

# AFFORDABLE ELECTRICITY FOR KOSOVO?

A Review of World Bank Group Cost Estimates  
For New Lignite-fired Plants in Kosovo

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## EXECUTIVE SUMMARY

This report provides a review of economic issues within the “Terms of Reference” (“TOR”) that has been provided to the Kosovo Strategic Framework for Development and Climate Change (“SFDC”) Expert Panel to assist the panel in determining whether the proposed Kosovo Power Project meets World Bank policy on participation in coal-based power generation projects. It focuses on that part of the proposal that would provide for World Bank Group support for a new base load lignite-fired power plant (“Kosovo C”) and examines whether the TOR provides a sufficiently credible evaluation of available alternatives to provide a basis for World Bank Group participation in the Kosovo Power Project as proposed.

The Review concludes that the TOR does not provide a basis for a full consideration of the diversity of available technologies, costs, and solutions to Kosovo’s energy needs or a basis for a World Bank Group decision to support the proposed new lignite-fired plant. Further, the TOR does not provide a sufficient analysis of the available alternatives and costs to establish compliance with the World Bank Group policy criteria. Specifically:

- 1) No evaluation of the temporal variation in Kosovo’s electric consumption patterns (i.e., the variation in energy demand as that demand changes throughout day and the year) was made to determine the least cost mix of base load, load-following or peaking units was conducted. As a consequence of failure to properly define Kosovo’s energy demand, the TOR simply and erroneously assumes that Kosovo’s needs can be met most cost-effectively by a system that is made up entirely of base load units, even though a mix of base load and non base load units is routinely incorporated in economically efficient systems. The TOR does not examine this issue and make a determination that for, some reason Kosovo’s low-cost mix is different from such systems; it simply assumes that 600 MW of new **base load** generation at Kosovo C is needed;
- 2) The TOR limits the alternatives to be considered to **base load** lignite-fired, gas-fired and oil-fired units. Given the high fixed cost of large lignite-fired base load units, building and operating such new base load units at low capacity factors is not likely to be the cost effective solution to addressing Kosovo’s energy needs;
- 3) The TOR specifically precludes the SFDC Expert Panel from conducting a full and inclusive assessment process that gives proper consideration to the diversity of technologies, costs, and solutions that would lead to an economically, socially, and environmentally sustainable energy plan for Kosovo and the region;
- 4) The TOR fails to document whether **any** new **base load** capacity is needed or whether there is a regional market for non-peak base load generation. A reduction in “technical losses” associated with transmission system deficiencies (currently 15 percent) to levels achieved elsewhere in the region (5 percent) would save the same amount of power as the power shortfall relied on in the

TOR to establish the need for new generation. Planned transmission system improvements, completion of the Zhur hydropower plant (“HPP”) and refurbishment of Kosovo B plant as contemplated would provide generating capacity 30 percent higher than the reported current annual average demand.

- 5) The cost of electricity that would be provided by the Kosovo plant is grossly underestimated. The figures used in the TOR for the capital cost of construction and for future fuel costs are based on preliminary estimates that are not been refined or updated and are inconsistent with both regional costs as documented by unbiased governmental and commercial entities and with published inflation indexes for those items since the initial date of the estimate.
- 6) Importantly, the predicted cost of electricity is based on the assumption that all four surviving Kosovo units will operate 85 per cent of the time. There is insufficient demand, especially in off-peak periods, in Kosovo to support this level of operation. The overall system load factor in 2006 was 46 percent. If one assumes that Kosovo B operates as the base load unit, the capacity factor for the new Kosovo C units at current overall demand would be 20 percent; not 85 percent, thus tripling the cost of generation for this plant.
- 7) Providing a credible cost estimate of the likely cost of electricity from the proposed project is beyond the scope of this review. However, given the magnitude of the errors in the TOR estimate, it is reasonable to assume that the cost of electricity under the proposed plan might be three times higher than current costs. As an increase of this magnitude could have a significant adverse impact on the Kosovar economy and quality of life it is important that a credible determination of the cost and benefit of **all** options be made and discussed publicly.
- 8) The proposed project would result in higher emissions of all conventional and hazardous air pollutants than a mix of transmission system improvements, constructing the Zhur HPP, HPP swaps with neighboring countries, development of conservation, demand side (peak load) management programs and small natural gas-fired peaking units as needed.
- 9) The proposed project is not shown to be “carbon neutral” when compared to either the *status quo* or to the mix of available alternatives.

## INTRODUCTION

The Kosovo government, with the assistance of the World Bank Group, USAID and others, has embarked on an ambitious effort to replace half of the generating capacity in Kosovo with new base load lignite-fired electric generating units and refurbish the other half of the capacity, all in the next 4 years. Several studies have been conducted and a “Terms of Reference” (“TOR”) has been provided to the Kosovo Strategic Framework for Development and Climate Change (“SFDCC”) Expert Panel to establish the parameters to be employed by the panel in determining whether the proposed Kosovo Power Project meets World Bank policy on participation in coal-based power generation projects. The SFDCC outlines the policy criteria for determining when the World Bank Group may support a particular coal project:

- “(i) there is a demonstrated developmental impact of the project including improving overall energy security, reducing power shortage, or access for the poor;
- (ii) assistance is being provided to identify and prepare low-carbon projects;
- (iii) energy sources are optimized, looking at the possibility of meeting the country’s needs through energy efficiency (both supply and demand) and conservation;
- (iv) 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;
- (v) coal projects will be designed to use the best appropriate available technology to allow for high efficiency and, therefore, lower GHG emissions intensity; and
- (vi) an approach to incorporate environmental externalities in project analysis will be developed.”

