange (JSE)'s top 100 companies provide information on their carbon intensity with plans to reduce these. In this regard, companies are starting to request emissions data from their suppliers as they start to realize the pressures they can exert on suppliers in terms of their sphere of influence. The CDP for South Africa was released on 22 November

2007 in which the level of disclosure on most issues showed valuable improvement since 2009. Subsequently, 94% of responding companies disclosed their GHG emissions showing that there is a growing awareness of the risks and opportunities of climate change, although often at a general level. Also, there has been a notable increase in the number of companies voluntarily setting (or publicly committing to set) reduction targets. More companies are also implementing direct emissions reduction measures and encouraging signs of companies reducing emissions within their sphere of influence. In addition, as part of the CaC approach, the carbon tax act no. 15 of 2019 has obligatory requirements on the reporting of GHG emissions by organisations. Government is of the view that imposing a tax on greenhouse gas emissions and concomitant measures such as providing tax incentives for rewarding the efficient use of energy will provide appropriate price signals to help nudge the economy towards a more sustainable growth path.

Hybrid approach

Nel and Wessels (2010) argue that in all the governing instruments, there is not a single instrument that offers a one-size-fits-all solution to environmental challenges, meaning that every instrument has particular strengths and weaknesses when it comes to performance. Some of these instruments will have similar characteristics even though they belong to different categories of environmental management approaches. The

