Global Economy and Development at BROOKINGS

Policy Brief 2011-10

GLOBAL VIEWS

PHOTO: © INGA NIELSEN

The World Bank and Coal Aid

Abigail Jones
Director of Research and Policy,
Climate Advisers

Andrew Stevenson
Senior Adviser,
Climate Advisers

Nigel Purvis
Nonresident Senior Fellow,
Global Economy and Development
President, Climate Advisers

October 2011

The Brookings Institution
1775 Massachusetts Ave., NW
Washington, DC 20036

Summary

World Bank staff and management proposed to phase-out lending for new coal generation projects in middle-income countries[1] in an initial draft of the institution's new ten-year energy sector lending strategy. One argument advanced by proponents of the restriction is that these projects typically have no trouble attracting private sector finance, and thus, the World Bank's involvement provides no additional development benefit.

An independent analysis confirms these facts and shows that less polluting coal plants[2] have been built in roughly two thirds of the middle-income countries that generate coal-fired power. Additionally, the vast majority of these plants have been built with private sector finance alone. Close scrutiny of financial data provides a clear reason for this trend. The weighted average cost of capital for a typical coal generation project in nations without a World Bank loan is roughly 13 percent, while the rate of return is roughly 18 percent over 20 years. Because energy projects can readily attract private capital to finance coal-fired power stations with the same proven technologies used in developed countries to minimize greenhouse gas emissions and local air pollution, the World Bank should allocate scarce multilateral development funding for other pressing investments that cannot attract private capital as easily.

Introduction and Political Context

World Bank staff has spent the last several years drafting a new strategy that will provide high-level policy guidance for energy sector lending decisions over the next decade. The World Bank's Committee on Development Effectiveness (CODE)—a subset of the board of directors—discussed a draft strategy in April that was leaked to the public by several media outlets. However, CODE did not approve the draft strategy and the World Bank is undertaking consultations with member governments to determine a way forward.

The 100+ page draft strategy places strong emphasis on both providing energy access to the poor and promoting an environmentally sustainabe energy sector. The draft includes quantitative targets for energy access and the percentage of clean energy in the World Bank's lending portfolio, and introduces new greenhouse gas accounting requirements that will be phased-in over the next several years.

One of the most important and controversial provisions in the draft strategy is a ban on lending for new coal-fired power plants in specific categories of World Bank client countries. The ban covers all countries that qualify for loans from the International Bank for Reconstruction and Development (IBRD), including "blend" countries that also receive loans from the International Development Association (IDA). This includes middle-income countries, ranging from India, China, Brazil and South Africa to Vietnam and Pakistan. IBRD offers loans with

The 100+ page draft strategy places strong emphasis on both providing energy access to the poor and promoting an environmentally sustainabe energy sector.

Of the 45 middle-income countries that generate coal-fired power, approximately 65 percent are planning to build, are constructing, or are operating less polluting coal-fired power plants. Of these thousands of less polluting plants, only six required multilateral development bank support over the last 10 years.

better terms than commercial lenders, including longer payback and grace periods. The ban on new coal generation lending does not cover the poorest (IDA only) countries or efficiency improvements for existing coal plants in middle-income countries.

The ban on new coal generation projects in middle-income countries sharply divided nations at the CODE meeting. Middle-income countries argued that placing restrictions on projects for specific groups of countries is unprecedented, and that countries should be allowed to choose their own energy pathways. Developed countries argued that middle-income countries are easily able to attract private capital for new coal plants, and thus, World Bank lending provides no additional development benefit.

This report evaluates the argument advanced by developed countries and describes our initial findings.

Analysis and Initial Findings

The World Bank is first and foremost a development organization, not a commercial bank, which means its primary mission is to lift people out of poverty. Consequently, lending to projects that could have attracted sufficient commercial financing is prohibited in the IBRD Articles of Agreement.[3] The principle that the World Bank should not lend to projects that are "commercially viable"—i.e. able to attract sufficient financing on commercial terms—is fundamental to its lending strategy.