This review concludes that the TOR does not provide a sufficient analysis of the available alternatives and costs to establish compliance with the World Bank Group policy criteria described above. The TOR limits the available alternatives to **base load** lignite-fired, gas-fired and oil-fired units. In doing so, it fails to recognize that efficiently functioning electric power generating systems must have a mix of base load, load following and peaking assets. If the Kosovo Power Project goes forward as described, Kosovo will be served by four units that are designed as base load units, with no load following or peaking units.<sup>1</sup> Demand for electricity is significantly reduced at different times of the day, especially during certain seasons. For this reason, in a system where there is no intermittent capacity, the projected utilization rates of 85 percent cannot be achieved. As a result the projected cost of electricity is greatly understated and the potential for eliminating load shedding will be less than forecast. The TOR provides no information upon which the SFDCC Expert Panel can base a judgment as to the amount of **base load** capacity that is needed; nor any discussion of the need for load following or peaking generation capacity and how that capacity can best be obtained. However, it can reasonably be concluded that, given the high fixed cost of such units, building and operating new base load units at low capacity factors is not likely to be the cost effective solution to addressing Kosovo’s energy needs.

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<sup>1</sup> Such a system is also not particularly cost effective means of providing “n-1 reliability.”

The TOR fails to compare the costs and benefits of rehabilitating existing units and does not recognize the very real prospect that attempting to replace such a large percentage of the country's base load capacity over a span of only a few years will cause a large increase in the cost of energy and adversely affect the economic development of Kosovo and the well being of the public. While the TOR argues that excess power can be exported to others in the region, it presents no market analysis to support this assertion. The TOR presents cost estimates for use by the panel that (1) are clearly out of date – some estimates go back to 2001; (2) were intended as “nominal” estimates at the time; not reliable figures; (3) are significantly different from figures provided by neutral government agencies and business entities for similar projects in the region and throughout the world; and (4) are demonstrably incorrect, based on published figures on the increase in cost since the original estimates were made.

The TOR also fails to incorporate into its analysis of the needs of the Kosovar system, ongoing projects that are underway, such as the reduction in “technical” losses due to deficiencies in the transmission system, the potential for development of the Zhur Hydropower Plant (“HPP”), and the ongoing development of Sibovc South Lignite Mine (“Sibovc Mine”), as well as options that may be available, such as the proposed new transmission line, a potential natural gas line, demand side management and power swaps with neighboring countries. By way of example and as described in more detail below, simply reducing current levels of “technical losses” associated with transmission system deficiencies would eliminate the reported current shortfall in generation.

The project assumes life extension and environmental upgrades at Kosovo B that would result in Kosovo B meeting EU Directive emission limits for existing units. While the new Kosovo C unit would meet somewhat more stringent limits than Kosovo B, it would not meet the far more stringent EU Best Available Techniques (“BAT”) guideline limits and would not have controls designed to minimize emissions of hazardous air pollutants such as mercury, hydrogen chloride, hydrogen fluoride, dioxins or heavy metals. If approved, the four base load system described in the Kosovo Power project would have substantially greater emissions than the mix of options in the available alternatives.

Finally, it must be noted that the proposed Kosovo Power Project has not been shown to be more efficient than the existing units would be if refurbished or to have lower greenhouse gas (“GHG”) emissions than a system solution that was comprised of a mix of (1) base load lignite-fired generation; (2) demand side management; (3) peaking hydropower from within Kosovo as well as that obtained from neighbors with high HPP resources (and possibly wind power); (4) reduction of transmission system losses and (5) peaking natural gas-fired units. It has also not been shown that the proposed Kosovo Power Project would serve the needs of the public at a lower cost than the alternatives describe above.

As in the United States, power costs associated with newly constructed generation assets in Kosovo will cost substantially more than the cost of generating power from existing assets that do not need to service debt. Most estimates put the levelized cost of energy (“LCOE”) of “new coal” at 50 to 75

percent higher than “existing coal<sup>2</sup>.” Contrary to claims by some advocates, the fuel efficiency of the fleet has not improved over the past several decades. In the U.S. as recently as three years ago low efficiency circulating fluidized bed (“CFB”) designs were popular because of their ability to burn very poor quality coal and coal waste. While the documents describing the Kosovo Power Project are at times vague and sometimes contradictory, it does appear that the project anticipates utilizing two lignite-fired boilers, which may or may not be of CFB design. The Request for Proposals (“RFP”) requires a generation efficiency of only 37 percent and is designed to meet EU Directive Limits for dust, SO<sub>2</sub> and NO<sub>x</sub>, but not the more stringent EU Best Available Technique (“BAT”) limits. Accordingly, it cannot be said that the project represents a meaningful reduction in GHG emissions from the existing units or significantly better dust, SO<sub>2</sub> and NO<sub>x</sub> emission performance than would be required of the existing units were they to be refurbished and continue in service past 2016. Recently has there been a greater worldwide usage of higher efficiency supercritical pulverized coal (“SCPC”) plant designs that date back to the 1970s and an effort to improve on those designs. The RFP allows bidders to propose SCPC, ultra supercritical pulverized coal (USCPC) or supercritical circulating fluidized bed (“SCCFB”) designs, but requires only low efficiency subcritical designs.<sup>3</sup> Even with the improved fuel efficiency of SCCFB, SCPC and USCPC designs, however, the high investment cost for new units results in a LCOE that cannot compete with the cost of generation of existing units.

The initial cost estimates for this project were preliminary, based on “nominal” figures and prepared eight years ago. Those figures are cited in the TOR notwithstanding the fact that in the interim there has been a substantial increase in the construction cost for similar projects associated with a dramatic increase in steel, copper and other essential commodities as well as a large increase in the market price for steam coal. The current estimates for the overnight capital cost and the fuel cost of the project are exceedingly low and lead to an unrealistically low calculation of the levelized cost of electricity. Insufficient allowance is provided in the estimate for the cost of any delay in the schedule. The cost to the developer of a delay of even several months can be substantial and much longer delays should be anticipated for the proposed project, given that the Republic of Kosovo has little recent experience with such projects and the lack of infrastructure in Kosovo to support such projects. In theory the government proposes to underwrite any cost overrun by adjusting the tariff to be paid to the developer, but experience in other countries has shown that this may prove to be politically difficult. Moreover, the difficulties experienced by the government in recovering the cost of generating electricity at current prices suggest that collecting a substantially higher tariff than the current rate may not be feasible.

