DOCUMENT OF THE INTER-AMERICAN DEVELOPMENT BANK

Coal Fired Power Plants Guidelines

An Approach to Reconciling the Financing of Coal-Fired Power Plants with Climate Change Objectives

(Revised 07/10/09)

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Final DRAFT - (Revised: 07/10/2009)

I. Executive Summary

1.1 The purpose of these guidelines is to set forth an approach for the financing of Coal Fired Thermoelectric Generation Plants (Coal Plants), in a manner consistent with the IDB's vision to prioritize the development of renewable energy sources and the IDB's commitment to the protection of the environment, including reducing adverse impacts on the global climate.

1.2 Not taking into account environmental externalities[1], coal is the least expensive, most abundant fossil fuel source for electric generation. It is one of the world's fastest growing energy sources and is likely to increase its share in the energy matrix in Latin America and the Caribbean (LAC) Region. The IDB and the other multilateral development banks (MDBs) operating in the region are faced with increasing requests to finance coal plants that different countries in the region plan to build to cope with increasing electricity demand, especially given a ceiling in their capacity to increase electricity generation from renewable sources within the existing national regulatory frameworks, particularly hydroelectricity.

1.3 Coal Plants produce a series of pollutants and other environmental impacts derived from the combustion of the coal. Technological development over the last decades has led to cleaner coal technologies that are able to increase the efficiency of a coal plant (i.e., increase the amount of energy gained from each ton of coal) and to significantly decrease its air emissions (specifically sulfur dioxide, particulate matter, and nitrogen oxides) and therefore its environmental impact. The implementation of some of these emerging technologies[2] comes at a cost. However, Green-House Gas (GHG) emissions originating from Coal Plants cannot be significantly abated with existing technologies.[3] As a result, coal plants are one of the most significant contributors to global climate change.

[1] For example, current international negotiations under the United Nations Framework Convention on Climate Change (UNFCC) may result in the adoption of a carbon charge imposed on CO_2 emissions, either directly by a tax or indirectly in the context of a global cap and trade system. In many instances such carbon charge could make other power generation options more competitive than coal plants. In general any carbon charge will make the economics of higher efficiency coal plants more attractive than those of lower efficiency plants.

[2] End of pipe technologies (e.g., gas desulfurization, particulate matter scrubbers, selective catalytic reduction) generally come at a cost, both in terms of initial capital costs and reduction in the net plant efficiency. On the other hand, technology that increases a plant's thermal efficiency (e.g., supercritical, ultra-supercritical, integrated gasification combine cycle) generally increases the initial capital costs, but reduces fuel costs during the life of the plant. As a result, the net present value or amortized costs of higher efficiency coal plants may be less than those of lower efficiency plants.

[3] While Carbon Capture and Storage (CCS) is a promising technology, it is unlikely to be available on commercial basis before 2015-2020.

Furthermore, due to longevity of Coal Plants (several decades), any newly built plant increases the risk that it may be more difficult and more costly in the future to encourage countries in Latin America and the Caribbean (LAC) to adopt a low-carbon economy.

1.4 IDB, and the other MDBs, are therefore facing a dilemma. On the one hand, access to modern forms of energy is a critical element in reducing poverty, promoting social equity and enhancing competitiveness. Conversely, financing of coal plants may undermine the IDB's objective in supporting climate change mitigation efforts, and its commitment to the protection of environment. To overcome this dilemma, most MDBs continue financing coal plants, while being more selective on the type of technology proposed to balance the environmental and economic benefits, and imposing more stringent emissions performance standards.

1.5 At the project level, the IDB will continue supporting those Coal Plants that are designed to use the best appropriate available technology to allow for high efficiency and therefore lower GHG emissions intensity, and to meet internationally-recognized best practices and standards.

1.6 Concurrently, the IDB will also consider developing other financing instruments, such as grants or concessional financing, to provide incentives for adoption of cleaner coal technologies, and in particular, where appropriate, to cover the incremental costs of adopting more advanced technology. Funds such as the Climate Investment Funds (CIF) are now available for cases where the selection of a cleaner technology proves substantially more costly; provided that the project meets the CIF criteria for eligibility.

1.7 At the country/sector level, the IDB will support the efforts of the country to diversify its energy matrix, providing the grounds for development of cleaner and sustainable energy sources over time. Additionally, the IDB may also assist the country for transfer of more advanced coal technologies that are under development. The IDB could also strengthen its support for the development of appropriate national regulatory frameworks which would reflect the environmental cost factors, including carbon dioxide (CO_2) emissions, and, in the future, the agreements reached at international level regarding the mitigation of global climate change. Lastly, the IDB will work with the countries to reduce or eliminate fossil fuel pass-through provisions typical found in Power Purchase Agreements (PPAs) in future public bidding PPAs.