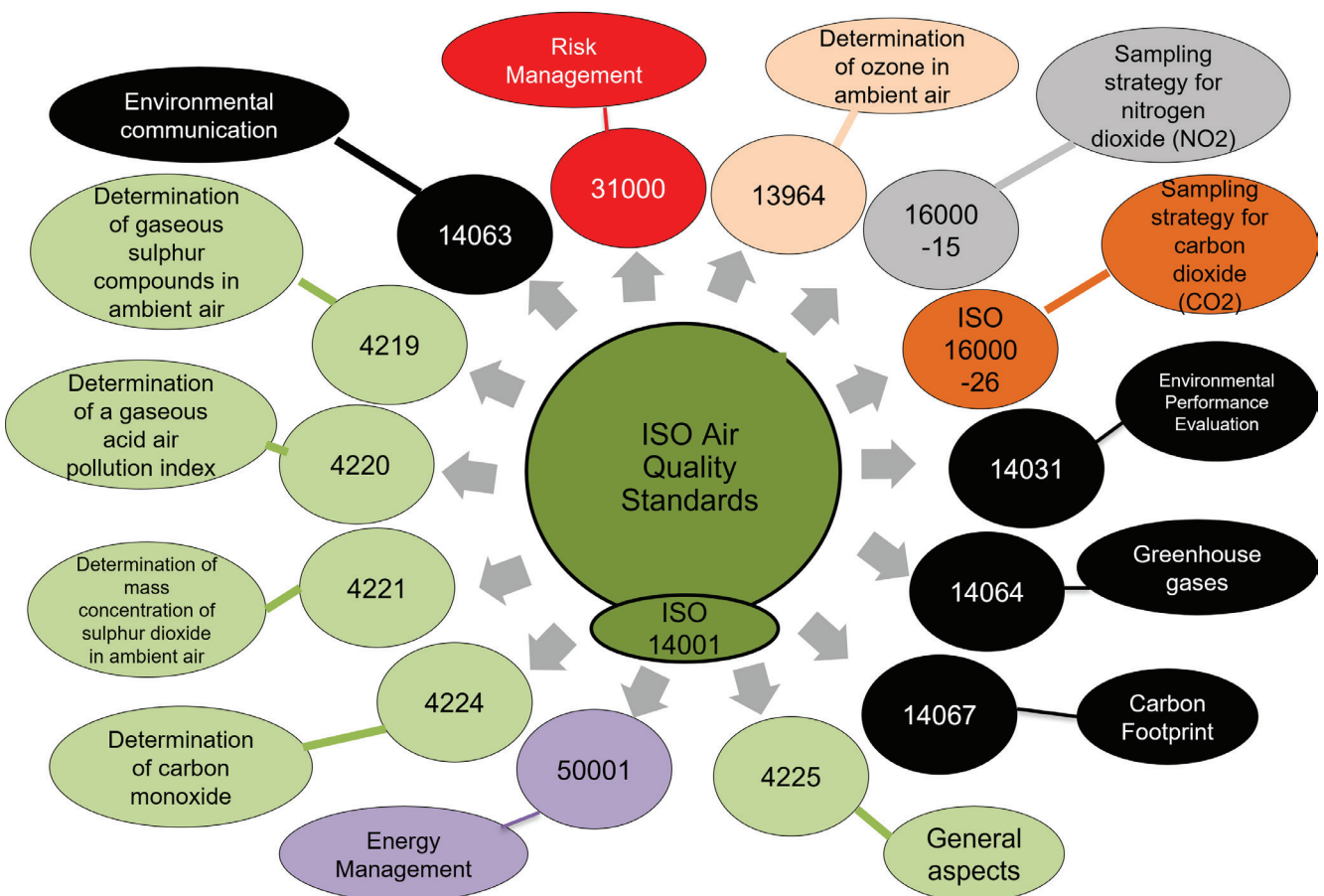


Figure 3: International Organization for Standardization (ISO) standards relating to air quality.

adoption of a hybridised approach, which is the integrated use of all the approaches to ensure sustainable governing efforts, is increasingly gaining popularity and organizations will adopt a combination of one or more instruments to address specific environmental issues (Nel and Alberts 2018). Internationally the application of more than one approach as part of a suite of instruments to address air quality challenges is recommended for effective air quality management. This is referred to as the “redundancy effect”. This redundancy effect argues that multiple instruments provide a better chance of success while also providing checks and balances by allowing some instruments to either rectify the problem or to generate alternative solutions should one of them fail (Landau 1969, Taylor 1984, Nel and du Plessis 2001, Kirschke and Newig 2017, Nel and Alberts, 2018). This has been shown internationally where Paris, Sao Paulo, Mexico City and New York managed to address their vehicular emissions by using CaC based regulatory approaches focusing on circulation restriction, fuel and technology initiatives as well as fiscal incentive approaches in targeting fuel and technology initiatives (Slovic and Ribeiro 2018; Molina et al. 2019). The adoption and use of these instruments in a hybridised

manner is also often specified as conditions in environmental authorisations (Nel and du Plessis, 2001; Nel and Wessels, 2010). Furthermore, another key aspect in adopting and using any suite of instruments is selecting them carefully to optimise synergy and avoid instruments working against each other, as well as to prevent injudicious and fruitless expenditure (Nel and Alberts, 2018). It is thus important to state that, separating these different approaches into classes is artificial or not really realistic in practice because most, if not all, instruments are hybridised in their application.

As shown in figure 4, there are four hybrid combinations that relate to the environmental management approaches discussed above. These approaches are: A=Fiscal/CaC Hybrid; B=Fiscal/Civil Hybrid; C=Civil/CaC Hybrid and D=Fiscal/Civil/CaC/Agreement Hybrid.

Examples relating to Fiscal/CaC hybrid (letter A in figure 4) include environmental levies such as carbon tax. Electric filament lamps, electricity generation, motor vehicle CO₂ emission, plastic bags, and tyres based on NEMA’s “polluter pays principle” are other