Before committing significant additional resources to the project, the earlier preliminary cost estimates should be revised and refined, and a candid assessment of the impact of highly leveraged new base load generation capacity on retail electric rates should be provided, as well as a more realistic

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<sup>2</sup> See, e.g. Deutsche Bank Group, *A Secure Low Carbon Future Energy Plan for the United States*, November, 2010

<sup>3</sup> At this time no proposal has been made public.

assessment of employment impacts<sup>4</sup>. Importantly, temporal demand should be analyzed to ascertain the lowest cost mix of base load, load following and peaking generation assets. Overly optimistic cost and load estimates do not serve the interest of any party, since, at the end of the day the bill will have to be paid. However, such estimates can lead to investment decisions that may result in very much higher energy costs for Kosovars<sup>5</sup>.

## REVIEW OF THE KOSOVO SFDCC EXPERT PANEL “TERMS OF REFERENCE”, JUNE 14, 2011

A preliminary review of the TOR was undertaken. It must be emphasized that this review was limited by time and available resources. While the overall project included development of a new Sibovc Mine, this effort apparently needs to go forward to provide fuel for existing generation at Kosovo A and B, irrespective of whether Kosovo C is constructed and does not provide a reason for constructing Kosovo C. Accordingly, the rationale for constructing a new mine was not reviewed. In the course of this review a number of errors and misstatements were found, but, given the available resources, only the most significant are addressed in this report.

### LCOE

Perhaps the most significant error in the TOR is the representation that the estimated LCOE for “new” coal generation is 3.5–3.6 eurocents/kWh (\$0.05/kWh). This estimate is substantially lower than found in the literature and is inconsistent with recent history in the United States and Europe. The International Energy Agency in concert with the Nuclear Energy Agency and the Organization for Economic Cooperation and Development has published LCOE costs for brown coal/lignite burning plants in several countries in the region: the Czech Republic (\$0.114/kWh), Germany (\$0.0874/kWh), the Slovak Republic (\$0.141/kWh).<sup>6</sup> For the United States, a LCOE of \$0.09/kWh is given for black coal<sup>7</sup>. According to the U.S. Department of Energy the LCOE for new U.S. coal generation will average \$0.0948/kWh in the U.S. with regional variation of between \$0.0855 and \$0.11/kWh.<sup>8</sup>

The underlying basis for this figure was reviewed and compared with published figures for key assumptions. The TOR indicates that its LCOE estimates were derived from two other documents prepared in conjunction with the project: (1) LPTAP Project Appraisal Document, 2006 and (2) World

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<sup>4</sup> For example, the TOR claims that there will be an increase in employment as a consequence of opening the new Sibovc mine, but fails to mention that this gain will be more than offset by job losses at the (hopefully) less efficient earlier mine the new mine will replace.

<sup>5</sup> The near term impact on residential and commercial tariffs is different from the *levelized* cost of energy that forms the basis for the TOR evaluation. The cost of energy to the consumer includes transmission and distribution. The near term cost of generation that is passed on to the consumer will be dependent on a number of factors specific to the cash flow needs of the generating entity (including how import tariffs on plant equipment are addressed) and market considerations. No attempt has been made to evaluate these issues.

<sup>6</sup> International Energy Agency, Nuclear Energy Agency and the Organization for Economic Co-operation and Development, *Projected Costs of Generating Electricity, 2010 Edition*

<sup>7</sup> Typically combustion units that fire low rank coals are physically larger than those that burn coal with higher heating values.

<sup>8</sup> [Levelized Cost of New Generation Resources in the Annual Energy Outlook 2011](#). Released December 16, 2010. Report of the [US Energy Information Administration](#) (EIA) of the [U.S. Department of Energy](#) (DOE).

Bank staff estimates, Kosovo Lignite Power Initiative – Economic Analysis, 2006. The Project Appraisal Document appears to be the source of the LCOE estimate. A spreadsheet is provided on page 77 of that document that sets out the assumptions and the resulting LCOE. However, no support is offered for the assumptions made and the calculation is general in nature. It appears that this estimate may be derived from an earlier “Pre-Appraisal” for a larger project that was contemplated several years earlier. One cannot determine from the spreadsheet the amount of cost that is assigned to controls on particulate matter, SO<sub>2</sub> or NO<sub>x</sub> and no decision has been made as to whether the unit will be subcritical or supercritical<sup>9</sup>. While there are a number of assumptions that one could question, the three that have the greatest impact on the overall evaluation are (1) the assumed capital cost of construction (2) the assumed capacity factor and (3) the assumed cost of fuel.

### Capital Investment Required

The LCOE estimate in the TOR assumes that the capital investment for the new facility would be 1000 €/kW (\$1,360/kW) of capacity or €660 million (\$897 million<sup>10</sup>) for the two new units if they are subcritical designs, and 1100 €/kW for SCPC<sup>11</sup>. This is far lower than the International Energy Agency (“IEA”) overnight capital cost estimate of \$2,762/kW for brown coal fired generation in the Slovak Republic, \$3,486/kW for the Czech Republic or \$2,197/kW in Germany. It is also substantially lower than the average figure published by the U.S. Department of Energy of \$2,408/kW. Finally, it is inconsistent with the most recent estimates prepared for this project. Construction costs have shown extreme volatility in the past few years. The IHS CERA Power Capital Cost Index<sup>12</sup> is one of a number of sources that document the sharp rise in capital cost of construction since the initial “Pre-Feasibility” estimates were prepared for Kosovo C.

