FOSSILIZED THINKING

THE WORLD BANK, ESKOM, AND THE REAL COST OF COAL

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I. Introduction

In early 2010, the World Bank Group (Bank) approved a loan of 3.75 billion dollars[1] to Eskom Holding Limited (Eskom). The purpose of the loan was to finance the Eskom Investment Support Project (Eskom Project) in South Africa, which included support for a 4,800 MW coal-fired power plant, investments in renewable energies (wind and solar), and support for a low carbon rail project.[2] While some funds linked to the project were allocated to the latter two projects, the total paled in comparison and scope to that of funding for the coal-fired power plant.[3] Shortly following the approval of the loan, local South African community members submitted a claim to the Inspection Panel, the accountability mechanism at the Bank, asserting, among other things, that the Bank did not comply with its own environmental policies and failed to adequately address important negative environmental effects associated with the project during the approval process.[4]

The Eskom Project has been challenged on a number of grounds.[5] To avoid duplication, we do not offer a comprehensive review of all Bank policies triggered by the Eskom Project.[6] Rather, we focus specifically on the Bank's failure to comply with requirements of Bank Operational Policy 10.04 (OP 10.04),[7] by not fully considering environmental externalities in the Economic Evaluation for the Eskom project. There are a number of concerns implicated by OP 10.04 requirements in the context of the Eskom loan, including a number of areas for which the Economic Evaluation did not sufficiently factor important environmental and social costs into its final cost-benefit determination. In particular, we examine issues related to water scarcity and quality, air quality, and related trans-boundary impacts.

This report documents the inadequate consideration of environmental and social costs in the cost-benefit analysis for the coal plant. We do not intend to address issues related to alternatives that would be most viable in the South African context. This is because unless and until a reliable cost-benefit analysis that fully incorporates social and environmental costs is undertaken, an accurate analysis of alternatives is not possible.[8] The failure to fully evaluate environmental and social costs renders the Bank's Economic Evaluation incomplete and inaccurate, thereby distorting the approval process. Moreover, the analysis raises the concern that the failure to sufficiently account for and quantify the environmental and social costs associated with coal-based power projects has led to a tendency to favor such projects.

This report also supports the conclusion that the benefits of large-scale centralized power projects may be overstated because of a failure to rigorously account for the very real negative costs associated with such projects. Large-scale energy projects – such as nuclear, coal, oil and gas, and large hydro – all carry significant negative social and environmental costs analogous to those associated with the Eskom loan. Thus the analysis conducted here reveals what may be a pattern in which the failure to fully value the negative aspects of such lending leads to over-investment in those sectors.

A key opportunity for the Bank to re-focus its lending practices with respect to energy projects like Eskom is the ongoing Energy Strategy Review, currently underway at the Bank. Experiences of South African communities with the Eskom project and the result of the pending Inspection Panel review related to this project should ideally inform the Bank's Energy Strategy. It appears, however, that the Inspection Panel process is unlikely to be completed prior to the release of the draft Energy Strategy. Thus the lessons that the Bank should learn from the Eskom loan may not be reflected fully in the draft Energy Strategy. If the Bank continues to inadequately reflect social and environmental costs in funding coal-based or other large scale power projects, it will be to the detriment of both the global climate system and the health of local communities and ecosystems.

II. The Eskom Loan

Following heavy criticism and heated internal debate, the World Bank approved a loan of 3.75 billion dollars to Eskom.[9] The loan comprised one quarter of all of the Bank's energy lending for FY 2010,[10] and is the largest investment the Bank has supported in South Africa.[11] The Eskom project consists of three components: 1) a 4,800 MW coal-fired power station at Medupi (Medupi); 2) the 100 MW Sere Wind Power Project; and the 100 MW Upington Concentrating Solar Power (Solar) Project; and 3) support for "lowering Eskom's carbon intensity," including the Majuba Rail Project that will be used for coal transportation in Majuba.[12]

At the time the loan was being considered, Medupi was only one of more than five large-scale coal-fired power plants Eskom had proposed in South Africa.[13] The Bank expects the first Medupi units to be

Photo courtesy of Wikimapia.org

completed by 2012, and the remaining units to be completed by 2015.[14] For its coal, the Medupi plant will rely exclusively on Grootegeluk, an open pit, back cast coal mine.[15] Grootegeluk contains an estimated 5,600 million metric tons of coal,[16] enough to fuel both the Medupi plant and the nearby Matimba plant, for the lifetime of both plants, a span of roughly 40 years.[17] However, to do so, existing mining operations will have to be expanded significantly,[18] with concomitant impacts on waste streams, the environment, and demand for scare resources.

Part of the Bank's rationale for the Eskom Project is the Bank's allocation of 260 million dollars to the project's 200 MW renewable energy component.[19] However, the bank's loan for renewable energy is dwarfed by the 3.04 *billion* dollars allocated to the Medupi 4,800 MW coal-fired power station.[20] At 4,800 MW, Medupi will tie for the largest coal-fired power station in South Africa and one of the largest in the world.[21] Coal is the most carbon intensive fossil fuel; thus Medupi will be a substantial carbon emitter.[22] As discussed below, in addition to the carbon emissions associated with the Medupi plant, other environmental and health impacts from the project are inadequately reflected in the Bank's analysis of the project – and these omissions led directly to the Inspection Panel Claim initiated on behalf of affected communities.[23] Moreover, the disparity between the carbon-intensive coal and the renewable portions of the Eskom project illustrates a tendency to fund problematic energy sources and highlights the need for the Bank to reprioritize its energy lending.

III. Consideration of Externalities – Requirements of OP 10.04

Bank OP 10.04 requires an Economic Evaluation of investment projects to "determine whether the project creates more net benefits to the economy than other mutually exclusive options."[24] Specifically, in order for an analysis to satisfy the Bank's requirements, the Economic Evaluation must show both (1) that a project's expected present value will have a net neutral or net positive effect, *and* (2) that the present value of the effect of the studied project is equal to or greater than alternative approaches.[25] The Bank requires numerous factors to be developed and assessed in making these determinations, including, but not limited to, alternatives, sustainability, and poverty, as well any externalities associated with the operation of the proposed facility.[26]

In the context of evaluating social and environmental impacts, the most relevant aspect of the policy is the requirement to take into account domestic, cross-border, and global externalities.[27] The Handbook on Economic Analysis of Investment Operations, which the Bank points to for guidance, provides that both positive and negative environmental or social costs (also known as externalities), should be taken into account and, if possible, measured in monetary terms.[28] Typically, environmental externalities "are identified as part of the environmental assessment, quantified where possible, and included in the economic analysis as project costs."[29] Thus, it is not enough to simply include impacts or potential costs in the environmental assessment; they have to be evaluated in the Economic Analysis as well. Environmental externalities are broadly defined and include "changes in production (e.g., of crops or fisheries affected by water pollution), changes in health, or damage to infrastructure due to air or water pollution, and even loss of aesthetic benefits."[30]