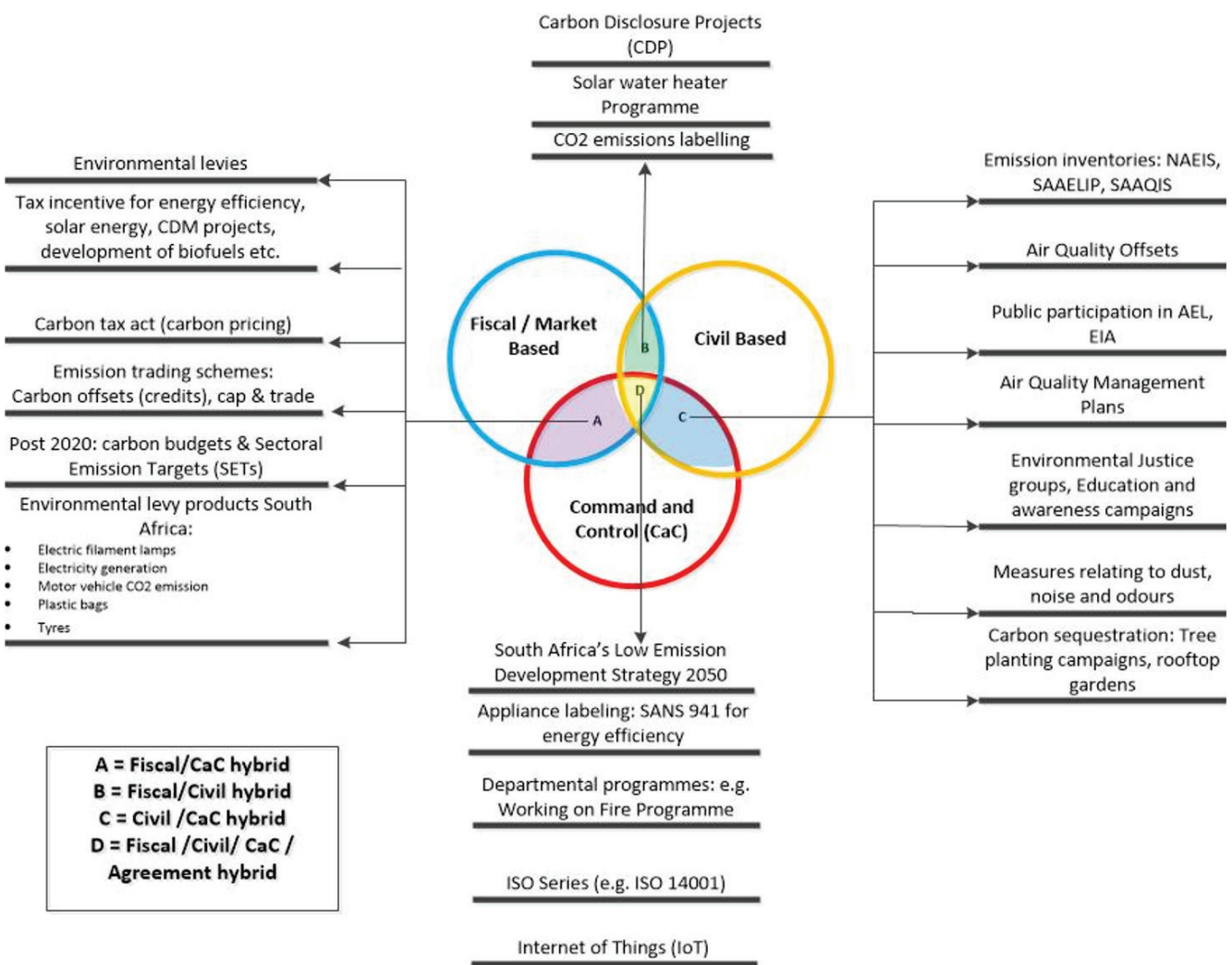


Figure 4: Hybrid air quality governance and management instruments relating to: A=Fiscal/CaC hybrid; B=Fiscal/Civil Hybrid; C=Civil/CaC Hybrid and D=Fiscal/Civil/CaC/Agreement Hybrid.

instruments which are imposed by the South African Customs and Excise Act, No. 91 of 1964 and administered by South African Revenue Services (SARS) in order to protect the environment by imposing tax on the CO₂ equivalent of greenhouse gas emissions (SARS, 2022).

The letter B in figure 4 provides for Fiscal/Civil Hybrid instruments which include instruments such as the solar water heater (SWH) programme. This programme was identified in the South African National Energy Efficiency Strategy of 2005 as integral to improving energy utilisation in South Africa with the aim to promote of broader socio-economic benefits for South Africans including the promotion and development of local manufacturing and the associated implementation of local content requirements, the promotion of small and medium enterprises, job creation and access to hot water for residential dwellings (Civil and Fiscal based instruments).

Instruments relating to the Civil/CaC Hybrid include emission inventories (i.e. SAAQIS, SAAELIP and NAEIS), air quality offsets, air quality management plans, measures relating to dust, noise and odours, as shown in figure 4 letter C. A recent example of this specific hybrid approach is the court case judgement handed in on 18 March 2022 between GroundWork and the Vukani Environmental Justice Movement versus the government on the air pollution challenges in the Highveld Priority Area (HPA). In this regard, the court ruled that government needs to pass regulations to implement and enforce the Highveld Priority Area AQMP which is aimed at cleaning up the air on the Highveld to meet health-based air quality standards (CER, 2022). Another popular instrument in this category is the role of public participation in EIA/AEL application processes. Public participation is mandatory in the application, scoping, and impact assessment phases of EIA/AEL and is considered as an important input to the EIA process to allow stakeholders to participate in environmental decision making (Sandham et al. 2019).

