



**AREVA**

**PURE ENERGY**

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***Pressing Issues  
Faced by Waste Management in 2009  
and Beyond***

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***President***  
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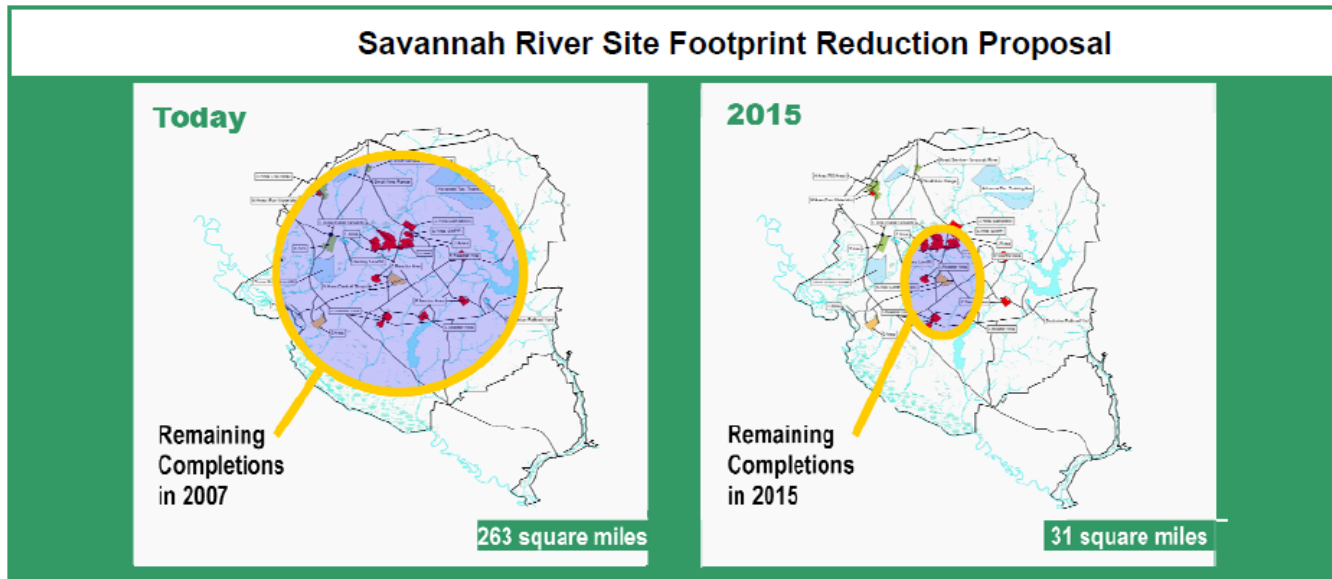
## ▶ Many issues affect Waste Management

- ◆ Program management & priorities
- ◆ Human capital / Aging workforce
- ◆ Funding
- ◆ Technology
- ◆ Public acceptance

## ▶ Focus on Technology

- ◆ Back in 80's - 90's DOE promoted emerging technologies
- ◆ But many technologies offered were not yet mature
- ◆ Since then funding in R&D have been reduced and focus shifted on commercial applications

*Do we have the appropriate Technology Mix to successfully address the present and future Waste Management challenges?*