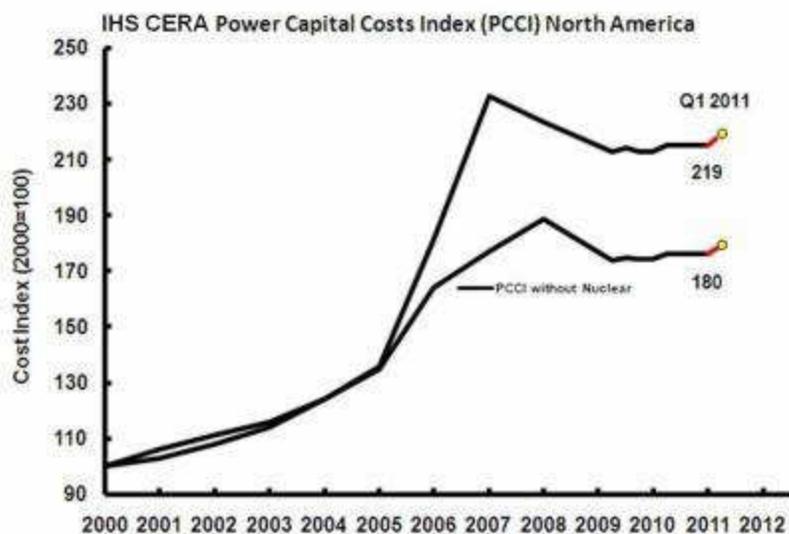
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<sup>9</sup> The terms “subcritical” and “supercritical” refer to whether the operating temperature and pressure of the boiler is greater than the point of criticality (where distinct liquid and gas phases do not exist) for the water/steam in the boiler. Overall efficiencies can be raised from about 39 percent for subcritical operation to about 45 percent for supercritical operation, thus reducing emissions of GHG and other pollutants per unit of electricity generated.

<sup>10</sup> This figure assumes an exchange rate of \$1.36/€, the rate as of this date. The estimate notes that the exchange rate at the time was €0.7844 to one dollar which results in an estimate of \$838 million.

<sup>11</sup> A subsequent analysis (“Pre-feasibility studies for the new lignite fired power plant and for pollution mitigation measures at Kosovo B power plant Task 5 ,Financial and economic analysis of the new TPP, Draft Final, February, 2006) estimated the investment cost of two 300MW units to be 1091€/kW (\$1484/kW) for CFB boilers and 1202€/kW (\$1635/kW) for PC boilers. This analysis reports that it is employing “nominal” values rather than project specific values. The TOR does not reflect these estimates, but continues to rely on the earlier figures.

<sup>12</sup> See, <http://press.ihs.com/press-release/energy-power/power-plant-construction-costs-cost-pressures-returning>. See, also, <http://www.decc.gov.uk/assets/decc/statistics/projections/71-uk-electricity-generation-costs-update.pdf>



Future cost predictions continue to show extreme volatility and higher costs. The overnight capital cost estimate of the highly respected U.S. Energy Information Agency for 2011 is 25 percent higher (\$2,844/kW) than that for 2010 (\$2,271/kW)<sup>13</sup>.

To be sure, there is a range in the published figures. The U.S. data includes one unit that has a capital cost of \$1,355/kW – but also a unit that cost \$5,350/kW. As discussed below, the TOR assumes that the best available control technologies for SO<sub>2</sub> and NO<sub>x</sub> controls will not be employed in all options, which would reduce the capital cost of the project but increase the environmental costs by a greater amount as well as the environmental benefit claimed by the project. However, while the level of environmental performance falls short of what has been demonstrated in practice, it does meet EU Directive limits, but not BAT requirements. Decisions respecting the use of two pollution control technologies can have a significant impact on the cost of the Kosovo C Plant. The Project contemplates installation of Flue Gas Desulfurization system (“FGD”) if a Pulverized Coal (“PC”) is design is used, but not if a Circulating Fluidized Bed (“CFB”) design is chosen. FGDs are relatively large and expensive pieces of equipment, the cost of which can approach 10 percent of overall plant costs.<sup>14</sup> The “Pre-Feasibility” cost estimate assumed that that the cost of the FGD would be offset by the more expensive cost for a CFB unit and assigned the same construction cost for each option. This is not an unreasonable assumption for the early stage of the process, but should be revisited before a determination of whether such units would constitute the lowest cost option is made.

<sup>13</sup> Ref, [http://www.eia.gov/oiaf/beck\\_plantcosts/index.html](http://www.eia.gov/oiaf/beck_plantcosts/index.html)

<sup>14</sup>The U.S. Energy Information Agency places the 2009 average cost of FGD controls at \$186.73/kW <http://www.eia.gov/cneaf/electricity/epa/epat3p11.html>. However, there is a large variability in this figure; most of the units in this database are retrofit units that can be anticipated to cost more than new units, where the design anticipates the pollution control.

The proposed design also does not contemplate installation of an SCR, another fairly expensive, but highly cost effective, pollution control device. SCR costs range from \$100/kW to 200/kW.<sup>15</sup> If required, this device would reduce NO<sub>x</sub> emissions by up to 90 percent, but would increase the estimate of the LCOE. This does not impact the comparison of the cost of generation in other countries, because this technology has not been regularly required at lignite burning facilities with relatively low natural NO<sub>x</sub> emission levels. Less capital expensive techniques are available to reduce NO<sub>x</sub> emissions by 40 to 60 percent from uncontrolled levels.

Even in the United States, the cost of construction of new power plants can vary by up to 50 percent, depending on the region of the country in which it is installed. There are a number of factors that would suggest that the cost of construction in Kosovo is likely to be above the average figures provided.

