Technology Fact Sheet for Mitigation

Technology Fact Sheet - Single Unit Integrated Gasification Combined Cycle [i]

Sector	**Power generation**
Technology name	Single Unit Integrated Gasification 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	Single Unit IGCC power plant is a new power generation system, consisting of a gasifier which gasifies coal to CO and H2 and separates ash from coal, a gas clean-up facility which separates dust and sulfur from the resulting gas, and a gas turbine combined cycle power plant using coal gas from the gas clean-up facility. IGCC has a potential of higher than 50% net thermal efficiency with increased gas turbine combustion temperature, as this has already been realized with natural gas fired combined cycle power plants. It will also result in a 20% reduction of CO_2 while generating the same amount of electricity using coal. Although many research and development projects aimed at CO_2 reduction and fixation have been carried out worldwide, it appears difficult to achieve an economical and industrial scale. Thus, it is clear that increased net thermal efficiency is the most practical way for reduction of CO_2, making IGCC an attractive and important technology for the next century. Another feature of IGCC is its superior environmental performance which is attained by means of the conversion process from ‘‘dirty’’ coal to ‘‘clean’’ purified gas and disposal of non-leaching glassy slag in place of fly ash. Based on: **The development of advanced energy technologies in Japan IGCC: *A key technology for the 21st century, Energy Conversion and Management* 43 (2002) 1221–1233**
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. While new gas-based plants may be set up, clean coal technology is an attractive alternative from two points in view. First, the country has some, though not very abundant, coal reserves. These needs to be utilized well and highly efficient technologies such as IGCC may be utilized for the purpose. Secondly, while there may be improved situation

	related to gas reserves, dependence on coal is likely to increase in future in which case efficient but also cleaner technologies (because coal is the dirtiest fuel from CO_2 emission point of view) needs to be employed to make the most of the scarce resource. And in that case, global support leveraged by UNFCCC (in the form of Green Climate funding) is likely to be available if the case is made well. 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 IGCC Single as well as double unit technology. It should be noted, that of the 4 coal-based power generation technology, the single unit IGCC has been ranked 1st. The nominal capacity, heat rate and the emission factor that have been assumed are 600 MW, 8,700 Btu/kwh and 206 lb of CO_2 emission per MMBtu.
Reduction in GHG emission	While the actual CO_2 emission depends on the run time and production, note that the heat rate is somewhat lower compared to the conventional gas turbine but due to the higher carbon content of the primary fuel, the Single unit IGGCC compares poorly with gas-based CT. For Single unit IGCC the CO_2 emission from the nominal capacity plant is 3.75 mn mt and for a CT with comparable capacity the emission is 2.65 mn mt in a year of operation.
Impact Statements – How this option impacts the country development priorities	
Country social development priorities	Each of the single unit IGCCs will produce almost the same of the nominal output of single unit APCs. 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 like IGCC is far costlier. However, for each case of new power generation technology, the marginal effect of import of newer technology equipments may not be large.
Country environment development priorities	The emission factors of a single IGCC unit are far less than the single unit APC. For SO_2 and NOx these are 0.025 and 0.0075 lbs per MMBtu respectively for the single IGCC. For the single APC these are 0.1 and 0.6 ibs/MMBtu. For equivalent power generation, therefore the lower emissions are expected to result in much less air pollution than single APC units. IGCC is basically coal turned into cleaner gas before using the gas turbine to produce electricity. In that sense it conserves the gas. On the other hand while it has lower heat rate, the net thermal efficiency can go up to 50% or more. In that sense, with less coal, one can have more electricity.
Other considerations and priorities	-
Costs	
Capital costs	The costs of a single unit IGCC is 3,565/kw and a single unit APC 3,167/kw. Given that the capacity of a single unit IGCC is 600 MW and that of a single unit APC is 650 MW, for equivalent capacity, the price tag of a single unit APC with equal capacity as single unit IGCC is somewhat similar. For a single unit APC it is US$ 1900 mn compared to an IGCC of same capacity at just about US$ 2139 mn. There is, thus, about a 10% cost advantage for investment in a of single unit APC over single unit IGCC.
Operation and maintenance costs Fixed O&M Variable O&M	Fixed O&M costs are for single unit APC US$ 35.97and for single unit IGCC 59.23 per year per kw. The differences are large on a kw basis, but when the comparison on an equivalent capacity basis, the costs for single unit APC gets to US$ 23.38 mn and for single unit IGCC US$ 38.50 mn. The absolute difference is also somewhat large. The case for variable O&M is, however, quite different. For single unit APC it is 4.25/Mwh and for single unit IGCC it is

	6.87/MWh. If we assume that the two are run exactly the same number of hours in a year, single unit APC variable O&M costs become US$21.2mn and for single unit IGCC US$31.65 mn or so. Again, a clear cost advantage for single unit APC over single unit IGCC for the same level of output.
Cost of GHG reduction	Compared to the gas-based CT which may be used as the benchmark, because of the similarity of the generation part of the technology, the estimated CO2 emission is higher for single unit IGCC. And thus, the issue of cost of reduction does not arise.

[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/**