Ref: REDUCTION OF EM FOOTPRINT AND ESTABLISHMENT OF ENERGY PARKS.  
OFFICE OF ENVIRONMENTAL MANAGEMENT DECEMBER 2008

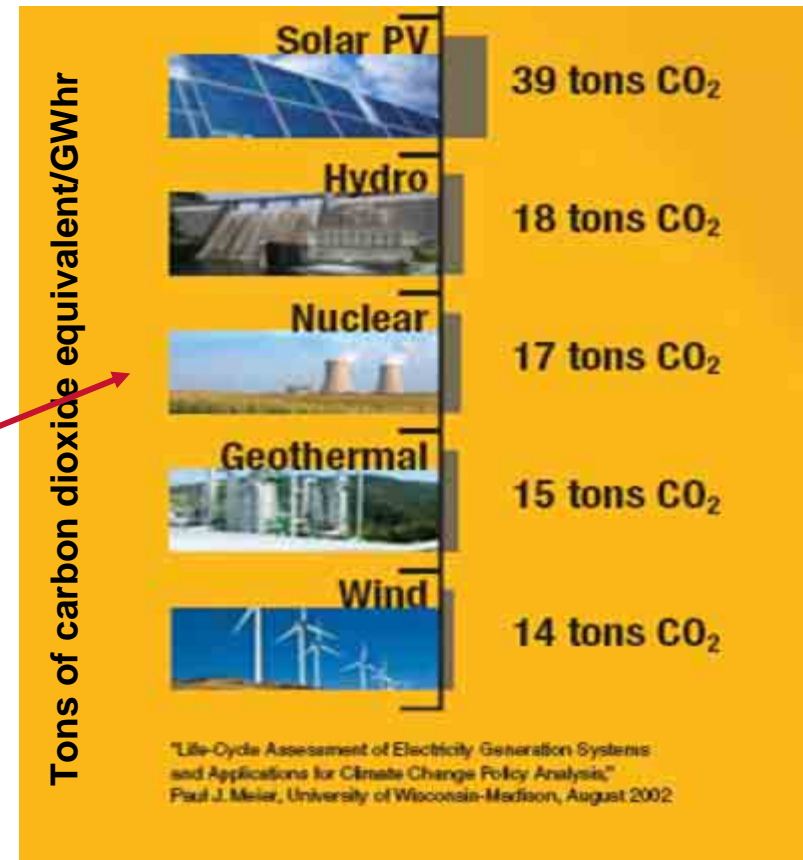
▶ **1/ Reduce the legacy footprint of the DOE complex**

- ◆ Life cycle costs reduction / Small sites completion / 90% footprint reduction by 2015

▶ **2/ Support new, beneficial sites missions**

- ◆ Enable reuse of infrastructure for other energy missions or community use
  - “Energy Parks” ; Produce energy and demonstrate advanced technologies
  - Ensure long-term mission at sites – sustain jobs

- ▶ **“Brownfield” sites**
  - ◆ reusing existing infrastructures and workforce
- ▶ **Clean Fuel / green energy production**
  - ◆ Including Nuclear Power Facilities
- ▶ **Attract Industry and facilitate Lab / Industry partnership**



▶ **3/ Treatment and Disposition of Highly Radioactive Material**

- ◆ Special Nuclear Material (e.g., Plutonium)
- ◆ Defense Nuclear Fuel and High Level Waste
- ◆ Tank Farms
- ◆ Commercial Used Fuel

▶ **4/ Prepare the future of Nuclear Energy**

- ◆ Nuclear Renaissance / Next generation of Reactors
- ◆ Advanced Recycling
- ◆ Security of Supply
- ◆ Non-Proliferation (including Global Threat Reduction)