A life cycle analysis is central to the cost-benefit analysis for coal. A recent study in the United States showed that health and environmental impacts of coal stem from all stages of the coal life cycle, i.e. mining, processing, transportation, and combustion.[31] This includes waste streams associated with each of those stages.[32] Generally speaking, the numerous impacts in the coal life cycle include:

- Release of toxic pollutants, such as mercury, lead, and cadmium during coal mining and combustion;
- Release of particulate matter and chemicals during coal crushing, washing, and processing;
- Emissions of carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen oxide (NO_x), mercury, and particulate matter (PM_{10} and $PM_{2.5}$) during coal combustion; and
- Emissions of greenhouse gases (GHGs), including methane and black carbon, during coal mining and transportation.[33]

These impacts can affect surface and ground water quality, and air quality, leading to numerous health problems and deterioration of the environment.[34] Additionally, the coal life cycle and efforts to minimize resulting impacts put an enormous drain on resources, which have negative impacts of their own.[35] In the case of Medupi, the main externalities relate to water, air quality, and resulting health concerns, in the transboundary and domestic context. However, they are by no means exhaustive.[36] Unfortunately, these externalities were, at best, superficially considered[37] and, at worst, ignored entirely in the Bank's Economic Analysis.[38]

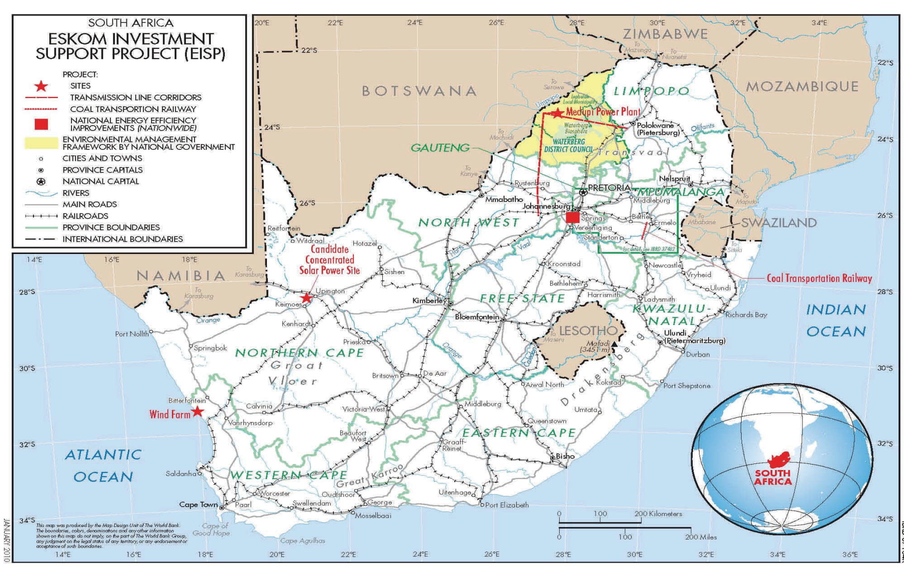
In sum, based on OP 10.04 and international cost-benefit standards/best practices, an effective cost-benefit analysis for Medupi includes: a comprehensive life cycle analysis; consideration of both domestic and transboundary impacts; and a full evaluation of social and environmental costs.

IV. Consideration of Externalities – Assessment of the Economic Analysis

An examination of the Bank's Economic Analysis for the Eskom Project,[39] which we understand is the Bank's attempt at meeting OP 10.04 requirements, demonstrates that the Bank has failed to fully and adequately consider the environmental and social costs that will be caused by the Medupi coal-fired power plant. This failure has led to a drastically skewed and overly positive present net value assessment of the project.[40] Though many environmental and social impacts associated with Medupi (discussed below) were raised in the Environmental Impact Assessment (EIA), they are not fully evaluated in the Economic Analysis.[41] This may be because mitigation strategies to address certain impacts are expected;[42] however, the environmental and social costs of implementing those strategies and any remaining impacts still require consideration.[43] Without an adequate assessment of all-harms (as World Bank policy dictates), there is no way to conclude whether the project is net present value neutral or net present value positive, or whether its net present value exceeds that of an alternative mutually exclusive project.[44] Therefore, the Bank's analysis fails to meet the requirements of OP 10.04. The following sections identify some major gaps in the Bank's Economic Analysis with respect to transboundary impacts, and domestic impacts to water and air quality, including their related health concerns.

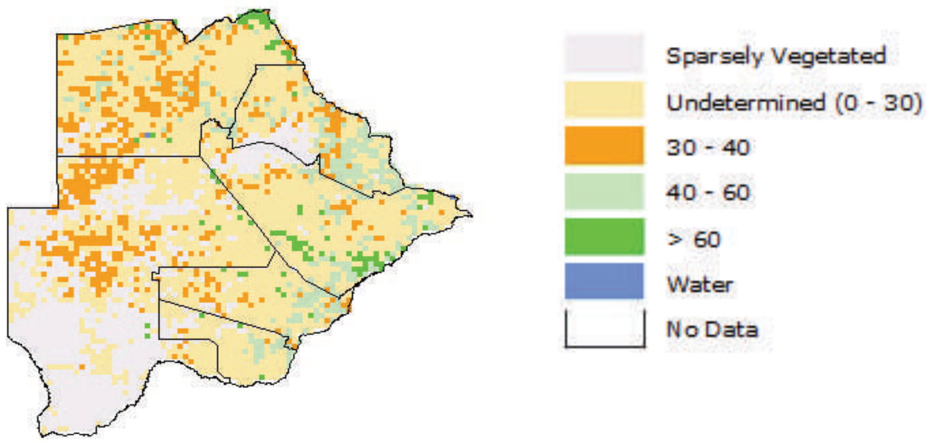
1. The Transboundary Context

A glaring gap in the Bank's analysis is the failure to consider transboundary impacts associated with Medupi. Medupi is situated in the Lehphalale locality, less than 30 miles from the international border between South Africa and Botswana.[45] Additionally, the primary sources of water for Medupi are tributaries to the Limpopo River,[46] a shared watercourse and the main river system supplying water to South Eastern Africa.



