Recommendations to the World Bank Group on Lending to South Africa for Eskom Investment Support Project that includes a Large Coal Burning Power Station at Medupi

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Recommendations to the World Bank Group on Lending to South Africa for Eskom Investment Support Project that includes a Large Coal Burning Power Station at Medupi

Executive Summary

1. The South African and neighbouring economies are in desperate need of additional electricity production in the near term – with all economies in the Southern African Region having experienced crippling shortages in early 2008 and current growth being constrained due to capacity shortages. As such there is a critical need for rapid expansion of electricity supply and for significant improvements in energy efficiency to provide essential energy services. The process of adding power plants started in 2004 with the rapid construction of the Medupi coal fired power plant amongst other initiatives. This very large facility will add about one-eighth to South Africa's generation capacity and is scheduled to come on stream beginning in 2012. Medupi will produce large quantities of carbon dioxide. The World Bank Group has been asked to provide financing for this project, and this raises the question of whether such financing would be fully aligned with the Bank's policy position on climate change.

2. An Expert Panel has been assembled to advise the Bank regarding this project and specifically on its compatibility with the Bank's Development and Climate Change Strategic Framework (DCCSF). The Panel recommends that the Bank Group finance Medupi, but also engage in a longer term relationship with South Africa which is aimed at placing South Africa on a low carbon road. To be fully consistent with its own policy, the Bank needs to adopt a supportive program to help South Africa meet its own climate goals. In this regard the Panel finds that a major opportunity exists to introduce more sustainable energy technologies and practices as part of a program of investing for transition to an eventual low carbon future. The South African Long Term Mitigation Scenarios (LTMS) and its National Integrated Resource Plan (NIRP) for energy places Medupi in the context of an emission scenario where emissions plateau between 2020 and 2025 and thereafter decline in real terms – potentially to below 2003 levels by 2050. World Bank finance, initially for the Medupi project, could play a major role in changing the technology base of the region – addressing energy constraints while improving the performance of the South African and Regional economy. Since, South Africa already has announced goals to lower carbon intensity and eventually emissions, the World Bank Group should assist the government in meeting its goals so that the government's low carbon plans can now be realized through a long-term partnership with the Bank.

3. If the World Bank decides to approve the Medupi project, we find that the spirit of the DCCSF criteria requires that the Bank should also commit itself, in principle, to such a transition partnership with the South African Government. This partnership must clearly include elements whose long-term benefits, in terms of greenhouse gas savings, are aligned with achieving the savings envisaged in the LTMS – which far exceed the emissions of Medupi. While, we call for the Bank to link these energy delivery improvements with lower carbon dioxide emissions, we recognise that decisions about many of the specifics of these emission reducing technologies and measures must come at a later date, and must be

consistent with the aims of the South African government. This report suggests a portfolio of potential measures that would be in addition to the measures that are already included in the current financing plan associated with Medupi.

4. While this report focuses on South Africa and the Medupi project we suggest that the recommendations may have wider implications. Particularly, that Bank funding of major fossil fuel projects without the potential for adding carbon sequestration or alternative low emission technologies be considered a transitional development strategy and that the Bank create a portfolio of policies and measures for supporting recipient countries in their efforts to move to less carbon intensive development paths.

Introduction

5. The South African and neighbouring economies are in desperate need for additional electricity production in the near term. There is a critical need for rapid expansion of electricity supply to sustain economic growth and social development. In response to this situation Eskom initiated a build programme in 2004, including the Medupi coal fired power plant. This very large supercritical facility is being built rapidly and will add about one-eighth to South Africa's generation capacity. It will however, produce large quantities of carbon dioxide that will contribute to global climate change. The World Bank Group has been asked to provide financing for this project and this raises the question of whether such financing would be fully aligned with the Bank's policy position on climate altering emissions, as set out in its document D*evelopment and Climate Change: Strategic Framework for the World Bank Group* (DCCSF). An Expert Panel has been assembled to advise the Bank on this project. There are two "easy" possible choices. One is to approve the power plant and ignore its emissions. However this would not be consistent with the spirit of Bank Policy as described in the DCCSF. The second is not to finance the power plant because of its emissions, a policy that would increase the economic stress of poor nations. This clearly would not be consistent with the Bank's development goals. These two options represent a traditional perspective that economic development may be in conflict with environmental goals, and one must choose one or the other. The Expert panel is proposing a third option reflecting its strong belief that environmental and development objectives must be pursued together.

6. The third option, which we strongly recommend, is that the Bank Group finance Medupi and at the same time, also commit itself, in principle, to a transition partnership with the South African Government. This partnership must specifically include elements whose long-term benefits, in terms of greenhouse gas reductions, are aligned with achieving the savings envisaged in the Government's Long Term Mitigation Scenarios (LTMS) – which far exceed the emissions of Medupi. While we call for the Bank to link these energy delivery improvements with lower carbon dioxide emissions, we recognise that decisions about many of the specifics of these emission reducing technologies and measures must come at a later date, and must be consistent with the aims of the South African government. This report suggests a portfolio of potential measures that would be in addition to the measures that are already included in the current financing plan for Medupi.

There is a major opportunity to introduce a portfolio of additional sustainable energy technologies and practices as part of a strategy of investing in an eventual low carbon future.

This will better align the practice of Bank financing with its climate goals. The leadership shown by South Africa in recent years in preparing a low emitting plan can now be turned into reality in the form of a long-term partnership with the Bank. The South African LTMS and its National Integrated Resource Plan (NIRP) for energy places this plant in the context of an emission scenario where emissions plateau between 2020 and 2025 and thereafter decline in real terms – potentially to below 2003 levels by 2050. .

South Africa and Climate Change Mitigation

7. Climate change represents a grave threat to humanity and, in many cases, it is the citizens of developing countries who are most exposed to the consequences. Climate change mitigation should be considered as an integral component of sustainable economic development. Global mitigation strategies, if they are to be successful, must also be supportive of economic development. To achieve sustainable development requires that the economy, social and political institutions and the environment be sustainable.

