EXECUTIVE SUMMARY

According to the 2007 report from the Intergovernmental Panel on Climate Change (IPCC), global warming is real and it is "very likely" due to the increase in the atmospheric concentrations of the anthropogenic green house gases (GHG) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2¬O) and others. Of these, CO_2 accounts for 77% of the green house gases, and is generated largely from burning fossil fuels. The report clearly suggests that there is a dire need to reduce the GHG emissions to the level that can be absorbed by the Earth's system. At present, the U.S. Congress is debating to address this problem by legislation, in which finding ways to engage developing countries, particularly India and China, is a central issue. Clearly, it is not possible to coerce these nations into a mandatory agreement. An approach would, therefore, be to develop sustainable and economical technologies that can help reduce CO_2 emissions without imposing mandatory limits, which is consistent with the objectives and policies of the Asia Pacific Partnership (APP) for Clean Development and Climate.

India is the world's third largest coal producer, and 67% of its mined coal is used to generate about 62% of its electricity. As one of the fastest growing economies of the world, its coal consumption is expected to increase rapidly, along with all of the environmental concerns associated with burning coal. If the current 8% GDP growth rate is sustained, India's energy consumption would be 5- to 6-times larger in 2030 than at present. According to the World Energy Outlook 2006, non-OECD countries will consume 6.4 billion tonnes of coal in 2030, an increase of 3.7 billion tonnes over the reference case of 2003. The increased coal use is expected to generate 13.6 billion tonnes of CO_2 over and above what is being released to the atmosphere today, which is twice the amount generated in North America in 2003 (6.8 billion tonnes). Thus, there is a need to help the non-OECD counties curb their GHG emissions.

The first step toward reducing the CO_2 emissions from the coal-fired power plants in India would be to increase the availability of beneficiated coals using appropriate separation technologies. It has been shown that use of beneficiated coals can increase thermal efficiencies by 2-3% on existing PC boilers, possibly as much as 4-5%, and can thereby reduce CO_2 emissions by up to 15%. If the low-ash coals are used as feed stocks for advanced clean coal technologies (CCT), such as IGCC or supercritical PCC, the thermal efficiencies can become as high as 45%, which will further reduce the GHG emissions. According to a recent IEA report (Couch, 2002), "*India could reduce CO_2 emissions to nearly 45% of its present level by using state-of-the-art technologies relating to coal quality, boiler/generator design, instrumentation and control, and high voltage distribution system*". The use of beneficiated coals will have many other benefits, e.g., increase in the plant utilization factor (PUF) by 13%, minimize fouling and slagging problems, reduce fugitive dusts, and decrease in the amounts of unburned carbon in fly ash. More importantly, shipping beneficiated coals can increase railway capacities by approximately 20%, which will be of paramount importance in India. Therefore, the Government of India has recently promulgated a law mandating companied to clean coal to less than 34% ash if it is to be shipped to power stations located beyond 1,000 km from a pit head.

Unfortunately, the coal industry in India has been slower than in other countries in embracing coal beneficiation as part of their normal operating practice. The reasons for this include the difficulty in cleaning Indian coals, the high capital and operating costs associated

with using the conventional wet-beneficiation processes, and the lack of capital. Ash-forming minerals are finely disseminated in Indian coals, making them difficult to remove them from carbonaceous matrix using the conventional physical separation methods. Further, water is a scarce resource in India. It is, therefore, proposed to develop dry beneficiation technologies that can remove easy-to-remove rocks (or shales) from thermal coals at low capital and operation and maintenance (O&M) costs. One of the processes has already been tested successfully in the U.S. at pilot-scale, as a result of which a power company is planning to install commercial units in 2007. While the process is highly efficient in cleaning relatively coarse coals whose particle size is in the range of 80 to 3 mm, its efficiency deteriorates below the lower size limit. Therefore, a new method of cleaning finer coal will be explored in the present work. According to a recent study conducted by Bhattacharya (2007), the dry beneficiation technologies such as those proposed in the proposed work hold promise in India if the O&M costs are less than US$1.00-1.50 per tonne. Recent studies conducted in the U.S. showed that the costs of desahling coarse coals are substantially below this limit (Honaker et al., 2007).

The specific tasks of the proposed work have been designed to promote a rapid deployment of the dry beneficiation processes in India. In Phase 1, a pilot-scale deshaling unit with a maximum capacity of 5 t/hr will be constructed and installed at different mine sites and/or power plants. The test work will be carried out to identify optimal operating conditions. At the same time, methods of processing fine coal and utilizing it will be studied. The experimental results obtained from both the coarse and fine coal cleaning processes will be analyzed, and a preliminary flowsheet incorporating appropriate unit operations will be developed. In Phase 2, a detailed flowsheet and engineering diagrams will be developed to construct a full-scale proof-of-concept (POC) plant in India. Upon completion of the plant, a detailed test program will be developed and carried out to fully define the operational capabilities of this technology and to establish installation protocols for future installations. The data from this portion of the study will also be used to quantify the benefits of using the dry beneficiation technologies developed in the present work in India.

To ensure a successful completion of the proposed work, an international team with diverse expertise has been assembled. It consists of leading mining schools in the U.S. and India, a process equipment manufacturer (Eriez Manufacturing), a major A&E firm specializing in coal plant design and construction (Taggart Global), an Indian coal producer/consumer (ACL), and a company with expertise in accessing the impacts of various coal technologies on controlling GHG emissions (Leonardo Technologies). The partnership represents a group with demonstrated capabilities and experiences in successfully managing large interdisciplinary projects at international arenas. The expertise assembled herewith will be useful in developing the unique technologies ideally suited for cleaning Indian coals at low capital and O&M costs. The partnership is confident that the proposed approach will be successful in view of the past experiences in testing the deshaling technology on various U.S. coals and on the basis of studying the washability characteristics of several Indian coals. Taggart Global is planning to install many more plants in India on the basis of the build-own-and-operate (BOO) scheme, which is strongly promoted by the Indian Government. In addition, the proposed work will be an excellent vehicle for marketing U.S. clean coal technologies in developing countries..