- **Kosovo does not have the capacity to manufacture the specialized components needed** – only a few countries do. Accordingly, the plant will essentially be imported and likely have to be shipped several thousands of miles.
- **Kosovo is land locked and so, the large components that will be fabricated elsewhere will then have to be trucked many miles over poorly maintained roads or rails** – negotiating switchbacks, tunnels and possibly requiring air lifting of heavy components at certain points.
- **Kosovo does not have the infrastructure to support such construction.** Accordingly, specialized equipment will have to be transported and maintained onsite, rather than being leased as needed.
- **Kosovo does not have a sufficient number of engineers, boilermakers and welders experienced in the construction of large power plants.** Thus, while some local labor can be employed, much of the labor will have to be brought in from other countries and housed on or near the site.
- While partial or full loan guarantees will help reduce financing costs, **the perception of the risk of investing in Kosovo will push lending costs and investor return demands upward.**
- **The planned Kosovo C units, at 300 ME each are relatively small.** Published cost figures show a clearly increased cost of construction per MW of capacity for smaller units.

### Capacity Factors – Peaking vs. Base Load Generation

Electricity cannot be stored in any meaningful fashion<sup>16</sup> and so the amount of electricity that is produced at any point in time must be as a response to the demand within that system at that same point in time. Demand rises and falls with time of day, season of the year and weather, as each consumer turns on the lights or starts to cook a meal or as a factory commences a high demand activity. Accordingly, the low cost solution for meeting an area's energy needs will ordinarily be a mix of base

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<sup>15</sup> See, Northeast States for Coordinated Air Use Management, *Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants*, March 2011. <http://www.nescaum.org/documents/coal-control-technology-nescaum-report-20110330.pdf/>

<sup>16</sup> Admittedly, the water that generates hydropower can often be stored during wet periods for some period of time.

load units that have a high capital cost, but low operating costs and overall COE, load-following units that have lower capital costs, higher operating costs and overall COE and peaking units, with lowest capital costs, but high operating costs and COE. In developed countries, base load units might be large coal-fired or nuclear plants that have long ramp up time<sup>17</sup>, load following units might be smaller coal-fired units or combined cycle gas-fired units, while peaking units will typically be very small oil or gas-fired combustion turbines. Hydropower plants are especially well suited to peaking applications as the ramp up time can be quite rapid and the source for the power is susceptible of storage. In estimating cost of generation for base load units an 85 percent capacity factor is commonly employed, while peaking units may have utilization factors of 15 percent or less.

The “Kosovo C” plan put forward in the TOR makes no provision for temporal variation in load and assumes that Kosovo’s electrical needs will largely be met by four base load units. No evaluation was conducted to determine the mix of base load, load following and peaking generation that would best fit Kosovo’s usage profile. Instead, the TOR assumes that nearly all of Kosovo’s demand will be met by four base load units. As a consequence, the system operator would need to continue to shed load during peak periods and/or continue to operate generating resources at lower utilization levels during non-peak periods. In the absence of units designed to respond to variation in load, it can reasonably be forecast that the Kosovo C units will not operate 85 percent of the time. For this reason use of an 85 percent capacity factor in the TOR and related documents for estimating LCOE is not appropriate. The *Kosovo Energy Sector Profile* published in 2005 reveals that load factors for existing generating units varied from 2.5 percent to 65 percent; the average load factor for the Kosovo system was 46 percent. The Profile asserts that these low load factors were the consequence of poor maintenance, but also references sharply higher load during peak demand periods. Until this issue is addressed, the least cost generation mix cannot be determined. However, it is possible to estimate the overall load factor for the proposed four base load unit system that has been proposed. **Using current demand, the load factor for these units would be below 50 percent.** Allowing the refurbished units to run as base load units (85 percent load factor) current levels of demand would result in utilization rates of less than 20 percent for the Kosovo C units even if excessive transmission losses are not corrected<sup>18</sup>. The utilization rate has a dramatic effect on LCOE.<sup>19</sup> While fuel costs decrease proportionally, the capital cost of construction (and associated financing costs) remains constant as generating capacity is idled. This fixed cost is then assigned to a smaller quantity of generation and must be paid for by increases in the per kW tariff paid by consumers.

The TOR asserts that any generation that is not needed in Kosovo could simply be exported to neighboring markets and some sales of electricity to neighboring countries have occurred. However, the TOR does not consider temporal load factors in those areas and does not establish that there is a market

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<sup>17</sup> Such units cannot respond to short peaks or drops in demand without compromising the life expectancy of the unit.

<sup>18</sup> The operators of the future plant might prefer to run the Kosovo C units as “base load” and allow the Kosovo B units to operate at lower load factors. For purposes of analyzing whether there is a need for additional generation, however, the existing facility should be dispatched first.

<sup>19</sup> Under these conditions, the LCOE for the new Kosovo C units could exceed €150/MW.

for new base load generation of this magnitude in those areas. Attempting to serve peak demand in those areas with base load units simply broadens the problem and increases the high cost and inefficiency associated with operating capital intensive base load plants at low load factors.<sup>20</sup>

### **What additional *base load* generation does Kosovo need?**

The TOR, Annex 1, asserts that the need for 600 MW of additional base load generation is demonstrated by the 2009 Annual Report Energy Report from Kosovo's Energy Regulatory Office that

“[t]he gap between unmet electricity demand and generation was 477 GWh in 2009. The medium growth demand scenario 3 forecasts that electricity demand would rise to about 7,000 GWh in 2018.”