8. The stabilization of greenhouse gases in the atmosphere as required by the United Nations Framework Convention on Climate Change (UNFCCC) requires that all Countries in the world shift to a cleaner energy and lower carbon development trajectory. Further, UNFCCC requires that countries should progress with their developmental aspirations in a sustainable manner so as to ensure a more equitable and fair world. These actions need to be carried out in a way that recognizes common but differentiated responsibilities, capacities and circumstances. However, the predicted and current impacts of the changing global climate are felt all over the world and so actions to lower greenhouses gases in the atmosphere should be universal while ensuring that developing countries will progress in a sustainable manner.

9. Shifting to a low carbon intensive path and the widespread use of renewable energy will need significant scaling up of energy investments in renewable energy technologies, low-emission fossil-fuel technologies, such as Carbon Capture and Storage (CCS), and energy efficiency technologies and measures. Energy needs vary worldwide from national energy needs to survive, to needs for development, and eventually to the need to sustain developmental gains. Different needs call for different approaches.

10. This project should be viewed as the aspiration of a developing country, South Africa, trying to satisfy its national energy needs as well as its obligation to provide energy to six other neighbouring African countries that will continue to depend on South Africa for the foreseeable future. The South African government has adopted a climate change mitigation strategy that envisages stabilizing their GHG emissions by 2020-2025 followed by a decline in absolute terms by mid-century.

11. South Africa ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1997 and acceded to the Kyoto Protocol in July 2002. More recently South Africa has been prominent in developing the collective African negotiating position on climate change, and in the preparation of the Copenhagen Accord. Nationally, South Africa first developed a National Climate Change Response Strategy in 2004, which outlined a broad range of principles and policy measures of mitigation and adaptation to climate change. In 2005, the country adopted a White Paper on Renewable Energy, which sets a target of 4% of electricity supply, equivalent to 10,000 GWh annually, from renewable energy sources by 2013. Further, South Africa adopted a National Energy Efficiency Strategy in 2006, which

has been updated in 2009. In this strategy, ambitious national targets for energy efficiency improvement were set, including the aim of a 12% improvement by 2015. A National Energy Efficiency Agency (NEEA) has been established to pursue this target through various energy conservation programs. In 2009, the South African national regulator, NERSA, implemented the REFIT program, which sets prices for the purchase of electricity produced by renewable energy projects such as wind, solar, etc.

12. In 2008, South Africa completed a major analytic study identifying the priority sectors for carbon mitigation. The LTMS is a pioneering effort by a developing country to combine high-quality research with extensive stakeholder consultations. Based on this process South Africa has put forward an aggressive LTMS based policy recommending priority climate change mitigation strategies for the country. This strategy includes the National Integrated Resource Plan (NIRP) which details the specific capacity and energy efficiency investments required over time to stabilise emissions between 2020 and 2025, and thereafter reduce emissions – potentially to 2003 levels by 2050.

13. On 29 January 2010, South Africa formally notified its climate change mitigation proposals with the United Nations Convention on Climate Change. These included a 34% reduction of emissions below "Business as Usual" by 2020 and a 42% reduction by 2025. This would enable South Africa's greenhouse gas emissions to peak between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter. The letter of notification says that, "the extent to which this action will be implemented depends on the provision of financial resources, the transfer of technology and capacity building support by developed nations". We believe that the World Bank now has the opportunity to play a major role in helping South Africa to achieve this transition.

Challenges in the Power Sector in Africa

14. Africa's contribution to the current global climate change threat is extremely small, both currently and cumulatively. In fact the whole of Africa contributes less than 4% of global CO2 emissions, and its forests partially offset these emissions as an important global carbon sink. However, due to the reliance on coal for electricity production needs, South Africa is a net emitter of greenhouse gases.

15. Africa, as a continent, is the lowest consumer of electricity worldwide and has yet to meet the average threshold of electricity use needed to ensure minimum power needs for acceptable quality of life. The continent urgently needs to improve this situation. Paradoxically, the continent's share of global fossil energy resources is slightly less than 10%. 24% of Africa's hydropower resources have been exploited, which amount to over 10% of world hydropower resources. The location of the continent makes it extremely favourable for solar and biomass energy.

16. These vast energy resources are generally differentiated among its regions and are concentrated in a few countries within the different regions. Northern Africa dominates the production of natural gas, which is concentrated in Libya and Algeria. The West African coastline has significant crude oil deposits concentrated in Nigeria and Angola. All the countries along the Rift Valley dominate the energy resources of the Eastern African region, as they all have significant reserves of geothermal energy. Hydropower dominates the energy

sources of Central Africa, with much of this resource being in the Republic of Congo. Southern Africa has most of the coal deposits with almost 90% being in South Africa, which has the fourth largest global reserves.

17. Africa is undergoing a major energy crisis despite having sufficient fossil and renewable energy, to produce all the power needs of the continent. The challenge is to develop these resources and associated infrastructure. Developing the power sector in the continent will require overcoming certain obstacles. Although South Africa itself has relatively low energy costs, in many African countries the cost of producing power and the price to consumers are still among the highest in the world. Electricity tariffs in the African region average around twice the world average. In some inland African countries, it costs up to 25 cents per kWh. The OECD average is about 16 cents per kWh. Energy investment needs are enormous, but both public and private funds available are far from adequate. Also, several power institutions in African countries are pursuing various types of institutional reforms but their overall impact is limited.

18. Historically, electricity consumption in Africa, especially in the sub-Saharan region was at a very low level in comparison to other developing regions. Since the 1950s, power plants installed in Africa have averaged only 40 MW per 1 million inhabitants when in the same period it was 200 MW in Latin America and 800 MW in Asia. Unfortunately, electricity growth rates on the continent have been very low. As a result, access to electricity in the continent is very low, only about 35% and even lower for the sub-Saharan region at 24%. Electricity consumption for the rest of Africa is only about 124 KWh/ year, excluding South Africa, while it is 10 times that for China as compared to 8,800 KWh/year for the OECD.

19. Africa, as a whole, has an installed electric power capacity of about 100 GW and Sub Saharan Africa has only 63 GW, which is equivalent to that of Spain. Without South Africa, the 48 countries in sub-Saharan Africa have only 28 GW, equivalent to that of Argentina. Hence, the need for a substantial increase in installed power is not only huge but also urgent.

