

**Reduction of Environmental Impacts by Development of Industrial Symbiosis
in Japan**
**Case Studies for Application of Co-production Technologies in Steel
Industries and its Reduction Potential of Greenhouse Gas Emissions**

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Japanese industries are required to reduce greenhouse gas emissions for the achievement of COP 3 goal. Although many energy conservation technologies have been widely adopted, the adoption of such technologies seems to be a limited stage. Recently, some researchers have proposed a new energy conservation technology concept of “Co-production”. This technology involves the incorporation of a new industrial process into an existing industry. It maximizes the use of energy in an industry, while producing substances required in other industries by using cheap industrial by-products as raw materials. Thus, Co-production enables energy generated by one industry to be supplied to another industry through conversion into a substance that stores the chemical energy. Therefore, use of co-production technologies will achieve industrial symbioses and improve overall energy efficiency and reduce environmental impacts for the industrial complex. Research is under way in Japan on the development of leading and pioneering technologies for use in co-production systems.

In this study, we examined the introduction of co-production systems at steel industries; a low-temperature gasification plant and a CO₂ recovery and utilization system for effective utilization of waste heat and resources in steel works. Constructed was a model whereby exhaust heat was recovered and the industries simultaneously produced the main steel product and other by-products (methanol, steam, electric power, dry ice etc.) for supply to other industries and transport sectors. Reduction potential of greenhouse gases were calculated for each steel works in Japan, based on a life-cycle assessment (LCA), considering production capacity, waste heat distribution, location and avoided impacts in conventional systems.

It was estimated that the CO₂ emissions per unit product were significantly smaller than those from conventional technologies. The total reduction of CO₂ emissions made possible by the co-production technologies was about 6 million-tons.