## *HLW : Haven't we picked the Low Hanging Fruit ?*

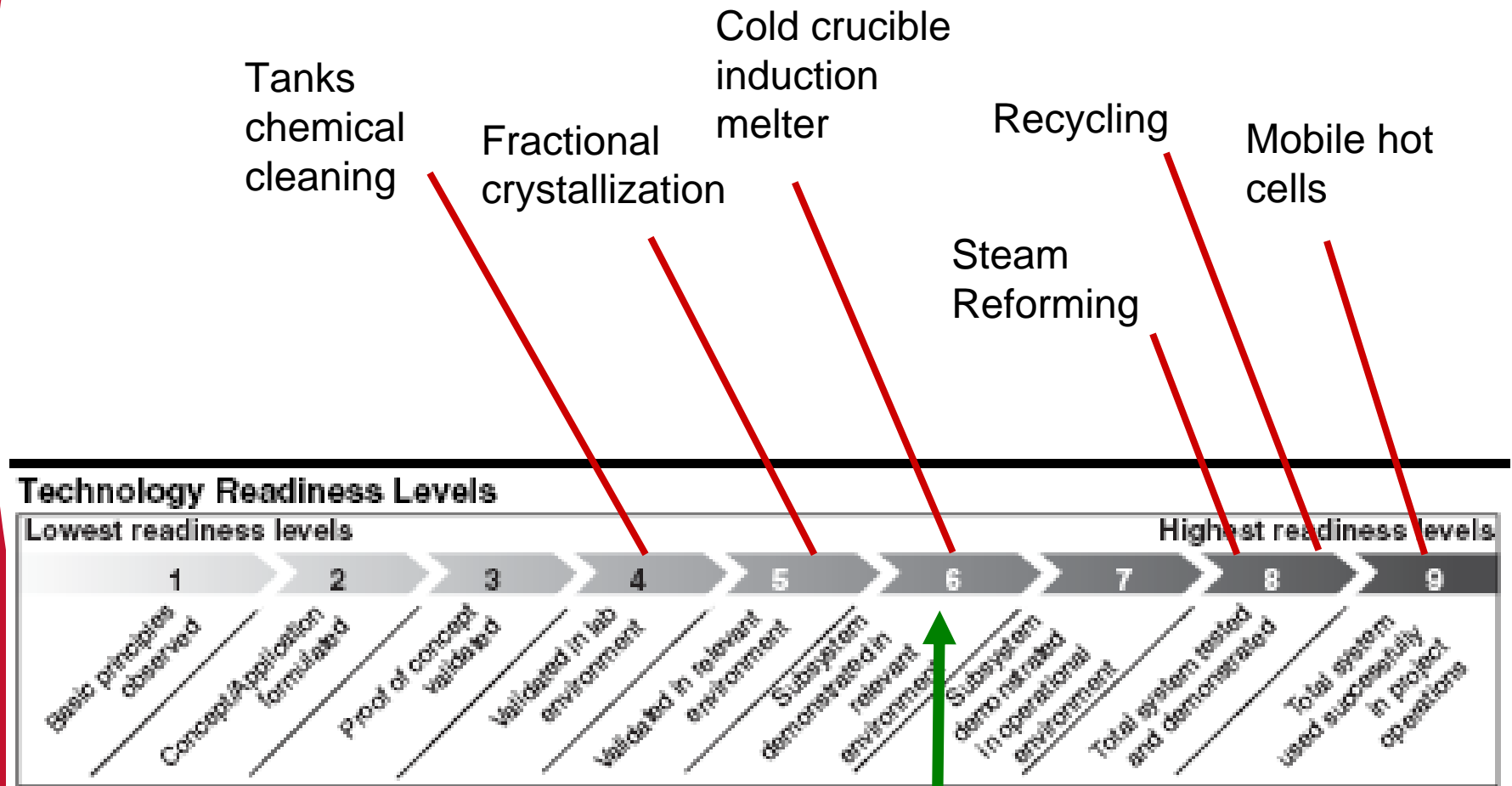
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▶ **Most of the difficult problems lie ahead**

- ◆ Large quantities of High Level Liquid and Sludge Waste
  - remain to be processed, with complex retrieval and chemistry issues
- ◆ Hundreds of low integrity underground tanks
  - remain to be emptied, cleaned and administratively “closed”
- ◆ Large quantities of DOE used fuel and special nuclear material
  - remain to be stabilized and prepared for disposition
- ◆ > 50,000 tons of civilian used fuel requiring disposition
  - Yucca Mountain ?