20. In general, it has been observed that the main reason for Africa's lack of competiveness is its infrastructural deficiencies, estimated to account for 40-80% of the difficulties. Over half of these have been attributed to the power sector. The constraints of electricity supply have resulted in major economic problems amounting to a loss of 5.6% of GDP. Some countries in the region have been forced to use emergency power which is mostly diesel operated, proving to be very expensive, costing between 35-40 US cents/KWh. Such systems are estimated to have reached the total of 700 MW costing countries between 2 - 4.3% of their GDP.

South Africa and Southern Africa

21. South Africa is a member of the South African Power Pool (SAPP), which is made up of the power utilities in 12 African countries. South Africa exports electricity to six of these countries, namely Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe. The share of electricity imports in these countries varies between 50-100% of their total needs.

22. SAPP as a region intends to increase its electricity consumption substantially in the next few years and South Africa is expected to satisfy much of this growth. As an example, neighbouring countries could potentially double their imports from South Africa by 2015. As a whole SAPP intends to increase its power reserve margin from the present 6% to 17% by 2015.

23. Unfortunately, prolonged droughts have affected the capacity of Southern African countries to meet their current and future needs as water is vital for cooling thermal plants and the region also heavily depends on hydro plants. This dependence on a limited water supply may become worse with climate change.

24. South Africa and the Southern African region exchange electric power through the SAPP. Today, the region is suffering an unprecedented power crisis. The Medupi project will help to alleviate the electric power crisis by using a locally available source (coal) and one of the most efficient coal technologies available (super critical boilers) to reduce CO2 emissions.

South African CO2 Emissions in Context

25. The context for this investment includes the existing emission levels in the region. Because South Africa is the hub for electricity supply throughout Southern Africa it is reasonable to consider the position of sub-Saharan Africa as a whole, as well as for South Africa itself. CO2 emissions per person for Africa, as a whole, are less than a quarter of the World average and less than one tenth of those for OECD. South Africa's own emissions reflect the fact that it is a rapidly developing coal based economy with a large resource sector. CO2 emissions per person are above the World average but below the average for the OECD and less than half those of developed resource based economies such as Canada and Australia. The energy intensity of South Africa's economy is high by World and OECD standards, but it is not out of line with other rapidly developing economies such as China, India, or Indonesia. The fact that South Africa's economy is considerably more energy intensive than the developed resource based economies may suggest, however, as the South African economy develops, large potential exist for energy efficiency gains. This potential is discussed further below.

26. International opinion has established, as key objectives of climate change mitigation, the need to stabilise greenhouse gas concentrations in the atmosphere below 450 ppm CO_2 equivalent in order to limit global warming to 2 degrees Celsius, a figure that has been endorsed by the recent Copenhagen Accord, signed by South Africa among other nations. The international agreements needed to achieve this and the precise implications for individual countries are still under discussion. However, it is possible to take the 450 ppm Scenario published by the International Energy Agency in their World Energy Outlook 2009 as one example of how the targets might be achieved.

27. In the 450 ppm Scenario, South Africa is grouped with other non-OECD countries such as China, Russia, Brazil, and countries of the Middle East, with GDP expected to exceed $13,000 per capita in 2020. For these countries, CO2 emissions are expected to continue growing until about 2020 before declining towards the level of 2010 in 2030. These countries are projected to increase their coal generation capacity by a total of about 250 GW

between 2010 and 2020. However after 2020 any additional coal capacity without CCS would be balanced by retirements. The South African LTMS is largely aligned with this approach.

South Africa's Strategy for Climate Change Mitigation

28. South Africa has been a leader among developing countries in recognising climate change and its role in addressing carbon dioxide emissions. The Government of South Africa is seeking to implement an ambitious Long Term Mitigation Scenario (Required by Science) in which South Africa's emissions would peak in 2020, and then decline. This is based on the assumption that South Africa does not have to take the same mitigation actions as the developed countries but that, along with other major emitters in the developing world, it takes responsibility and quantifiable mitigation action commensurate with its level of development and national circumstances. The Scenario requires strong measures to improve energy efficiency across the economy as well as in the power sector. South Africa has also announced an "intensity target" for its emissions during the Copenhagen negotiations, where it also signed an agreement along with China, India, Brazil and the United States to a set of general goals to limit future warming – the Copenhagen Accord.

29. The South African power company Eskom has developed a Policy Adjusted Integrated Resource Plan (PIRP) for the power sector, consistent with the Government's strategy, in which CO2 emissions from electricity generation rise from 220 M tonnes per annum today, peak at about 320 M tonnes in 2022, and then decline to 275 Million Metric Tonnes by 2025 - which is the national target for the power sector. The strategy requires an ambitious programme of up to 5 GW of renewable power (currently assumed to be concentrating solar), 4.5 GW of hydro and gas, at least 10.5 GW of nuclear, and a program of demand side measures including the installation of a million solar hot water heaters. The feed-in tariffs that have been put in place by the Government are expected to incentivise substantial additional sources of renewable power supplied by independent companies. The South African Government has adopted this plan as the National Integrated Resource Plan (NIRP).

30. The NIRP includes about 10 GW of additional coal capacity to be commissioned by 2017 from t Medupi and Kusile, as well as Ingula pumped storage project. These are already planned and ongoing. Kusile, and any subsequent plant will be designed as Carbon Capture-ready. Eskom recognises that coal plants without CCS should now be recognised as a transitional technology and, as far as possible, any further new coal capacity would be CCS ready. Eskom's Climate Change Strategy recognises that CCS could play a critical role in reducing emissions for new coal plant depending on how the technology progresses and its potential for application in South Africa. While it is envisaged that, from 2020, retired plants will be replaced with either non-emitting technologies or low emitting clean coal technologies including CCS, the potential for retrofit on existing plant has not been excluded.