Instruments relating to the Fiscal/Civil/CaC hybrid approach as shown by letter D on figure 4 include Low-Emission Development Strategy (SA LEDS) 2050. This strategy describes how various sectors of the economy would implement policies and measures to reduce emissions up to 2050 as well as how it will ensure broader socio-economic development (DFFE 2018).

Other examples in this category include the working on fire programme which is a multi-partner programme that is mandated under the National Veld & Forest Fire Act of 1998 (CaC). This government-funded, job-creation programme is implemented by the FFA Group of Companies which is a leading supplier of Integrated Fire Management (IFM) services that takes up the youth from disadvantaged communities, trains them in fire awareness and education, prevention and fire suppression skills and employs them as participants (Civil-based). The creation of employment to participants provides an incentive for the participants to be economically active citizens (Fiscal-based instrument).

Another instrument in this category is the introduction of mandatory energy efficient labelling (SANS 941) for domestic appliances by African Bureau of Standards (SABS) (CaC based) in a bid to influence consumers purchase decisions (Civil based) to promote energy savings (Issock et al. 2018). The South African Energy Efficiency Label must be attached to all appliances that meet the minimum energy performance standards (MEPS) so that consumers have a choice when buying appliances (Fiscal-based). The label would include information on the energy consumption level of appliances. Examples of appliance programmes would include air conditioners, washing machines, electric ovens, refrigerators, electric geysers, audio and video equipment, dishwashers and electric lamps.

Discussion and conclusions

Government, civil society and the private sector have been developing, adopting, and implementing various air quality management instruments as a means to address and mitigate air quality management challenges in South Africa since the 1960s. Over recent years there has been a proliferation of instruments. However, no holistic conceptualised understanding of these instruments exists to critically inform air quality governance. The aim of this paper was to identify existing air quality management instruments and conceptualise them in terms of broader environmental management approaches (Nel and Alberts 2018). This allows for a critical understanding of the overall air quality governance framework in South Africa. The research results highlight the following main conclusions:

- *Over reliance on CaC:* The majority of instruments identified could be classified as CaC based. This means that policy and legislation essentially drive AQ management and governance, with a strong reliance on effective compliance and enforcement measures. Moreover, over reliance on CaC suggest limited innovation and incentive-based thinking. In light of the important role CaC instruments play the continual development and refinement thereof does however contribute positively to the overall governance framework such as the review of the national ambient air quality standards, priority areas regulations and the SAAELIP data policy (DFFE 2021). Therefore, although the important role of CaC approaches is acknowledged, further expansion of approaches beyond CaC is recommended.
- *Lack of innovative hybridisation across approaches:* The research results show a high level of hybridisation, especially in relation to CaC. This again suggests that, even where fiscal and civil based thinking is applied, it tends to rely on CaC arrangements. For example, financial incentives are still based in law and the mandate for civil society to effect change is ultimately reliant on access to the courts. We still seem to be far away from real innovative thinking around incentive and community-based solutions to air quality management.
- *High level of complexity:* Dealing with air pollution and air quality management is fundamentally complex especially in the South African context. This is partially as a result of the maturity and complexity of the South African air quality

management legal framework (Nel and Alberts, 2018). As a result of this complexity, many of the most effective management instruments do not fit neatly into a specific approach, but rather are designed as hybrid instruments. There clearly exists a need to deal with this complexity by finding ways to simplify the legal framework and find a more balanced approach with less reliance on enforcement and more reliance on incentives. This research is therefore in agreement with earlier studies that the solution to air pollution lies in a holistic and balanced approach (Nel and du Plessis 2001, W. 2001, Engelbrecht and van der Walt 2007).

- *Lack of synergy*: This study suggests that there is often lack of synergy among the instruments in their application. These instruments often have different objectives addressing specific issues at different levels from strategic, tactical, and political, operational and technical instruments. An understanding of the level of application of each instrument is therefore important to yield an effective adoption and implementation (Nel and Alberts, 2018). For example, specific legal requirements around energy generation are often a disincentive to innovation and/or the use of new technologies. This is because, based on the current legal requirements, it is challenging for the individual power producers to generate and make this power accessible to the market, particularly to those entities intending to sell further, such as municipalities. Therefore, CaC based instruments should aim to provide a regulatory framework that invites incentives and innovation towards dealing with environmental challenges. The current over reliance on compliance and enforcement with limited discretion built into the licencing processes suggests failure in this regard.