# Technology readiness & examples

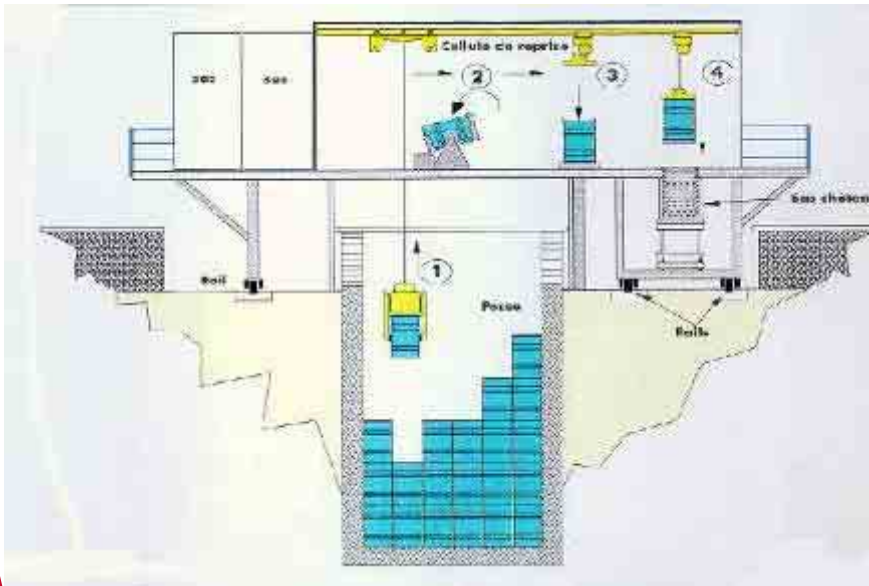


Source: GAO analysis of DOD data.



## *Example: Mobile Hot Cells*

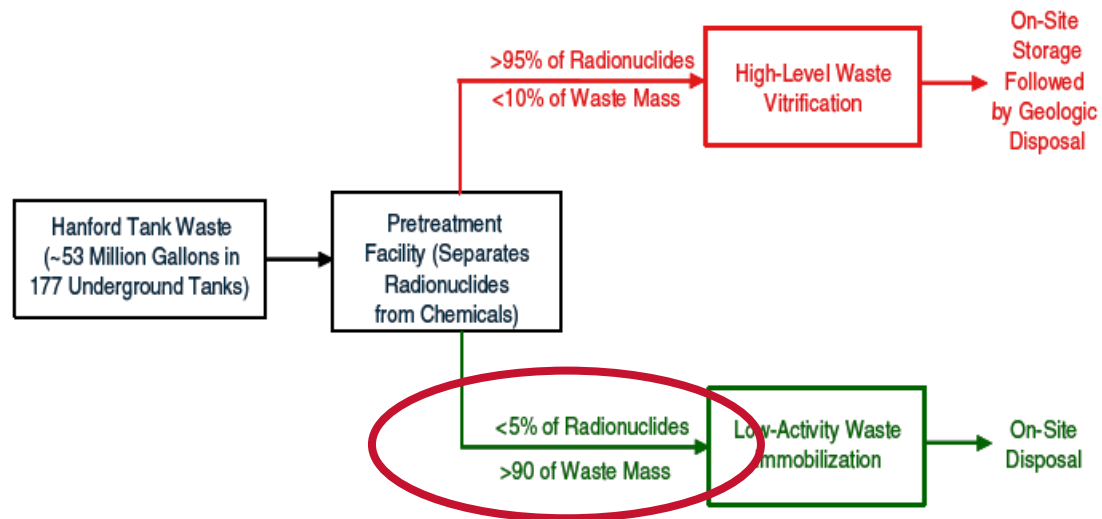
- ▶ **At site retrieval, characterization, treatment and repackaging without new fixed facilities**



- ◆ Increase flexibility / reusability
- ◆ Reduce D&D costs

## Example: Waste Pre-treatment

- ▶ Segregate radionuclides from non-radioactive waste species that increase glass volume
  - ◆ Sodium Removal (Fractional Crystallization)