II. Introduction

2.1 The IDB is firmly committed to support the implementation of an energy matrix that contributes the most to reduce climate change through programs oriented to increase energy efficiency from the demand side and the production of non-conventional renewable sources of energy from the supply side.

2.2 This document delineates the basic elements of IDB's approach to finance Coal Plants. The document is divided into four parts: (i) a mid-term scenario which describes the need to increase Coal Plants at a faster pace than overall electricity demand; (ii) a technical section which summarizes the types of coal plants and associated environmental issues, with a specific focus on climate change impacts; (iii) the principles of other multilateral development banks with regard to financing of Coal Plants; and (iv) the proposed IDB approach to finance Coal Plants.

III. Latin America Electricity Demand and the need for thermoelectric plants

III. A. Demand and supply Scenarios.

3.1 LAC electricity generation is forecast to grow more than two-fold (127%), between 2005 and 2030, while electricity generated by Coal Plants is forecast to increase more than threefold.[4] However, mainly due to relative abundance of renewable (notably hydroelectric) generation sources, Coal Plants generate approximately 5% of the total electricity production in LAC (worldwide 40% of electricity production is derived from coal). In spite of the expected large increase in fossil fuels thermoelectric generation in Latin America by 2030, the region ranks lowest in the world in terms of fossil fuels as a source of electricity generation. Even if coal plants were to increase threefold in LAC over the next twenty five years, it would continue to represent a 5% of regional electricity supply by 2030, compared to 37% in the OECD countries and 45% in the world. Appendix I present additional information on the electricity demand and supply in LAC.

III. B. Power Needs and Thermoelectric Plants

3.2 The cost of producing cleaner and sustainable energy depends on each country's endowment of sources of primary energy. The larger the endowment of biomass, wind, geothermal or hydroelectric sources of primary energy, the cheaper it is to produce energy out of non-fossil sources given access to technology and the adequate sector infrastructure. For countries with the same income per capita the extra cost per person of producing cleaner energy will depend on their endowment of renewable resources. As such, the costs of changing the energy matrix are country specific.

3.3 The reasons that countries may favor fossil fuel based thermoelectric plants as their primary source of electricity supply are: (i) costs; (ii) security; and (iii) reliability considerations associated with the endowment of sources of primary energy. In terms of reliability, countries in the region with hydro-dependent grids will need to diversify their energy matrix to mitigate the Natural Risk (NR)[5] ensure sufficient energy supply during dry spells. Regional supply constraints of natural gas reinforce the notion that coal-fired generation is likely to be a necessary energy source in the short to medium term. The reasons that favor the installation of fossil fuel thermoelectric plants include the

[4] International Energy Agency (IEA), World Energy Outlook 2007, Reference Scenario, pp. 626.

[5] Natural Risks are referred to risks in which renewable energy projects, by their very nature, are affected their surroundings and fundamental source of fuel (i.e., wind projects natural risk is availability of wind, solar projects natural risk is availability of sunlight, and hydro-project's natural risk is hydrology).

endowment of natural resources, economics, access to technology, size of plant and versatility, reliability and construction time.

IV. Available technologies and impact on climate change

4.1 Essentially there are two principal technologies for the generation of electricity from coal: (i) combustion, such as Pulverized Coal Combustion (PCC) or Fluidized Bed Combustion (FBC); and (ii) gasification, mainly Integrated Gasification Combined Cycle Units (IGCC). The arrangements and combination of these technologies results in different generation capacity, capital and operational costs, and environmental and social impacts. Cleaner coal technologies include a wide range of options in two main areas: (i) advanced pollution control systems to reduce harmful emissions, mainly sulfur dioxide (SO_2), particulate matter (PM), and nitrogen oxides (NOx); and (ii) more efficient advanced power generations.

4.2 However, GHG emissions originating from Coal Plants cannot be significantly abated with existing technologies. Additionally, the carbon content of coal, and therefore the quantity of CO_2 released per unit of energy produced by its combustion is the highest of all fossil fuels.[6]

4.3 Increasing the thermal efficiency of converting coal to power is generally one of the less expensive ways of generating more energy with less CO_2 emissions. For conventional coal plants, increasing thermal efficiency by 1% point decreases CO_2 emissions by about 2.5% to 3.0% (for the same power generated). Increasing thermal efficiency also has the additional benefit of reducing other emissions per megawatt (MW) of energy generated, such as those of SO_2 and NOx.