These estimates do not support the need for 600 MW of new base load capacity as 477 GWh is only 64 MW of base load capacity<sup>21</sup> and 7000 GWh is only 340 MW of additional<sup>22</sup> base load capacity<sup>23</sup>. The 2009 Tariff application filed by KEK reveals that technical and "unaccounted for" losses amount to 1,400 GWh in 2008. This amount is three times the shortfall relied on to justify new base load capacity. **Simply reducing the reported “technical losses” from 15 percent to 5 percent of generation would save the reported current shortfall in generation.**<sup>24</sup>

The TOR predicts that there will be 7,000 GWh of electric power demand in Kosovo by 2016. This represents a 48 percent increase over 2008 consumption. Given the current economic climate in Europe (and elsewhere), an increase of this magnitude is unrealistic. Completing the refurbishing of Kosovo B, addressing transmission system losses as discussed above and completing the Zhur hydropower<sup>25</sup> plant project would provide an overall capacity of 6,146 GWh – 30 percent more than 2008 consumption. Additional reserve margins can be created by demand side management programs, minimizing theft of power and. Here it should be noted that the cost of generation avoided by utility managed conservation and demand side management (peak shaving) programs in the U.S. is reported to be less than \$50/MWh.<sup>26</sup> This amount is less than the LCOE projected for new coal generation in the U.S. and less than the likely LCOE for the Kosovo Power Project.

Kosovo may well have a need for additional peaking and or load following capacity. This potential need was not addressed in any of the earlier studies and should be evaluated in depth before

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<sup>20</sup> This inefficiency extends beyond the financial issues raised; thermal efficiency and pollution control device efficiencies tend to decline with variations in load.

<sup>21</sup> This calculation assumes a capacity factor of 85 percent.

<sup>22</sup> If Kosovo B were to operate at a capacity of 600MW and a load factor of 85 percent, it would generate 4,468 GWh of electricity, leaving a need for 2,532 GWh of electricity.

<sup>23</sup> Much of the shortage of electricity was associated with a shortage of fuel, not generation capacity.

<sup>24</sup> In its 2009 Tariff Application KEK reports that in 2008, 704,843 MWh of electricity (15 percent of total generation) were lost due to technical losses that were assigned to deficiencies in transformers and other elements of the transmission system. (704,843 MWh x .67 = 472,444 MWh or 472 GWh). This is in addition to 693,899 MWh which is reported as “unaccounted for.” Presumably some amount of system demand that results from theft of power would be reduced if the user is required to pay for it.

<sup>26</sup>[http://www.eia.gov/cneaf/electricity/epa/epaxfile9\\_7.pdf](http://www.eia.gov/cneaf/electricity/epa/epaxfile9_7.pdf)

committing significant resources to additional base load capacity. The use of base load units as load following or peaking units should be reflected in the load factor used to calculate the COE.

### Fuel Costs

The LCOE estimate in the TOR assumes a fuel cost of €0.89/GJ.<sup>27</sup> This assumption is based on “Pre-Feasibility” estimates of the capital and operating costs of opening a new lignite mine that relies on a 2002 study of a proposed new mine and does not incorporate documented worldwide producer cost increases due to inflation or inflation rates within Kosovo. The lignite cost estimate is also substantially lower than lignite and brown coal costs published by the CARDS Programme at that time for countries in the region:

Bosnia & Herzegovina	1.71 €/GJ
Bulgaria	0.88 €/GJ
FYR Macedonia	1.34€/GJ
Montenegro	2.44€/GJ
Romania	1.52€/GJ
Serbia	1.34€/GJ

While some trading occurs, because of the low heat content per volume of lignite, there is no commodity market and it is reported that prices tend to reflect the ease or difficulty of the mining and subsequent processing of the resource. The 2002 study reported that the indicated price was an “internal” KEK price, that a higher price was charged to private customers and that the cost did not include lignite management in the stockpile. More important is the fact that these estimates are now 10 years old and there has been a significant increase in the cost of producing lignite since the estimate was generated. The U.S. producer price index published by the Bureau of Labor Statistics reports that the cost of various lignite products has increase by 170 percent to 250 percent since December of 2001 and that some lignite products costs have increased by as much as 35 percent since June of 2008.<sup>28</sup> A review of the 2009 KEK Tariff Request suggests that these costs have indeed increased significantly.<sup>29</sup> Moreover, the lignite prices for the future will be determined by the relative ease with which lignite can be extracted from the new Slibovc Mine, not the characteristics of mines that had been previously developed and so it can readily be concluded that they are not well understood at this time.

Far more information is available today about the likely cost of fuel from the new mine

<sup>27</sup> GJ or Gigajoule is a measure of the energy content of coal and is often used as a way of comparing the cost of fuels with different head content. At the reported energy content of Kosovar lignite, this amounts to approximately €7.50/metric ton (“mt”).

<sup>28</sup> <http://www.bls.gov/web/ppi/ppitable06.pdf>

<sup>29</sup> Additional information is needed before firm conclusions can be drawn. In particular, the nature of the expenditures by the KEK Supply operation were not available at this time and some portion of KEK mining needs is presumably for cleaning up earlier environmental contamination and closing the old mine. Nonetheless, at a “ballpark level” the needs attributed to KEK’s mining operations in the 2009 Tariff Request are in the range of €1.50/GJ.

(including, for example, resettlement costs and overburden disposal costs) than was known in 2002. Rather than relying on 10 year old information, current data, including the extent of any KEK subsidy of lignite prices (that will presumably be eliminated if the operation is privatized), should be obtained, provided to the public and factored into more accurate fuel costs for the alternatives.

