Reevaluating Kosovo's Least Cost Electricity Option

Preliminary Evaluation of the World Bank's December, 2011 "Background Paper, Development and Evaluation of Power Supply Options for Kosovo"

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EXECUTIVE SUMMARY

The Kosovo government, with the assistance of the World Bank Group, USAID and others, has embarked on an ambitious effort to replace half of its electric generating capacity with new base load, lignite-fired generating units, while refurbishing the other half of its generating capacity, over the next 4 years. Analysis of initial project documents provided by the World Bank Group revealed a number of critical flaws.

Subsequently the World Bank commissioned further analysis (World Bank Background Paper) that re-evaluated the electric supply options previously presented. The Background Paper corrects a number of grossly inaccurate assumptions in the earlier analyses: it recognizes the need for a diversity of energy generation capacity, the presence of significant clean energy generation potential, and the need to reduce losses and invest in energy efficiency. Nevertheless, it still fails to provide an accurate assessment of the least cost energy options for Kosovo. Specifically:

The Background Paper fails to demonstrate the need for a new base load coal plant: The Background Paper erroneously concludes that over 1,200 MW of base load generating capacity should be brought online before load following and peaking generating needs are determined, current distribution waste and theft are reduced to reasonable levels, and end use efficiency opportunities are quantified and implemented.

The Background Paper fails to analyze the economic impacts to the Kosovo economy, or to average ratepayers, of a costly new coal plant: Significant tariff increases will be needed to support financing of the simultaneous development of a new mine, renovation of Kosovo B plant and the construction of the proposed new 600 MW plant. However, Background Paper significantly underestimates the tariff increases that will be required in the near term,[1] and fails to examine the impacts of these increases on the Kosovo economy and quality of life of ratepayers.

[1] The analysis also adopts the incorrect assumption that tariffs have already been increased to fund the project.

Recommendations

Reduce losses and invest in energy efficiency: Reducing technical and non-technical losses to 5 percent or less should be a top priority and should be completed within the next 5 years. In addition, implementation of energy efficiency programs should have higher priority than construction of new generation capacity.

Invest in alternative peaking generation: It is neither technically nor economically feasible to cycle base load units such as proposed new coal plants to meet peaking needs. Investments in appropriate peaking assets are therefore required. Such assets include:

> **1) Hydro:** Development of the Zhur HPP is a critical component in addressing Kosovo's peaking needs and should be completed within 5 years. Further detailed analysis of load patterns should be conducted to determine whether Zhur HPP and smaller proposed hydropower plants are sufficient to supply present and anticipated peak power needs.
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> **2) Imports:** A "time-of-day" analysis of past power purchases should be conducted to determine whether continued purchases of electricity from Albania are more cost effective than development of additional thermal peaking power.
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> **3) Natural Gas:** Development of a natural gas transmission line would appear to offer numerous advantages for fuel diversity in areas of space heating, cooking, commercial/industrial development and transportation, in addition to providing a firm backup for renewable sources of electricity.
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> **4) Wind:** The analysis of wind power potential cited in the WB Background Paper presents a more optimistic portrayal of potentially available wind resources than reflected in original project documents; importantly the wind resource is aligned with the time of greatest demand (winter). Hydropower and wind power are complementary sources – the peaking capacity of hydropower resources is thus extended where wind power is also available.

Renovate existing Kosovo B units: Renovation of Kosovo B plant is a top priority that should be completed before Kosovo A units are closed. Consideration should be given to staging the renovation of Kosovo B over

several shorter outage periods rather than attempting the renovation of each unit in a single eight-month outage.

Ultimately, our assessment of the World Bank's new paper strongly argues for the need for an independent alternative assessment that considers in analytic detail an added range of energy supply, transmission and distribution management, and end-use energy options. The Renewable and Appropriate Energy Laboratory at "the University of California, Berkeley (http://rael.berkeley.edu), is engaged in such an assessment and their findings will provide a much needed contribution to the future direction of Kosovo's energy system.

