# AIR QUALITY AND CLIMATE CHANGE CO-BENEFITS IN DURBAN

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**Abstract**

The relationship between air quality and climate change provides a scientific basis for developing integrative policies. Emission control measures implemented can have varying counteracting influences, simultaneously affecting air quality pollutants and greenhouse gas emissions. The potential to include climate change considerations in air quality policy in South Africa includes the use of local air quality management plans (AQMPs). A case study investigating the opportunities for air pollution and climate change co-benefits in Durban was undertaken. This study focused on two of the areas for intervention prioritised in Durban's AQMP, namely the industrial and road transportation sectors, which are also considered to be significant contributors to greenhouse gas emissions. Specifically, the industrial sector is considered to have the largest energy demand, whereas passenger transport and the use of carbon intensive fuels dominate the road transportation sector. Emissions inventories were developed for these sectors and used as a basis to explore air pollution interventions that are likely to result in trade-offs or synergies for climate change mitigation. Policy options to promote the implementation of a co-benefits approach to air quality management in Durban are considered.

*Keywords*: air quality management, climate change, industrial sector, road transport, Durban

## 1. Introduction

The combustion of fossil fuels has been the dominant source of global energy, enabling industrial development, thereby fuelling the economy and allowing for the provision of a variety of services (Bilgen *et al*., 2008). However, fossil fuel combustion is also the dominant anthropogenic source of carbon dioxide ($CO_2$), sulphur dioxide ($SO_2$), particulate matter (PM) and nitrogen oxides ($NO_x$) emissions (Angulo-Brown *et al*., 2009; Kaygusuz, 2007).

As air quality and climate change share common sources of pollutants, emission control measures implemented can have varying influences, simultaneously affecting air quality pollutants and greenhouse gas emissions. The policy frameworks that are established to manage air pollution and mitigate against climate change thus may have unintended consequences.

In recent years there has been much emphasis placed on understanding the impacts of air quality polices for climate change and vice versa. Research suggests that the traditional policy responses to these environmental challenges have to be reformulated.

Knowledge of the possible trade-offs or synergies in air quality management (AQM) and climate change mitigation is imperative to ensure that more effective management of atmospheric emissions occurs and that policies are designed to intentionally capture synergies and avoid trade-offs. This is especially relevant for developing countries

that are still grappling with growing urban air pollution challenges and are further typically characterised as following a sequence to policy agendas, with intentions to deal with the more distant issues of concern such as climate change later on.

Opportunities therefore exist for developing cities to play a role in initiating innovating responses to mitigate against climate change, with the use of air quality policies being a possible avenue to achieving this.

Within a South African context it has been established that the opportunities to include climate change considerations into air quality policy include the use of local air quality management plans (AQMPs) (Thambiran and Diab, 2010).

A project aimed at understanding the opportunities for achieving co-benefits from air quality interventions in South Africa was undertaken, using the case study of Durban (eThekwini Municipality). The case study primarily focused on two of the areas for intervention prioritised in Durban's AQMP, namely the industrial and road transportation sectors. In this paper, the key finding of this project are summarised, followed by a brief discussion on the implications of a co-benefits approach for future AQM and climate change mitigation policy.

## 2. Case Study of Durban

The industrial and road transport and logistics sectors are important contributors to Durban's gross domestic profit, with a cumulative contribution of ~39% in 2007 (EM, 2009). However, the combustion of fossil fuels within these sectors is one of the most significant contributors to air pollution and greenhouse gas emissions in the city. The AQMP developed in 2007 serves as the foundation to ensure that measures are implemented within these sectors to maintain ambient air quality levels that are acceptable for human health and ecosystems.

At present there are no climate change mitigation goals set for Durban and as such no long-term greenhouse gas mitigation plan has been developed for the city. Despite the lack of climate change mitigation targets, the AQMP could still be used to at least influence the adoption of best practices to at least curb the growth of greenhouse gas emissions.

During this project, emission inventories for 2008 for the industrial and road transport sectors in Durban were developed. The Computer Program to Calculate Emissions from Road Transport (COPERT) model was used to create an emissions inventory for road transport, focusing on both air pollutants and greenhouse gas emissions. Information regarding the motor vehicle fleet in Durban, fuel consumption, mileages, speed and vehicle classifications according to Euro standards were important inputs into this model. Estimates of emissions related to energy consumption in the industrial sector were derived using energy consumption data for industries in 2008. Local and US-EPA air pollution emission factors were used to estimate emissions that impact on air quality. To estimate greenhouse gas emissions, the IPCC (2006) guidelines were used. Of particular interest from these inventories, is that the cumulative contribution of these sectors to greenhouse gas emissions increased by ~10% since the last greenhouse gas inventory in 2005.

