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Carbon Capture and Storage Research Project

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Executive Summary

Constant Group LLC (CG) assessed the current state of carbon capture and storage (CCS) technological and economic viability as well as the current progress and prospects for CCS implementation in low and middle-income countries.

The Consultant conducted desk research complemented with interviews with the key technology and industry players as well as international financial institutions. This report presents a broad overview of the CCS technology as it stands today, especially in relation to its applicability to power plants.

Overall assessment provides the following conclusions:

- CCS is an evolving technology and has not yet reached commercial maturity particularly as it relates to the power industry. No real industrial-size projects currently exist to confirm technological or economic viability of CO₂ “Capture” component;
- The transport and storage of CO₂ component of CCS is not innovative and has been in use for the last 30 years in oil and gas recovery projects worldwide. At the same time, no significant monitoring of storage has been ever conducted in these oil/gas projects;
- CCS in power applications has been somewhat successfully tested on small-scale pilots and modeling. Current estimated costs for CCS are prohibitively high and may double the cost of coal-fired units. Actual costs may be even higher given uncertainty of model scaling-up for real size units;
- A significant R&D effort is currently being carried out by domestic and international entities to bring CCS costs down. General guidelines target cost reduction of 60-80% for new technologies from estimates for currently available technologies. Significant breakthroughs are expected in the next 5-10 years. Several large demonstration projects are scheduled for commissioning worldwide in the same timeframe to show the viability of underlying research;
- Extensive work has been carried out utilizing carbon capture with Integrated Gasification Combined Cycle (IGCC). However the cost factors for both the IGCC technology itself and the transport/storage components are still debatable and cannot be described as having reached commercial viability;

- Economic viability of CCS as it reaches technological maturity will eventually be linked to such factors as the price of CO₂, tax incentives, etc. There is no current meaningful pricing mechanism for CO₂ in the U.S. The Regional Greenhouse Gas Initiative (RGGI) initiated in the U.S. has low CO₂ price because of the overallocation of allowances by the regulators. Clean Development Mechanism (for countries who ratified Kyoto Protocol) has a higher market price than RGGI. Even at these levels, it is difficult to substantiate CCS investment. Analyses performed by various institutions indicate that CCS becomes an attractive option at \$45-55/ton of CO₂. Given significant escalation of raw materials and labor since the time that estimate was performed, the corresponding “break-even” CO₂ price maybe even higher. However, a lot would depend on the technological innovations, market price of the carbon at the time and importantly, government policies and interventions;
- Most of the industry specialists confirm the above-mentioned summary. Some are more optimistic, referring to confidential progress in their research;
- CCS application in low and middle income countries in the near-term would be tied to any regional initiatives that may be subsidized or guaranteed by the government. There is increasing evidence of interventions by the developed nations in countries such as India and China which have become some of the largest emitters of CO₂, given their growth rates. Consultants do not foresee any major adaptation of CCS in a market environment in the next 5 years and not without external help.
- The EU proposal for 12 full-scale CCS demonstration projects by 2015 is the most probable avenue for the large-scale implementation in Eastern Europe. However, the economic value of such projects is of serious concern. Projects, if selected for the full development, would require heavy subsidies of CCS technologies that are currently unavailable for commercial implementation.
- The U.S. export component for such projects will include conventional core equipment as well as emerging carbon capture technologies. U.S. companies should be very competitive in the area of CO₂ capture technology. A number of commercial and academic entities are involved in state-of-the art research on this subject. The commercial success and final product is expected in 3-5 years.
- Nevertheless, there is a general consensus amongst the experts that CCS today represents one of the most promising near term options for the mitigation of CO₂ in the atmosphere amongst the basket of other interventions such as renewable, energy, efficiency improvements, nuclear, etc. Billions of dollars are being spent

on R&D efforts worldwide with significant measure of confidence to bring the CCS technology into the commercial domain as early as possible to meet CO2 reduction commitments.

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