BACKGROUND: THE EXPERT PANEL TERMS OF REFERENCE AND ITS SHORTCOMINGS

In accordance with the World Bank's Strategic Framework for Development and Climate Change ("SFDCC"), the Bank drafted a "Terms of Reference" (TOR) for an Expert Panel to assess whether the proposed Kosovo Power Project meets World Bank policy requirements for coal-based power generation projects.

In November, 2011, the Sierra Club and the Kosovar Institute for Development Policy commissioned a review of the TOR by an independent consultant ("Sierra Club Review[2]"), which was provided to the World Bank and other interested parties. The Sierra Club Review found:

The TOR does not provide a sufficient analysis of the available alternatives and costs to establish compliance with the World Bank Group policy: The TOR analysis of the available alternatives and their costs was not sufficient to demonstrate that the proposed Kosovo Power Project would serve the needs of the public at a lower cost than the available alternatives, as required by the Strategic Framework on Development and Climate Change.

The project as described in the TOR does not address Kosovo's need for a mix of base load, load following, and peaking capacity: Efficiently functioning electric power generating systems must have a mix of base load, load following and peaking units. Nevertheless, the TOR limited its alternatives assessment to **base load** options. In so doing, it failed to recognize that given the high fixed cost

[2] Affordable Electricity for Kosovo? Available at: http://action.sierraclub.org/site/DocServer/Review_of_TOR_Final.pdf?docID=8341

of base load units, building and operating them at low capacity factors is not cost effective. Moreover, the TOR provided no information upon which the SFDCC Expert Panel could assess the relative amounts of **base load,** load following and peaking generation capacity that is needed. Nor did it provide any discussion of how load following and peaking capacity can best be obtained. Finally, the TOR presented no market analysis to support its assertion that a ready export market for excess base load power exists. As a result of these shortcomings, the TOR significantly underestimated the costs of electricity and overstated the potential for eliminating load shedding;

The project will significantly raise electricity rates for average Kosovans: The TOR cost estimates for new lignite-fired generation were significantly below published estimates of the current cost of such units, and did not account for the increase in cost since the original estimates were made. Replacing such a large percentage of the country's base load capacity over a span of only a few years will cause a substantial increase in the cost of energy that will adversely affect the economic development of Kosovo and the well-being its people; and

Kosovo does not need a new 600 MW base load coal plant: The TOR failed to analyze the impacts of ongoing projects such as the reduction in "technical" losses due to deficiencies in the transmission system, and the potential for development of the Zhur Hydropower Plant ("HPP"); or to assess other options such as the proposed new transmission line, a potential natural gas line, demand-side management initiatives, and power swaps with neighboring countries. Reducing current levels of "technical losses" associated with transmission system deficiencies and non-technical losses (theft) and adding needed peak generating capacity would eliminate the reported current shortfall in generation, and therefore the need for new lignite fired generation.

Ultimately, the Sierra Club Review demonstrated that the proposed Kosovo Power Project has not been shown to be more efficient than a system-wide solution that includes a mix of (1) reduction of transmission system losses; (2) demand side management; (3) base load lignite-fired generation from a refurbished Kosovo B plant; (4) peaking hydropower from within Kosovo and from neighbors with high HPP resources (and possibly wind power); and (5) peaking natural gas-fired units.

ANALYSIS OF WORLD BANK BACKGROUND PAPER

Subsequent to the Sierra Club Review, the World Bank commissioned further analysis by an external consulting firm and published it as a new "Background Paper" ("World Bank Background Paper') that re-evaluated the electric supply options presented in the TOR. The World Bank Background Paper corrects a number of grossly inaccurate assumptions in the TOR. It recognizes (a) the need for a diversity of energy generation capacity including a mix of base load, load following and peaking generating assets; (b) there is significant clean energy investment potential for renewable and other sources of load following and peaking generating resources; and (c) provides the data proving the need to reduce losses and invest in energy efficiency to eliminate the need for new capacity construction if technical and non-technical losses are reduced to reasonable levels and if energy efficiency programs are implemented.

