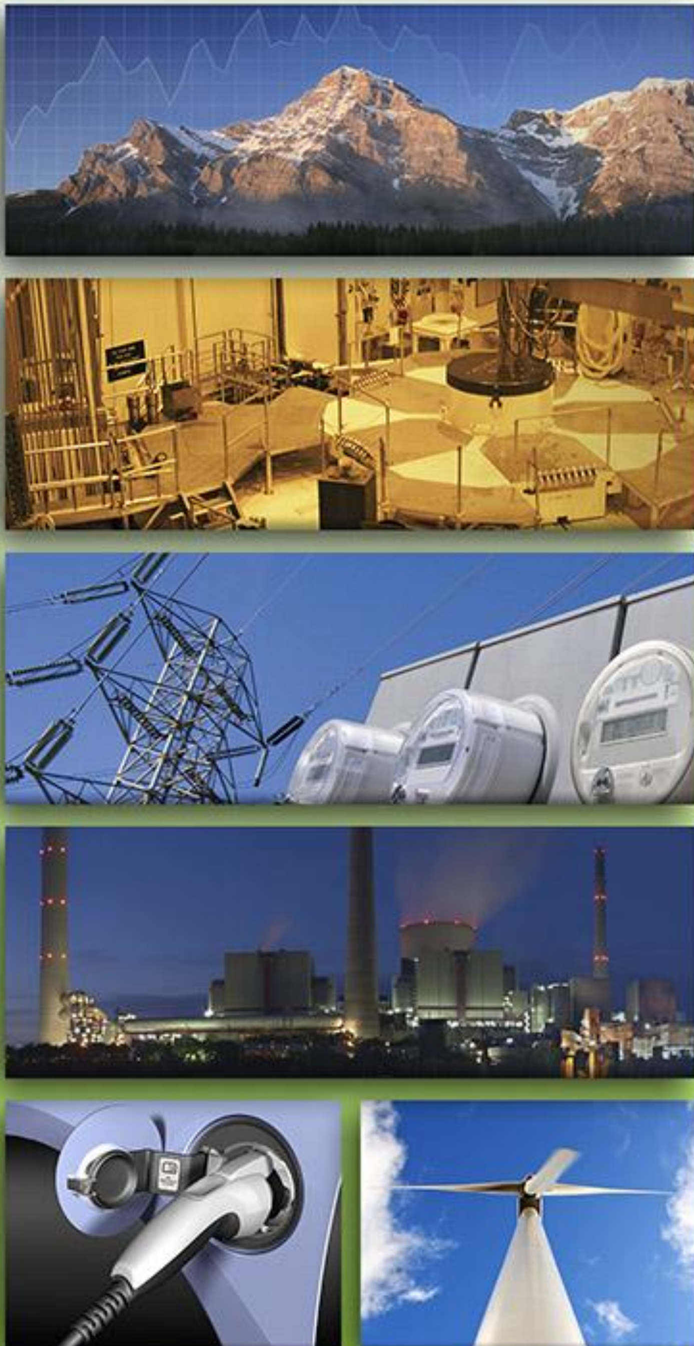

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Challenges and Strategic Choices for a Sustainable Nuclear Fuel Cycle

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Blue Ribbon Commission on America's Nuclear Future
Subcommittee on Reactors and Fuel Cycle Technology
Washington, D.C.

12 October 2010

Evaluating the Advantages and Disadvantages of New Fuel Cycles – Questions for Panel

- What are the performance criteria?
- How should criteria be weighted?
- What can be done to develop and deploy reactor and fuel cycle technologies to satisfy performance criteria?

