Nuclear: A versatile and clean energy source for the 21st century

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In the 21st century the world faces the new challenge of drastically reducing emissions of greenhouse gases while simultaneously expanding access to energy and economic opportunity for billions of people. In a recent MIT study we have examined this challenge in the electricity sector, which has been widely identified as an early candidate for deep decarbonization. In most regions, serving projected electricity load in 2050 while simultaneously reducing greenhouse gas emissions will require a mix of electrical generation assets that is different from the current system. While a variety of low- or zero-carbon technologies can be employed in various combinations, our analysis shows that excluding nuclear energy as an option may significantly increase the cost of achieving deep decarbonization targets. The least-cost portfolios in our analysis include an important share for nuclear, and the magnitude of this share grows substantially as the cost of nuclear energy drops.

Despite this promise, prospects for the expansion of nuclear energy remain decidedly dim in many parts of the world. The nuclear industry, as presently configured, is inherently dis-advantaged with respect to most other industrial sectors: it relies on large and costly machines, delivered by an inefficient construction sector, requiring a lengthy safety-driven licensing process, and producing grid-connected electrons (a near-zero-margin commodity). If advanced nuclear is to thrive in the 21st century, its development, demonstration and deployment paradigm must be completely reversed. Nuclear energy systems must become small and factory-fabricated, with inherent safety features that allow for rapid and efficient licensing, and possibly supplying energy products that command a high added value in the market. In this talk we will focus on (1) Small Modular Reactors (a <300 MW-class nuclear systems that could replace existing coal, NG and larger nuclear plants, as well as cogenerating heat and electricity for industry), and (2) Nuclear Batteries (a <10 MW-class nuclear systems that fit within a standard shipping container, are ready for plug-and-play deployment and require no refueling for 3-5 years). The opportunities afforded by these new technologies are potentially massive in markets as diverse as power, industrial processes, district heating, water desalination, containerized agriculture and pharmaceutical production, manufacturing, ship propulsion, synfuel production, etc.