The Proposed World Bank Financing

31. The proposed financing by the World Bank Group consists of three components; Component I, about $3billion of IBRD support for the Medupi coal-fired power plant;

Component II, about $510million of IBRD, CTF and AfDB support for wind and concentrating solar power projects; and Component III, IBRD support of about $490million to finance a railway to an existing coal power plant, efficiency upgrades at two other existing coal plants, and other supply side efficiencies.

Component I: The Medupi power plant

32. The Medupi project consists of six 800MW units, giving a total capacity of 4.8GW, due to be commissioned progressively between 2012 and 2016. The station is already under construction and orders for most of the major components have already been placed. The World Bank will be contributing about $3b towards a total cost of the plant of $15.4b. The assistance of the World Bank is needed to enable Eskom, South Africa's government owned electric utility, to complete the project to this timetable. Without the Bank's help there would be major delays and additional impacts that would compromise security of electricity supply in the region. This would in turn have a major negative impact on the South African economy and the economies of the other Southern African Development Community nations. The project would increase Eskom's total generating capacity by about 12%.

33. As described above, the additional capacity is urgently needed to meet the recent power shortfall and expected power demand in South Africa and throughout the region of Southern Africa in the next few years. Power shortages during the first quarter of 2008 caused load-shedding by Eskom which are estimated to have reduced GDP growth to an annual equivalent of 1.7%, its lowest level in more than six years, and reduced mining activity by 26%, its sharpest decline on record. Although the recession in South Africa has eased the situation for the time being, there is every reason to expect that, without additional capacity, the economic recovery in Southern Africa will again be vulnerable to power shortages in the near future. Southern Africa is one of the most energy-deprived regions of the World and improved access to electric power will be vital for improving living standards.

34. The Government of South Africa has responded with actions to increase generating capacity and reliability, including investment in renewable energy sources, and to enhance energy efficiency. Projects to enhance energy efficiency and to promote renewables are included in other components of the World Bank's assistance package. South Africa has considerable potential for wind power and for concentrated solar power, and there is also potential to further develop hydropower in the Southern Africa region. As described in more detail below, it is essential that every effort be made to develop these low carbon energy resources, and to improve the efficiency of delivering energy services to the regional economy. But, starting from the present level of development, this will take time, which is why it is essential to begin the process of developing these resources immediately. Coal fired power is, for the moment, the most competitive and easily accessible source of power to South Africa. Within the scope of this study, we accept the view of the South African Government and of the World Bank that large scale additions of coal capacity are urgently needed in the near term. They are necessary to meet the development needs of South Africa and the Southern Africa region as part of a transitional strategy to a low carbon, highly efficient economy.

35. Eskom has chosen super-critical pulverized coal air-cooled technology for Medupi. The plant will have an overall efficiency of 37.5%. This does not include parasitic losses at the power station itself. If added, flue gas desulphurisation will lower efficiency by 0.8 to 1.5% resulting in an additional 0.6 MMT of CO_2 being emitted annually. We have not

undertaken any detailed engineering assessment, but we understand that a rigorous process was carried out by Eskom to ensure that the best-proven available power generation technology is employed. The choice of this technology appears reasonable for South Africa. Super-critical technology gives significant efficiency benefits as compared to the sub-critical technology used for most existing stations in South Africa and throughout the World. There will be an efficiency penalty from using air-cooling rather than water-cooling, but this choice is probably inevitable given the water scarcity in South Africa. At this point water is the most significant constraint on thermal power development, and future thermal power plant development will need to take account of both the limitations of physical supply and the provisions of the progressive South African water law.

36. Desulphurisation technology will not be included as part of the original equipment of Medupi. However the plant will be Flue Gas Desulphurisation (FGD) ready, and we understand that Eskom proposes to proceed to install FGD progressively, with all Medupi units to be equipped by 2020. According to one analysis, this will require additional water, which is already scarce. Addressing the water problem is essential. We urge Eskom and the World Bank to ensure, as far as possible, that this timetable is met, in compliance with international good practice.

37. At this stage in the international development of carbon capture and storage (CCS), and of geological studies in South Africa, it is hard to tell whether retrofitting with CCS will ever be a realistic option for Medupi. The plant is not being laid out specifically to facilitate the possibility of retrofit, as Eskom's next plant, Kusile, and all future plants, will be. This is due to the fact that at design stage in 2005 CCS engineering concepts were at a preliminary stage. We, however, understand that there would be ample space in the area of Medupi to accommodate a capture plant, so retrofit remains a possibility depending on the progress of CCS technology and the availability of local resources – mainly water and sequestration sites. Nevertheless South Africa is taking several steps to improve its knowledge of CCS and Eskom is conducting a geological study into sequestration sites in South Africa and undertaking research into CO2 mineralisation and bio extraction technologies. We therefore urge the World Bank, as part of its continuing relationship with South Africa, to support efforts to demonstrate South Africa's CCS potential, including geological exploration of reservoirs and the South African National Energy Research Institution's vision of having a CCS demonstration plant operational in South Africa by 2020.

Component II: Wind and solar power

38. The second component consists of support for a wind farm, for transmission enhancements, and for a concentrating solar power (CSP) plant. These are expected, together, to cost about $1b, of which the IBRD will contribute $260m and the CTF $350m ($250m through the IBRD and $100m through the AfDB).

39. South Africa has no significant wind energy plant at present, but has a significant wind and solar resource. Eskom has been a leader in wind power development through its Klipheuwel test station and is now ready to build the proposed Western Cape Province Wind Energy Facility. The World Bank package will help finance the first phase of this, a 100 MW wind farm expected to have a load factor of about 25-31%. The transmission enhancements will open the door for further development of the Western Cape facility in the future.

40. Africa has exceptional potential for CSP. The particular technology that is being proposed by Eskom, which uses molten salt for thermal circulation and storage, has the

potential to function as a base load unit. The Upington Concentrating Solar Power Plant will, once the technology feasibility study has confirmed Eskom's R&D, be the first commercial scale plant of its kind in Sub-Saharan Africa, with a rated capacity of 100 MWe. Eskom envisages that this will be the first of a major fleet of solar plants and is currently developing a solar park concept which could enable massive future investment in solar in the region – as well as the development of a local solar manufacturing base.