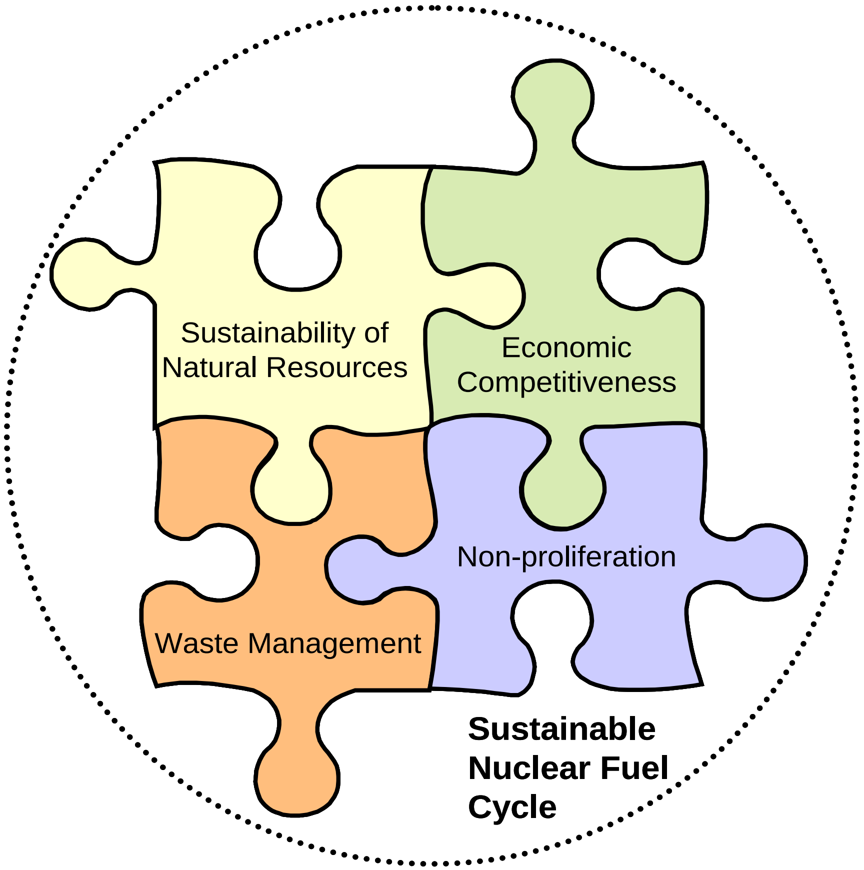
Current Situation

- Light water reactor technology
  - Remains technology foundation for much of 21st century
  - Industry is comfortable with technology … It works!
- Once-through fuel cycle
  - Most economic option for at least next 50 years
  - Uranium resources not limiting for near-term fuel cycle decisions
  - MOX use not economically competitive unless driven by external factors, such as need to manage plutonium stockpiles

Q1: What are the performance criteria?

- Economic competitiveness
- Natural resource sustainability
- Waste management
- Non-proliferation

