Health impacts of coal-fired power generation in South Africa

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- Clients include:
  - National Governments (UK, France, Sweden…)
  - European Commission and its Agencies, World Bank, OECD, WHO
  - Industrial companies
  - Environment and health NGOs, including groundWork
- Memberships include:
  - UK Committee on the Medical Effects of Air Pollutants (COMEAP)
  - European Association of Environmental and Resource Economists
  - UK Chemicals Stakeholder Forum
  - UN/ECE Task Force on Integrated Assessment Modelling
  - RCP / RCPCH Task Force on Air Pollution
The RCP report

- Produced by RCP and RCPCH
- Written by Royal College members and invited experts
- Released February 2016
- Available at: https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution
  or google ‘every breath we take’
Most pollution work has focused on mortality and hospital admissions, which are concentrated in the elderly.

However, there are links to many other diseases including:
- Cancer
- Asthma
- Stroke
- Heart disease
- Diabetes
- Obesity
- Dementia

Throughout the full life course
Development of disease during foetal development

Mechanistic links to illness

- Small changes in lung function link to a significant increase in illness
Air quality limits and public protection

- Neither the concentration limits set by governments nor the World Health Organization’s air quality guidelines are fully protective of health.
Health burden of outdoor air pollution in the UK

• Each year, air pollution leads to the equivalent of 40,000 deaths in the UK from outdoor air pollution, valued at >£20 billion
  – PM$_{2.5}$
  – NO$_2$
  – O$_3$
• Much of that impact is from exposure below statutory limits in the UK
Role of the medical profession

• “When our patients are exposed to such a clear and avoidable cause of death, illness and disability, it is our duty as doctors to speak out.”
  – Medical profession is good at dealing with symptoms
  – Barriers on acting on causal factors like air pollution
Selected recommendations for action

• Act now, think long term
• Educate professionals
• Protect the public when air pollution levels are high
• Tackle inequality, protecting those at most risk
• Lead by example in the National Health Service
  - Major polluter!
  - Collaborate with local authorities?
Study on health impacts of coal burning in South Africa

• Funded by groundWork (FoE South Africa)

• Objectives:
  – Inform the current debate on power generation in South Africa
    • Choice of power generation technologies
    • Consequences of not meeting emission limits
  – Raise awareness of the harm to health caused by air pollution
Impact pathway approach

• Tracks emissions through to impacts using best available science

- EMISSIONS
  e.g. tonnes of $\text{SO}_2$

- DISPERSION
  Increase in ambient concentrations
  e.g. local and regional ppb $\text{SO}_2$

- IMPACT
  Using exposure-response curves,
  e.g. change in crop yield per ppb
  together with geographical databases of receptors (e.g. people, crops, buildings)

- COST
  Damage costs (e.g. market price)
  Willingness to Pay
Previous studies in South Africa

- Vivid Economics
  - Extrapolation of UK damage estimates per tonne emission

- Lauri Myllyvirta for Greenpeace International
  - More detailed dispersion modelling
  - Use of GBD response functions
  - Use of OECD methods for valuation
Approach adopted here

• Based on Myllyvrita study
  – Dispersion modelling
  – Quantification of mortality
• Adds in:
  – Quantification of illness (morbidity) using WHO recommendations
  – Valuation of impacts using OECD, European Commission methods
Starting point: emissions from the power stations
Forecast annual average PM2.5 contribution from plant covered by Eskom’s application for emission limit derogation, ug.m$^{-3}$
Map of population distribution
Great London Smog, 1952

- First conclusive evidence of air pollution effects on health
- 4,000 excess deaths in London in 1 week
Annual impacts of coal fired generation in South Africa

<table>
<thead>
<tr>
<th>Table 3-2. Annual health impacts linked to coal fired generation in South Africa.</th>
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</thead>
<tbody>
<tr>
<td>Equivalent attributable deaths</td>
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<tr>
<td>Lung cancer</td>
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<tr>
<td>Ischaemic heart disease</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
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<tr>
<td>Stroke</td>
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<tr>
<td>Lower respiratory infection</td>
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<tr>
<td>Total equivalent attributable deaths</td>
</tr>
<tr>
<td>Chronic Bronchitis (adults, cases)</td>
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<td>Bronchitis in children aged 6 to 12</td>
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<tr>
<td>Equivalent hospital admissions</td>
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<tr>
<td>Restricted Activity Days (all ages)</td>
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<tr>
<td>Asthma symptom days (children 5-19yr)</td>
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<tr>
<td>Lost working days</td>
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<tr>
<td><strong>Total costs</strong></td>
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‘Equivalent attributable deaths’?

• A reference to ‘deaths’ might imply that a number of specific individuals, and only those individuals are affected, and perhaps even that those individuals would be traceable.

• However, air pollution acts alongside a number of other agents to bring forward the time of death (smoking, disease, diet, etc.)

• COMEAP concluded that the total number of people likely to be affected by air pollution in some way would be larger than the estimated number of deaths, but that the estimate would indicate the ‘equivalent’ mortality burden of air pollution.

• This does not make the impact of pollution on mortality any the less real: the fact remains that a large number of epidemiological studies have found links between mortality and air pollution, and reducing pollution would benefit the health of the population substantially.

COMEAEP: mortality effects of long-term exposure to particulate air pollution in the UK.
Variation in population sensitivity

- European data suggests sensitivity is greatest for those in poorer health
Conclusions

• Coal fired power generation is a major source of air pollution in South Africa
• This pollution has a serious impact on health, equivalent to 2,200 attributable deaths per year, and associated ill health
• Total costs associated with these impacts exceed $2 billion annually
• These impacts should be considered in future energy policy
Additional slides
UK response to poor air quality

- Limited number of measures were implemented in 1950s and 1960s
  - Ban on highly polluting fuels
  - Industrial zoning
  - New technologies
The result – 30 year decline in emissions and pollution levels

Levels of SO2 are now negligible in UK cities, smoke concentrations also further reduced since 1997.
UK emissions of PM$_{10}$ and SO$_2$
1970 - 2015

Emissions reduced by:
- Fuel switching
- Use of abatement technologies
- Efficiency improvements

Further actions after 1997, largely in response to EU legislation