Before lending to a project, the World Bank analyzes whether similar projects in country have been fully financed by the private sector in the past, therefore this methodology will serve as the basis of our analysis. Investor behavior will then be rationalized by comparing the weighted average cost of capital in an average scenario to the financial rate of return.[4]

Of the 45 middle-income countries that generate coal-fired power, approximately 65 percent are planning to build, are constructing, or are operating less polluting coal-fired power plants (see Appendix B).[5] Of these thousands of less polluting plants, only six required multilateral development bank support over the last 10 years.[6] The rest were solely financed by the private sector—no multilateral development bank assistance was required. Private finance has generated roughly 99 percent of total coal-fired power capacity in middle income countries, while multilateral development bank (MDB) finance has helped generate the other 1 percent (see Table 1).

Table 1. Total capacity (MW) of less polluting coal-fired power plants that are planned, in construction or in operation

	Financed without MDB Loan	Partly Financed with MDB Loan	Percent Financed with MDB Loan
Albania	200	-	0%
Argentina	240	-	0%
Bosnia-Herzegovina	900	-	0%
Botswana	-	600	100%
Brazil	2,836	730	20%
Bulgaria	2,878	670	19%
Chile	1,702	330	16%
China	551,388	-	0%
Croatia	210	-	0%
Guatemala	300	-	0%
India	221,758	4,150	2%
Indonesia	3,469	-	0%
Kazakhstan	7,900	-	0%
Malaysia	2,000	-	0%
Mexico	880	-	0%
Namibia	120	-	0%
Pakistan	150	-	0%
Philippines	2,462	-	0%
Poland	27,583	-	0%
Romania	800	-	0%
Russia	20,600	-	0%
Serbia	744	-	0%
South Africa	6,556	4,769	42%
South Korea	28,343	-	0%
Thailand	3,971	-	0%
Turkey	8,972	-	0%
Ukraine	10,290	-	0%
Uzbekistan	2,400	-	0%
Vietnam	13,810	-	0%
Total	**923,461**	**11,249**	**1%**

Source: Authors' calculations using data from Platts (2011).

Private investment is readily available for middle-income countries that generate coal-fired power because the projects are profitable enough to attract sufficient private investment. By comparing the weighted average cost of capital (WACC) to the financial rate of return generated by the power plant, we find reason to believe there is a considerable profit margin for private investors.

Our results show that the WACC for a coal generation project in an average scenario without a World Bank loan is roughly 13 percent, while the rate of return is roughly 18 percent over 20 years and 20 percent over the lifetime of the plant (see Tables 2 and 3). Sensitivity analyses using different weighting schemes confirmed that these results are robust in the sample (see Appendix C).

Table 2. Weighted Average Cost of Capital in Middle Income Countries

	Coal-Fired Power Plants			Less-Polluting Coal-Fired Power Plants		
	50/50 debt to equity	80/20 debt to equity	Average	50/50 debt to equity	80/20 debt to equity	Average
Without World Bank loan	15.76%	12.11%	13.94%	14.81%	11.56%	13.19%
With World Bank loan	13.03%	7.75%	10.39%	12.20%	7.39%	9.80%

Table 3. Rate of Return

	Internal Rate of Return after 20 years	Internal Rate of Return after 40 years
Representative plant	17.9%	19.8%

In addition to the representative global case, data availability allowed analysis of three coal-fired power plants in China.[7] Our results show that in an average scenario the WACC for a coal generation project without a World Bank loan in China is about 8 percent, while the rate of return is roughly 10 percent at a 56 percent load factor and 16 percent at an 85 percent load factor (see Tables 4, 5 and 6).

Table 4. Weighted Average Cost of Capital in China

	50/50 debt to equity	80/20 debt to equity	Average
Without World Bank loan	10.1%	6.7%	8.4%
With World Bank loan	10.0%	6.5%	8.2%

Table 5. Rate of Return in China, 56% Load Factor

	Internal Rate of Return after 20 years	Internal Rate of Return after 40 years
Plant 1, Black SC	10.7%	12.1%
Plant 2, Black SC	9.5%	11.1%
Plant 3, Black USC PCC	9.1%	10.8%
Average	9.8%	11.3%

Table 6. Rate of Return in China, 85% Load Factor

	Internal Rate of Return after 20 years	Internal Rate of Return after 40 years
Plant 1, Black SC	17.4%	18.0%
Plant 2, Black SC	15.8%	16.6%
Plant 3, Black USC PCC	15.4%	16.2%
Average	16.2%	16.9%

Conclusions

This analysis confirms that less polluting coal plants have and are being built in roughly two-thirds of the middle-income countries that generate coal-fired power. The vast majority of these plants have been built with private sector finance alone, because new coal generation projects in middle-income countries are typically commercially viable. Less polluting technologies are now being introduced in a variety of middle-income countries without MDB help as they are now more mainstreamed and profitable.