Project Map – Eskom Project[47]

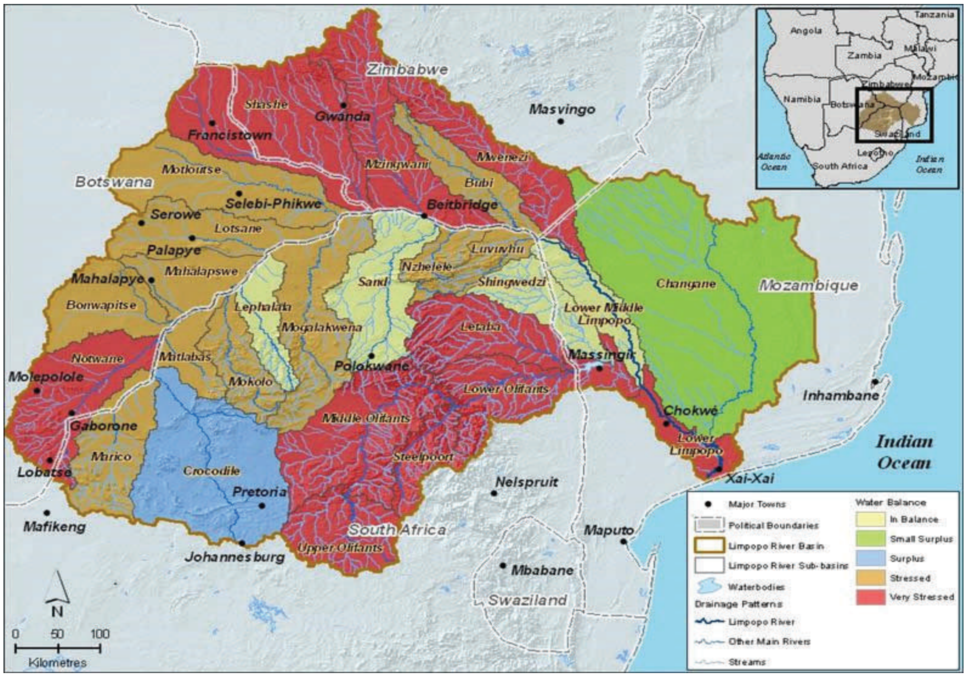
Despite the obvious need for studying transboundary impacts, the study areas for the EIA relating to Medupi appear to be limited to South Africa.[48] There is also no evidence of evaluating transboundary impacts in the Economic Analysis.[49] Thus, the impacts to air, water, and health (described below) in surrounding areas beyond South Africa are not fully examined. For example, a good portion of Botswana's crops and arable land are along the border near the Lephalale area. Air pollution and water contamination could have significant impacts for agriculture and for communities in those areas.



Botswana-Permanent Crops and Arable Land[50]

Despite the dominance of winds from the northeast, the wind patterns for the Lephalale area demonstrate that winds can also blow from the east, i.e. in the direction of Botswana.[51] Further, the height of the stacks (200m at Medupi and 250m at Matimba, a nearby coal plant)[52] impact the range of dispersion; emissions from tall stacks can stay in the atmosphere longer and be carried by wind currents.[53] Depending on the impact of westerly prevailing winds, emissions could be carried into Botswana, particularly if abatement measures are delayed. Thus, the potential effects of long-range air pollution on Botswana's crop land and cities (e.g. Gaborone, Botswana's capital is located in South Eastern Botswana) should be considered.

The potential water scarcity concerns for the broader area are of particular importance. The Limpopo river basin is an extremely water-stressed region, and the effects on water will likely be felt downstream.[54]



Water Stress in the Limpopo Basin[55]

Given the tremendous volume of water that will be required for Medupi (approximately 12 million m^3 of water per year),[56] the potential costs of water scarcity to Botswana, Zimbabwe, and Mozambique, all of which are downstream from Medupi, must be considered. Indeed, they are required to be considered under Bank policies and under an international agreement specific to the Limpopo Basin.[57]

In 2003, after nearly a decade and a half of dealing with failed management of the Limpopo river basin,[58] the Limpopo Basin States (Botswana, Mozambique, South Africa, and Zimbabwe) created the Limpopo Water Commission.[59] The Commission's purpose is to offer recommendations to stakeholder countries as to the fair and responsible use of the Limpopo[60] and to act to help resolve disputes between stakeholder countries.[61] While relevant project documents for the Eskom project refer to some consultation with Botswana government entities, they fail to elaborate the substance of those communications, and more importantly make no reference to consultation with affected communities.[62] Similarly, there were some communications with other Basin States, but descriptions of the communications do not include reference to consultation with affected communities.[63]

Thus, without an expanded study area and broader consultation, extending to other Basin States *and* their affected communities, the full scale of negative impacts caused by the Medupi project cannot be fully identified or considered. If the Bank intends to fund coal plants in the Southern African region, both presently and in the years to come, it is vital that impacts to water, air, and health in neighboring countries and their communities be identified and fully evaluated. Unfortunately, in the present case, transboundary externalities have not been adequately evaluated in the Bank's Economic Analysis of the Eskom loan.

2. Water-related Concerns

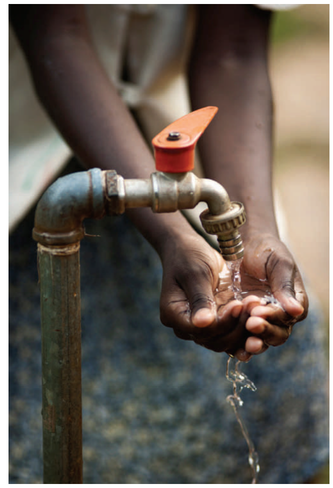
In the domestic context, the Bank recognizes that, "[w]ater is a resource in critical supply in South Africa . . . ."[64] It follows that the Bank would carefully consider in its Economic Analysis each reasonably foreseeable impact that Medupi would have on surrounding potable and agricultural water resources. As noted above, the Limpopo River, in particular, is a vital (and increasingly stressed) water source for a number of countries, including neighboring Botswana.[65] The Bank, however, made only passing reference to water issues in its Economic Analysis, while applauding Medupi for adopting "dry cooling for its power stations . . . ."[66] Dry cooling is a process where air is used for plant cooling instead of water, thus reducing water usage.[67] But, even with dry cooling, water scarcity remains a significant problem. Further, the Bank failed to evaluate the numerous water quality issues that will arise from Medupi's operation.

i. Water Scarcity

As stated above, the Bank was apparently satisfied with the fact that Eskom would use a dry cooling system that would use far less water than that of a standard water-intensive cooling system.[68] What the Bank failed to fully consider, however, was that in order to abate SO_2 emissions generated by the plant, Eskom would need to employ a highly water-intensive process that could have significant impacts for water in the area.[69] The process uses a scrubbing technology known as wet flue gas desulphurization (FGD or "wet sulfur scrubbing").[70] Although a "dry" method was considered, had it even been feasible, the process would have consumed only 40 percent less water than the wet method and would have been less effective at extracting the SO_2 from the coal smoke.[71]

The projected figures for water consumption are: 6 million m^3 per year for regular operation without wet FGD, and 12 million m^3 per year for operation with wet FGD.[72] At present, the Bank expects that there is enough water in the Mokolo River (a tributary of Limpopo) reservoir to operate the plant without sulfur scrubbing; the additional water is expected to be obtained through the first and second phases of the Mokolo-Crocodile Water Augmentation Project, which is in progress.[73] The Augmentation Project involves channeling treated water from the Crocodile River into the Mokolo River catchment; both are tributaries to the Limpopo.[74]