## **LEAST COST ALTERNATIVES ANALYSIS**

Reducing electric demand by insulating residences, providing “time of day” rates and feed in tariffs for large commercial users and repairing known deficiencies in the transmission systems are quite likely to be the lowest cost measure for the Kosovar ratepayers – but these options have not been analyzed and their cost effectiveness has not been compared to the proposed options. In addition, hydropower in the region has been shown to be cost effective – but the impact and effectiveness of the planned Zhur HPP is not considered in the analysis. Given the substantial hydropower resources in the region, additional analysis of a wind/hydropower/thermal power exchange program, such as that employed by Denmark<sup>30</sup> and its neighbors should be conducted. So, too, should be the effect of reducing unit size and diversifying the mix of generation in reducing overall system costs by lessening the amount of reserve capacity dedicated to compensating for a unit that goes offline. The TOR examines none of these options. It also fails to consider the mix of base load, load following and peaking generation that will provide the low cost solution to Kosovo’s energy needs. Instead, the TOR limits the alternatives analysis to a review of large, new baseline capacity fueled by lignite, oil and gas. Future gas price options are assumed to be too high for base load application, but no effort is made to evaluate gas-fired combustion turbines for peaking applications or combined cycle gas turbines for load following applications. The TOR devolves to an analysis of three options for 500-600 MW of new lignite-fired base load generation capacity. The resulting analysis dramatically understates the cost of electricity for a “baseline only” system forced to balance a continually varying load and fails to address the potential adverse impact on the Kosovar economy and standard of living of sharply increased costs of electricity. This mix of generation is contrary to what has been found to be cost effective in other countries, including countries with significant coal and lignite reserves.

## **ENVIRONMENTAL ISSUES**

The TOR takes the position that the existing Kosovo units should be retired because they are “old<sup>31</sup>” and because Kosovo A is “the dirtiest plant in Europe.” The environmental assessment identifies high particulate matter (“PM”) emissions as a significant issue. However, much of the PM problem is

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<sup>30</sup> See, e.g. [http://en.wikipedia.org/wiki/Wind\\_power\\_in\\_Denmark](http://en.wikipedia.org/wiki/Wind_power_in_Denmark)

<sup>31</sup> The age of the facility is not as relevant as its physical condition. These facilities are among the “older” units in service, but there are many similar units throughout the world that have undergone life extension and environmental upgrade programs. The average age of coal-fired units in operation in the United States is over 40 years, and in some areas (e.g. the State of Michigan) the average age is over 50 years. These units are expected to remain in service for several decades. When faced with regulations requiring either shutdown or significant expenditures for environmental upgrades, most of the U.S. fleet of coal-fired plants chose to upgrade those facilities.

described as related to ash handling and fugitive emissions as well stack emission rates. Ground level emissions impact the nearby community far more than stack emissions. These emissions can and should be addressed, and the relevant systems should be improved, irrespective of whether a new plant is built. Reportedly, both Kosovo A and Kosovo B are equipped with electrostatic precipitators (“ESP”) for control of PM stack emissions. Those controls had been allowed to deteriorate over the past two decades, but the ESP servicing the Kosovo B unit is being redesigned and refurbished. The June 2008, Environmental Assessment reports that no measurements of the rate of emissions for Kosovo A or Kosovo B are available,<sup>32</sup> but provides engineering estimates the current PM, SO<sub>2</sub> and NO<sub>x</sub> emission rates. The Environmental Assessment also reports the applicable emission EU rates (which are akin to New Source Performance Standards (“NSPS”) in the U.S. regulatory structure. As in the U.S. these emissions limits are only infrequently updated and so advances in pollution control technology are reflected in Best Available Technique determinations and the emission limitation that flow from those technologies<sup>33</sup>. The reported current emission levels, applicable EU limits and BAT guidance levels are

	PM (mg/Nm <sup>3</sup> )	NO <sub>x</sub> (mg/Nm <sup>3</sup> )	SO <sub>2</sub> (mg/Nm <sup>3</sup> )
Current Kosovo A emissions	700-1300	~700	300
Current Kosovo B emissions	150-230	500	400
Applicable Kosovo A/B Limit <sup>34</sup>	50	500	400
Applicable Kosovo C Limit <sup>35</sup>	30 <sup>36</sup>	500	200
Nominal BAT for modified units	5-20	50-200 (PC)	20-200 (PC) 20-200 (CFB)
Nominal BAT for new units <sup>37</sup>	5 -10 <sup>38</sup>	50-150 <sup>39</sup>	20 -150(PC) <sup>40</sup> 100-200 (CFB)

<sup>32</sup> This appears to be contradicted by other documents in the record.

<sup>33</sup> “Recital 8 of the LCP Directive states that “Compliance with the emission limit values laid down by this Directive should be regarded as a necessary but not sufficient condition for compliance with the requirements of Directive 96/61/EC regarding the use of best available techniques. Such compliance may involve more stringent emission limit values, emission limit values for other substances and other media, and other appropriate conditions.” In the U.S., the analogous process is the Best Available Control Technology (“BACT”) review under the PSD program of the Clean Air Act.

<sup>34</sup> These are the limits that would apply if Kosovo A were to be operated in the future and rated greater than 500 MW. Currently Kosovo A is subject to limit of 1200 mg/Nm<sup>3</sup> (SO<sub>2</sub>); 600 mg/Nm<sup>3</sup> (NO<sub>x</sub>) and 100 mg/Nm<sup>3</sup> (PM), applicable to units that are to be closed by 2016, but actual emissions are reportedly far less because of the characteristics of the coal employed.

<sup>35</sup> Assuming construction commences prior to January 1, 2016. Thereafter, the applicable limit would be 200 mg/Nm<sup>3</sup>. This also assumes that an obligation to install BAT is not imposed.

<sup>36</sup> The Environmental Assessment reports this figure as 50 mg/Nm<sup>3</sup>.

<sup>37</sup> See, European Commission, *Integrated Pollution Prevention and Control Reference Document on Best Available Technologies for Large Combustion Plants*, July, 2006. (“BAT Reference Document”). [ftp://ftp.jrc.es/pub/eippcb/doc/lcp\\_bref\\_0706.pdf](ftp://ftp.jrc.es/pub/eippcb/doc/lcp_bref_0706.pdf)

<sup>38</sup> The BAT Reference Document indicates that FGD, combined with a fabric filter (bag house) and sorbent injection are considered BAT for limiting emissions of mercury.