Finally, the research notes that even amidst the plethora of instruments, some of which have been in existence for decades, such as AQMPs and AELs, South Africa is still facing serious air quality challenges especially in those areas that have been declared as priority areas (September 2012; Tshehla, and Wright 2019). This raises the very important question as to how effective different instruments are in achieving their goals and how effective the overall air quality management system is in dealing with air quality challenges. We hope that the conceptualisation provided in this paper provides a basis and first step towards a more detailed analysis of the strengths, weaknesses, and performance of different approaches and instrument to ensure effective air quality governance and management in South Africa.

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Appendix A

Appendix A shows other pieces of national legislations directly or indirectly linked to the management of air quality as adopted and updated from the 2017 National Framework for Air Quality Management in the Republic of South Africa.

Table 1: Command and control instruments for air quality management with relevant examples.

Legislation	Air quality management links	Relevance
Climate Change Bill	<ul style="list-style-type: none"> Transitional provisions relating to the Declaration of greenhouse Gases as Priority Air Pollutants, the National Pollution Prevention Plans Regulations and the National Greenhouse Gas Emissions Reporting Regulations published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) 	To enable the development of an effective climate change response and a long-term, just transition to a low-carbon and climate-resilient economy and society for South Africa in the context of sustainable development
National Building Regulations and Building Standards Act 103 of 1977	<ul style="list-style-type: none"> To further efforts to decrease energy consumption and associated GHG emissions of new commercial and residential buildings, the government has implemented energy efficiency and energy consumption standards under the National Building Regulations and Buildings Standards Act. The first of these is South African National Standard (SANS) 204 ± Energy Efficiency in Buildings. This standard specifies the design requirements for energy efficiency in buildings and of services in buildings with natural environmental control and artificial ventilation or air conditioning systems. The second, SANS 10400-XA ± Energy Usage in Buildings, includes the provisions of SANS 204 and others, providing a standard for energy efficient buildings 	To provide for the promotion of uniformity in the law relating to the erection of buildings in the areas of jurisdiction of local authorities; for the prescribing of building standards
Carbon Tax Act (Act No. 15 of 2019)	<ul style="list-style-type: none"> Gives effect to the “polluter pays” principle of NEMA Price carbon by internalizing the costs of emitting carbon 	To provide for the imposition of a tax on the carbon dioxide (CO ₂) equivalent of greenhouse gas emissions; and to provide for matters connected therewith
National Key Points Act, 1980 (Act No. 102 of 1980)	<ul style="list-style-type: none"> Provides for the protection of significant State or private assets, relative to national security Regulates the flow of information regarding Key Point activity Allows for measures to be implemented to maintain the security of a Key Point 	Many significant emitters have been classified as National Key Points, and the Act is used to regulate access to information
Protection of information Act, 1982 (Act No. 84 of 1982)	<ul style="list-style-type: none"> Covers the protection of information related to defence, terrorism and hostile organisations Information regarding these activities in any form is prohibited access and cannot be disseminated Prohibited places can be declared, which also fall under this protection 	Can be used to regulate access to information on air quality
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)	<ul style="list-style-type: none"> Regulates burning of veld, except in state forests Allows for control and prevention of veld fires through prescribed control measures Allows for control measures to be prescribed regarding the utilisation and protection of veld that has been burned 	Addresses controlled burning, which directly impacts on ambient air quality
Local Government Municipal Structures Act, 1988 (Act No. 117 of 1998)	<ul style="list-style-type: none"> Establishes municipal categories Designates functions and powers of municipalities 	Specifies that responsibility for integrated development planning, within which air quality management plans must reside, rests with district municipalities
National Veld and Forest Fires Act, 1988 (Act No. 101 of 1998)	<ul style="list-style-type: none"> Purpose is to combat and prevent veld, forest and mountain fires Fire Protection Agency can be designated for control and has power to conduct controlled burning with respect to conservation of ecosystems and reduction of fire danger Lighting, maintenance and using of fires is regulated 	Addresses controlled burning, which directly impacts on ambient air quality