There are a number of potential problems with this scenario. The recent Environmental Management Framework Report for the Waterberg District states that the Mokolo Dam's water is currently fully allocated - this allocation does not include Medupi.[75] If the government is guaranteeing allocations for Medupi, the opportunity costs involved in reallocating the water will require consideration. If providing water to Medupi exceeds current allocations, impacts that will be felt downstream in the longer-term from channeling extra quantities of water away from Limpopo river tributaries (in this case the Mokolo River) should be considered. Another stress factor is the additional water that will be required by the coal mine to expand operations and provide sufficient amounts of coal to Medupi, not to mention additional resources needed to dispose of waste.[76] With respect to additional water, there is no guarantee that the Augmentation project will provide enough water for FGD-ready operation of Medupi,[77] and this risk, especially with respect to air quality, must be taken into account. Additionally, although the Augmentation Project was approved independent of Medupi's construction, the opportunity costs associated with using and transporting additional water to Medupi need to be considered. Further, because the Crocodile River is also a tributary of the Limpopo River, transboundary impacts of channeling water away from the Crocodile River should be considered.[78]



While the Bank's Economic Analysis briefly deals with the opportunity cost of water, it does not explain what specific factors were included in the assumption scenario for calculating that cost.[79] In an area where there is limited potable water, it is critical that the opportunity cost fully considers the lost benefits of alternative uses and reflects the fact that many of these alternatives, such as human consumption or agriculture, are fundamental and not fungible.[80] Moreover, the increased price of water (from 30 Randcents per m^3 to 20 Rand per m^3) that is expected to apply to the project may, by the Bank's own admission, not fully reflect the economic value.[81]

ii. Water Quality

Coal mining, processing, and plant operation can lead to chemicals leaching into water supplies.[82] The presence of toxics and heavy metals in drinking water (as well as in water for agricultural uses) can have significant human health impacts.[83] Particular concerns in the case of Medupi are:

- *Coal Combustion Waste:* Coal fired power plants produce large quantities of potently toxic coal ash and waste water that require storage.[84] Among them, wet sulfur scrubbing creates, as a byproduct, a diluted sludge that requires specific protections for storage to prevent harm.[85] Improper storage of waste can lead to disastrous results for the environment – particularly ground and river water – and thus for human health.[86] Ground water quality near the Matimba coal plant (a nearby Eskom-owned coal plant) has deteriorated over time as a result of plant operations.[87] Thus, potential costs related to Medupi must be examined and quantified.

- *Waste Storage:* Although there are plans to use existing ash dumps to store waste from Medupi, the additional environmental and social costs of storing another coal plant's waste have not been factored into the Economic Analysis, thereby ignoring a costly externality of coal power plant operation. Furthermore, the potential health impacts of water contamination should be considered; there can be leaching of toxic substances even with the best containment technologies.

- *Acid mine drainage (AMD):* AMD is a significant and long-term impact of coal mining that can continue for decades after mining operations cease.[88] With Medupi in operation, coal mining operations will increase, providing more opportunities for drainage to occur.

- *Sand mining:* Recent reports indicate that Medupi's construction has resulted in sand mining (both legal and illegal).[89] Generally, sand mining in rivers can cause significant changes to river streams, and aquatic and riparian habitats.[90]

Although risk assessments were conducted for water scarcity and quality in the EIA,[91] the Economic Analysis does not quantify the impacts of those risks.[92] Consequently, the existing Economic Analysis fails to reflect the true cost of the negative environmental and health impacts associated with water use and quality.

3. Air Quality Concerns

Burning coal causes air pollution, and mining activities that supply coal "have a severe impact on the environment" and human health.[93] Medupi is located in South Africa's Lephalale Local Municipality, only 5 kilometers to the southwest of Eskom's Matimba power station.[94] The Lephalale Local Municipality is home to about 100,000 people.[95] The effects and associated costs to these communities must be considered in the Economic Analysis when approving projects of the nature of Medupi. In situations where air pollution is a likely impact, the analysis must consider not only environmental impacts of pollution, but the health costs associated with the pollution as well.[96] Following the Bank's own guidance for evaluating environmental externalities for assessment,[97] costs associated with treating health problems caused by pollution constitute a negative environmental externality that must be listed, assessed, and calculated into the net present value of any coal project.[98] For example, costs associated with pollution-induced health problems include doctor's visits, hospital stay, medicine, and lost work time, among other things.[99] There is no evidence that pollution-related costs were considered in the Economic Analysis conducted by the Bank.

The American Lung Association (ALA) links emissions from coal-fired power plants to deaths and other significant public health impacts.[100] The U.S. Clean Air Task Force, in a report endorsed by the ALA, found that no industrial source of air pollution "poses greater risks to human health and the environment than coal-fired power plants."[101] The report based this on its finding that "emissions from the U.S. power sector cause tens of thousands of premature deaths each year and hundreds of thousands of heart attacks, asthma attacks, emergency room visits, hospital admissions and lost workdays."[102] As yet, no comparable study exists with respect to South Africa, but the human population around the Medupi plant must not be overlooked or deemed insignificant. The EIA recognizes that the nearby town of Marapong, home to about 17,000 people, is currently the most affected by air pollution and that despite being upwind of Medupi, health risks rise because of existing respiratory conditions.[103] Unfortunately, that recognition did not translate into an evaluation of health costs in the Economic Analysis for Medupi. It is true that there are other factors in the area that affect respiratory conditions, such as burning firewood indoors, and that providing electricity to such households would help reduce those factors. However, even if electricity

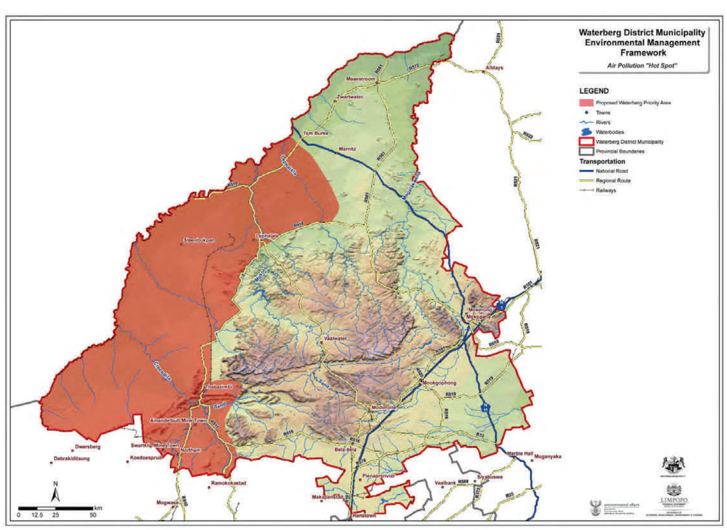
did reach those households, air pollution from coal burning would still be a contributing factor to respiratory conditions; in the best case scenario, pollution from combustion replaces one type of harm with another, and, in the worst case scenario it adds yet another harmful pollutant to the environment. This worst case scenario would be realized if people were unable to afford the electricity being provided – a distinct possibility in the case of the Medupi plant.