41. The immediate CO2 savings that will be attributable to these renewable projects will be modest by comparison to the emissions of Medupi, bearing in mind that the total generating capacity is less than 5% of Medupi. Nevertheless, we applaud the decision of the World Bank to include them in this financing package because they will demonstrate for the first time some power technologies that can play an important part in a sustainable energy future for South Africa and Southern Africa generally. CSP, especially, is a clean energy technology of great promise for Africa. In addition this finance will unlock the potential for massive development in renewable energy in the region over the next two decades.

Component III: Road to rail and other efficiency projects

42. The third component of the package consists of $490m of IBRD financing towards a railway to the existing Majuba coal power plant, power plant efficiency improvements, and technical assistance on efficiency.

43. The 68 KM railway will displace the convoy of 700 trucks a day that now supplies coal to Majuba with substantial efficiency gains and benefit to the local environment.

44. The efficiency improvements may include enhanced dry air cooling at the 2.4 GW Matimba plant (33% efficiency) and upgrading of turbines at the 400 MW Hendrina plant (34% efficiency).

45. As with the renewable projects, the direct impact of the energy efficiency projects in the financing package will be modest by comparison to the Medupi emissions. Nevertheless we welcome their inclusion because the progressive upgrading of the efficiency of Eskom's fleet, combined with retirement of the least efficient plant when capacity considerations permit, will play an important part in moderating and eventually reversing the growth of South Africa's CO2 emissions. This also needs to be seen in the context of the much bigger national energy efficiency programme, which has already seen a reduction of almost 2000MW in demand at peak in South Africa. The future programme includes the roll out of 1 million solar water heating systems by 2015 as well as continued improvements in domestic, commercial and industrial efficiency

Options for Reducing Carbon Emissions in South Africa

46. The government of South Africa has recognized "the scientific imperative" to reduce heat trapping emissions, and has stated its commitment to eventually achieve that goal. Given South Africa's role in supplying electric power not only for itself, but also for other countries in southern Africa, it is highly desirable that the World Bank assist South Africa in meeting the current acute need for additional electric power generation capacity and in assisting them to effect a transition to a sustainable energy system. The strategy for reducing climate altering

greenhouse gas emissions should be designed to enhance regional economic development in a sustainable manner. It is possible to meet the current electricity power needs while making the regional economy more energy and economically efficient, and to do so in a manner that supplies needed energy services and goods, creates jobs, and which utilizes technologies that, to the extent possible, could be manufactured or assembled in South Africa. As such a long-term partnership in support of South Africa's climate change strategy would be of major benefit to South Africa and the region.

47. It is recognized that South African CO2 emissions will increase at least until 2020, and that Medupi will contribute substantially to this increase - estimated at nearly 25MMT of CO2 per annum. Nevertheless, the World Bank should develop with the South African government and Eskom a full range of options that will reduce emissions from other operations and activities to lower (or moderate the increases in) national emissions arising from the project. The South African Government's LTMS (Required by Science) and the Government's NIRP together provide an excellent framework for such an initiative. These emission reductions can range over time and space within and even outside of South Africa. The *near term* increase in coal-based electricity should be seen as a *transition strategy* so that South Africa can eventually meet its goals of emissions stabilization and *long term* emissions decrease.

48. The strategy can be framed in terms of the delivery of energy services, mobility and industrial processes with the least energy input at minimal cost and lowest emissions. It is convenient to divide possible actions for achieving this goal into several categories that can be utilized singly or in concert.

- Reduce emissions directly related to the Medupi project, and from other Eskom operations – potentially building on Eskom's existing internal energy efficiency programme.

- Expand the end use energy efficiency program in South Africa and the entire Southern African region to lower demand for electricity and reduce emissions. Substantial resources are already included in Eskom's current price increase application for the roll out of the national programme.

- Use this opportunity to expand the introduction of alternative renewable energy beyond the 100 MW concentrating solar power plant and the 100 MW wind project.

- Find additional opportunities for reducing heat trapping emissions from the mining and construction industries, coal mine fires, methane leaks and by reducing other greenhouse gases.

- Build capacity by training engineers, inspectors, government regulators and financial experts in energy efficiency, renewable energy and energy finance.

- Further expand carbon saving transport opportunities such as road to rail electric vehicles and improved public transport.

- Develop the immense low carbon energy potential, especially in hydropower, within the continent.

Reduce emissions directly related to the Medupi project, and from other Eskom operations

49. Some aspects of this strategy are already in future plans of South Africa and that of sub- Saharan Africa. Shifting coal delivery from truck to rail is already in the plan for Majuba, which will significantly lower emissions. During the construction phase, efforts should be made to maximize energy savings and carbon dioxide emissions in all phases of operations at Medupi.

50. A major source of electricity use by the Medupi plant is the pumping energy to deliver vast amounts of cooling water (6.0 million m^3/annum). It is important that the Medupi plant utilizes the highest efficiency lighting, motors, pumps, and vehicles in the operation of the plant to reduce parasitic loads. Exploration of an integrated solar electricity supply for the water pumping system could lower emissions significantly and maximize the net delivered power to the grid. Using a simple water storage system would allow the full energy from the solar electricity system to be utilized despite its variable nature. Establishing a multiyear program to shift to highest efficiency lighting, motors, pumps and vehicles at other Eskom sites, can expand this effort.

51. Although CCS technology is not currently available, space should be retained at the site for possible future installation of this technology should it become available for Medupi (or other Eskom facilities). Whether this technology is viable also depends upon finding acceptable geological storage sites in the region for carbon dioxide as well as the availability of resources such as water, so it would be useful to continue to pursue the search for such regional locations with support from the World Bank. Alternatives such as algae capture of carbon dioxide, which is being researched in South Africa, might also be examined for future use, since it does not require storage locations. It can either be utilized as a power plant fuel or can produce transportation biofuels and other products. The World Bank should develop policies for what types of CCS projects it might finance in the future.