Further, the WB Background Paper recognizes that there is insufficient information to accurately project future electric demand in Kosovo[3]. The WB Background Paper also provides additional useful data concerning load patterns in Kosovo that had not previously heretofore been available and which help to illustrate the type of analysis that should be undertaken to develop the least cost solution to Kosovo's energy needs.

These are welcome improvements over the original TOR. However, much of the substance of our original critique remains. Our preliminary review of the Background Paper finds the following:

The WB Background Paper fails to demonstrate the need for a new base load coal plant: It fails to identify the need for current or future base load generation. It erroneously concludes that over 1,200 MW of base load generating capacity should be brought online before load following and peaking generating needs are determined, current distribution waste and theft are reduced to reasonable levels, and end-use efficiency opportunities are quantified and implemented.

The WB Background Paper fails to properly analyze the economic impacts of a costly new coal plant on ratepayers and the Kosovo economy: Significant tariff increases will be needed to finance the simultaneous

[3] Background Paper: Development and Evaluation of Power Supply Options for Kosovo. Available at: http://siteresources.worldbank.org/INTENERGY2/Resources/Kosovo_generation_options_report_12312011.pdf

development of a new mine, renovation of the Kosovo B plant, and the construction of the proposed new 600 MW plant. However, Background Paper significantly underestimates the tariff increases that will be required in the near term, and fails to examine the impacts of these increases on the Kosovo economy and quality of life of ratepayers.

The WB Background Paper projects the anticipated average or "levelized" cost of generation throughout the period by using the LRAIC or "Long Run Average Incremental Cost" analysis, which averages the discounted cost of the project over the period from 2011 to 2050. This approach ignores the fact that investors and lenders will require a tariff that allows repayment of debt and equity over a much shorter period (typically 5-10 years for equity and 15 years for debt). For this reason, development of the proposed new Kosovo plant will require much higher tariffs in the near term than suggested in the WB Background Document.[4] To clarify the magnitude of the tariff increases that would be necessary to repay lenders and investors, the Bank should conduct a year-by-year analysis of the projected annual revenues needed to support the proposed capital improvements. This, then, should be compared with the year-over-year revenue needed to finance other alternatives, including the more modest approach suggested herein. Each of these analyses should incorporate more reasonable estimates of the cost of lignite, typical financing provisions for similar high-risk projects in underdeveloped countries and the likely need for some additional fossil-fired peaking capacity.

Recommendations

Renovate existing units prior to construction of a new plant: Renovation of Kosovo B plant is a top priority that should be completed before Kosovo A units are closed. Consideration should be given to staging the renovation of Kosovo B over several shorter outage periods rather than attempting the renovation of each unit in a single eight-month outage after the new plant is constructed.

Reduce losses and invest in energy efficiency: Reducing technical and non-technical losses to 5 percent or less should be a top priority and should be completed within the next 5 years. The document assumes non-technical losses can be reduced to 5 % within 5 years simply due to privatization of the system, but that technical losses will only be cut from 16 to 8 percent by 2025. This suggests a lack of commitment to reducing technical losses and an overly

[4] The analysis also knowingly adopts the incorrect assumption that tariffs have already been increased to fund the project.

optimistic view of how easy it will be to reduce theft of power. Adequate commitment to reducing technical losses could achieve this goal in less than 5 years.

In addition, implementation of energy efficiency programs should have higher priority than construction of new generation capacity.