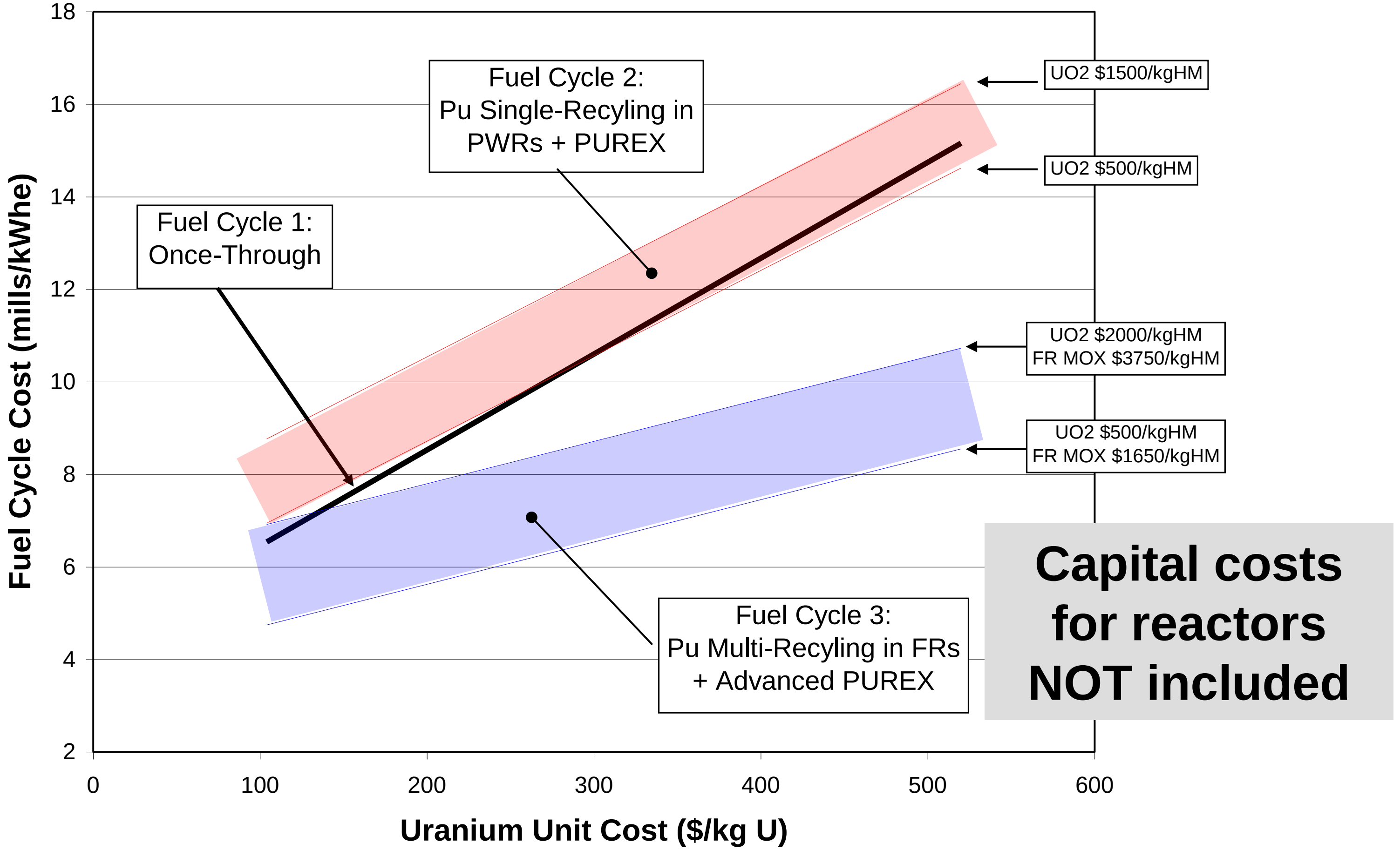
- *Safety – a mandate for all fuel cycle options*



Advanced Nuclear Fuel Cycles – Main Challenges and Strategic Choices, EPRI Report 1020307, September 2010.

Economic Competitiveness

EPRI equilibrium modeling of fuel cycle costs using OECD/NEA SMAFS model*



For high uranium prices, recycling of plutonium (as MOX) becomes economically feasible as long as reprocessing and fast reactor costs are kept low.

*EPRI Reports 1018575 (2009) and 1020660 (2010)

