EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT

Methodology for the assessment of coal fired generation projects
25 September 2014

1. Background

The activities of the European Bank for Reconstruction and Development (**EBRD**) in the energy sector for the period 2014 to 2018 are governed by its Energy Sector Strategy, approved on 10 December 2013 by EBRD's Board of Directors (the **Energy Strategy**)[1].

The Energy Strategy sets out in Section 5.6.3 EBRD's approach to the financing of coal-fired generation and associated infrastructure. It provides that EBRD will only finance such projects in rare and exceptional circumstances and where they satisfy three coal screening criteria (referred to as the tripartite test). These criteria are set out in detail in the Energy Strategy and are summarised below:

- The infrastructure being financed must be the *least carbon-intensive* of the realistically available options.

- The infrastructure must use *best available techniques (BAT)*, as defined in the EU Industrial Emissions Directive[2].

- The plant must comply with the EU Industrial Emissions Directive requirements in relation to *carbon capture and storage* readiness.

The Energy Strategy also provides that for any proposed financing of coal-fired generation and associated infrastructure, EBRD will assess the impact of carbon and other emissions, using shadow prices in order to demonstrate that the investment is economically viable even taking account of emissions externalities. This assessment is a separate analysis to that required for the three screening criteria. However it is expected to be relevant to the first criterion, in helping to identify the realistically available options.

This paper describes in more detail the methodology EBRD will apply in making this economic assessment. It also specifies the shadow prices EBRD will use for the main emissions. This paper was prepared with support from an independent external economic consultant in particular in relation to the level of shadow costs to be applied to emissions of CO2 and other substances.

2. Outline of methodology

EBRD will use a levelised cost of energy (**LCOE**) methodology in assessing any proposed financing for coal-fired generation or associated infrastructure. The methodology will have the following steps:

- Identify the proposed project.

- Identify all other realistically available options to meet the same energy needs as the proposed project.

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1 The Energy Sector Strategy is available at http://www.ebrd.com/downloads/policies/sector/energy-sector-strategy.pdf.

2 Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control).

- Calculate the LCOE of the proposed project and each other option with the inclusion of externalities, including a shadow price of carbon.

- Verify that the LCOE of the proposed project is lower than all other options.

To define the set of comparators for the proposed project EBRD will review the full range of feasible options, including energy efficiency measures, interconnections to other energy supply options, renewable energy, other conventional energy sources and combinations of such measures. The feasible options should be considered for a country rather than for the project site. They may include phased implementation of technologies or a combination of shallow modernisation to extend the lifetime of an asset by a few years pending the construction of other assets or interconnections. Options may also include a benchmark 'do nothing' option if applicable to the particular circumstances of the project under consideration. Feasible options should be chosen irrespective of political priorities of country's energy policy and time constraints resulting from inadequate planning processes or market signals.

In circumstances where there are so many such options that detailed analysis of each is impractical, EBRD will identify representative examples for each group of options and then refine the analysis further based on the results of the analysis of the representative example. EBRD will not screen options in or out on the basis of cost, since this is taken account of in the LCOE analysis.

Where options have different output characteristics in terms of energy security, reliability and flexibility, this will be quantitative and qualitatively taken into account in the analysis. This paper defines these three characteristics of security, reliability and flexibility as follows:

- *Security* is the level of certainty that energy can be delivered when needed, based on factors such as the diversity and reliability of trading partners – both with respect to electricity interconnections and fuel supplies.

- *Reliability* is the incremental contribution of an additional generating unit to reducing the chance that the power system will have insufficient installed capacity to meet expected peaks in demand.

- *Flexibility* is the ability of a generator to respond to changes in supply/demand conditions in the power system, which in practice can be represented by generators' start-up times, ramp rates and minimum stable load.

Within this framework EBRD will assess security aspects in a qualitative manner, since they are not typically susceptible to a quantitative analysis. EBRD will incorporate an assessment of reliability and flexibility into the LCOE analysis of each option, as described further below.