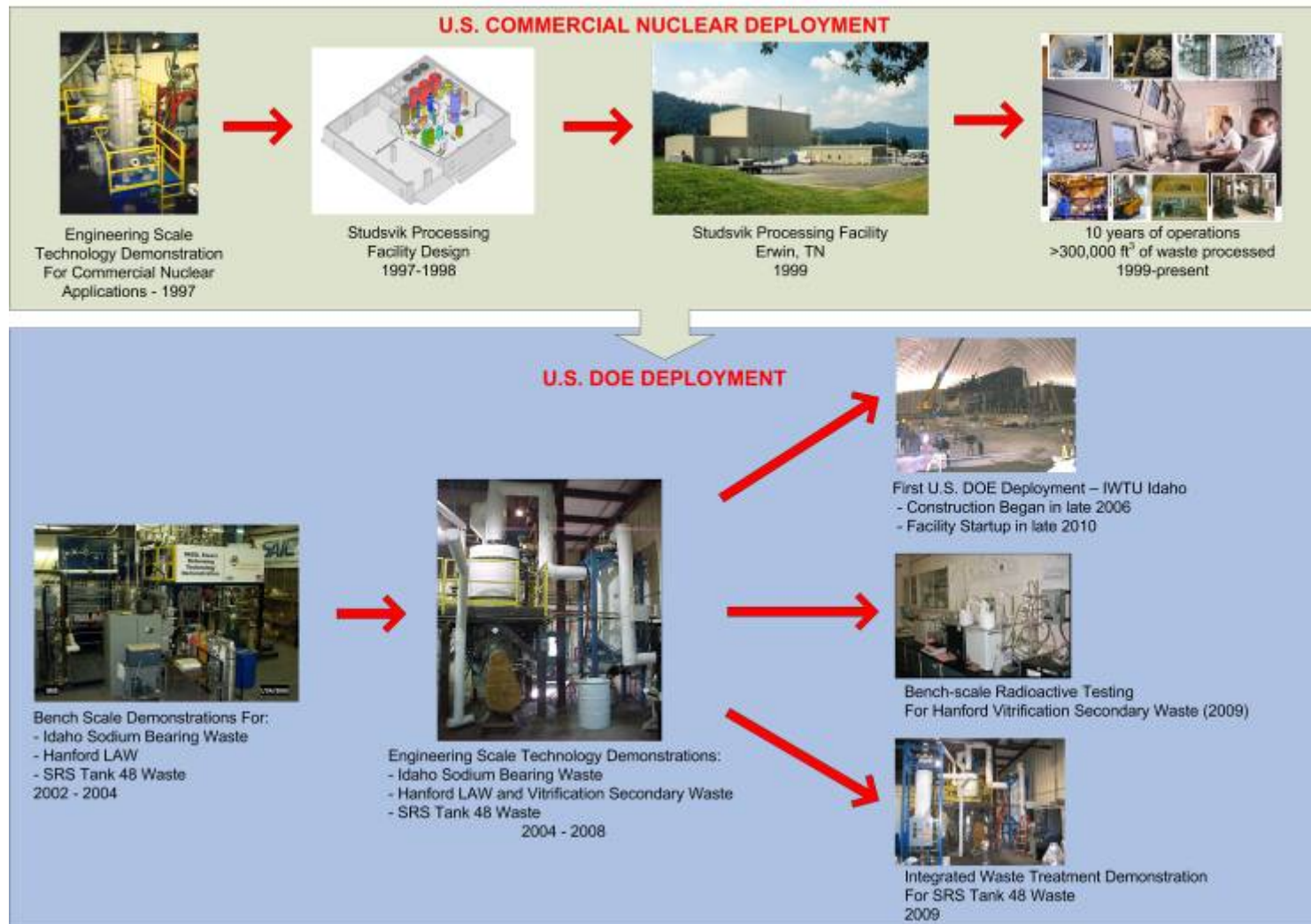
***“Reducing the quantity of sodium in LAW to be vitrified...is the most important element in determining the duration, the need for additional LAW treatment capacity, and the cost of the mission.”***