52. Phasing out old, inefficient power plants as Medupi and other new plants come on line and as end use efficiency programs slow demand for electricity would improve overall performance of the electrical system, and reduce emissions and overall fuel costs. It is recommended that anticipating these eventualities be undertaken within the overall energy and environmental planning process of South Africa with financial support and any needed expertise provided by the World Bank. Eskom's current plans indicate that older stations will start being decommissioned from around 2020 and these will be replaced with non-or low emitting technologies.

Expand the end use energy efficiency program

53. Lower demand for electricity and reduce emissions by expanding the end use efficiency program in South Africa and the entire Southern African region, while improving the delivery of energy services. Eskom has an internal energy efficiency programme aimed at achieving a 15% decrease in non-essential energy consumption by 2015. This includes actions aimed at improving the efficiency of plant and power delivery infrastructure. It is essential that this programme continue to meet its goals. In order to emphasise this point Eskom's shareholder – the South African Government has included the target of this programme in Eskom's shareholder Compact.

54. There are currently end use efficiency programs underway within South Africa. These can be scaled up by ensuring that Eskom and other Energy Service Companies can be paid

for introducing energy services such as lighting, cooking, hot water, heating and cooling to customers with less electricity or fuels and lower emissions. This will improve both local air quality and climate altering greenhouse gas emissions, and will lower costs to consumers. For this to be effective, policies must be developed that assure that profits on these energy savings are greater than if equivalent new power generation capacity were built.

55. A major program that is currently under way is to deliver one million rooftop solar water heaters over the next 5 years. This program appears to be moving relatively slowly, and needs to be expanded. We recommend setting a goal of 3 million installed solar hot water systems over the next 5 years to take advantage of South Africa's abundant solar resource. In addition to residential units, opportunities also exist for commercial buildings, schools, hospitals and government facilities. This is also a relatively simple technology that can be manufactured in South Africa or developed as joint ventures with heavy user countries such as China. Combining these solar heaters with integrated solar PV powered water pumps can further lower the demand for grid electricity and emissions.

56. Standard setting is essential to improving the efficiency of lighting, office equipment and appliances. South Africa already has such a program in its "2005 End Use Standards" targets for energy efficiency performance. Establishing more stringent standards for government ministries, schools, Eskom and Sasol (for the purchase of office equipment, heating and cooling technologies and lighting) could accelerate the shift to more efficient products. Developing policies that would encourage industry and commercial sectors to do the same would have a similar effect. In the consumer sector introducing standards for TV and other commonly purchased appliances in the near-term would help customers, especially if good informational labeling and lower prices accompanied it. It is recommended that the Bank explore the potential of the cost effectiveness of this approach with the South African government and the role it might play in reducing the cost of the transition to more efficient goods.

57. After industry, buildings are perhaps the largest users of energy in South Africa. Improving commercial and residential buildings' performance is a long-term strategy that can lead to substantial reductions in energy use and emissions. There are several opportunities for improving building performance.

58. Devise energy performance standards and building codes for new construction, and in particular limit the construction of large glass box buildings that require major cooling and heating energy. Create major programs to retrofit government offices, schools, universities, hospitals and commercial buildings with better insulation more efficient lighting and office equipment (huge job potential). Utilize the existing Energy Accord to reduce energy use by 15% by 2015. Create a major, sustained program to retrofit residential buildings with better insulation more efficient lighting, solar hot water and appliances (huge job potential).

59. Assisting industry in a phased transition to more efficient industrial processes by making certain that the full price (including externalities) is being paid for electricity and for energy, mining and refining is an important component of the strategy. This can be enhanced by a gradual shift to a full cost pricing system for residential and agricultural electricity consumers while supplying a basic fee or low cost core amount for low-income consumers. In addition the potential to improve the efficiency in the transmission and distribution infrastructure should be further explored. We understand that Eskom and the South African Government are planning to make progress in this direction.

Use this opportunity to expand the introduction of alternative renewable energy beyond the 100 MW concentrating solar power plant and the 100 MW wind project

60. The current project already includes financing for a 100 MW concentrating solar thermal system and a 100 MW wind turbine project. These will be the first renewable technologies of this scale in South Africa or indeed in Sub-Saharan Africa. While each of these projects is a commercial scale project, they are dwarfed by the 4800 MW coal burning Medupi project and others that may follow it, and in no way are comparable in terms of saved emissions. It is recommended that if these pilots are successful, means of rapidly expanding large scale renewable energy farms – especially solar - be developed as a priority. Additional projects might include more initiatives of this kind, including the installation of solar rooftop PV technology utilizing the new thin film technology developed within South Africa. This again could provide jobs as well as low carbon emitting electricity generation. There is scope for expanding the solar water heater program as cited above. Wind projects can be encouraged using these policies as well. Policy development such as feed-in tariffs and other successful techniques that have been developed in Spain, Germany, Denmark and California can be helpful in devising an effective implementation strategy. South Africa has already established feed-in tariffs for a range of renewable power options. Partnering with countries like Denmark, Germany, Spain, US, India and China that have substantial experience with wind technology may be helpful in devising strategies and measures for expanding wind power.

61. The installation of more distributed renewable electricity power sources may require upgrading of the transmission and distribution system, which will require financing.

62. Finally, the adoption of renewable technologies by the government and Eskom may be critical. We recommend a major planning effort aimed at realising the LTMS Required by Science scenario – using the NIRP as a base and with support from the World Bank to develop the necessary policies and measures. This should include finding more opportunities for major funding including further CTF funding, and the CDM and any new mechanisms that may be developed in the future.

Find additional opportunities for reducing heat trapping emissions from the mining and construction industries, coal mine fires, methane leaks and by reducing other greenhouse gases

63. There are numerous additional places to look for emissions reductions and energy inefficiencies. Many of these have already been identified by the South African government and by researchers and universities within South Africa, and are included here for completeness. These might become part of South Africa's energy and climate strategies in the future.

64. The mining and refining industries are major producers of heat trapping greenhouse gases along with the electric power sector. The means for reducing these emissions are specific to each industry, and coordinated efforts can be made to help develop appropriate actions in an accelerated manner. Those efforts that reduce energy use or fuel use often have significant cost saving features, and the major barrier is finding the initial financing even when it has a relatively short term payback. Working in a coordinated manner between these

industries, the South African government and the World Bank may provide an effective means for addressing the needs of these sectors.