4.4 During the last thirty years, research has led to the efficiency of coal plants being improved by approximately 30%. The average gross efficiency of larger existing plants with sub-critical steam[7] burning higher quality coals is in the region of 35% to 37 %. New plants, with advanced super-critical steam can currently achieve gross thermal efficiencies in the 43% to 45% range. Thermal efficiency can be improved by several means, including: (i) using a higher grade coal; (ii) better control of air ratio; (iii) recovering heat; and (iv) increasing the steam pressure and temperature. The majority of existing coal plants is based on sub-critical technology. Super-critical PCC power plants first came into operation in the early 1960s. More recently, ultra-super-critical facilities

[6] On average, the carbon content for coal is 75% higher than for gas, and 25% higher than for oil. In addition, since it is generally possible to utilized combined cycle plants, it is usually considered that the carbon intensity of a gas fired power plant is about half the carbon intensity of a coal fired power plant (i.e., it generates half of the CO_2 emissions for the same electrical output).

[7] The terms super-critical and ultra-super-critical are derived from the definition of the temperature and pressure at which water vapor and liquid water are indistinguishable (known as the critical point). Sub-critical steam cycle conditions are generally around 16.5-Megapascal (MPa), which is approximately 2,400 Pounds per Square Inch (psi) and 538°C (1000° F), while a typical super-critical steam cycle operates at a steam pressure above 22.1-MPa (~3,200 psi), and an ultra-super-critical cycle at a temperature above 580-593 °C (1075-1100 °F). The ultra-super-critical cycle is currently the most advanced steam power cycle that is in the long-run, both economical and reliable.

have been constructed and operated successfully first in the 1990s in developed countries, and now in some developing countries.

4.5 There are trade-offs between capital costs and operating costs involved in the use of different technologies. Higher efficiency plants generally involve higher Engineering, Procurement and Construction (EPC) costs. For example, for the normal range of PCC plant sizes (i.e., 200-MW to 1,300-MW), the EPC cost of a medium to high efficiency unit (super-critical and ultra-super-critical conditions) is generally 2% to 5% higher than a lower efficiency unit (sub-critical). They have however lower operating costs due to reduced fuel requirements for the same output.

4.6 Another cost-effective way to increase the efficiency of energy supply systems is through co-generation, which uses a single process to produce both electricity and usable heat, thus having higher fuel efficiencies. This results in lower emissions than the separate production of electricity and heat. Thermal efficiencies can reach more than 90% depending on plant specifications.

4.7 Another possible way to mitigate climate change impacts of coal fired power plants is through Carbon Capture and Storage (CCS). CCS is a process consisting of the separation of CO_2 either from the fuel (pre-combustion) or from the flue gas (post-combustion) transport to a storage location and long-term isolation from the atmosphere. It is a promising development[8] for effective mitigation of GHG emissions from coal plants at reasonable costs. However, a complete CCS system has not yet been applied at a large (e.g., 500-MW) fossil-fuel power plant[9] and is unlikely to be available on a commercial basis before 2015-2020. The concept of CCS-readiness[10] has been developed to ensure that newly built plants can be retrofitted to incorporate CCS when commercially available while remaining competitive. Since detrimental effects of post-combustion CCS on a plant's efficiency are more pronounced for lower efficiency coal plants (e.g., sub-critical technology), these plants are less likely to be considered CCS-ready than higher efficiency plants (e.g., super-critical and ultra-super-critical technologies). Retrofitting IGCC plants to incorporate CCS, is currently expected to be less costly than for PCC/CFB.

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[8] The Joint Statement by G8 Energy Ministers in Aomori, Japan, on 8 June 2008, has expressed strong support to the IEA's recommendation that 20 large-scale CCS demonstration projects be launched globally by 2010. The European Union's Communication on Sustainable Power Generation from Fossil Fuels sets out options for supporting a network of 10-12 large scale CCS demonstration projects, including specific financing instruments with the participation of the banking sector (possibly through the EIB and/or EBRD). The United Kingdom (UK) Government has launched a tender process for a CCS demonstration project. The project will use post-combustion technology on coal fired power generation at 300-MW to 400-MW.

[9] *Schwarze Pumpe* in Germany is the first coal-fired power plant in the world to integrate CCS technology into a pilot-scale site (30-MW), which began operation on September 9, 2008.