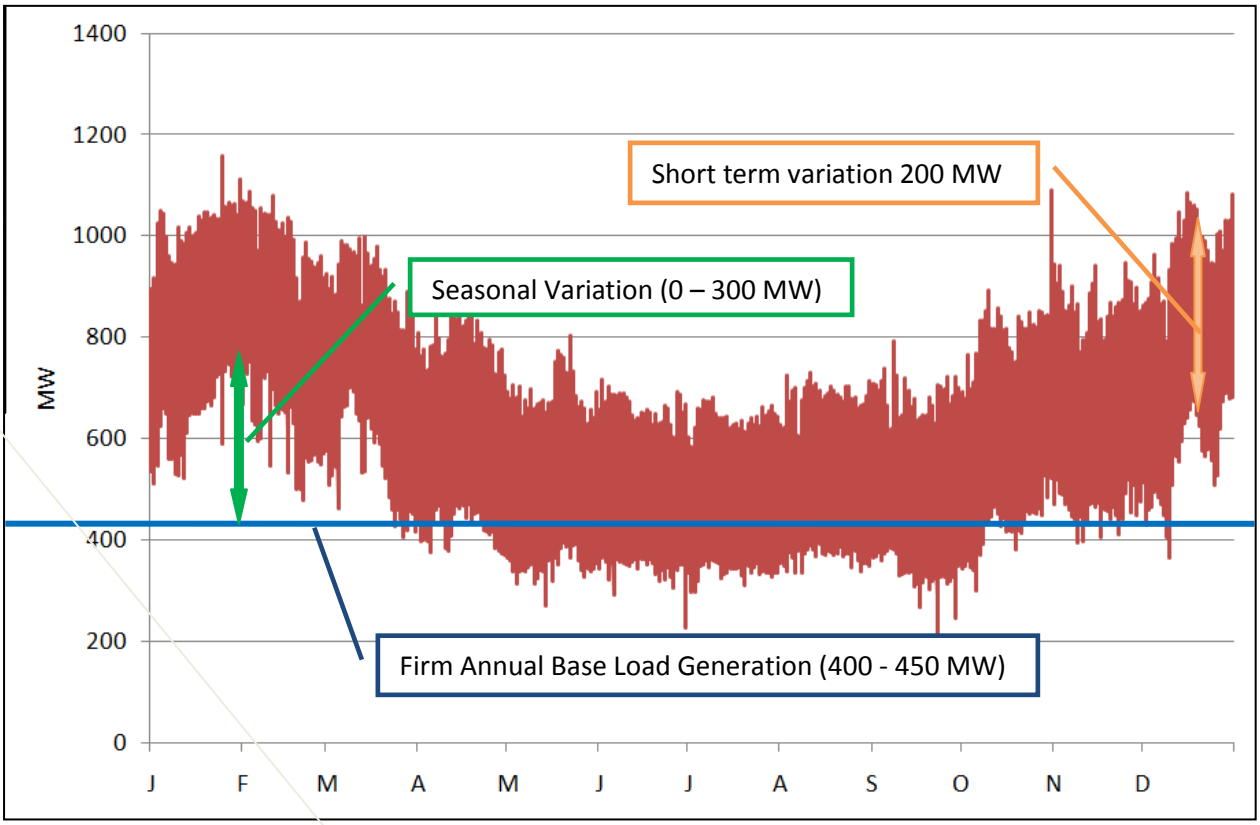
Invest in alternative peaking generation: It is neither technically nor economically feasible to cycle base load units such as new coal plants to meet peaking needs. Investments in appropriate peaking assets are therefore required. Such assets could include:

1) Hydro: Development of the Zhur HPP is a critical component in addressing Kosovo's peaking needs and should be completed within 5 years. Further detailed analysis of load patterns should be conducted to determine whether Zhur HPP and smaller proposed hydropower plants are sufficient to supply present and anticipated peak power needs.
2) Imports: A "time-of-day" analysis of past power purchases should be conducted to determine whether continued purchases of electricity from Albania are more cost effective than development of additional thermal peaking power.
3) Natural Gas: Development of a natural gas transmission line would appear to offer numerous advantages for fuel diversity in areas of space heating, cooking, commercial/industrial development and transportation, in addition to providing a firm backup for renewable sources of electricity.
4) Wind: The analysis of wind power potential cited in the WB Background document presents a more optimistic portrayal of potentially available wind resources than reflected in the WB Background document. Importantly the wind resource is aligned with the time of greatest demand (winter). Hydropower and wind power are complementary sources – the peaking capacity of hydropower resources is thus extended where wind power is also available.