The 2008 emission inventories for these sectors were then used as a basis to explore air pollution interventions that are likely to result in trade-offs or synergies for climate change mitigation. The outcomes of this co-benefits analysis were then qualitatively considered within the context of other key priorities within the city, such as improving energy efficiency and road safety. The key results are briefly discussed below by sector.

### 2.1 The industrial sector

The industrial sector in South Africa has been regulated by the Atmospheric Pollution Prevention Act (Act No. 45 of 1965) (the APPA) and new regulations under the National Environmental Management: Air Quality Act (Act No.39 of 2004) (the AQA) are being phased in. Many of the major industries in Durban, particularly those within the South Durban Industrial Basin, were subjected to emission standards that were more stringent than that of the APPA through the South Durban Multipoint Plan. Interventions that have been previously implemented to improve air quality in the city were analysed to determine the impact on greenhouse gas emissions. It was found that the city has regulated the implementation of industrial air quality action plans that consist of numerous measures with synergies and trade-offs for climate change. These include the increase in electricity consumption due to the installation of air

pollution cleaning devices and fuel switching. The impact on greenhouse gas emissions were not quantified or considered in the decision to implement these air quality control measures. Consequently in instances where interventions resulted in increases of greenhouse gas emissions no measures were taken to offset the trade-offs for climate change.

Furthermore, to date, industrial measures that have contributed toward improvements in energy efficiency and reduced fossil fuel consumption have been as a result of cost-savings measures on the part of the industry, and demand management of electricity consumption as required by the city. Many of the large industrial consumers of electricity do not directly contribute toward air pollution and are therefore not regulated under the city's AQMP. Further to this, as grid-supplied electricity is not generated within the city's boundaries there has been no direct co-benefit for improved air quality from reduced electricity consumption. Thus, whilst it was also found that the implementation of industrial energy efficiency measures provides a favourable option for co-benefits allowing for a reduction of air pollution and greenhouse gas emissions (Table 1), it is not being realised within the city.

An energy strategy has been developed for Durban highlighting energy efficiency and the use of renewable energy within the industrial sector as key factors in the city reaching its targets for reducing fossil fuel consumption. A holistic approach to meeting air quality and energy-saving targets, may offer both industries and authorities a way to reduce the dependence on fossil fuels and the associated atmospheric emissions.

In order to achieve co-benefits, energy strategies and AQM planning need to be co-ordinated with respect to industrial interventions. Specifically, industries should be encouraged to voluntarily conduct energy audits to determine how effectively energy is being used, to reveal opportunities to reduce consumption, costs and related emissions. As end-of-pipe technologies usually decrease the efficiency of the industry and forgo the opportunity to switch to cleaner forms of energy, the AQMP needs to promote the adoption of air quality measures with co-benefits over those with trade-offs.

## 2.2 The road transportation sector

The road transport sector is considered to be a growing source of air pollution in the city. Unlike the industrial sector, regulations for the road transport sector are not as well developed within the country, with little incentive to ensure that motor vehicles are low contributors to air pollution.

Poor spatial zoning and mixed-use developments during the apartheid regime combined with high numbers of old passenger motor vehicles and heavy-duty trucks contribute toward high levels of air pollution and fuel consumption experienced in Durban. Engineering solutions have typically been adopted to manage congestion, with consequences for air pollution.

Many of the measures that are typically proposed to tackle air pollution within this sector have the potential to simultaneously impact on road safety and fossil fuel consumption as shown in Table 2.

The AQMP can play an important role in ensuring that interventions with multiple benefits are selected, by supporting and influencing interventions that target the types of vehicle technologies, fuel changes and road transport management measures that are implemented in the city.

Opportunities for co-benefits are theoretically much larger within the road transport sector. However, the actual routes that the city can take to achieving these co-benefits are far more limited, as there are currently no legislation or policies that regulates vehicle kilometres travelled (VKT).

Furthermore, the city alone is unlikely to have significant influence over atmospheric emissions from road transport. For example, with strategies such as fleet renewal campaigns, the impacts of inter-city travelling, VKT by local motor vehicles and road freight transport may prevent significant improvements from being made. Furthermore, the average age of motor vehicles in the city is over 10 years old, thus there may be limited environmental benefits to interventions that require changes to fuel specifications and the types of fuels that are used by motor vehicles.

Additionally, whilst measures such as congestion charging have been shown to be successful at reducing VKT in developed cities, the implementation in Durban, may not

be justifiable, and would have to be considered against other socio-economic issues.

