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Leo Szilard Lectureship Award Talk: "Recycling" nuclear waste: risks and benefits[1]

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A large-scale expansion of nuclear energy could help reduce greenhouse gas emissions, but it would raise the question of what to do with the additional nuclear waste. Most countries have made little progress in finding permanent sites for disposing of waste produced by the current generation of light-water-cooled nuclear reactors—both spent nuclear fuel and the tails left over from enriching mined uranium for fresh fuel production. Recently, there has been a resurgence of interest in advanced nuclear reactors that would not be water-cooled; their supporters claim they would be able to recycle nuclear waste, reducing disposal requirements. These proposals include molten-salt cooled reactors and Terrapower's liquid metal-cooled "standing wave" reactor (a more recent variant of the "traveling wave" reactor). However, developing a safe, secure, and workable reactor to recycle nuclear waste is easier said than done. Many of the proposed designs would require chemical "reprocessing" systems to separate materials that can be reused in fuel from those that cannot. But reprocessing increases proliferation and terrorism risks because it increases the accessibility of plutonium and other materials that can be misused to make nuclear weapons. As a result, reprocessing facilities require safeguards and security measures that are costly, intrusive, and of limited effectiveness. Moreover, realistic assessments show that these approaches would have only a limited impact on nuclear waste stockpiles. Some reactors, such as the standing wave reactor, may be able to use uranium more efficiently without the need for reprocessing, but many technical challenges remain. This talk will provide an overview of the waste-recycling capabilities of selected advanced reactor concepts and assess their risks and benefits compared to current-generation reactors.

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