KOSOVO 2010 GENERATION AND CONSUMPTION DATA ANALYSIS

The WB Background Paper includes plots of electric consumption (including technical and nontechnical losses) for 2010. These plots are reproduced and annotated below.

Chart No 1 2010 Generation over time



Net consumption by consumers (residential and commercial) is reported in the WB Background Paper at 57 per cent of the amounts generated. Thus, the actual base load consumption (assuming no losses) in 2010 was met by 228 MW of generation. If the "distribution" losses are reduced from 17 percent to 5 percent and "commercial" losses similarly reduced from 24 percent to 5 percent (and assuming a price elasticity of -0.4) then net base load consumption rises by an equivalent of 11.4 MW (since those who had been getting "free" (i.e. stolen) or unmetered electricity would now pay for and consume 60 percent of the earlier amounts). However, net base load consumption rises to 80 per cent of firm base load net generation – and can be met by 320-340 MW of firm annual base load generation. Thus, if distribution and "commercial" losses are reduced to levels commonly experienced throughout the world, a refurbished Kosovo B (618 MW

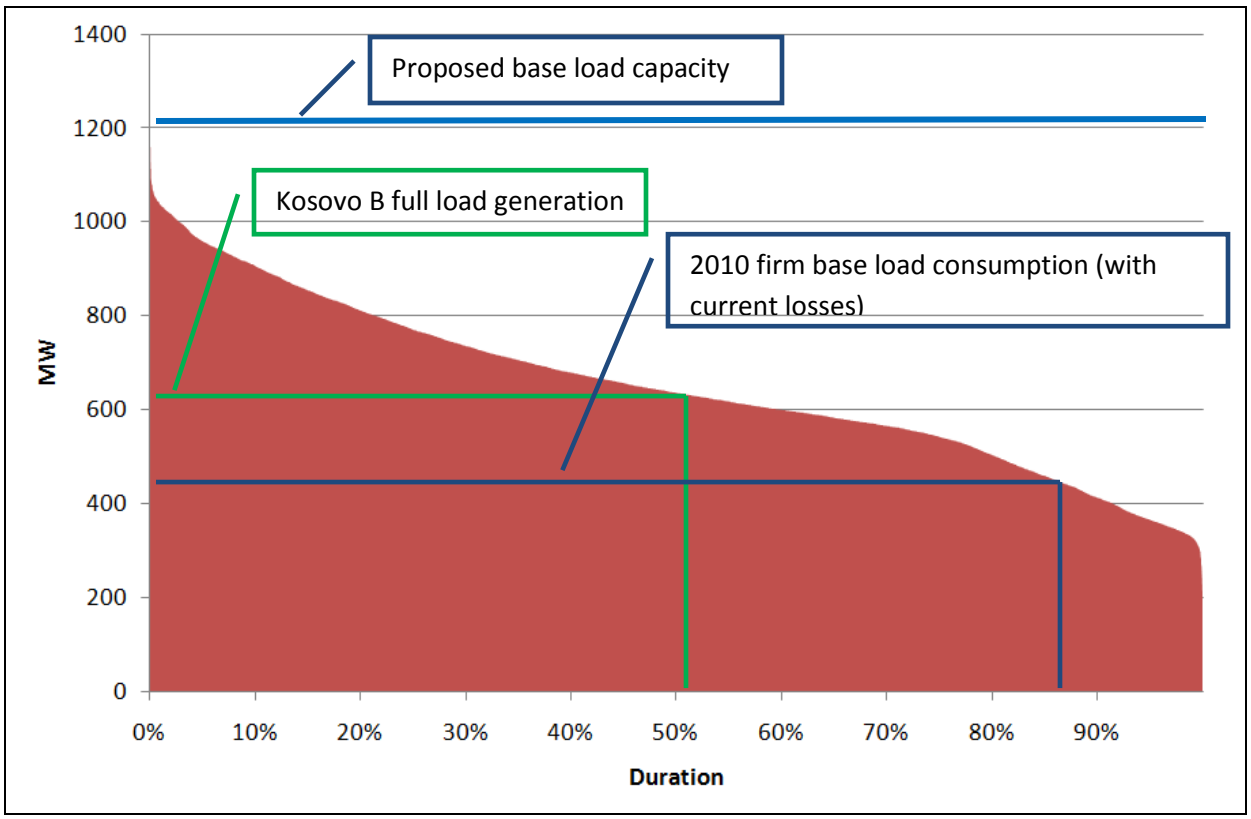
net generation) could of supply almost twice the firm base load consumption as occurred in 2010.