65. Methane can be captured from landfills and sewage treatment plants and used for heat or small-scale electric power production. Methane captured from livestock can be used for on-site heat or small-scale electric power production on farms.

66. Increasingly it is realized that "black carbon" arising from smoky fires from cooking and land clearing is an important short-lived contributor to global warming. It has long been known to be a major health threat to women and children's eyes and lungs when they cook over biofuel fires in unventilated dwellings. Attacking this as a public health matter would improve people's lives and address climate change.

67. Many options exist for modest scale distributed combined heat and power systems in industry, refining (Sasol) and in government offices, schools, universities, hospitals, municipalities, commercial buildings and other campus settings. This represents a compliment to the large central power model that currently dominates South Africa's power system. It is, however, highly efficient and can improve the performance of the electric grid system while substantially reducing emissions.

68. South Africa relies heavily on coal and the extraction process releases coal mine methane (a strong heat-trapping gas), which can be trapped and utilized as a fuel for power and industrial processes. There are also coalmine fires that release carbon dioxide and methane within South Africa (and in many other parts of the world), waste an energy resource and add to global warming without providing any economic benefit. An exploration of how to curtail these fires and prevent future ones might be part of the carbon dioxide storage study.

69. Finally, there are other heat trapping gases that are released such as sulphur hexafluoride that may be used in transformers, operating fluids from refrigerators and air conditioners or other industrial gases that could be curtailed at low cost without diminishing the delivery of goods and services.

Build capacity by training engineers, inspectors, government regulators and financial managers in energy efficiency, renewable energy and energy finance

70. A very low cost action that can be taken is to enhance the existing capacity of government, Eskom and other actors who can implement any of the low emission options identified in this report. These needs can be ascertained through consultation with the government and with Eskom and others who are involved in supplying electricity and other energy services identified here. These actors include, but are not limited to engineers, inspectors, government regulators and financial managers who will work on energy efficiency, renewable energy and energy finance.

Further expand carbon saving transport opportunities

71. The transportation sector provides an additional opportunity to reduce energy use and emissions. The LTMS of the South African Government recognizes the benefits of restricting inefficient vehicles such as SUVs. Following the lead of China, efficiency and environmental standards for vehicles purchased or imported into South Africa can be enhanced. With several

auto manufacturing companies in South Africa, there is the opportunity to utilize their expertise. Government purchases can also be shifted to more efficient standards in each vehicle class. Additional energy efficiency and environmental standards for construction vehicles including trucks and off road construction equipment is an additional area that can reduce the use of fuels and lower both locally and globally important emissions. Finally, providing efficient Bus Rapid Transit as has been done in cities in Brazil, Colombia and Ecuador enhances mobility services of all citizens including the poor, reducing auto use and lowering both fuel use and emissions. In cities such as Johannesburg and Cape Town such systems are being implemented and we recommend introducing them in other cities in the medium to. In addition, Eskom is also exploring the development of infrastructure for electric and hybrid vehicles as part of its smart grid work.

Develop the immense low carbon energy potential, especially in hydropower, of Sub-Saharan Africa

72. Sub-Saharan Africa has immense potential for the development of hydropower, probably the greatest untapped potential anywhere in the World. The investment required is huge, and needs to include the financing of a very long distance transmission network. Regional stability and strong political support will be essential. We urge the World Bank to continue working with national governments towards creating the conditions that can make them possible in the future, while having careful regard for the environmental and social implications.

Concluding remarks on ways to reduce net greenhouse gas emissions from the Medupi project

73. To what extent any of these more efficient emissions reduction strategies are utilized in connection with the Medupi project is up to the government of South Africa. Which of these strategies the World Bank might decide to finance as part of a larger effort to provide energy services and a supply of needed goods to the citizens of Southern Africa can only be decided in consultation with the government and Eskom. As such it is recommended that a long term partnership, building on the proposed financing package, be established with the South African government with a view to achieving a low emissions future for the nation while it develops economically and socially.

Conclusions

74. Climate change arises in large part because of the release of heat trapping gases from the combustion of fossil fuels that drive national economies. However, this is not so much a pollution problem as it is a development issue. The world's economies are exceeding the capacity of nature to absorb the waste from our chosen mode of development. We therefore believe that addressing climate change should be one of the highest priorities of the Bank.

75. The consequences of climate change can be devastating, undermining the achievement of the level of well being that all are entitled to, especially for developing countries and for Africa in particular. Shifting to a sustainable development trajectory that provides essential goods and services to all is essential for all economies. We therefore conclude that the Bank's climate change strategy must go hand in hand with its strategies for

economic development. It should also be noted that this must include provision for the adaptation to the negative impacts of climate change. This is particularly important for the power sector specifically for water and the robustness of power delivery infrastructure.

76. South Africa is facing an immediate shortage of electric power that has already crippled its economy. Hence as a transition strategy in the near term we accept that it is necessary to build additional coal fired electric power units. But this must be coupled to a longer-term strategic shift to an economy based upon a low carbon energy supply.

77. The finding of this Expert Panel is that it is essential to help to accelerate the move of developing countries like South Africa into an era of more and better energy services, a more energy and economically efficient economy that produces substantially lower carbon emissions using sustainable energy sources. The focus needs to be on sustainable development that does not add to the environmental, economic and climate burden. Linking large additions of coal fired capacity to the implementation of a long term low carbon strategy, coupled with immediate energy efficiency and renewables investments is one way to avoid having a major rise in heat trapping gases into the atmosphere just as the world is moving to reduce them. Fortunately, the South African government has already taken actions to move in this direction, and indicated that it has a long-range plan to do so as well as initiatives currently being implemented as part of this plan. It is our recommendation that the World Bank work with South Africa to achieve that goal for its own citizens and to assist neighbouring nations that rely on the power production and economic activity of South Africa to do the same.

