Highlighted local research

Summary of research paper published in Journal of Energy in Southern Africa titled:

A perspective of South African coal-fired power station emissions

(2015) Volume 26 Issue 3 pages 27-40

I. Pretorius[1], S.J. Piketh[1], R.P. Burger[1], and H. Neomagus[2]

[1]Climatology Research Group, Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa;
[2]School of Chemical and Minerals Engineering, Chemical Resource Beneficiation, North-West University, Potchefstroom, South Africa

http://dx.doi.org/10.17159/2410-972X/2016/v26n1a2

Emissions from South African coal-fired power plants are significant on a regional and global scale. Globally, South Africa ranks seventh of the top 10 countries that are responsible for more than 85% of global carbon emissions from coal-fired plants (preceded only by China, USA, India, Germany, Russia and Japan and superseded by Australia, Korea and Poland). The carbon dioxide (CO_2) emissions intensity (CO_2 emissions per economic output) of South Africa was found to be one of the highest in the world and more than triple that of industrialized countries. Regionally, South Africa is the main power generator in Africa and the energy sector (of which around 83% is contributed by coal-fired power plants) is one of the major emitters of criteria (Particulate Matter (PM), Nitrogen Dioxide (NO_2), and Sulphur Dioxide (SO_2)) pollutants in the country.

The reasons for the high emissions from South African coal fired power stations are the high reliance on coal as a fuel (coal is a fuel that is more difficult to burn cleanly than other fossil fuels) and the high specific emissions associated with South African coal combustion.

Even though the South African government is trying to reduce the country's dependence on coal; it will remain a dominant source of energy in South Africa, at least in the medium term. The country's coal use for electricity supply is expected to rise as two new power stations, namely Medupi and Kusile are added to the fleet and another 2450 MW of new build coal-fired power plants are planned between 2010 and 2030 (IRP, 2013).

Because South African coal-fired power station emissions are so prominent globally and regionally, it is important to understand the effects of changes (especially those changes that can lead to increases) on emissions. The paper entitled "A perspective on South African coal fired power station emissions", recently published in the Journal of Energy in Southern Africa (Pretorius et al., 2015) investigates the effect the South African energy crisis had (and has) on emissions from coal-fired power stations and makes projections of future emissions based on different future scenarios.

The first signs of the energy crisis were evident in the early 2000s when the electricity reserve fell well below the aspired 15%. During the end of 2007and beginning of 2008 the energy system could not keep up with demand (at an electricity reserve of around 6%) and load shedding was implemented for the first time.

In 2008, a decision was made to defer maintenance at major coal-fired power stations amidst the increasing pressure the South African government placed on Eskom to 'keep the lights on' at all cost. This lead to the decline in performance of the fleet and three older power stations that were mothballed during the 1980s and early 1990s returned back to service to alleviate the pressure on existing stations. The overall effect was a decrease in the thermal efficiency of the coal-fired power station fleet of around 8% between 2005 and 2012. During this period, coal quality remained relatively stable with an average calorific value of 19.25 (MJ/kg) and a standard deviation of 0.34 (with the exception of sulphur content of coal which declined by around 8% at times from 2005 to 2012). The deteriorating thermal efficiency meant that approximately 8% more coal had to be burned in 2011 compared to 2005 in order to produce the same amount of energy. This led to an increase of all criteria pollutants (with the exception of SO_2 – as the sulphur content of fuel coals decreased) and CO_2. Apart from the increase in emissions due to a decrease in thermal efficiency, PM emissions further increased due to increased pressure on PM abatement and lowered maintenance opportunity. The lesson learned from the increase of emissions during the energy crisis is of global importance as many countries in the world are currently facing energy shortages, including major developing countries such as China and India.

The paper continues to make projections of future coal-fired power station criteria and CO_2 emissions. Four future (2015 to 2030) scenarios are explored. Three of the four scenarios are based on the lower projected energy demand baseline case as published in the updated Integrated Development Plan (IRP). The difference between these three scenarios is different retrofit rates of power stations with emissions abatement technologies. The fourth scenario is a worst case scenario and assumes high energy demand (and therefore no decommissioning of power stations), high emission rates (similar to worst past emission rates during the period 1999-2012) and no further abatement of emissions above and beyond current mitigation efforts. This scenario gives an indication of what South African coal-fired power station emissions could look like if the energy crisis persists.

The research found that there are marked differences between the various scenarios for all pollutants. Worst case PM emissions was projected to rise by 40% compared to a 2015 baseline value whereas best case PM emissions were projected to decline by 40% against the same value. Worst case NO_x emissions were predicted to increase by 40% in 2030 from a 2015 baseline value and best case emissions are expected to decline 10% from the same level in 2030. Worst case SO_2 emissions were predicted to increase by around 38% in 2030 when best case emissions were expected to decrease by around 20% in 2030 from a 2015 baseline value. CO_2 emissions projections indicate that it is very unlikely that the South African climate commitment target for 2030 will be met. The difference in projections highlights the importance of the various assumptions made in each scenario and most importantly show how emissions will increase if energy demand remains high and the energy crisis persists.