## 3. Discussion

The case study of Durban illustrates the opportunities and complexities involved with using air quality interventions to influence greenhouse gas emissions within the key polluting sectors of the city. Industrial and road transport activities also present numerous socio-economic concerns and are impacted on by other plans and strategies initiated within the city that aim to improve road safety and reduce the dependence on fossil fuel use. Significant co-benefits can therefore result from improved co-ordination of industrial, energy and transport plans.

Existing air quality related legislation has a limited role to play in ensuring that air quality interventions are prioritized to have co-benefits or at least result in minimal greenhouse gas emissions. Within the industrial sector, atmospheric emission licenses (AELs) are issued to industries that are considered as listed activities under the AQA. However, the impact of air quality interventions for greenhouse gas emission is not a condition for the issue of an AEL. In the case of the road transport sector, the impact of national emission standards for motor vehicles in Durban is limited due to the age of motor vehicles in the fleet and further such measures do not influence the VKT.

**Table 1: Impact of industrial interventions on atmospheric emissions and fossil fuel consumption within Durban**

| Industrial measure | Emissions increase | Emissions decrease | Impact on fossil fuel consumption |
|---|---|---|---|
| Installation of cleaning devises | $CO_2$<br>$N_2O$ | $SO_2$ or PM or $NO_x$ (depends on type of device used) | + |
| Modification to cleaning devices | $CO_2$ | $SO_2$ or PM or $NO_x$ | + |
| Change in fuel toward cleaner more efficient fuels | | Reduces all related emissions from original fossil fuel source | - |
| Change in fuel toward use of renewable energy | PM, $NO_x$ | $CO_2$, $SO_2$ | - |
| Change high sulphur coal to low sulphur coal | | $SO_2$ | No change.<br>Increase if capacity requirements increase |
| Boiler modifications | | Increases efficiency, reduces all air pollutants related to fossil fuel | - |
| Energy efficiency measures | | Reduces all related emissions from fossil fuel source | - |

***+ (-) indicates an increase (decrease) in fossil fuel consumption***

**Table 2: Impacts of road transport interventions on atmospheric emissions, fossil fuel consumption and road safety within Durban**

| Transport Intervention | Impact on emissions | Impact on fossil fuel consumption | Impact on road safety |
|---|---|---|---|
| Fleet renewal | Decrease of PM, $NO_x$ (diesel vehicles) and CO (petrol vehicles).<br><br>Impact on other pollutants depends on VKT | - (improve fuel efficiency of newer vehicles)<br><br>+ (increase in VKT by newer vehicles) | -/+ |
| Promotion of ultra low diesel | $SO_2$ decreases, no change to other pollutants | No impact | No impact |
| Reducing congestion | Decrease in all emissions due to lowering of VKT | - | - |
| Uptake of biodiesel | Decrease $CO_2$<br>Increase: PM, $NO_x$ | - | No impact |
| Promotion of public transport over private motor vehicle use | Reducing VKT and all related emissions | - | - |
| Raise awareness of energy efficiency | Reducing VKT and all related emissions | - | - |
| Increased efficiency of freight transport system | Reduction in all emissions related to road freight transport due to reduced VKT | - | - |

***+ (-) indicates an increase (decrease) in fossil fuel consumption; + (-) indicates no benefits (benefits) for road safety.***

Specific direction from authorities is therefore required to facilitate the adoption of best practice in AQM to ensure that all stakeholders that contribute toward maintaining acceptable ambient air quality recognise the implications for climate change mitigation. The inception of voluntary programmes, municipal by-laws and or regulatory guidance from the AQA, that support strategies with co-benefits is critical to ensure that local AQMPs can be used to promote reductions or avoidance of greenhouse gas emissions.

## 4. Conclusion

Interventions that target energy efficiency and reduce fossil fuel consumption within the road transport and industrial sectors have the potential for achieving multiple social and environmental benefits. The decisions taken to meet these specific challenges may determine the city's success in simultaneously achieving air quality targets and mitigating against climate change.

A co-benefits approach to AQM could help to co-ordinate and prioritise different strategies within the city and ensure that the best policies for meeting the multiple of goals of road safety, use of cleaner fuels, and air pollution reduction are implemented. Furthermore such an approach may help to bridge the gap between climate change and air quality policies, allowing for progress toward greenhouse gas mitigation to be made in the short term.

The mainstreaming of climate change considerations into local AQMPs is essential as it may allow cities to make strides in reducing their baseline greenhouse gas emissions. This is especially relevant for cities that lack the financial resources and institutional capacity to effectively implement air quality policies as it may allow for higher levels of pollution abatement through opportunities to participate in the carbon market.

In the long-term, a co-benefits approach to AQMPs alone cannot be expected to meet greenhouse gas mitigation targets. Policies that require cities to develop greenhouse gas emissions action plans should also be promoted. These climate change policies

should further support interventions with co-benefits for air quality.

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