In the subsections below, we focus on SO_2, particulate matter, and CO_2 emissions. However, there are other significant impacts, such as emissions of NO_x and mercury, that affect air quality and human health, which should not be ignored in the Economic Analysis.[104]

i. Sulfur Dioxide Emissions

As noted above, SO_2 emissions are of great concern in this case. In addition to contributing to acid raid,[105] the impacts of SO_2 emissions include: "respiratory illnesses – wheezing and exacerbation of asthma, shortness of breath, nasal congestion, and pulmonary inflammation – plus heart arrhythmias, LBW [(low birth weight)], and increased risk of infant death."[106] Full operation of the Medupi plant, which entails operation of 6 units (and has projected actual SO_2 emissions of 3,000 – 4,500 mg/Nm^3),[107] would exceed allowable air quality thresholds and would double the size of the impacted area.[108] The area where the plant is located is "not yet considered degraded with respect to ambient air quality."[109] However, ambient SO_2 standards are already intermittently exceeded in the area of the development due to Eskom's existing Matimba Power Station and to other local emitters.[110] Given that backdrop, there is potential for cumulative concentrations of SO_2, and increased frequency and magnitude of exceeding air quality standards, with associated public health costs in the area.[111]

The South African Government has recognized that there are potential air pollution concerns in the North Western part of the Waterberg District, and this area is marked as an air pollution "hot zone."[112] Particularly, as coal reserves in the area are unlocked over time, it will be important to monitor and address air pollution concerns.[113] Although the mapping ends at the South Africa-Botswana border, it is unlikely that the air pollution and related health risks do.



***Air Pollution "Hot Zone" Map[114] - the area shaded in red indicates the "hot zone."**

While South Africa has proposed new emissions limitations[115] that would require Medupi to utilize wet sulfur scrubbing/FGD, this process nevertheless results in other environmental impacts. As described above, it is a highly water intensive process and adds to the waste stream. Additionally, it can result in increased emissions and decreased efficiency, which requires more coal combustion to meet output requirements.[116] Indeed, the EIA recommended that these costs be quantitatively assessed;[117] however, there is no evidence that they have been fully considered in the Economic Analysis.[118] Moreover, in the time that it will take to channel enough water to operate wet FGD for all six units, it is possible that Medupi will operate without wet FGD or any other sulfur abatement process.[119] Thus, the Economic Analysis should have calculated the expected environmental and health costs associated with unabated SO_2 emissions at least until wet FGD would be fully operational.

ii. Particulate Matter

The World Health Organizations recognizes that "by reducing particulate matter . . . pollution from 70 to 20 micrograms per cubic metre, we can cut air quality related deaths by around 15%."[120] In the U.S., fine particle pollution from coal plants is expected to cause 13,200 deaths in the U.S. this year, in addition to 9,700 hospitalizations, 20,000 heart attacks, and other adverse impacts that cost the U.S. over $100 billion per year.[121] These impacts are particularly severe for the elderly, children, and individuals with respiratory disease.[122] As noted above, a number of people in the Medupi-affected localities suffer from respiratory conditions.[123] In the EIA for Medupi, ambient PM_{10} concentrations were within "lenient South African standards but exceeded . . . E[uropean] C[ommunity] limit values."[124] The highest concentrations were recorded at the Grootegeluk mine,[125] which means that the most affected individuals are likely to be mine workers. However, there is no evidence of evaluating related health costs for mine workers, or for individuals in surrounding areas whose conditions may worsen. In this way, the Economic Analysis fails to fully account for the costs associated with fine particulate emissions.

iii. Carbon Dioxide Emissions

Emissions of CO_2 and other heat trapping gases (commonly known as GHGs) contribute to climate change. As the devastating impacts of climate change are being felt across the globe, international climate change negotiations, while far from complete, have reached agreement that dramatic reductions in GHG emissions are fundamental to avoiding dangerous climate change. In South Africa, the impacts of climate change will be felt most acutely in the "health sector, maize production, plant and animal biodiversity, water resources, and rangelands."[126] These impacts have real human and economic costs that cannot be ignored in the Economic Analysis.

While the Economic Analysis incorporates the social cost of carbon as defined in the Stern Review, assumptions about CO_2 emissions require further examination. The analysis states that the Medupi plant, when it reaches full output, will emit gross GHG emissions at around 30 million tons per year.[127] These emissions are projected to account for about 6.8 percent of South Africa's increase in CO_2 emissions over the next 20 years.[128] The Bank argues that net GHG emissions from Medupi will be far less than 30 million tons per year (closer to 12.6 million tons/year), because if Medupi did not receive funding, people would be using emissions-intensive energy sources, such as candles, kerosene, and diesel generators.[129] However, this assumes that the energy produced by the Medupi plant is certain to reach those who use candles and other self-generated sources that emit greenhouse gases, which is by no means guaranteed.[130]

It is not just a question of being able to access the grid, but of what people can afford. Even if electricity did reach those who currently have no access to electricity, coal combustion emits "more GHGs per unit of electricity produced than any other fuel."[131] Thus it is not clear what the benefit would be from an emissions perspective for replacing these other sources with coal-based power.

In incorporating the social cost of carbon, which is not an insignificant amount at US \$29/ton CO_2, the Economic Analysis notes that the cost could be covered by levying a tax on Eskom to be recovered through a surcharge on consumers.[132] Depending on whether it is calculated based on gross emissions or net emissions, the increase in consumer tariff ranges from 36% to 10% and in turn would affect accessibility of electricity.[133] If implementing this means that people currently using other emissions intensive energy sources cannot benefit from electrification, it would change the net emissions calculation and the strength of the energy access argument. Passing on the social costs of carbon to the average consumer in this manner thus illustrates the limitations of highly emissions intensive energy projects like Medupi.

V. Conclusion

As noted above, this report is focused on a limited range of the typically undervalued negative externalities associated with lending activities such as coal plants based on a narrow definition of economic growth. Nevertheless, it illustrates a broader dynamic with the Bank's conduct of Economic Analysis of the negative environmental and social costs associated with coal fired power projects – both because they appear to be incompletely addressed in the impact assessment phase and because the economic analysis of such costs is woefully inadequate. Studies in the United States demonstrate that the "economic implications of coal go far beyond the prices we pay for electricity."[134] The end result appears to be a tendency to over value the benefits of large-scale, centralized, coal-based energy production. A corollary to this is that alternative approaches, such as decentralized renewable-based energy production designed specifically to meet the needs of disadvantaged communities, are undervalued by comparison.

Moreover, if the Bank were to truly prioritize energy access for the poor – the oft stated goal of projects like Medupi – massive coal-based and other centralized power projects are rarely the answer. The portion of power generated by Medupi that goes/will go to industrial users compared to that which truly feeds the energy needs of the poor testifies to this dynamic.