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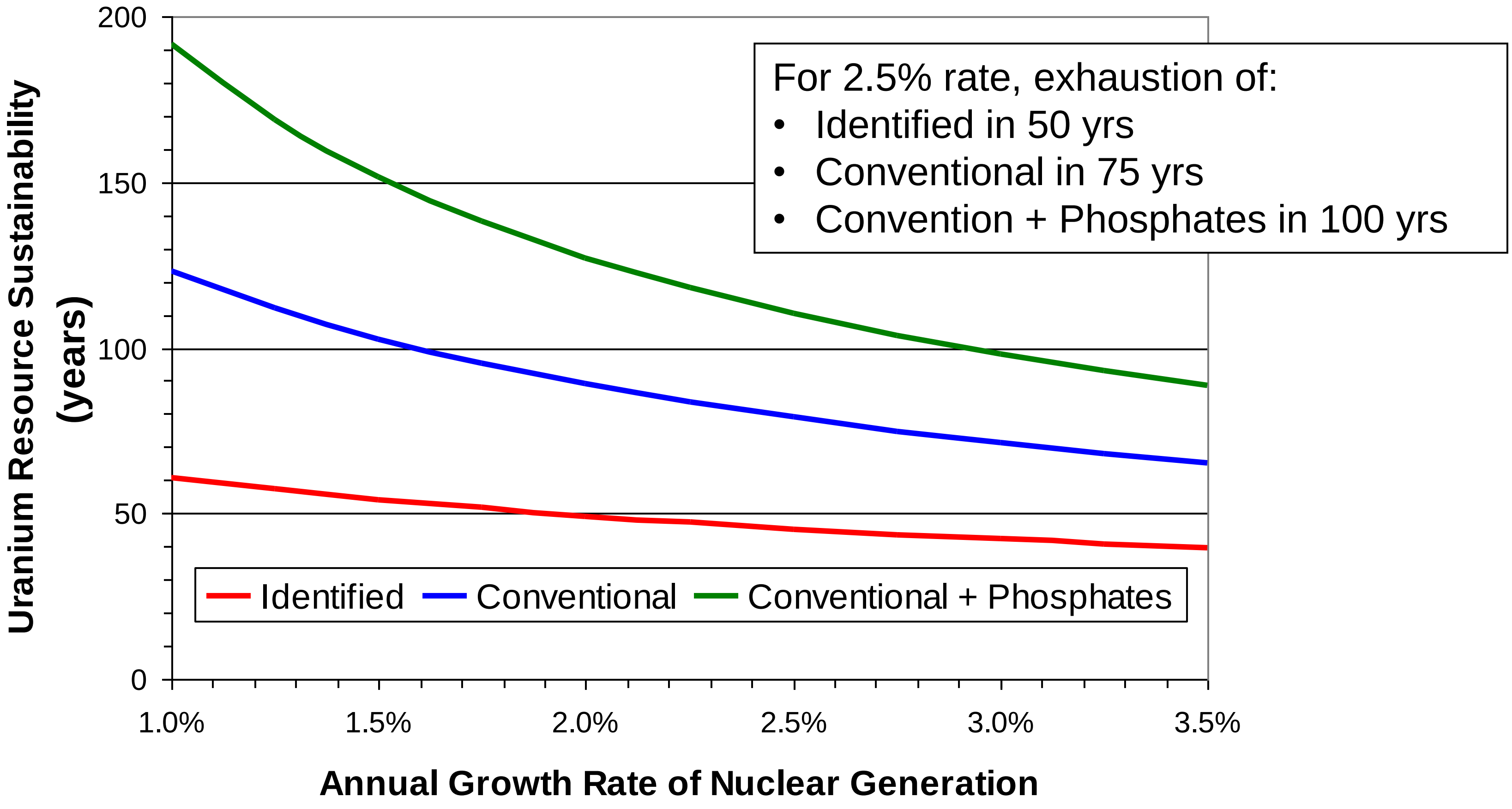