[10] Post-combustion CCS readiness criteria is generally understood as including considerations such as: (i) land area and layout able to accommodate: (ii) the capture equipment, new pipelines, expanded utilities and additional generation units; (iii) design of the steam cycle to be compatible with the likely steam extraction requirements of the capture unit; (iv) provisions for new pipe work in the Water-Steam-Condensate cycle; (v) installation of FGD that can readily be upgraded to meet flue gas purity required; (vi) route to CO_2 storage that is economically competitive on a global stage ($/t$CO_2$); (vii) identification of potential sequestration sites and preliminary geological investigations to screen these; and (viii) pipeline route determined, where CO_2 exported.

V. Other MDBs approach to the financing of coal plants

5.1 Most MDBs continue financing coal plants (new plants and rehabilitation of existing plants), while being more selective on the type of technology supported to balance the environmental and economic benefits, and more stringent on their emissions performance.

5.2 The World Bank Group's (WB) Strategic Framework for Development and Climate Change adopted in October 2008 lays out the criteria that a coal plant project should meet to receive traditional financing from any of the entities within the WB, including the International Finance Corporation (IFC) and Multilateral Investment Guarantee Agency (MIGA). Specifically, it requires, among others, that coal projects be designed to use the best appropriate available technology to allow for high efficiency and therefore lower GHG emissions intensity, after full consideration of viable alternatives to the least-cost (including environmental externalities) options and when the additional financing from donors for their incremental costs is not available. The Framework is expected to inform and guide the development of the upcoming energy sector principles (fiscal year 2010), which will articulate the WB's approach to different renewable and non-renewable energy resources.

5.3 The Asian Development Bank's (ADB) draft revised energy principles, which is expected to be adopted in the first half of 2009, provides for possible support of coal plants only if: (i) cleaner technologies are adopted; and (ii) adequate mitigation equipment and measures are incorporated into the project design, with a possible exception on a case-by-case basis for base-load power plants in countries with lower electricity demands that are dependent on oil-based power supply or imports from neighboring countries. The European Bank for Reconstruction and Development's (EBRD) environmental and social principles adopted in May 2008 requires the client to assess technically and financially feasible and cost-effective options to reduce its carbon intensity during the design and operation of the project. The European Investment Bank (EIB) may finance coal plants when: (i) the best available technology is used, (ii) are CCS ready and (iii) are cost-effective, taking into account CO_2 externalities. The African Development Bank (AfDB) is currently developing energy sector principles that elaborate further on the proposals outlined in its Clean Energy Framework for Africa. Several key commercial banks have adopted the Carbon Principles, according to which any fossil fuel power generation project should be subject to an Enhanced Diligence Process in order to evaluate the mitigation strategy and plan of the developer to address the risks posed by the increased CO2 emissions

5.4 Concurrently, the MDBs have developed the Climate Investment Funds (CIF) as a new source of interim funding through which MDBs can now provide additional grants and concessional financing to undertake investments that achieve a country's development goals through a transition to a climate-resilient economy and a low carbon development path. Regarding Coal Plants specifically, the investment criteria for public sector operations require achievement of significant GHG reductions by adopting best available coal technologies with improvements in energy efficiency and include readiness considerations in design for implementation of new carbon reduction technologies, such as CCS.

VI. Guidelines to be followed for the IDB to finance coal plants

6.1 The IDB is committed to a long-term strategy to support the diversification of the energy matrices in the LAC region in favor of clean and sustainable sources of primary energy. However, the potential growth of renewable sources of primary energy, in a reference scenario without additional supporting policy measures, will not be sufficient to supply the forecasted mid-term growth in electricity demand in LAC. As such, the region is likely to require sizeable expansion of fossil fuel thermoelectric generation capacity.

6.2 As a result, the IDB is faced and is likely to be faced in years to come with increasing demands from both companies and countries to finance Coal Plants. In order for the IDB to continue promoting access to modern forms of energy while not undermining IDB's objective in supporting climate change mitigation efforts, and its commitment to the protection of environment, the IDB will continue supporting those Coal Plants that are designed to meet minimum performance criteria in terms of efficiency and GHG emissions intensity[11], and to use the best appropriate available technology to allow for high efficiency and therefore lower GHG emissions intensity.

6.3 Compliance with the minimum performance criteria or, at a minimum, a commitment to comply with those criteria by QRR or CRM stage will be assessed at eligibility stage. For a project to be eligible to receive IDB financing, compliance with minimum performance criteria will have to be verified during analysis or due diligence, and confirmed at the Quality Risk and Review (QRR) or Credit Review Meeting (CRM) stage.