Ideally, as part of the Bank's Energy Strategy Review, the Bank will commit to eliminating support for coal based energy projects entirely and focus on more benign ways to meet the energy needs of the poor. At a minimum, however, the Bank must take action to improve the quantification of negative environmental and social externalities associated with coal-based power projects. Studies now exist that clearly point to the magnitude of these costs from an environmental and societal perspective. The Bank must refine its approach to analyzing coal projects to reflect these very real and substantial costs. Likewise, the Bank must also consider the negative externalities associated with other large-scale centralized power projects. Finally, the consequences of the largest negative externality problem ever experienced – global climate change – are not fully reflected in the Bank's Economic Analysis. This failure locks in long term investments in coal-based power systems that will continue to contribute to the problem of global climate change, and will negatively impact the environment, human development, and economic development for decades to come.

Endnotes

[1] World Bank, *Eskom Project Appraisal Document on a Proposed Loan in the Amount of US $3,750 Million [sic] to Eskom Holdings Limited Guaranteed by Republic of South Africa for an Eskom Investment Support Project*, i (Mar. 19, 2010), *available at* http://web.worldbank.org/external/projects/main?menuPK=51447259&pagePK=51351007&piPK=64675967&theSitePK=40941&menuPK=64187510&searchMenuPK=51351213&theSitePK=40941&entityID=000112742_20100412110336&searchMenuPK=51351213&theSitePK=40941 [hereinafter Project Appraisal Document] (last visited Mar. 17, 2011).
[2] For example, the renewable energy component (200 MW), was only allocated 260 million dollars. *Id.*at ii.
[3] *Id.*
[4] *See Generally Request for Inspection* (April 7, 2010) *available at* http://siteresources.worldbank.org/EXTINSPECTIONPANEL/Resources/Request_for_Inspection_%28PUBLIC%29.pdf (last visited Mar. 17, 2011).
[5] *Id.*
[6] *See e.g.*, World Bank Safeguard Policies, *available at* http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTSAFEPOL/0,,menuPK:584441~pagePK:64168427~piPK:64168435~theSitePK:584435,00.html.
[7] *See* Operational Policy 10.04, *Economic Evaluation of Investment Operations* (Sept. 1994) *available at* http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTOPMANUAL/0,,contentMDK:20064625~menuPK:4564185~pagePK:64709096~piPK:64709108~theSitePK:502184,00.html {hereinafter OP 10.04] (last visited Mar. 17, 2011).
[8] Issues related to the benefit of electrification provided by coal versus the costs to health from coal are highlighted in a recent article by the U.S. National Institute of Environmental Health Sciences. It analyzed data from 41 different countries between 1965 and 2005, and found that the hidden costs of coal can be devastating and need to be fully accounted for. Manuel Quinones, Greenwire, *Another Study Spotlights Health Risks*, (Feb. 23, 2011), *available at* http://climatesolutions.org/press-room/press-clips/coal-another-study-spotlights-health-risks (last visited Mar. 17, 2011).
[9] Project Appraisal Document, *supra* note 1, at i.
[10] Matthew O. Berger, INTER PRESS SERVICE, *World Bank Pressured over Record Fossil Fuels Lending* (Oct. 12, 2010), *available at* http://ipsnews.net/news.asp?idnews=53138 (last visited Mar. 14, 2011).
[11] World Bank Website, http://web.worldbank.org/external/projects/main?pagePK=217672&piPK=95916&theSitePK=40941&menuPK=223661&category=regcountries&regioncode=1&countrycode=ZA&pagenumber=1&pagesize=50&sortby=BOARDSORTDATE&sortorder=DESC (last visited Mar. 17, 2011).
[12] World Bank, *Eskom Project Information Document*, 6, *available at* http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/03/01/000262044_20100303102346/Rendered/PDF/EISP0PID01appr10revised01219120101.pdf (last visited Feb. 17, 2011).
[13] Smita Nakhooda, WORLD RESOURCES INSTITUTE, *The World Bank Eskom Support Program* (March 8, 2010), http://www.wri.org/stories/2010/03/world-bank-eskom-support-program (last visited Mar. 17, 2011).
[14] Project Appraisal Document, *supra* note 1, at 116.
[15] World Bank, *Bank Management Response to Request for Inspection Panel Review of the Republic of South Africa Eskom Investment Support Project*, 12 (May 25, 2010), *available at* http://siteresources.worldbank.org/EXTINSPECTIONPANEL/Resources/SA_Eskom_Management_Report_NO_Memo.pdf [hereinafter Bank Response] (last visited Mar. 17, 2011).
[16] *Id.*
[17] *See* Eskom Project, *Environmental Impact Assessment Report for the Proposed Establishment of a New Coal-Fired Power Station in the Lephalale Area, Limpopo Province* (22 May 2006), *available at* http://web.worldbank.org/external/projects/main?menuPK=51447259&pagePK=51351007&piPK=64675967&theSitePK=40941&menuPK=64187510&searchMenuPK=51351213&theSitePK=40941&entityID=000020953_20091109115541&searchMenuPK=51351213&theSitePK=40941 [hereinafter EIA Report] (last visited Mar. 17, 2011); Project Appraisal Document, *supra* note 1, at 70.
[18] Project Appraisal Document, *supra* note 1, at 72.