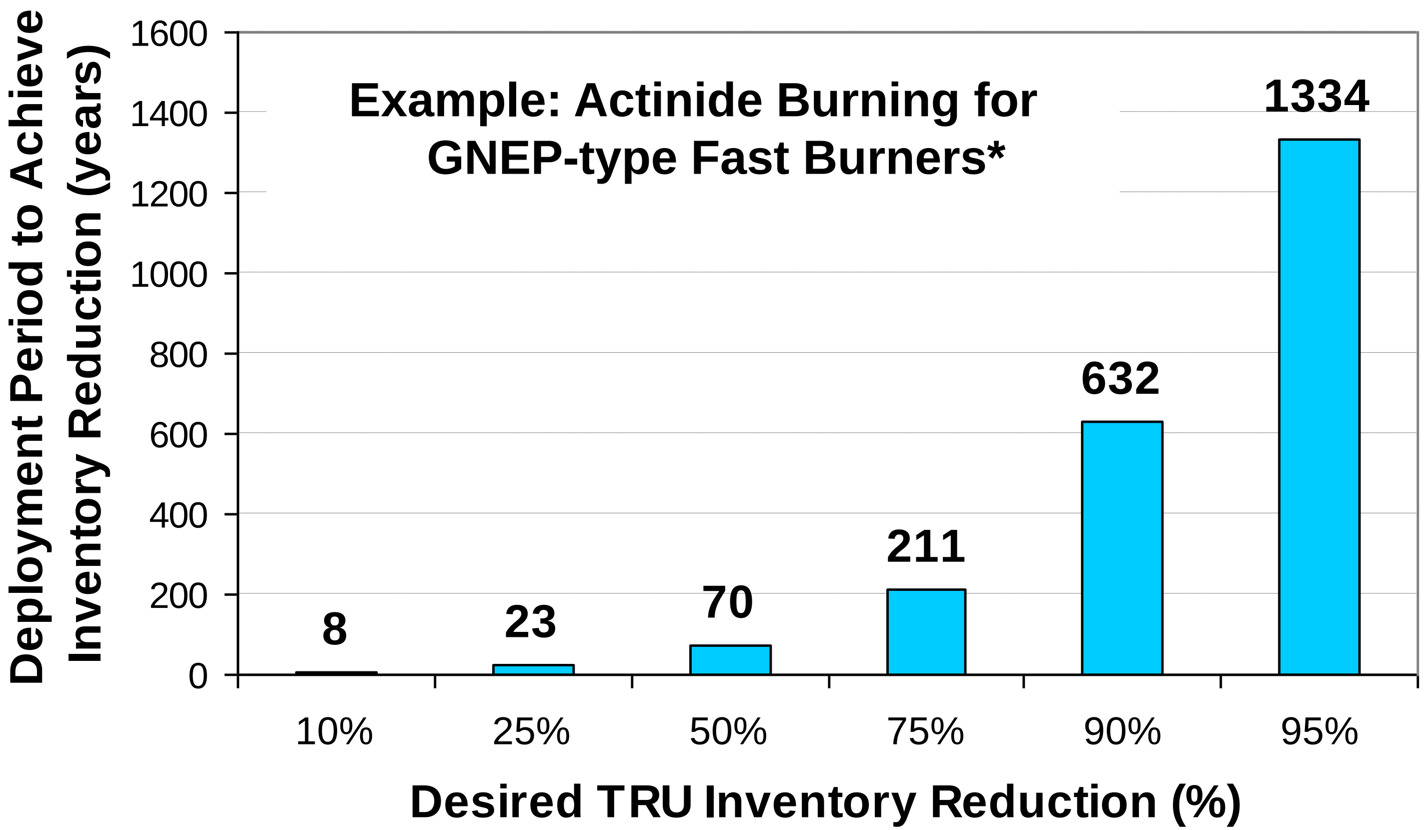
Natural Resource Sustainability*