***- DOE External Technical Review on System Planning for LAW, 2008***

# Example: Steam Reforming

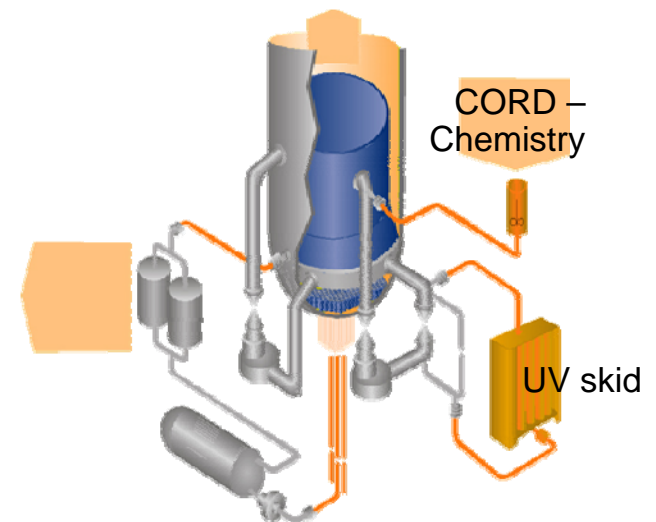
## THOR<sup>®</sup> Fluidized Bed Steam Reforming Technology

U.S. Commercial and U.S. DOE Technology Deployment



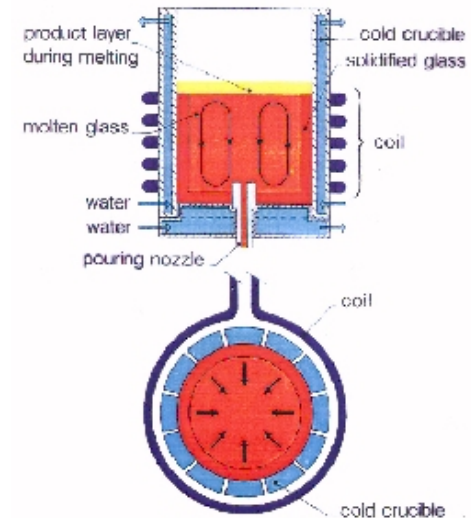
## *Example: Tank Chemical Cleaning*

- ▶ **Technology derived from Reactor primary loop decontamination**
  - ◆ for hands-on maintenance
- ▶ **Potential to remove heels and most of remaining contaminants in tanks and pipes**
  - ◆ Up to “Mirror Polish” surface finish
- ▶ **While minimizing production of secondary waste**
  - ◆ local regeneration and recycling of chemicals
- ▶ **Directly relevant for final steps in tanks closure**



## *Example: CCIM advanced vitrification*

- ▶ Reduced footprint
- ▶ High temperature
  - ◆ high waste loading
  - ◆ high throughput
  - ◆ process new / highly corrosive waste
- ▶ High equipment durability
  - ◆ lifetime design / reduced maintenance
  - ◆ reduction of secondary waste
- ▶ High flexibility
  - ◆ small holdup
  - ◆ easy to stop and restart
- ▶ Potential for longer-term improvements
  - ◆ new advanced matrix formulation
    - Glass-ceramics, Ceramics



