Cost-Effective Target Fabrication for Inertial Fusion Energy*

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A central feature of an Inertial Fusion Energy (IFE) power plant is a target that has been compressed and heated to fusion conditions by the energy input of the driver. For direct drive (laser-driven) IFE, energy is applied directly to the surface of a spherical capsule containing the deuterium-tritium (DT) fusion fuel at approximately 18 K. For indirect drive (heavy ion driven), the target consists of a fuel capsule within a "hohlraum" which converts the incident driver energy into x-rays to implode the capsule. The ability to economically manufacture and inject cryogenic targets is a significant feasibility issue for future inertial fusion energy power plants. The fabrication programs are focusing on methods that will scale to mass production, and working closely with target designers to make material selections that will satisfy a wide range of required and desirable characteristics.

Targets produced for current inertial confinement fusion ignition experiments are estimated to cost about $2500 each. Design studies of cost-effective power production from laser and heavy-ion driven IFE have found a cost requirement of about $0.25–0.30 each. While four orders of magnitude cost reduction may seem at first to be nearly impossible, there are many factors that suggest this is achievable. This paper: (a) summarizes the major changes in fabrication methodologies and processes that will be needed to economically supply targets for IFE power plant fueling, (b) presents the results of engineering studies to estimate the cost of the target supply in a fusion economy, and (c) describes the unique materials science and scaleup programs that are underway to enable low-cost target manufacturing. We show that the major target fabrication "paradigm-shifts" that will be needed for mass-production have been identified. We have completed initial engineering analyses that show that "nth-of-a-kind" Target Fabrication Facility costs are within the range of commercial feasibility for laser-driven and for heavy ion driven IFE, and we have begun cost studies for Z-pinch driven IFE. The development programs that are required to design the Target Fabrication Facility are well underway and are beginning to show positive results.

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