

Abstract for an Invited Paper  
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**The Sustainable Nuclear Future: Fission and Fusion E.M. Campbell Logos Technologies**

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Global industrialization, the concern over rising CO<sub>2</sub> levels in the atmosphere and other negative environmental effects due to the burning of hydrocarbon fuels and the need to insulate the cost of energy from fuel price volatility have led to a renewed interest in nuclear power. Many of the plants under construction are similar to the existing light water reactors but incorporate modern engineering and enhanced safety features. These reactors, while mature, safe and reliable sources of electrical power have limited efficiency in converting fission power to useful work, require significant amounts of water, and must deal with the issues of nuclear waste (spent fuel), safety, and weapons proliferation. If nuclear power is to sustain its present share of the world's growing energy needs let alone displace carbon based fuels, more than 1000 reactors will be needed by mid century. For this to occur new reactors that are more efficient, versatile in their energy markets, require minimal or no water, produce less waste and more robust waste forms, are inherently safe and minimize proliferation concerns will be necessary. Graphite moderated, ceramic coated fuel, and He cooled designs are reactors that can satisfy these requirements. Along with other generation IV fast reactors that can further reduce the amounts of spent fuel and extend fuel resources, such a nuclear expansion is possible. Furthermore, facilities either in early operations or under construction should demonstrate the next step in fusion energy development in which energy gain is produced. This demonstration will catalyze fusion energy development and lead to the ultimate development of the next generation of nuclear reactors. In this presentation the role of advanced fission reactors and future fusion reactors in the expansion of nuclear power will be discussed including synergies with the existing worldwide nuclear fleet.