3. LCOE analysis

EBRD will calculate the LCOE of the proposed project and each option as a cost per MWh, calculated as the net present value of its lifetime cost divided by the net present value of its lifetime generation. Where a project being assessed is a combined heat and power plant heat energy will be converted into MWh and aggregated with electrical energy.The main inputs into the LCOE calculation and the methodology for establishing their values are as follows:

Capital cost	The capital cost of each project will be actual forecast costs, in the case of any project under specific development, or otherwise benchmark international costs adapted for country-specific conditions.
Operating costs	The operating costs of each project will be actual forecast costs, in the case of any project under specific development, or otherwise benchmark international costs adapted for country-specific conditions.
Fuel	Fuel costs will be consensus international forecasts for traded fuels and estimates of opportunity cost for non-traded indigenous fuels.
Reliability	EBRD will first assess whether, in the absence of the proposed project, the energy system in question is expected to have installed capacity above a reasonable reserve margin. An option's contribution to reliability will only be valued in years during which existing capacity does not meet the long–term reserve margin. Where a situation of projected capacity shortfall pertains, EBRD will calculate the value of reliability of a generating option in any given year as the annualised fixed costs per MW of a best new entrant peaking plant, adjusted by the availability at times of peak load of the option being considered. This reliability benefit will be deducted from the annual costs of the option being considered. Alternatively the cost implications of ensuring a sufficient level of resilience to short-term fuel supply disruptions will be internalised, for example by adding the cost of additional storage to the LCOE calculation.
Flexibility	EBRD will assess flexibility similarly to reliability. First EBRD will assess the extent to which flexibility is needed in a particular system, taking account of the share of unpredictable intermittent generation sources and the flexibility of existing capacity amongst other aspects. If this qualitative assessment indicates that there is value associated with adding flexible generation capacity to a power system, then EBRD will assess that value. Where an energy market exists with sufficient liquidity and price information, EBRD will use this information to establish the value of flexibility. Where this is not the case, as in many EBRD countries of operations, EBRD will incorporate the actual costs associated with meeting marginal flexibility demands.
CO2 emissions	The cost of greenhouse gas emissions will be set at 35 EUR/TCO2e for an emission in 2014 and in 2014 prices. To reflect the fact that marginal damage costs of additional emissions will be higher at higher concentrations of carbon dioxide in the atmosphere and marginal abatement costs increase over time, EBRD will apply a 2.0% real growth rate per year to this cost.[3] EBRD will also conduct

[3] The carbon cost level and escalation factor are based on a 2014 desktop review by NERA Economic Consulting for EBRD of internationally accepted estimates of costs associated with CO2 emissions, based on both social damage and

a sensitivity analysis to check the sensitivity of the LCOE to changes in the price of CO2 emissions.

Other emissions

EBRD will also attribute costs to emissions of sulphur dioxide (SO2), nitrogen oxides (NOx) and particulate matter (PM), both fine particulates (PM2.5) and larger particulates (PM10)[4]. EBRD will apply a Value of a Life Year approach which attributes a EUR cost to each tonne of such emission based on impacts on mortality. EBRD will use the following costs, in 2014 EUR:

SO2	8,215 EUR/tonne
NOx	7,915 EUR/tonne
PM2.5	27,404 EUR/tonne
PM10	27,795 EUR/tonne

These values are drawn from a 2011 European Environment Agency study of the cost impacts of such emissions in the EU28 and Norway[5]. EBRD will adjust these values as appropriate to a given situation in an EBRD country of operation to reflect differences in wealth, population density and other project specifics.

Project lifetime

EBRD will calculate the LCOE of each option for its design lifetime.

Discount rate

Consistent with similar economic assessment methodologies, EBRD will discount all costs and generation by a discount rate, calculated as the social time preference rate for the relevant country. This rate is expected to be in the range of 5% to 8%.

4. Application

EBRD will apply the methodology set out in this paper to any investment in coal-fired generation and associated infrastructure presented to the EBRD Board of Directors after 10 December 2013. This paper is a staff working document and is subject to revision over time. The detailed implementation of the methodology will be dependent on the specifics of each project to which it is applied.

marginal abatement approaches. This included a review of the practice of the European Investment Bank, the World Bank, the US Environmental Protection Agency and the UK Department of Energy and Climate Change.

4 These three emissions (SO2, NOx and PM) are typically identified as the major pollutants from large combustion plants, particularly coal-fired plants, and are the main emissions regulated by the EU Industrial Emissions Directive.

5 EEA (2011), "Revealing the Costs of Air Pollution from Industrial Facilities in Europe".