The findings show that the WACC for a typical coal generation project in these nations without a World Bank loan is about 13 percent, while the rate of return is roughly 18 percent over 20 years. Because private capital is readily financing coal-fired power stations with the same proven technologies used in developed countries to minimize greenhouse gas emissions and local air pollution, the World Bank should allocate scarce multilateral development funding for other pressing investments that cannot attract private capital as easily.

The findings show that the WACC for a typical coal generation project in these nations without a World Bank loan is about 13 percent, while the rate of return is roughly 18 percent over 20 years.

Appendix A. Methodology

Our methodology had three components: identifying where less polluting coal-fired power plants are in operation, being constructed or are planned in middle-income countries; determining the WACC for coal generation projects in middle-income countries; and calculating the expected financial rate of return on these projects.

The Geography of Less Polluting Coal-fired Power Plants

Using the Platts World Electric Power Plant Database (2011), coal-fired power plants in operation, under construction, or being planned were identified and then categorized as either a less polluting or dirty plant.

Weighted Average Cost of Capital

The WACC is used by companies around the world to assess their overall cost of financing, and is also used to discount cash flows returned by a particular investment. It is typically calculated using this formula: WACC = [cost of debt]*[percentage of debt in overall financing]*[1 – tax rate] + [cost of equity]*[percentage of equity in overall financing].

The cost of debt was estimated as interest rates offered by commercial banks to prime customers, using World Bank data. The cost of debt for World Bank loans was assumed to be equal to recent analyses prepared by World Bank consultants. Tax rates were estimated as the corporate tax rate, using PriceWaterhouseCoopers data. The cost of equity was either calculated using the Capital Asset Pricing Model (CAPM), where data was available for a sufficient number of publicly-listed electric utility companies, or estimated using Morningstar data. The percentage of debt and equity in the overall investment were estimated as a range of 50/50 to 80/20, based on a literature review and discussions with experts.

Expected Financial Return

The expected financial return on a representative coal generation project as well as a number of specific coal-fired power plants in China were estimated using a simplified project finance spreadsheet model.

For the representative coal-fired power plant, the model is intended to capture average construction and fuel costs for coal plants in middle-income countries using data from China, Mexico and South Africa. Data and assumptions were drawn from an International Energy Agency report, "The Projected Costs of Generating Electricity: 2010 Edition," Goldman Sachs' "China: Utilities: Power—Generation" (October 26, 2010) and from the International Energy Agency's World Energy Outlook.

Key Assumptions, Representative Plant

Project construction time	3 years
Project size	1,000 MW
Investment costs per kW (5% discount rate)	$559–$1312
Fuel costs per MWh	$7.59–$26.71
Operation and maintenance costs per MWh	$1.51–$6.51
Plant lifetime	40 years
On-grid tariff	0.05 cents
Load factor	85%

For the Chinese plants, the model included both reported (0.56) and assumed (0.85) load factors. Assumptions and plant-level data were drawn from an International Energy Agency report, "The Projected Costs of Generating Electricity: 2010 Edition," and Goldman Sachs' "China: Utilities: Power—Generation" (October 26, 2010).