6.4 Table 1 provides minimum performance criteria for IDB financing of acceptable technologies[12]. Such minimum performance criteria are based on (i) performance of model Coal Plants as defined by the US EPA and DoE, (ii) typical performance of Coal Plants specified by the International Energy Agency (IEA), and (iii) the EU Best Available Techniques Reference Document for Large Combustion Plants. While those criteria preclude IDB financing of inefficient coal fired plants, they are in the relatively low part of the range of efficiencies that are achievable with a typical design, as illustrated in Chart 1, particularly for IGCC which is a relatively new technology, and CFBC, which can co-fire biomass and therefore reduce its GHG emissions intensity even with subcritical design. The Minimum Performance Criteria depicted as Table 1 will be revised from time to time to take into account new technological and institutional developments regarding the IDB financing of Coal Plants.

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[11] In addition to internationally-recognized best practices and standards on the other aspects of environmental and social sustainability, such as the WBG Environmental, Health and Safety Guidelines for Thermal Power Plants.

[12] Because of its low efficiency and high GHG emissions intensity, subcritical pulverized coal technology is not considered an acceptable technology for IDB financing.

6.5 In addition to meeting those Minimum Performance Criteria, it will be verified during the due diligence that the coal plant project is designed to use the best appropriate available technology. The selection of best appropriate available technology should take into account: (i) source of fuel and whether the coal is indigenous (local natural resources endowment) or needs to be imported; (ii) reliability of the technology; (iii) overall efficiency of the technology (how much input is needed to generate a MWh of electricity); and (iv) level of GHG emissions per MWh. A comprehensive options analysis including environmental externalities and GHG emissions should be carried out to justify the proposed technology. Current best available technology includes cogeneration, supercritical and ultra-supercritical boilers and turbines, IGCC, and CCS readiness designs. Subcritical pulverized coal technology is not considered to be best available technology. Subcritical circulating fluidized bed combustion (CFBC) may be considered best available technology for plants less than 300 MWe depending on the grid size, type and source of fuel, possible biomass co-firing to reduce GHG emissions intensity, and overall efficiency.

VII. Other actions to be pursued by the IDB

7.1 The IDB will join the other MDBs and the energy community at large in their efforts to increase the knowledge base and development of new technologies. An effort should be made to find ways to help finance the cost differential to favor cleaner technologies. The IDB will consider developing other financing instruments, such as grants or concessional financing, to provide incentives for adoption of cleaner coal technologies, and in particular, where appropriate, to cover the incremental costs of adopting more advanced technology. Funds such as the CIF are already available for cases where the selection of a cleaner and more advanced technology proves substantially more costly.

7.2 The IDB will take advantage of the financing to engage with the country where the plant is to be built in a dialogue to contemplate the application of EE on the demand as well as the supply side (e.g., retrofits of existing hydroelectric power plants). The IDB may also assist the country to transfer more advanced coal technologies that are under development, for instance through providing Technical Cooperation (TC) funds to research and development activities, and implementation of pilot projects.

7.3 The IDB will strengthen its support for the development of appropriate national regulatory frameworks which would reflect the environmental cost factors, including CO_2 emissions, in the least cost requirements, and, in the future, the agreements reached an at international level regarding the mitigation of global climate change, either through the development of stand-alone TC projects, or as part of targeted country environmental analysis or country specific analysis.

7.4 The IDB will continue supporting changes in the energy matrix for renewable electricity generation sources. This comprises the analysis and evaluation of alternative generation scenarios with non-conventional renewable energy sources, taking into account a full life-cycle approach where relevant.

Minimum Performance Criteria

Table 1 - Characteristics and Performance of New Coal Fired Power Plants That May be Supported by the IDB

Technology	(PCC) Super-critical	(PCC) Ultra-super-critical	Circulating Fluidized Bed Combustion (CFBC)	Integrated Gasification Combined Cycle (IGCC)
Net Plant Higher Heat Value (HHV) Efficiency (%) (Bituminous coal)	>38.3 [1]	>42.7 [1]	>36.0 [2]	>38.2 [3]
Net CO_2 Emissions Intensity (kg CO_2/net MWh)	<832 [4]	<748 [4]	<890 [4]	<832 [4]

Sources: [1] US EPA, Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies, 2006; [2] International Energy Agency, Developments in fluidized bed combustion technology, 2006; [3] US Department of Energy (DoE) - Cost and Performance Comparison Baseline for Fossil Energy Power Plants, 2007; [4] Based on US EPA emissions factors for bituminous coal (93.47 kg CO_2/MMBtu) and minimum net plant efficiency.

Chart 1 – Efficiency Performance Ranges