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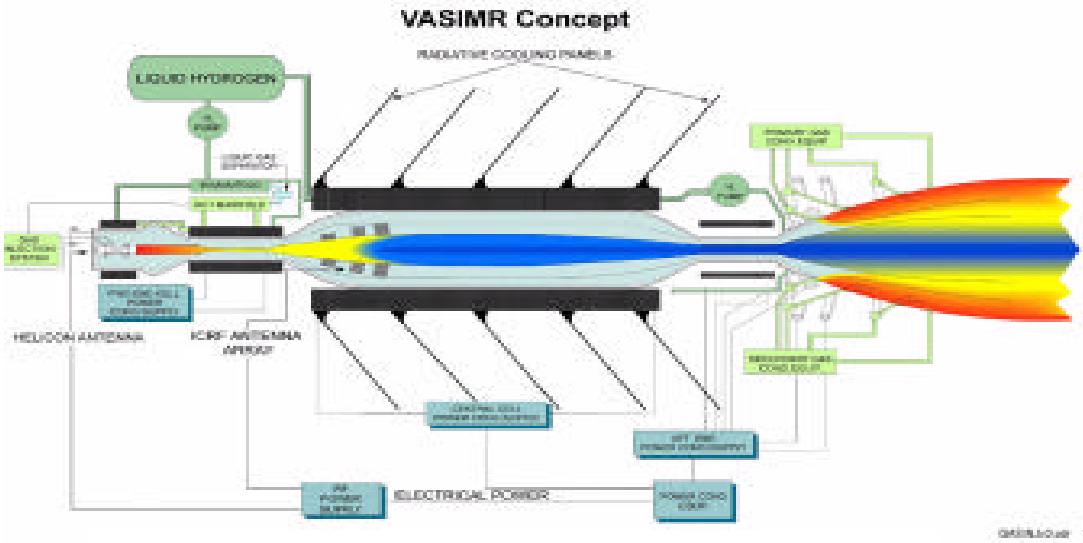
Investments for the 21st century

Fusion R&D yields a good return on U.S. investment

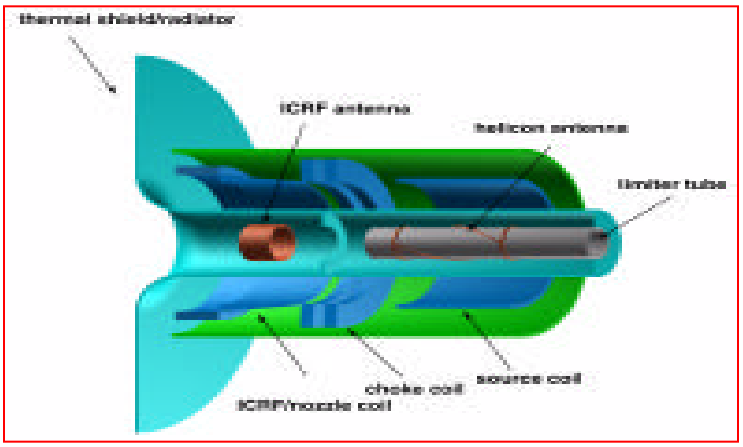
Advancing fusion research requires the development of new technologies and materials. Innovative solutions developed to address the challenges of fusion energy research have had near term industrial applications, as well as other demanding government programmatic applications.



Oak Ridge National Laboratory's research in high temperature superconducting magnets and radio frequency technology utilized for NASA propulsion systems

The creation of new products and processes – or technology transfer from the fusion program to the economy – has strengthened our technological base thereby improving U.S. competitiveness in the global marketplace as well as enhancing our standard of living. Even the ubiquitous internet can trace aspects of its beginning to the computing demands of fusion scientists requiring access to the centralized supercomputing resources of the U.S. Magnetic Fusion Energy Computer Center.

Government-funded fusion research has fostered a wide variety of new technological solutions – or "*spin offs*" -- to major industry sectors such as transportation, electric utilities, environment, health, and information technologies. In turn, there are "*spin ins*" of new technologies from the industrial and applied sectors that advances the fusion energy mission of the research program. The most visible spin offs have emerged from the fusion technology program.



NASA's Radiation Technology Demonstration Mission will launch a plasma thruster, which is a prototype of the VASIMR concept, from the Space Shuttle

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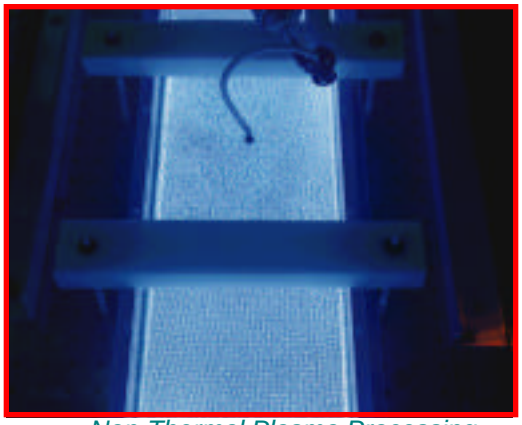
"Plasma processing is a technology that is of vital importance to several of the largest industries in the world, including the electronics, aerospace, automotive, steel, biomedical and toxic waste management industries."
Plasma Processing of Materials, National Research Council, 1991

Surface decontamination with plasma jets based on research at Los Alamos National Laboratory

- **Optics materials**
- **Plasma coatings of materials and films**
- **Plasma cutting, drilling and welding**
- **Plasma electronics**
- **Plasma processing of chips and circuits**
- **Plasma thrusters for space propulsion**
- **Power conversion systems**
- **Sensor detection and control technology**
- **Soil treatment**
- **Solvent-free surface cleaning**
- **Superconducting magnet technology**
- **Waste processing and reduction**
- **Asphalt repair**
- **Biomedical applications**
- **Concrete removal**
- **Diagnostics and instrumentation**
- **Food preservation**
- **High current switches for electric power**
- **High performance ceramics**
- **High power microwave technology**
- **High speed computers and networks**
- **Laser and pulse engineering**
- **Laser surgery and tissue welding**
- **Medical instrument sterilization**
- **Magnetic resonance imaging (MRI)**



Non-Thermal Plasma Processing Using Electrical Discharges

Photo courtesy of Los Alamos National Laboratory

Based on knowledge, experience, and societal benefits gained from the fusion program, national laboratories and universities are engaged in high-quality, near-term plasma applications to support national priorities in government and industry. Many of these dual research initiatives have grown out of expertise in plasma technologies such as radio frequency power systems and laser diagnostics. Other vibrant applications have evolved from fusion related plasma science, such as plasma stability theory, plasma surface interactions, and fundamental atomic physics. These near-term efforts are focused on pre-competitive basic research, and are not intended to be competitive with industry's product development R&D.