<sup>39</sup> BAT reference emission rate does not assume use of SCR; with SCR the emission rate would be substantially lower. The 2006 BAT Reference Document is currently under review.

<sup>40</sup> The BAT reference emission rate does not assume a combination of CFB with FGD, as has been employed in the AES Puerto Rico and Dominion VCHEP (US) plants, among others. With this combination, an even lower rate of emissions has been demonstrated.

From this information several conclusions can be drawn respecting the relative stringency of EU Directive Limits:

- (1) Since the going forward emission limits would be the same, **Kosovo C unit would provide no demonstrable improvement over PM emission performance of existing units.** Substantial improvements would be required in the rate of emissions of PM from existing Kosovo units if they are to operate in the future but both plants have had PM control devices installed that can be refurbished at far lower cost than new generation.;
- (2) Since each of the units would be subject to the same emissions limitation going forward, **no demonstrable NO<sub>x</sub> emissions performance improvement can be shown for Kosovo C over refurbishment of Kosovo B.** NO<sub>x</sub> emission rates for existing Kosovo units are driven by the low heat value and high moisture content of the fuel. The reported current performance is near required future levels and could likely be achieved by relatively low cost installation of low NO<sub>x</sub> burners and over fire air, the same technology anticipated for Kosovo C.
- (3) **The relatively low reported uncontrolled SO<sub>2</sub> emission rates from Kosovo A and B appear to be a function of fuel characteristics and are estimated to meet (or come close to meeting) applicable EU limits.** Some form of minimal added SO<sub>2</sub> reduction technology might be required at Kosovo B. **The Kosovo C SO<sub>2</sub> limit is half of the limit applicable to Kosovo A and B and would require better performance in the future than that required of the refurbished Kosovo B unit.**

The proposal for the Kosovo C plant requires only that the new plant meet minimum EU Directive standards; it does not require that the plant use BAT. Importantly, there is no obligation under current Kosovar law to utilize BAT. While the law would likely change once Kosovo is admitted to the EU, it would provide no particular benefit if, the Kosovo C plant commences construction before a change in law is made effective. The proposed plant assumes low NO<sub>x</sub> burners and over fire air for NO<sub>x</sub> control, adding selective catalytic reduction (“SCR”) would substantially improve NO<sub>x</sub> reduction. The proposed plant does assume an unspecified level of FGD utilization if a pulverized coal design is employed, but not if CFB design is selected. The BAT guidance emission limits that would be applicable to the construction of Kosovo C are only modestly more stringent, if at all, than those that would apply to the refurbishment of Kosovo B.

Finally, while there is some level of discussion of the environmental benefits of high-efficiency designs, that reduce emissions of GHG, mercury and other toxic air pollutants as well as the conventional pollutants discussed above, the RFP requests only a minimum thermal efficiency of 37 percent<sup>41</sup>. This level of efficiency is far below what can be achieved at new plants and would lead to GHG and other emissions approximately 10 to 15 percent greater than would occur if currently achievable efficiencies were required. Moreover, the specified minimum level of thermal efficiency has been achieved at units designed and built decades ago and may be no greater than the design efficiency the Kosovo A and B units, assuming proper operation and maintenance of those units.

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<sup>41</sup> The average thermal efficiency of all lignite Large Combustion Plants (“LCP”) in Germany is given at 38 percent.

It has been represented that the project is carbon neutral. This statement is correct only if you just limit the project evaluation to replacing Kosovo A generation with Kosovo C generation, and you only consider the emissions after completion of construction of the Kosovo C plant and demolition of Kosovo A. Replacing Kosovo A with a new Kosovo C will involve very substantial GHG emissions from the manufacture and transportation of very sizable quantities of steel, concrete and other commodities for the new units as well as emissions associated with the decommissioning of Kosovo A. It is also not true if the construction and operation of the Kosovo C plant is compared to the mix of available options described in this report or if one assumes that you are running all four units at an 85 percent load factor compared to today's overall load factor of 46 percent.

## **CONCLUSION**

The information provided in the TOR does not provide a basis for determining that the proposed Kosovo C project is in the county's best interest. Until Kosovo's load pattern is defined, the most cost effective mix of base load, load following and peaking units cannot be determined. It can reasonably be asserted, however, that attempting to serve the constantly varying electric demands with only base load designed units is not the most cost effective mix. Where the average load factor for the system is currently under 50 percent; assuming that, with the refurbished Kosovo B units in service, the Kosovo C units will also run 85 percent of the time is unrealistic. Assuming a reasonable load factor for these units doubles the predicted LCOE of those units. If one then simply adjusts the outdated cost estimates to reflect the change in the Power Capital Cost Index, the effect is to roughly redouble the predicted LCOE. The World Bank Group should carefully consider the risk of imposing such a large increase in the cost of electricity on the Kosovar economy before participating in such an effort. It should require an update of the true costs of the project and the impact on rates charged to consumers and businesses. It should also require a market study to determine whether there is any demand for off-peak power in the region.

It is clear that Kosovo has a need for significant capital expenditures to improve the quality of its electric power generating system, but only a limited ability to fund such projects. If approved, the Kosovo C project will likely constrain funding for other projects that, if considered in the alternatives analysis, would likely prove to be more cost effective and lock Kosovo into an inefficient "four base load unit" system for decades to come. Reducing transmission losses, funding the Zhur HPP project and conservation/demand side management programs have been mentioned, as has the likely need for natural gas fired load following and peaking units. None of these options was evaluated in the alternatives analysis. The World Bank Group should insist that an objective analysis of all available options be undertaken before agreeing to participate in the Kosovo C Project. Finally, it should be noted that this Review did not address the TOR's failure to incorporate the external costs of the proposed Kosovo C plant in its evaluation of the potential options.