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Applications of Superconductivity and Impact on U.S. Economy

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In the past few decades, low temperature superconducting wires (niobium-titanium) have enabled multibillion dollar industries such as magnetic resonance imaging and nuclear magnetic resonance spectroscopy which otherwise would not have been possible. High temperature superconductors (HTS) hold the promise of impacting even a larger market in diverse applications such as energy, health, military, telecommunication, transportation and research. HTS tapes are now being manufactured in quantities of few hundred kilometers annually with current carrying capacity of about 300 times that of copper wire of the same cross section. Power transmission cables up to few kilometers in length made with HTS tapes have already been inserted in the power grid world-wide. In the past few of years, tremendous advancements have occurred in nanoscale defect engineering in these thin film superconducting tapes that has led to a doubling of critical current performance in high magnetic fields and operating temperatures of interest for various applications. Technologies developed in this area have been successfully inserted in production HTS tapes by industry. With the availability of such high performance HTS tapes, a number of coil-based applications are now being aggressively pursued by several institutions. HTS coils enable power devices with high power density with significant weight, size and power benefits. Energy storage, generation, use, transformation and transmission applications as well as magnetic applications such as magnetic shields, plasma confinement, and ultra-high field magnets are becoming possible with the availability of high-performance HTS tapes. An overview of the development and use of superconductors in electric power and magnetic applications will be provided in this presentation.