[19] World Bank, *Safeguard Diagnostic Review for South Africa Eskom Investment Support Project*, v (March 11, 2010), *available at* http://web.worldbank.org/external/projects/main?menuPK=51447259&pagePK=51351007&piPK=64675967&theSitePK=40941&menuPK=64187510&searchMenuPK=51351213&theSitePK=40941&entityID=000333038_20100311235302&searchMenuPK=51351213&theSitePK=40941 [hereinafter Safeguard Diagnostic Review] (last visited Mar. 17, 2011); Project Appraisal Document, *supra* note 1, at i.
[20] Project Appraisal Document, *supra* note 1, at ii.
[21] *See* List of Coal Power Stations in South Africa, http://en.wikipedia.org/wiki/List_of_power_stations_in_South_Africa (last visited Mar. 17, 2011); Eskom, *Progress of Construction at* Medupi Power Station, http://www.eskom.co.za/live/content.php?Item_ID=11978&Revision=en/4 (last visited Mar. 17, 2011); Eskom, *Progress of Construction at Kusile*, http://www.eskom.co.za/live/content.php?Item_ID=11980 (noting that Kusile, another 4,800 MW coal plant underway in South Africa, is among the largest coal plants in the world, meaning that by inference Medupi is also among the largest in the world) (last visited Mar. 17, 2011).
[22] *See e.g.* Epstein et. al., *Full Cost Accounting for the Life Cycle of Coal* in Ecological Economics Reviews, 74, ANN. N.Y. ACAD. SCI. 1219, 73-98 (2011) (on file with author); U.S. Energy Information Administration, *Carbon Dioxide Emission Factors for Coal* (1994), *available at* http://www.eia.doe.gov/cneaf/coal/quarterly/co2_article/co2.html (last visited Mar. 17, 2011).
[23] Bank Response, *supra* note 15, at 1.
[24] OP 10.04, *supra* note 7, § 1.
[25] *Id.* § 2.
[26] *See generally id*.
[27] *Id.* § 8.
[28] Handbook on Economic Analysis of Investment Operations, Chapter 7, *available at* http://siteresources.worldbank.org/INTCDD/Resources/HandbookEA.pdf (last visited Mar. 17, 2011).
[29] *Id.* at Chapter 7.
[30] *Id.* at Chapter 7 ¶ 9.
[31] Epstein et. al., *supra* note 22, at 76.
[32] *Id.* at 76
[33] *Id.* at 74.
[34] *See generally id.*
[35] For example, wet FGD has a number of negative impacts. *See infra* sections IV.2, 3.
[36] For example, noise pollution, impacts to flora and fauna and so on. *See generally* EIA Report, *supra* note 17.
[37] *See infra* sections IV.1.
[38] *See id.*.
[39] Project Appraisal Document, *supra* note 1, at 163
[40] *See infra* sections IV.1-3..
[41] *See* Project Appraisal Document, *supra* note 1, at 163-187.
[42] Safeguard Diagnostic Review, *supra* note 19, at 59 – 71.
[43] Additionally, mitigation strategies are not necessarily 100% effective and so the costs of negative impacts cannot be totally ruled out. For example, wet sulfur scrubbing can abate up to 90% of sulfur emissions, while dry scrubbing can abate only 60%. EIA report, *supra* note 17, at 19-20. Regardless, there are still sulfur emissions that need to be accounted for.
[44] OP 10.04, *supra* note 7, § 1. Indeed, the "Development and Climate Change, A Strategic Framework" for the World Bank Group (DCCSF), which is explicitly mentioned in the Project Appraisal Document, requires full consideration of environmental externalities. Project Appraisal Document, *supra* note 1, at 25.
[45] National Geographic Atlas of the World, 96 (9^{th} ed., 2011).
[46] EIA Report, *supra* note 17, at Chapter 5.5.1.
[47] Project Appraisal Document, *supra* note 1, at Annex 16: Maps.
[48] EIA Report, *supra* note 17, at 50-62.
[49] Project Appraisal Document, *supra* note 1, at Annex 9.
[50] Botswana-Permanent Crops and Arable Land FAO Country Profiles and Mapping Information System, *available at* www.fao.org/countryprofiles/Maps/BWA/12/al/index.html (last visited Mar. 17, 2011).

[51] *See* EIA Report, *supra* note 17, at 225-226; Waterberg District Environmental Management Framework – Draft EMF Report, Section A Introduction & Summary of Status Quo, 25 (Oct., 2010), *available at* http://www.metrogis.co.za/docs/WDEMF_Draft_EMF_Report_SectionA.pdf (on file with author) [hereinafter WDEMF Report] (last visited Mar. 17, 2011).
[52] Project Appraisal Document, *supra* note 1, at 114; EIA Report, *supra* note 17, at 229.
[53] HUNTER, SALZMAN, & ZAELKE, INTERNATIONAL ENVRIONMENTAL LAW AND POLICY, 523-24 (1998).
[54] Limpopo River Awareness Kit, http://www.limpoporak.com/en/river/climate+and+weather/climate+of+the+limpopo+river+basin/water+scarcity+in+the+basin.aspx (last visited Mar. 17, 2011).
[55] Limpopo River Awareness Kit, http://www.limpoporak.com/en/river/climate+and+weather/climate+of+the+limpopo+river+basin/water+scarcity+in+the+basin.aspx (as of 2010) (last visited Mar. 17, 2011).
[56] *See infra* section IV.2.
[57] *See generally* OP 10.04, *supra* note 7; Agreement Between the Republic of Botswana, the Republic of Mozambique, the Republic of South Africa, and the Republic of Zimbabwe on the Establishment of the Limpopo Watercourse, (2003) *available at* http://www.icp-confluence-sadc.org/sites/default/files/Limpopo%20Water%20Course%20Commission_Eng.pdf [Commission [hereinafter the Limpopo Watercourse Comission Agreeement] (last visited Feb. 17, 2011).
[58] Michael Kidd and Nevil W. Quinn, *Public Participation in Southern African Watercourses*, 156, in Public Participation in the Governance of International Freshwater Resources, 159 (ed. Carl Bruch, Libor Jansky, Mikiyasu Nakayama, and Kazimierz A. Salewicz 2005).
[59] LimpopoWater Commission Agreement, *supra* note 57.
[60] *Id.* Art. 3, cl. 1.
[61] *Id.* Art. 9, cl. 2.
[62] Project Appraisal Document, *supra* note 1, at 70.
[63] *Id.* at 76.
[64] *Id.* at 173; Competing for Limpopo Water, WATER RHAPSODY: RE: THINKING WATER (April 29, 2010) *available at* http://www.rainharvest.co.za/2010/04/29/competing-for-limpopo-water/.
[65] *See* EIA Report, *supra* note 17, at 55 (discussing the main surface water area); IFPRI, *Climate Change Implications for Water Resources in the Limpopo River Basin*, Introduction (Apr. 2010), *available at* http://www.ifpri.org/sites/default/files/publications/ifpridp00961.pdf (last visited Feb. 17, 2011).
[66] Project Appraisal Document, *supra* note 1, at 173. Dry cooling is a less water-intensive process used in the normal operation of the plant. EIA report, *supra* note 17, at 5.
[67] Project Appraisal Document, *supra* note 1, at 36.
[68] *Id. a*t 173.
[69] EIA Report, *supra* note 17, at 18-20.
[70] *Id.* at 20-21.
[71] *Id.* at 18-20.
[72] Project Appraisal Document. *supra* note 1, at 38, 73.
[73] *Id.* at 72-73.
[74] EIA Report, *supra* note 17, at 91.
[75] Current allocations are for: the Matimba Coal Power Station, the Iscor Coal Mine, Lephalale, and Irrigation. WDEMF Report, *supra* note 51, at 28.
[76] There is no evidence that this environmental cost has been taken into account in the Economic Analysis.
[77] Project Appraisal Document *supra* note 1, at 42-43.
[78] EIA Report, *supra* note 17, at 92. Interestingly, another option for additional water was raising the Mokolo Dam wall, which was ruled out partly because doing so would affect the Limpopo River and that would require consultation with Limpopo Basin States. Transferring water from the Crocodile River did not, in their view, raise this concern, however, the Crocodile is also a tributary of the Limpopo. Even though the water is treated inter-basin water, there may be opportunity costs with transboundary implications.
[79] Project Appraisal Document, *supra* note 1, at 175.
[80] There is currently a human reserve for water allocation, but human needs can change drastically over time; it is imperative that reserves for human consumption are met first. *See* EIA Report, *supra* note 17, at Appendix L.
[81] Project Appraisal Document, *supra* note 1, at 173, 175.
[82] Epstein et. al., *supra* note 22, at 82.