Key Assumptions, Chinese Plants

	Plant 1, Black SC	Plant 2, Black USC PCC	Plant 3, Black SC
Project construction time	2 years	2 years	2 years
Project size	1,119 MW	932 MW	559 MW
Investment costs per kW (at 5% discount rate)	$632	$689	$705
Fuel costs per MWh	$23.06	$23.06	$23.06
Operation and maintenance costs per MWh	$1.51	$1.64	$1.68
Plant lifetime	40 years	40 years	40 years
On-grid tariff	0.05 cents	0.05 cents	0.05 cents
Load factor	56% and 85%	56% and 85%	56% and 85%

Appendix B. Geography of Privately Financed Coal-fired Power Plants in Operation, Under Construction or Planned in Middle-Income Countries

	Coal plants in country	Less polluting coal plants in country
East Asia and Pacific		
China	✓	✓
Indonesia	✓	✓
Malaysia	✓	✓
Philippines	✓	✓
South Korea	✓	✓
Thailand	✓	✓
Vietnam	✓	✓
Europe and Central Asia		
Albania	✓	✓
Belarus	✓	
Bosnia and Herzegovina	✓	✓
Bulgaria	✓	✓
Croatia	✓	✓
Kazakhstan	✓	✓
Macedonia	✓	
Montenegro	✓	
Poland	✓	✓
Romania	✓	✓
Russian Federation	✓	✓
Serbia	✓	✓
Turkey	✓	✓
Ukraine	✓	✓
Uzbekistan	✓	✓

	Coal plants in country	Less polluting coal plants in country
Latin America and Caribbean		
Argentina	✓	✓
Brazil	✓	✓
Chile	✓	✓
Colombia	✓	
Dominican Republic	✓	
El Salvador	✓	
Guatemala	✓	✓
Jamaica	✓	
Mexico	✓	✓
Panama	✓	
Peru	✓	
Venezuela	✓	
Middle East and North Africa		
Iran	✓	
Morocco	✓	
Syria	✓	
Sub-Saharan Africa		
Botswana	✓	
Mauritius	✓	
Namibia	✓	✓
South Africa	✓	✓
Swaziland	✓	
Zimbabwe	✓	
South Asia		
India	✓	✓
Pakistan	✓	✓

Source: Platts, 2011.

Where data availability permitted, further analysis of the weighted average cost of capital in countries lacking less polluting coal-fired power plants was conducted in order to determine if capital constraints or policy choices were driving these decisions.[8] The results show that of the 12 countries examined, all but one country's weighted average cost of capital in either the low or high debt to equity ratio fell within roughly one standard deviation of the region's average (see table 1B). These findings suggest that it is likely that policy choices rather than capital constraints have prevented the construction, operation and/or plans to build less polluting coal-fired power plants in these countries.

Table 1B. Weighted Average Cost of Capital for Countries Lacking Less Polluting Coal-fired Power Plants

	Low Equity		High Equity	
	WACC	Distance from the mean	WACC	Distance from the mean
Europe and Central Asia				
Belarus	12.0%	-1.8	18.8%	0.9
Macedonia, FYR	12.6%	-1.1	17.2%	-0.7
Montenegro	12.4%	-1.3	17.8%	-0.1
Regional Average	**13.8%**		**17.9%**	
Standard Deviation, Region	**3.1**		**2.9**	
Latin America and Caribbean				
Colombia	11.3%	-2.8	13.6%	-3.6
Dominican Republic	17.0%	2.9	20.6%	3.4
El Salvador	-	-	-	-
Jamaica	15.0%	0.9	20.4%	3.1
Panama	8.4%	-5.7	11.7%	-5.6
Peru	-	-	-	-
Venezuela	14.8%	0.7	18.8%	1.5
Regional Average	**14.1%**		**17.2%**	
Standard Deviation, Region	**6.7**		**5.3**	
Middle East and North Africa				
Iran	-	-	-	-
Morocco	-	-	-	-
Syria	11.7%	0.1	18.2%	1.7
Regional Average	**11.8%**		**16.5%**	
Standard Deviation, Region	**2.9**		**3.0**	

Table 1B. Weighted Average Cost of Capital for Countries Lacking Less Polluting Coal-fired Power Plants continued

	Low Equity		High Equity	
	WACC	Distance from the mean	WACC	Distance from the mean
Sub-Saharan Africa				
Botswana	13.2%	0.0	15.3%	-2.0
Mauritius	18.6%	5.4	19.7%	2.4
Swaziland	12.9%	-0.3	19.4%	2.1
Zimbabwe	-	-	-	-
Regional Average	**13.2%**		**17.3%**	
Standard Deviation, Region	**2.5**		**2.6**	

Source: Author's calculations using data from PriceWaterhouseCoopers, publicly-listed electric utility companies, or Morningstar.