RD&D on advanced reactors and fuel cycle technologies can help ensure fuel supply if uranium resources become limiting.

*Advanced Nuclear Fuel Cycles – Main Challenges and Strategic Choices, EPRI 1020307, 2010.

Waste Management



Waste management benefits are secondary. Advanced fuel cycle technologies are NOT needed for safe disposal of used fuel and high-level waste.

*A. Machiels, S. Massara, and C. Garzenne. Dynamic analysis of a deployment scenario of fast burner reactors in the U.S. nuclear fleet. *Proc. Global 2009*. Paper No. 9089, Paris, France (2009).

Non-proliferation

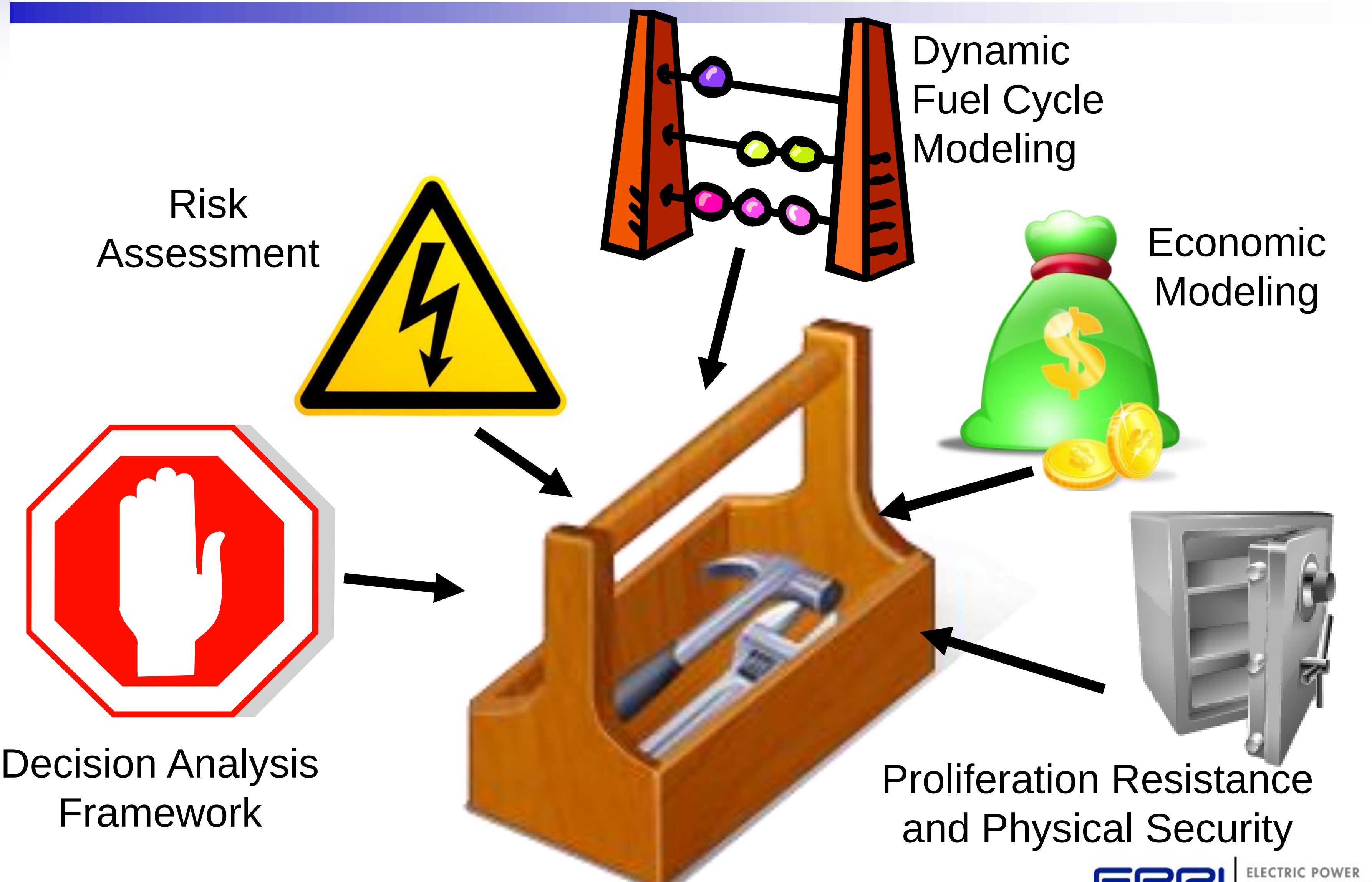
- Institutional (extrinsic) issues dominate
- Intrinsic safeguards tend to be more debated
  - fissile material attractiveness
  - self-protecting dose rate

No silver bullet: All fuel cycle options require a combination of intrinsic AND extrinsic measures.

Q2: How should criteria be weighted?

- **High: Economics**
  - simple, deployable; someone has to build, maintain, and operate facilities for reliable, affordable power generation
- **Medium: Resource utilization**
  - natural uranium supply not likely limiting for next 50 years, but resource amplification represents a compelling driver for security of future fuel supply
- **Low: Waste management**
  - technical solutions for waste management exist
- **Universal: Safety and Non-proliferation**
  - must be adequately addressed regardless of fuel cycle option, not as useful for differentiating options

Q3: What can be done?
EPRI Approach: Fuel Cycle Analysis Toolbox



Decision Analysis Framework

Major Issues	Example of Considerations
National Strategy	Energy security; access to uranium; non-proliferation policy; balancing regional energy production with demand
Economics	Design output; capacity factor; uses other than electric power; construction and operating costs; new infrastructure costs
Deployability	Technological maturity; demonstration and testing; reliability of supporting infrastructure facilities
Safety	Public and worker operational exposure; types of accidents; potential release scenarios: frequency and consequences
Regulations	Regulatory licensing readiness; use of proven technology
Security and Non-prolif.	Physical protection of facilities; special nuclear material (SNM) configurations; SNM accounting and control at activity nodes
Environmental Impact	Water usage, heat discharge, non-radioactive waste streams, loss of land use
Waste Management	Number of distinct high and low-level radioactive waste streams; physical characteristics; quantity; toxicity

Summary: Attributes of a Sustainable Fuel Cycle

- Focus on cost-competitive power generation

- Better utilization of natural resources is *desirable* and may be needed depending on new resource identification and nuclear growth
  - What reactor technology will take us there?
  - What fuel cycle infrastructure will be required?

- Waste management, non-proliferation, safety can and must be appropriately addressed for all fuel cycle options

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