

#### §44. Comparative Assessment of Economics and CO<sub>2</sub> Emissions in Inertial and Magnetic Fusion Reactors

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Global warming due to rapid CO<sub>2</sub> emission is one of the present-day crucial problems all over the world, and nuclear power plant systems including future fusion reactors are expected as an abundant electric power generation system to reduce global warming gas emission amounts.

In order to search for economically and environmentally optimized reactor designs, the system analyses of fusion reactors on physics, engineering, cost and CO<sub>2</sub> emission amounts have been carried out for toroidal magnetic confinement fusion (MCF) reactor designs, and some comparative studies among conventional electric power generation systems were carried out. Here, we extend this to the inertial confinement fusion (ICF) system, and include the effect of CO<sub>2</sub> tax. Various blanket designs including fission-fusion (F-F) hybrid and D-3He reactor designs are assessed with respect to the cost of electricity (COE) and the life-cycle CO<sub>2</sub> emission amounts.

Recently, we had compared the CO<sub>2</sub> emissions from the life-cycle of several fusion reactors<sup>1-3)</sup>. The magnetic confinement systems evaluated here are the tokamak reactor (TR), helical reactor (HR), and spherical tokamak

reactor (ST). These models are calculated by the Physics-Engineering-Cost (PEC) code. The inertial confinement fusion reactor (IR) is also evaluated, assuming its driver energy and driver efficiency. In addition, different blanket modules and fuels are considered in the TR designs. To calculate life-cycle CO<sub>2</sub> emission from fusion reactors defined by plasma parameters and radial build, we used a basic unit for CO<sub>2</sub> weights (kt-CO<sub>2</sub>/t-material). The flow chat of these assessments are shown in Fig.1.

Calculation results indicate that CO<sub>2</sub> is emitted mainly in the construction stage of superconducting magnet systems for magnetic confinement fusion reactors. For the IR design, the driver system construction and pellet fabrication stages involve considerable CO<sub>2</sub> emission. By comparing fusion reactors with other electric power generation systems in terms of CO<sub>2</sub> emission, we confirmed that fusion reactors emit less CO<sub>2</sub>. Therefore, introducing a carbon tax has little effect on the economics of fusion reactors, and the cost of electricity (COE) from fusion reactors might be lower than that of oil-fired electric power plants when a carbon tax of around several hundred yen/t- CO<sub>2</sub> is introduced.

- 1) K. Yamazaki, T. Oishi, K. Mori, Proc. IAEA-Fusion energy Conference, SSE-1c (Deajeon, Korea, Oct.10-15, 2010) .
- 2) S. Uemura, K. Yamazaki, H.Arimoto, T. Oishi, T. Shoji, Plasma and Fusion Research **5** (2010) S1027.
- 3) K. Yamazaki, S. Uemura, T. Oishi, J. Plasma Fusion Res. SERIES, **9** (2010) 635.

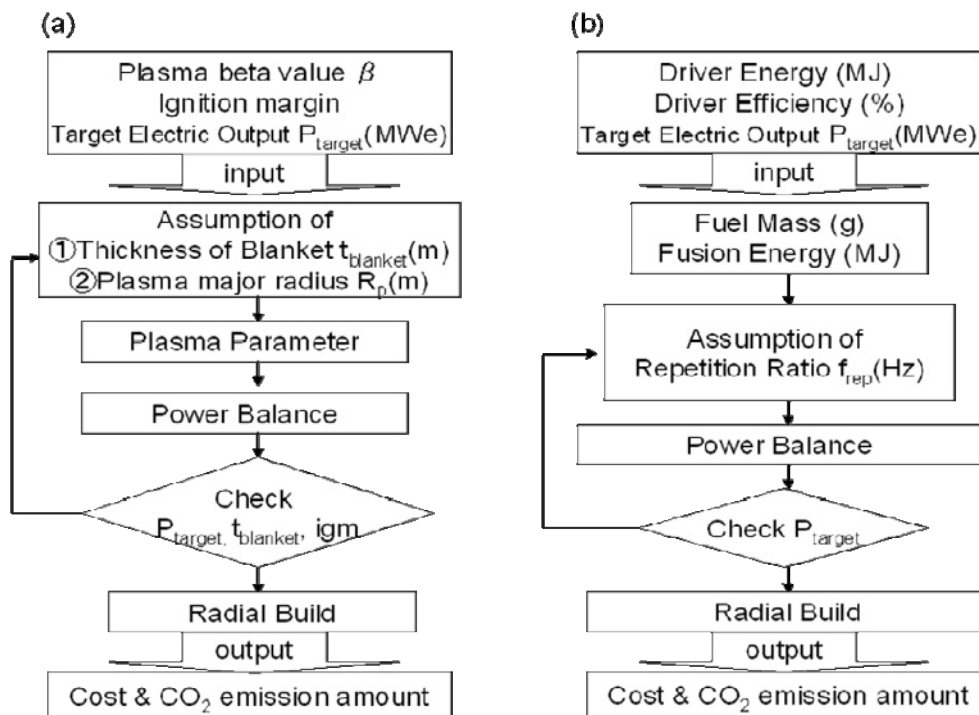


Fig.1 Assessment flow chart of (a) magnetic confinement fusion and (b) inertial confinement fusion reactor designs