Technology Fact Sheet for Mitigation

Technology Fact Sheet – Advanced Generation Natural Gas Combined Cycle [i]

Sector	**Power generation**
Technology name	Advanced Generation 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	The Conventional NGCC technology utilizes two natural gas-fueled F-class CTs and associated electric generators, two supplemental-fired heat recovery steam generators ("HRSG"), and one condensing ST and associated electric generator operating in combined-cycle mode. The AG-NGCC design is the same as the Conventional NGCC, except an H-class CT is utilized in lieu of F-class, and there is only one CT/HRSG supporting the ST included. Since the H-class CT design employees steam cooling of both stationary and rotational hot parts, the HRSG systems and the ST are both considered "advanced" designs, as compared to the Conventional NGCC. **Based on: U. S. Energy Information Administration Office of Energy Analysis, *Updated Capital Cost Estimates for Electricity Generation Plants, November 2010*.**
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. It should be noted that of the 3 gas-based power generation technology, this one is ranked second. The nominal capacity, heat rate and the emission factor that have been assumed are 400 MW, 6430 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. Gross CO_2 emission for a 400MW AG-NGCC is 1.05 mn mt. For CT with equivalent capacity, gross CO_2 emission is 1.77 mn mt.

	Thus, the emission from an AG-NGCC is lower by 0.72 mn mt or 40% less from CT of equivalent capacity in a year.
Impact Statements – How this option impacts the country development priorities	
Country social development priorities	Each of the AG-NGCC will produce almost 4.7 times the nominal generation of combustion turbines and at much lower gas consumption because of the utilisation of the residual heat from the first round generation. This will allow more gas and 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 may be 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 factors of SO_2 and NOx will be the same as for the conventional gas turbines. But for equivalent output of electricity, again the emission will be broadly $1/5^{th}$ of that from conventional gas turbine. Thus there will be less emission and the air pollution will be comparatively less. There is likely to be apparently a small fall in resource (gas) use efficiency as the heat rate is somewhat lower, 6,430 Btu/kwh for AG-NGCC compared to 10850 Btu per kwh for CT i.e., AG-NGCC heat rate is nearly 40% lower. However, note that for the surplus heat no additional fuel is necessary. Thus, on the whole the over-all resource use efficiency may be no less than that for CT.
Other considerations and priorities	-
Costs	
Capital costs	The investment cost of an **AG-NGCC plant** is US$ 1,003/kw and for a CT it is US$ 974/kw. Given that the capacity of a **AG-NGCC**

	is 400 MW and that of a CT is 85 MW, for equivalent capacity, the price tag of a CT with equal capacity as **AG-NGCC** is 4.7 times the cost/kw of CT. That is for a CT it is 4.7*US$ 974//kw which comes to US$ 389 mn compared to an **AG-NGCC** of same capacity at just about US$401 mn. There is thus a small investment cost advantage of CT over **AG-NGCC.**
Operation and maintenance costs Fixed O&M Variable O&M	 Fixed O&M costs are for CT is US$ 6.98 and for AG-NGCC it is US$ 14.62 per year per kw i.e., almost double that for CT. When the comparison is made on an equivalent capacity basis, the costs for CT gets to US$ 2.79 mn and for AG-NGCC it becomes US$ 5.85 mn which is more than double the cost for equivalent capacity with CT. The case for variable O&M is however quite different. For CT it is 14.70/Mwh and for **AG-NGCC** it is 3.11/MWh. If we assume that the two are run exactly the same number of hours in a year (320 days for 24 hours /day), CT variable O&M costs become US$ 45.10 mn and for **AG-NGCC** US$ 9.55 mn at the most. There is thus a very clear cost advantage in terms of variable O&M for **AG-NGCC** over CT for the same level of output.
Cost of GHG reduction	If CT is replaced with AG-NGCC, for equivalent output of CT as for AG-NGCC, the reduction in CO2 emission as pointed out earlier is 0.72 mn mt per year. The yearly operational costs are estimated to be US$ 47.89 mn for CT equivalent to an AG-NGCC while for the latter it is US$ 15.40 mn. Noting that if we assume similar life cycle for the two types of plants, the cost of depreciation of capital for AG.NGCC may be is more or less the same as for equivalent CT or slightly more. The lower emission is thus achieved at a negative (operational and total) or almost equivalent 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/**