Appendix C. Sensitivity Analyses

Table 1C. Weighted Average Cost of Capital in IBRD and Blend Countries with Less Polluting Coal-Fired Power Plants

	Privately Financed			With a World Bank Loan		
	Low Equity	High Equity	Average	Low Equity	High Equity	Average
Sample average	11.56%	14.81%	**13.19%**	7.39%	12.20%	**9.80%**
Weighted by no. less polluting coal plants	8.67%	11.79%	10.23%	6.64%	10.41%	8.53%
Excluding China	10.08%	13.00%	11.54%			
Weighted by GDP	11.34%	13.64%	12.49%	6.81%	10.81%	8.81%
Weighted by GDP per capita	11.38%	14.37%	12.87%	7.26%	11.79%	9.52%

Table 2C. Weighted Average Cost of Capital in IBRD and Blend Countries with Coal-Fired Power Plants

	Privately Financed			With a World Bank Loan		
	Low Equity	High Equity	Average	Low Equity	High Equity	Average
Sample average	12.11%	15.76%	**13.94%**	7.75%	13.03%	**10.39%**
Weighted by no. coal plants	8.69%	11.82%	10.25%	6.74%	10.60%	8.67%
Excluding China	8.69%	11.82%	10.25%			
Weighted by GDP	11.44%	13.82%	12.63%	6.87%	10.97%	8.92%
Weighted by GDP per capita	12.02%	15.37%	13.69%	7.59%	12.60%	10.10%

Source: Author's calculations using data from World Development Indicators, and PriceWaterhouseCoopers, publicly-listed electric utility companies, or Morningstar.

References

Goldman Sachs. (2010, October 26). "China: Utilities: Power—Generation." Global Investment Research.

International Energy Agency. (2010). The Projected Costs of Generating Electricity: 2010 Edition. Paris: Organization for Economic Cooperation and Development/International Energy Agency.

International Energy Agency. (2010). World Energy Outlook 2010. Paris: Organization for Economic Cooperation and Development/International Energy Agency.

Platts. (2011). UDI World Electric Power Plants Data Base (March 2011). Washington, DC: Platts.

World Bank Group. (2008). Development and Climate Change: A Strategic Framework for the World Bank Group. Report to the Development Committee. Washington, DC: World Bank Group.

Endnotes

1. Middle-income countries are defined as IBRD and IBRD/IDA blend countries.

2. Following the World Bank's Strategic Framework for Development and Climate Change (2008) that calls for the use of "the best appropriate available technology to allow for high efficiency, and therefore, lower greenhouse gas emissions intensity" in its coal lending portfolio, less polluting coal plants use select pollution control technologies that have been identified by the World Bank in previous lending activity over the last 5 years and include: 1) ultrasupercritical or supercritical design—the same proven technology used in OECD countries to minimize carbon emissions (Eskom Power Support Project in South Africa, 2010); 2) subcritical design if the plant uses dry-cooled systems to conserve water (Eskom, 2010 and Morupule B Generation and Transmission Project in Botswana, 2009) and/or sulfur dioxide scrubbers to minimize air pollution, and, if it is less than 500 MW, features circulating fluidized bed boiler technology (Morupule, 2009).

3. "The Bank may guarantee, participate in, or make loans to any member or any political sub-division thereof…subject to the following conditions: … ii) The Bank is satisfied that in the prevailing market conditions the borrower would be unable otherwise to obtain the loan under conditions which in the opinion of the Bank are reasonable for the borrower…" IBRD Articles of Agreement, Article III: General Provisions Relating to Loans and Guarantees, Section IV: Conditions on which the Bank may Guarantee or Make Loans, Subsection II.

4. For a full description of the methodology, see Appendix A.

5. Figures are based on analysis of the Platts World Electric Power Plant Database (2010).

6. Includes loans issued for the construction of new coal-fired power plants by the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and the World Bank Group.

7. Chinese plants were analyzed solely due to plant-level data availability in the International Energy Agency's "The Projected Costs of Generating Electricity: 2010 Edition."

8. Data were missing to analyze the WACC in El Salvador, Iran, Morocco, Peru and Zimbabwe.