Economic modeling of wood and coal for grate-fired systems in arctic conditions under varying fuel costs

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Abstract

After decades of service, many grate-fired power plants are reaching the end of their economic lives. Cofiring coal and biomass at low ratios has proven technically feasible and can potentially reduce greenhouse gas emissions, reduce fuel costs, and improve air quality. However, questions remain regarding the economics of biomass procurement, transportation, storage, fuel handling, and the possibility of up-front capital costs. Risk assessment involves studying the probability that projects achieve satisfactory financial metrics, often in terms of internal rate of return (IRR), net present value (NPV), or return on investment (ROI). We provide financial models for a 32MW capacity coal power plant for cofiring rates of 10 percent (based on energy value), using 2 different waste wood residues. We used Monte Carlo simulations to model coal prices of $50 to $60 per ton and wood prices of either $10 or $31 per delivered ton. We modeled cofiring scenarios that considered 1) no initial investment, and 2) plant improvements required. This research found that cofiring was economically feasible at wood waste prices of $10 per green ton and coal prices of $50 per ton or higher. Average NPV when cofiring with low-value manufacturing residues was close to $10,000,000 while NPV for a 50/50 mixture of aspen chips and manufacturing residues was close to -$750,000. Assuming a hurdle rate of 25 percent ROI, an initial investment of up $3.6 million could be justified in plant capital improvements (such as fuel handling equipment) when cofiring low value hog fuel. This work illustrates the dramatic influence that wood fuel costs can have in cofiring applications under diverse scenarios. It is important because of its implications for other grate-fired coal power plants internationally, especially in cases where low cost biomass is available.