Legislation	Air quality management links	Relevance
National Water Act, 1998 (Act No. 36 of 1998)	<ul style="list-style-type: none"> Establishes strategy to address management of water resources including protection and use of water Establishes management agencies Provides for pollution prevention and remediation, including land-based sources Addresses emergency incidents, including land-based pollutant sources 	Pollution sources from land-based activities that impact on water resources
Local Government Municipal Systems Act, 2000 (Act No. 32 of 2000)	<ul style="list-style-type: none"> Provides a framework for planning by local government Describes contents of an integrated development plan and the process to be followed 	Air quality management plans are to be incorporated into integrated development plans
Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)	<ul style="list-style-type: none"> Provides for the health and safety of persons at work, including atmospheric emission from workplaces Sets out certain general duties of employers and to their employees Empowers the Minister of Labour to make regulations regarding various matters Further require any employer to ensure that their activities do not expose non-employees to health hazards 	The air emissions from the workplace environment has atmospheric quality implications
Promotion of Access to Information Act, 2000 (Act No. 2 of 2000)	<ul style="list-style-type: none"> Facilitates constitutional right of access to any information whether held by State or another person (if it is related to exercise or protection of a right) Details the means to access records, whether public or private Does not detract from provisions in the NEMA Section 1 and Section 2 Allows for denial of access based on defence, security or international relations 	Promotes access to information, including air quality information, although it has provisions for refusing access
Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000)	<ul style="list-style-type: none"> Details the administrative procedure to be followed when carrying out an administrative action, and the process of review 	Formal interactions between government departments, the public and other stakeholders by informing due process in decision-making
International Trade Administration Act, 2002 (Act No. 71 of 2002)	<ul style="list-style-type: none"> Establishes the International Trade Administration Commission as an administrative body Regulates the import and export of controlled substances 	Import and export control related to ozone-depleting substances through the declaration of controlled substance
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)	<ul style="list-style-type: none"> States that environmental authorisation is required for obtaining prospecting and mining right For environmental authorisations, scoping, EIA, specialist reports (including air quality specialist report), and EMP are needed. The Act states that it is necessary to submit an environmental management programme if applying for a mining right, and an environmental management plan if applying for reconnaissance permission The Minister is required to consult with any state department which administers any law relating to matters that affect the environment and must request the comments of that department on the environmental plan or programme being considered Provisions are made for monitoring and auditing of environmental performance Regulation 64 of MPRDA regulations stipulates that, the holder of a mining right or permit must comply with laws relating to air quality management and control Stockpiles require compliance monitoring and decommissioning Closure certificate authorisation is dependent on approval from other environmental departments that potential environmental impacts have been addressed 	Grants the decision-making power on matters potentially affecting the air environment to the Minister of Minerals and Energy in the case of mining activities but includes the obligation to comply with the AQA

Legislation	Air quality management links	Relevance
National Health Act, 2003 (Act No. 61 of 2003)	<ul style="list-style-type: none"> Makes reference to the performing of environmental pollution control by municipalities. Municipal health services are defined as including the responsibility for environmental pollution control The responsibility for municipal health services rests with metropolitan and district municipalities National and provincial departments of health have the duty to perform environmental pollution control 	Air quality management falls within environmental pollution control
Intergovernmental Relations Framework Act, 2005 (Act No. 13 of 2005)	<ul style="list-style-type: none"> Determines a framework to facilitate interaction and co-ordination, in the implementation of legislation, between spheres of government Principles of participation, consultation and consideration are included Establishes structures for coordination at different spheres of government Establishes an implementation protocol mechanism as a tool for coordination Provides mechanisms for conflict resolution, including the appointment of a facilitator 	Provides mechanisms for coordination and conflict resolution across spheres of government in aspects of legislative implementation
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)	<ul style="list-style-type: none"> Promotes cleaner technology, cleaner production and consumption practices for pollution minimisation Addresses impacts of waste disposal on the environment, including air Provides for numerous measures related to waste disposal including standards, integrated waste management planning, municipal waste management, priority wastes, licensing, waste management information system 	Closely linked through issues of emissions to the air from thermal treatment activities and landfill sites
Disaster Management Act, 2002 (Act No. 57 of 2002)	<ul style="list-style-type: none"> Provides for the declaration of certain areas as disaster areas; Disaster is defined as including the damage to the environment; Provides for an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery; Provides for the establishment of national, provincial and municipal disaster management centres 	Certain air pollution episodes can be disastrous. Inversely, certain disasters result in air pollution
Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice, 2006 (Act No. 19 of 2006)	<ul style="list-style-type: none"> Provides national and international recognition of the reliability of data produced by conformity assessment bodies involved in air quality management 	An accreditation service can be used to provide confidence to stakeholders regarding the reliability of data produced by conformity assessment bodies