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Developing a Commercial Production Process for 500,000 Targets Per Day — A Key Challenge for Inertial Fusion Energy[1]

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As is true for current-day commercial power plants, a reliable and economic fuel supply is essential for the viability of future Inertial Fusion Energy (IFE) power plants. The "target" is the vehicle by which the fuel is delivered to the reaction chamber. Thus the cost of the target becomes a critical issue in regard to fuel cost. Typically six targets per second, or about 500,000/day are required for a 1000 MW(e) power plant, thus the cost per target must become extremely low for commercial application of IFE. The electricity value within a typical target is about $3, allocating 10% for fuel cost gives only 30 cents per target as-delivered to chamber center. Complicating this goal, the target supply has many significant technical challenges - fabricating the precision fuel-containing capsule, filling with DT, cooling to cryogenic temperatures, layering the DT, characterizing the finished product, accelerating to high velocity for injection into the chamber, and tracking the target to steer the driver beams to meet it with micron-precision at chamber center.

The target cost of about 30 cents represents about four orders of magnitude reduction from current experimental targets. Thus, the technology development program for IFE targets becomes a critical component of any proposal to commercialize fusion energy using inertial confinement. Over the past few years, fabrication processes have been identified for every step of the IFE target supply, and a significant development program is underway to experimentally demonstrate their feasibility. In this paper we describe the target supply process steps, provide an overview of the planned development program, and assess the probability of success for this key challenge for fusion energy.

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