78. We emphasize that our recommendations are compatible with and supportive of South Africa's stated goals and policies including the following. South Africa has set a goal of 4% renewable energy (10,000 GWh) by 2013 in a 2005 White Paper on Renewable Energy. In 2006, South Africa adopted National Energy Efficiency Strategy (updated in 2009), which calls for national targets for energy efficiency improvement (12% by the year 2015). The government has established a National Energy Efficiency Agency (NEEA) to pursue this target through energy conservation programs. The Long-Term Mitigation strategy developed in 2008 sets South Africa on a course to address climate change in a major way.

79. The World Bank in its DCCSF "Technical Report" proposes to increase annual funding for demand side management (end use efficiency) and renewable energy by 30% above $600m in the period 2005-2007, and the share of such projects will grow from 40% to 50% by 2011. The document further states a commitment to support climate actions. Matching these goals of the Bank with those of South Africa suggests that Medupi is the ideal project for enhancing all aspects of sustainable development in South Africa and the region through offsetting emissions linkages as recommended in this report.

Findings on the Screening Criteria

80. We were asked to advise specifically on whether the Medupi financing project was consistent with the six specific screening criteria set out in the Bank's Development and Climate Change Strategic Framework (DCCSF). We give our views on each criterion below:

Criterion 1. Demonstrated development impact of the project including improving overall energy security, reducing power shortage, or increasing access for the poor.

81. There are very strong development imperatives for this project, including security, reliability, and access aspects. The criterion is well met.

Criterion 2. Assistance is being provided to identify and prepare low carbon projects.

82. This project does include low carbon elements to promote solar and wind power and energy efficiency. While the scale is nowhere near commensurate with the CO2 emissions of the Medupi power station there is significant future renewables potential which these projects could help to unlock. Therefore, as described more fully in our general conclusions, to meet the spirit of this criterion the Bank must demonstrate that its sustained commitment to South Africa's low carbon energy development strategy matches up to the scale of its commitment to Medupi.

Criterion 3. Energy sources are optimised, looking at the possibility of meeting the country's needs through energy efficiency (both supply and demand) and conservation.

83. We accept as reasonable the conclusion of the Government of South Africa and the Bank that energy efficiency measures alone will not meet the current, very pressing, power needs of Southern Africa. While the energy efficiency element in the project is modest in relation to the scale of Medupi emissions, the Bank should note the substantial programme currently being implemented by the South African Government and Eskom. Nevertheless a lot more needs to be done to realise the large potential for efficiency gains in South Africa. The World Bank must commit itself to supporting the South African government's efforts to improve energy efficiency on a scale that matches its commitment to Medupi.

Criterion 4. After full consideration of viable alternatives to the least cost (including environmental externalities) options and when the additional financing from donors for their incremental cost is not available.

84. We accept as reasonable the conclusion of the Government of South Africa and the Bank that there are no viable alternatives to Medupi for meeting Southern Africa's need for additional power to support economic development in the short term. However, in our conclusions we stress the need to develop other, cleaner, options for the future.

Criterion 5. Coal projects will be designed to use the best appropriate available technology to allow for high efficiency and, therefore, low GHG emissions intensity.

85. We have not carried out detailed engineering studies of this project. But, as set out in our report above, in general terms we consider Eskom's choice of super-critical air-cooled technology to be appropriate for South Africa at this stage.

Criterion 6. An approach to incorporate environmental externalities in project analysis will be developed.

86. The Medupi project carries a large environmental penalty. A theme that runs through all our conclusions is that this can only be justified in the context of the Bank's wider strategy to support the low carbon development of South Africa. We agree that the Bank needs to develop a high-level low carbon transition strategy for economic development that can provide the framework for judgements of this kind.

General Conclusions

87. The Expert Panel was asked whether financing one of the world's largest coal burning power complexes is consistent with the Bank's stated goal of addressing climate change in accordance with the principles of sustainable development and the UN Framework Convention on Climate Change and the Kyoto Protocol and, more specifically, with the Bank's own DCCSF criteria. Our conclusion is that financing this project does address the development impact goal of South Africa, but needs to address the climate goal more fully. This requires a longer-term strategic partnership with South Africa aimed at achieving its plans for a low emissions future coupled with economic growth and social development.

88. We recommend that the Bank Group define projects such as Medupi as part of a transition strategy to a more climate protective future, and that it specifically link approval of such near-term carbon intensive projects to longer-term sustainable energy programs. The World Bank's support for this transitional strategy must, in the case of Medupi, clearly include a plan to assist South Africa to achieve long-term greenhouse gas savings comparable in magnitude with the Medupi emissions. Therefore, if the World Bank decides to approve the Medupi project for financing, we believe that the spirit of the DCCSF criteria requires that the Bank should, at the same time, also commit itself to such a transition strategy. Since South Africa already has announced goals to lower carbon intensity and eventual emissions, the World Bank Group should assist the government in meeting its goals.

89. While we call for the Bank to link these energy delivery improvements with lower carbon dioxide emissions, we recognise that decisions about many of the specifics of these emission reducing technologies and measures must come at a later date, and must be consistent with the aims of the South African government.

90. The "Required by Science Scenario" in South Africa's Long Term Mitigation Strategy represents a huge challenge for South Africa, as does the Government's National Integrated Resource Plan. Support for the delivery of these plans should be central to the transition strategy. In the section of our report on Options for Reducing Carbon Emissions in South Africa, we have proposed specific actions that can help to deliver energy services in South Africa at the least cost and with the lowest emissions.

91. For the longer term, the expert panel recommends that the World Bank Group redefine its criteria and policies on how the projects that they finance relate to climate change and other significant environmental issues. When it is deemed necessary, as in this case of South Africa, to finance a project with large heat trapping greenhouse gas emissions, there should be direct linkage to strategies that will reduce the net emissions or contributions to global warming and climate change. It is understood that governments decide which projects they wish to do, but the World Bank Group can encourage more sustainable options and partner with Governments in implementing their long term emission reduction plans. The

first choice of linked projects is those that enhance the performance of the developing country economy by delivering energy, transportation and industrial services with greater energy and economic efficiency. Job creation and options that are appropriate to the country are also important criteria. These linked projects need not be tied directly to the emitting carbon project, but may be distributed over time and space. It is essential that the World Bank view its support for projects in the context of the longer-term strategies of Governments.