A review of the current daily generation and demand forecast by KEK reveals that current needs for peaking generation are as suggested by the above data. Daily variations in demand are approximately 200MW. The hourly rate of change in demand in the morning and evening exceeds 50MW/hr which is largely met by purchased power (imports). The WB Background document reports that import prices for peaking power are up to €113/MWh and that imports are not available at some times of peak demand, leading to load shedding. This is consistent with pricing patterns in the United States. While the full distribution of hourly import prices has not been evaluated, it appears likely that the Zhur power plant (at the WB estimate of €96/MWh) is more cost effective than purchasing power to serve peak needs. However, the estimated annual capacity of Zhur is only about half of the peaking power needs of Kosovo and so some continued purchases or additional peaking generation capacity will likely be needed.

The WB Background document explicitly does not evaluate options for developing gas-fired peaking capacity. Rather, its discussion of gas fired alternatives is limited to base load generation. In that analysis, it assigns the entire cost of a 20 inch diameter, 268 km long pipeline[5], from Sofia to Pristina to the base load gas fired plant. While it may make sense in the long term to construct a large diameter natural gas pipeline to serve a variety of commercial, industrial and residential needs (including space heating and transportation) in or near Pristina, there is no reason why the additional electric generating capacity cannot be located closer to existing or proposed natural gas pipelines. The option of simply connecting to pipeline configurations that have already been proposed is dismissed with the comment that one cannot “depend on these proposals in the medium term.” In particular, the possibility of locating fossil fired peaking units near the proposed Zhur hydropower plant, so as to minimize the amount of electric transmission upgrades that would be required and to facilitate load management, should be evaluated.

[5] This is a far larger diameter pipeline than would be needed to support the needed gas fired capacity.

Chart No. 2 Cumulative Generation



The data from Chart No. 2 shows that, with 2010 levels of technical losses and theft, the firm base load level[6] was slightly above 400 MW and that the generation needed to meet demand (and cover losses) would have required full load operation of a refurbished Kosovo B plant only 50 percent of the time. If technical and non-technical losses are each reduced to five percent, the values of the vertical axis of the chart are reduced by 20 percent.[7] The full base load need of the system is reduced to 340 MW and a refurbished Kosovo B plant would only need to operate at full load 20 percent of the time to meet this demand. If the full base load demand is assumed to grow by the high end suggested by the World Bank Background Paper (4.5 percent per annum), the

[6] The firm base load level is the net generation produced by a unit operating at capacity factors typically assumed for base load units – 85 to 90 percent. The impact of the capacity factor on the cost of generation is quite significant. By way of illustration, if one assumes that repayment of debt and equity will require revenues of €150 million per year for a 600MW plant, at 85 percent capacity factor (typical for base load units), the cost will be €33.57/MWh; at a 15 percent capacity factor (representative of peaking units) the portion of the overall cost that is needed to service debt rises to €228/MWh.

