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Nuclear technology R&D strategies in an era of energy price uncertainty

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ABSTRACT:

The growth of **intermittent** generators, especially the **non-dispatchable renewables**, benefits technologies with strong **load following** capabilities. For this reason, flexible generators such as combined cycle gas turbines (CCGT) may out-compete baseload even if NG prices do not remain low, and nuclear units are facing load reductions or even early retirement. In one example, Exelon has warned that it may shut down its Quad Cities plant due to a large increase in the number of "…hours when negative pricing occurs and baseload generating units have to pay to operate," which Exelon attributes largely to non-dispatchable subsidized wind. Future nuclear plants may increase revenues by avoiding sales when electricity prices are low by directing their heat or electricity to a **hybrid NG-nuclear system** or into **energy storage**.

The aim of this research project is to identify nuclear technology options that are competitive over a wide range of plausible future business environments. No single nuclear technology or business practice will be the best choice across all or even most future conditions. Instead, a hedging strategy incorporating a set of technologies is envisioned. Energy storage and conversion as well as hybrid nuclear-fossil technologies will be the **nuclear strategies** considered in this work. Energy storage technologies are certain to come into wide use whether the nuclear industry adopts them or not. California has mandated that 1,325 MW of storage capacity be in place by 2020 in order to minimize costly reserve capacity in the solar and wind-heavy California ISO. Current storage technology development is largely directed toward smaller-scale systems, so a focus of this research will be to assess storage technologies that offer favorable economies of scale for 100 MW – 1 GW plants. High-Temperature Reactors (HTR) will be considered along with new and extended lifetime light water reactors (LWRs).

Energy sector scenarios will be defined that represent plausible future fossil energy costs and non-dispatchable renewable penetration for selected US electricity grids. The economic value of each nuclear strategy will be assessed for every energy sector scenario. This work will result in two key products. First, it will rank order the nuclear strategies for each energy scenario, illustrating strategies that succeed under each set of future market conditions. Second, it will identify a limited number of strategies that represent the best hedge across the range of future energy scenarios.