[83] *Id.* at 81.
[84] *See* Earthjustice, *Coal Ash Contaminates our Lives* (2011) *available at* http://earthjustice.org/our_work/campaigns/coal-ash-contaminates-our-lives?gclid=CNevu9ag76YCFYnd4Aod8mMLFg (last visited Mar. 17, 2011).
[85] EIA Report, *supra* note 17, at section 6.9; MIROSLAV RADOJEVIĆ & ROY M. HARRISON (eds.), ATMOSPHERIC ACIDITY: SOURCES, CONSEQUENCES, AND ABATEMENT, 469 (1992), *available at* http://books.google.com/books?id=aU3i3TEk8nYC&lpg=PR5&ots=gv0lCqaId_&dq=Atmospheric%20Acidity%3A%20Sources%2C%20Consequences%2C%20and%20Abatement&lr&pg=PA469#v=onepage&q&f=false (last visited Mar. 17, 2011).
[86] *See* RADOJEVIĆ & ROY M. HARRISON¸ *supra* note 86, at 469-70; U.S. Environmental Protection Agency Action Memorandum (AM) Fact Sheet on Selected Engineering Evaluation/Cost Analysis (EE/CA) Alternative Kingston Fossil Fuel Plant Release Site Harriman, Roane County, Tennessee, 1 (May 2010) *available at* http://www.epa.gov/region4/kingston/FINAL_TVA_EECA_Fact_Sheet051810.pdf (last visited Mar. 17, 2011).
[87] EIA Report, *supra* note 17, at 104.
[88] Epstein et. al., *supra* note 22, at 78; Greenpeace, *Acid Mine Drainage in Johannesburg*, http://www.greenpeace.org/africa/en/News/news/Acid-Mine-Drainage/ (last visited Mar. 17, 2011).
[89]News24, *Residents Complain About Medupi* (2010), http://www.news24.com/SouthAfrica/News/Residents-complain-about-Medupi-20100406 (last visited Mar. 17, 2011); Bretton Woods Project, *Eskom Loan Blackens the World Bank's Name* (2010), http://www.brettonwoodsproject.org/art-566122 (last visited Mar. 17, 2011); *World Bank Inspects Medupi Impacts* (2010), http://www.kwevoel.co.za/2010/11/05/world-bank-inspects-medupi-impacts/ (last visited Mar. 17, 2011).
[90] *See generally* Malaysian Department of Irrigation and Drainage, *River Sand Mining Management Guide* (2009), *available at* http://www.engr.colostate.edu/~pierre/ce_old/classes/ce717/Sand%20mining.pdf (explaining the general impacts of sand mining on river systems) (last visited Mar. 17, 2011).
[91] *See e.g.*, EIA Report, *supra* note 17, at Chapter 6.8.6.
[92] As noted before, even if mitigation strategies are employed, the impacts of the strategy and any outstanding impacts should be considered.
[93] Project Appraisal Document *supra* note 1, at 87 (Annex I).
[94] *Id.* at 35.
[95] EIA Report, *supra* note 17 at 59.
[96] This can be done through a dose relationship. *See* Handbook on Economic Analysis of Investment Operations, *supra* note 28, Chapter 7 ¶ 9.
[97] *Id.* at Chapter 7 ¶ 9.
[98] *Id.* at Chapter 7 ¶ 17 - 19. Note that changes in health can also increase costs in the form of relief labour (when workers are unwell), which in return increases the risk of exposure and associated health problems to even more individuals than initially may have been assessed.
[99] *Id.* at Chapter 7 ¶ 19; s*ee generally* Bruce Rich (Environmental Defense Fund), *Foreclosing Coal* (2009), *available at* http://www.edf.org/documents/9593_coal-plants-report.pdf (last visited Mar. 17, 2011).
[100] American Lung Association, *New Report from Clean Air Task Force Details Deaths and Other Public Health Impacts from Coal-Fired Power Plants in New York*, *available at* http://www.lungusa.org/associations/states/new-york/pressroom/news-releases/2009/rel-toll-from-coal-9-9-10.html (last visited Feb 24, 2011).
[101] Clean Air Task Force, *The Toll from Coal: An Updated Assessment of Death and Disease from America's Dirtiest Energy Source*, (September 2010), *available at* http://www.catf.us/resources/publications/view/138 [hereinfater Toll from Coal] (last visited Mar. 18, 2011).
[102] *Id.*
[103] *Id.* Additionally, surface winds in the area can cycle back, which could then impact even upwind towns.
[104] Epstein et.al., *supra* note 22, at 74-75.
[105] HUNTER, SALZMAN, & ZAELKE, *supra* note 53, at 523-24.
[106] *Id.* at 85.
[107] Safeguard Diagnostic Review, *supra* note 19, at 60.
[108] Project Appraisal Document, *supra* note 1, at 70.
[109] Safeguard Diagnostic Review, *supra* note 19, at xvii.
[110] *Id.* at 53. EIA Report, *supra* note 17, at 318-220.
[111] Safeguard Diagnostic Review, *supra* note 19, at 53.
[112] WDEMF Report, *supra* note 51, at 42.

[113] *Id.* at 42.
[114] *Id.* at 43.
[115] Safeguard Diagnostic Review, *supra* note 19, at xix.
[116] EIA Report, *supra* note 17, at 21, 327..
[117] *Id.* at 327.
[118] Project Appraisal Document, *supra* note 1, at 163-187.
[119] *Id.* at 56.
[120] World Health Organization, "Air Quality and Health: Fact Sheet No. 313" (August 1, 2008), *available at* http://www.who.int/mediacentre/factsheets/fs313/en/ (last visited Mar. 16, 2011).
[121] Toll from Coal, *supra* note 101.
[122] *Id.*
[123] *See supra* section IV.3 (introduction).
[124] EIA report, *supra* note 17, at 322.
[125] *Id.* at 319.
[126] South African Department of Environmental Affairs, *Effects of Climate Change,* http://soer.deat.gov.za/174.html (last visited Mar. 17, 2011).
[127] Project Appraisal Document *supra* note 1, at 48.
[128] *Id.* at 47.
[129] *Id.* at 170.
[130] *Id.* at 49.
[131] THE WORLD BANK GROUP SUSTAINABLE DEVELOPMENT NETWORK, *Energy Strategy Approach Paper,* 15 (October 2009), *available at* http://siteresources.worldbank.org/EXTESC/Resources/Approach-paper.pdf (last visited Mar. 14, 2011).
[132] Project Appraisal Document *supra* note 1, at 164, 170.
[133] *Id.*
[134] Epstein et. al., *supra* note 22, at 93.

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