[7] Since it is reasonable to assume that the reduction in losses is uniform across the load profile the shape of the curve should not vary significantly, but simply be reduced such that, where the vertical axis in Chart 2 reads 400 MW, it would become 320 MW and where the vertical axis of the Chart reads 800 MW, it would become 640 MW. The proposed base load capacity would remain at 1200 MW.

refurbished Kosovo B plant has the capacity to meet this demand through 2023. At the alternate growth rate analyzed in the Background Paper (2.9 percent) the refurbished Kosovo B plant would have the capacity to serve base load demand through 2030. In addition, energy efficiency programs, implemented at only a 10 percent effectiveness level add additional years to the period of time before additional base load capacity would be needed. Deferring construction of new base load capacity until it is actually needed would (1) facilitate development of additional renewable energy options and, (2) allow Kosovo to retire the debt associated with refurbishment of Kosovo B and improving its transmission and distribution systems before incurring additional debt for new capacity.

OBSERVATIONS

- Load shedding is primarily related to peak loads and will not be addressed by additional base load capacity.
- Under the Background Paper's analysis, construction of the new plant will waste or "strand" a significant portion of the value of the Kosovo B plant since the analysis assumes that Kosovo B plant will operate at less than its design capacity (with load factors from 33 to 50 percent).
- Any evaluation of whether the new plant should be constructed should assume full economic utilization of the refurbished Kosovo B plant.
- If, for purposes of the analysis,[8] one assumes that Kosovo B is the lead plant (and is therefore dispatched first) then load factors identified by the WB Background paper for the new plant will be between 33 and 55 percent, a range which is not commercially viable or justified compared to a gas plant.
- Much of the analysis of the need for base load capacity in the Background Paper is actually based on projections of peak (not base load) demand. The Background Paper thus incorrectly suggests that the need for "new firm capacity" – which may be peaking or base load capacity – should be met by new firm base load capacity.

[8] The WB Background Paper assumes that thermal units will be dispatched in order of operating costs and that the new unit will have lower operating costs than Kosovo B. However, since Kosovo B's capital costs are far less than the new unit, it should be considered the "given" first step. The question then becomes, if Kosovo B is refurbished, what additional generation does Kosovo actually need?

ADDITIONAL CONCERNS[9]

In addition to the specific issues arising out of the WB Background Document addressed above, the Sierra Club, the Kosovar Institute for Development Policy and other interested parties continue to have additional concerns and objections with respect to the TOR and the proposed power project. These additional concerns include the following:

Mine complex: According to the original TOR, the WB Background paper must include consideration of the coal mine complex required for the project. However, there are no costs associated with the mine complex in the WB Background paper. The mine complex itself is a component of the Bank-supported project - even if it is not a direct project component, these costs therefore must be considered as an "associated facility" according to World Bank policies. Specifically, the lignite project cost analysis completely omits substantial costs associated with the coal mine operations, including, inter alia: expansion of mining operations, resettlement, road upgrades/maintenance, mine reclamation, and ash dump costs (associated with mining and Kosovo C). Based on an analysis carried out by Vattenfall of the new mine to serve the new power station with 600MW capacity an investment of $300 million in constant prices over the period 2007-2038 would be required10.

Highly Stressed Water Supply: Kosovo B and the new Kosovo C power plant will both get their water supply from the Iber-Lepence water system. This water system is already assessed to be "severely stressed11." The World Bank-utilized water supply study12 appears to have underestimated requirements for potable water, hydropower, and irrigation. Given the shortcomings of the water supply study, the proposed Lignite Power Project needs to prepare an accurate water supply analysis. Moreover, the Project needs to clearly demonstrate that the determined necessary water system improvements will be completed before commencement of the Project and that a comprehensive, feasible water management plan will be implemented that ensures reliable water supply to the residential, agricultural, industrial, and energy sectors.

Resettlement: Resettlement has been identified as a major impact that the

[9] The analysis in this section was contributed by Heike Meinhardt of Bank Information Center
[10] Kosovo Lignite Power Initiative Proposed Lignite Power Development Project (LPDP): Economic Analysis
[11] Currently, the water exploitation index (WEI) is assessed at 50% for an average year. Severe water stress can occur where the WEI exceeds 40%.
[12] Water supply from the Iber-Lepenc hydro system for the proposed Kosovo C power plant (February 2008), funded by the European Agency for Reconstruction (EAR) and developed by COWI consortium.

