Technology Fact Sheet for Mitigation

Technology Fact Sheet – Natural Gas Combined Cycle [i]

Sector	**Power generation**
Technology name	Natural Gas Combined Cycle
Subsector GHG emission (mn mt CO2 equivalent	11.9 mn mt of CO_2 equivalent from power generation
Background/short description of technology	In NGCC plants, natural gas is used as fuel in a gas turbine. Electricity is produced from the generator coupled to the gas turbine, and the hot exhaust gas from the turbine is used to generate steam in a waste heat recovery unit. The steam is then used to produce more electricity. The output from both the gas turbine and the steam turbine electrical generators is combined to produce electricity very efficiently. NOx control in gas turbines is proven technology and can be accomplished with relatively inexpensive "low NOx burners." In addition, NOx can be reduced still further with such "add-on" control technology as Selective Catalytic Reduction. Emissions of particulate matter generated with this method are also quite low, although some secondary particulate matter is produced through atmospheric chemistry reactions involving NOx. **Based on: 2006 Update Including a Discussion of Carbon Capture and Storage in an Ontario Context, *A Comparison of Combustion Technologies for Electricity Generation, December 2006.*****
Implementation assumption, how the technology will be implemented and diffused across the sub-sector	Many of the new power plants in the pipe line are based on oil and are small as emergency measures for tackling the present shortages of electricity. One major problem had been the estimated shortage of gas. However, the present plants are very old and the same quantity of gas used in these plants can produce much more electricity using better technology. Also new discoveries and assessments of gas reserves indicate that the future supply of gas may not dwindle as fast as may have been thought so far. The revision of the existing Power Sector Master Plan is therefore necessary to take account of these new realities. The revision may thus include provisions for this technology. More emphasis is likely to be given, under gas based generation, to combined cycle and advanced combined cycle technology. The nominal capacity, heat rate and the emission factor that have been assumed are 540 MW, 7,050 Btu/kwh and 117 lb of CO_2 emission per MMBtu
Reduction in GHG emission	While the actual lowering of CO_2 emission depends on the run time of the plant and production, note that the heat rate is

	somewhat lower compared to the conventional gas turbine and thus, the emission of CO_2 is expected to be lower per kwh. The lowering of CO_2 emission depends on the nominal heat rate as the rate of emission is 117 lb per MMbtu for both NGCC and conventional turbine. The CO2 emission per year is 1.55 mn mt for an NGCC and 2.39 for an equivalent capacity CT plant, i.e., 0.84 mn mt or 35% less than for equivalent CT power output.
Impact Statements – How this option impacts the country development priorities	
Country social development priorities	Each of the NGCC s will produce almost 6.35 times the nominal generation of combustion turbines and probably at much lower gas consumption because of the use of the heat from the first round of power output in the combined cycle. This will allow more electricity to the citizens to consume allowing a better quality of life. With increased supply of electricity, and consequent access to it, the lighting for studies will improve leading to better education prospects as well as security. The process of women's empowerment will be better served as with increased access to electricity the may enjoy facilities to which their access was limited previously.
Country economic development priorities	*Productivity* may increase as with better supply of electricity new technology may be introduced or the run time of factories may lengthen. On the other hand, better supply may spur the establishment of new factories and facilities and various service centres. *Job creation* will be facilitated because of productivity increase or the establishment of new enterprises. Both direct and indirect job creation may happen. *Poverty* will be reduced as more and more jobs are created and people are gainfully employed. *BoP* may be negatively impacted; however, as the machineries need to import from abroad and more sophisticated technology is costlier. However, for each case of new power generation technology, the marginal effect of import of newer technology equipments may have not be large.
Country environment development priorities	The emission factor of SO_2 will be the same as for the conventional gas turbines. But for equivalent output of electricity, again the emission will be broadly $1/6^{th}$ of the

	conventional gas turbine. Thus there will be less emission and the air pollution will be comparatively less. There is likely to be a small fall in resource (gas) use efficiency as the heat rate is somewhat lower, 7050 Btu/kwh for NGCC or 35% less compared to 10850 Btu per kwh for CT.
Other considerations and priorities	-
Costs	
Capital costs	The costs of a NGCC unit is 978/kw and of a CT 974/kw. Given that the capacity of a NGCC is 540 MW and that of a CT is 85 MW, for equivalent capacity, the price tag of a CT establishment with equal capacity as NGCC is 6.35 times the cost/kw of a single CT unit. That is for a CT it is 6.35*US$ 974//kw which comes to US$ 525 mn compared to an NGCC of same capacity at just about US$528 mn.
Operation and maintenance costs Fixed O&M Variable O&M	Fixed O&M costs are for CT US$ 6.98 and for NGCC 14.39 per year per kw. The differences are around double on a kw basis, but for comparison on an equivalent capacity basis, the costs for CT gets to US$ 3.77 mn and for NGCC US$ 7.77 mn. The case for variable O&M is however quite different. For CT it is 14.70/Mwh and for NGCC it is 3.43/MWh. If we assume that the two are run exactly the same number of hours in a year (320 days for 24 hours), CT variable O&M costs become US$ 60.9 mn and for NGCC US$14 mn at the most, a very clear cost advantage for NGCC over CT for the same level of output.
Cost of GHG reduction	If CT is replaced with NGCC, for equivalent output of CT as for NGCC, the reduction in CO2 emission as pointed out earlier is 0.84 mn mt per year. The yearly operational costs are estimated to be US$ 64.67 mn for CT equivalent to an NGCC while for the latter it is US$ 21.77 mn. Noting that if we assume similar life cycle for the two types of plants, the cost of depreciation of capital is more or less the same. The lower emission is thus achieved at a negative (operational and total) cost.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment and Technology Action Plans For Climate Change Mitigation– Bangladesh. You can access the complete report from the TNA project website http://tech-action.org/**