World Bank Kosovo Lignite Power Project will have on the local population. Resettlement will be necessary mainly due to the coal mine field development aspect of the project, but also from the new power plant and related facilities and infrastructure. If resettlement is determined to be possible in the Kosovo Lignite Power Project, the project will require significant permanent relocation and rehabilitation of land, which are associated with high resettlement costs. On average, World Bank-supported hydropower projects' completion reports indicate resettlement costs of an average of 11 percent of overall project costs. Accordingly, resettlement costs for the Kosovo Lignite Power project are an estimated $33 million.

Impacts on Agriculture: The agriculture sector is the highest employer in Kosovo and 60% of the project-affected region's population are farmers. The impacts the new project will have on agriculture have not been adequately assessed, accounted for in the project costs, nor has adequate compensation been guaranteed. In addition to the unresolved water supply issues that will impact irrigation, the project will also involve agricultural land acquisition. The New Mining Field area is mainly inhabited by large families who work in agricultural enterprises or independently as subsistence farmers. The new mine will acquire approximately 13% of the territory of the Obiliq Municipality. The SESA concluded that "There is not enough replacement agricultural land to resettle people who rely on farming for their livelihoods." The Resettlement Policy Framework for Land Acquisition for the New Mining Field does not address this specific problem.

CONCLUSION

- Kosovo's 2010 electric "base load" consumption, including waste and theft, would be met by slightly more than 400 MW of base load generation, far less than the 618 MW net generation that would be provided by the refurbished Kosovo B plant.
- Reducing technical and non-technical losses to 5 percent (each) would reduce the needed base load 2010 capacity by 20 percent to 320-360 MW – again, far less than the 1,200 MW of base load capacity suggested by the World Bank documents.
- Energy efficiency efforts would reduce this need even further and would allow Kosovo B to meet base load generation needs through 2025 – even at a 4.5 per cent per annum increase in GDP.

- Seasonal base load variation would be met through greater utilization of Kosovo B in the near term; planning efforts should anticipate that annual base load will grow and that, at some point seasonal capacity that is economically efficient at 20 – 40 percent load factors will need to be added.

The proposed construction of 600MW of new base load generating capacity would lead to base load generating capacity that is three times higher than existing demand in 2010 and four times higher when corrected for avoidable losses. It would require Kosovo consumers (or the government) to service over a billion euro in debt at a time when they are also servicing debt for necessary improvements in the Sibovc mine, Kosovo's wasteful transmission and distribution systems, and refurbishment of Kosovo B. The Background Paper presents an "economic analysis" but is careful to note that this is not the same as a "financial analysis." In other words, the Background Paper does not examine the impact of the proposed excess base load capacity on tariffs. It assumes that the government will continue to subsidize rates, even after the system is privatized and that current levels of theft of electricity will be wholly eliminated. The Background Paper does not present an estimate of the increase in tariffs that would be needed, or the impact of those increases on GDP or demand for electricity. However, with substantially less than full load operation of 1,200 MW of base load generation, it is feasible that tariffs up to four times higher than current rates would be needed to service the total new investments.

The Background Paper suggests committing to the construction the new plant before refurbishing Kosovo B and aggressively reducing losses or developing needed peaking and load following capacity. This sequencing would be wasteful and imprudent.[13] Refurbishment of Kosovo B is far more cost effective than construction of a new plant and provides a number of years of base load capacity. If, after the "low hanging fruit" of extremely cost effective measures are captured, it appears that additional base load generation will be required, there will be ample time to plan for and construct any needed capacity. However, once the proposed new plant is built, there will be substantial bulk excess capacity in the system. This will create perverse incentives to increase the use of electricity to justify the initial investment. In this way, committing to construction of the new unit at this time will undermine efforts to reduce transmission losses and theft and end user energy efficiency. It will also undercut development of the most cost-effective mix of generating resources in Kosovo.

[13] A recent experience in the United States demonstrates the economic consequences of building capacity before demand exists. See, http://www.startribune.com/business/134647533.html