# Example: Recycling

*Minimizes Facilities Footprint  
Enhances Public acceptance*



*Reduces waste volume  
with Ultra Stable waste forms*

Long-term storage and preparation for disposal



*Destroys Special Nuclear Material  
Provides Energy Security*



Nuclear reactor

**Recycled fuel**  
- Mixed Oxide Fuel  
- Reprocessed uranium

**Used Fuel and Special Nuclear Material**

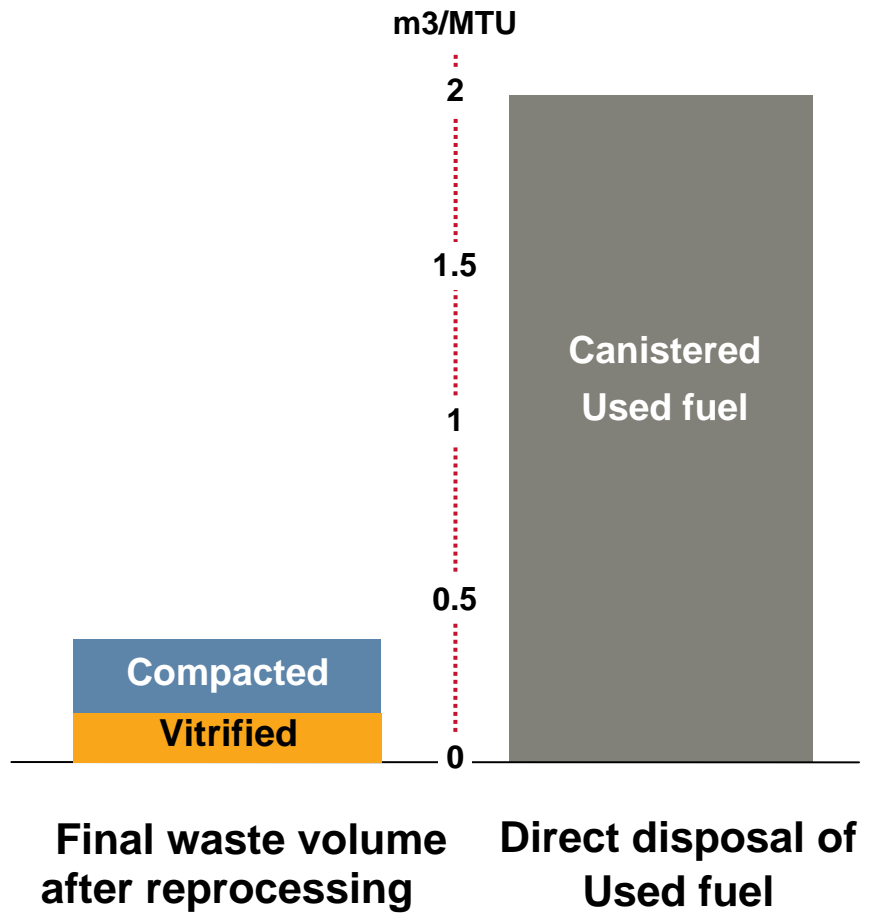
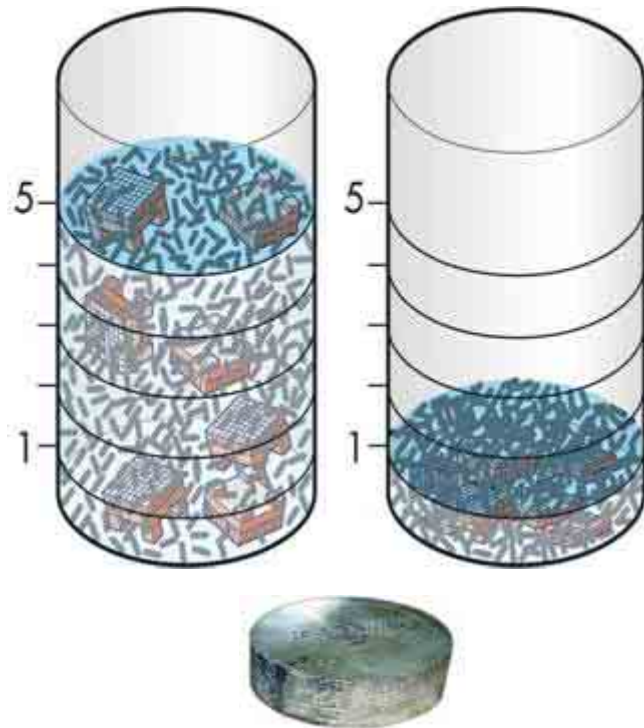
**Optimized Waste**



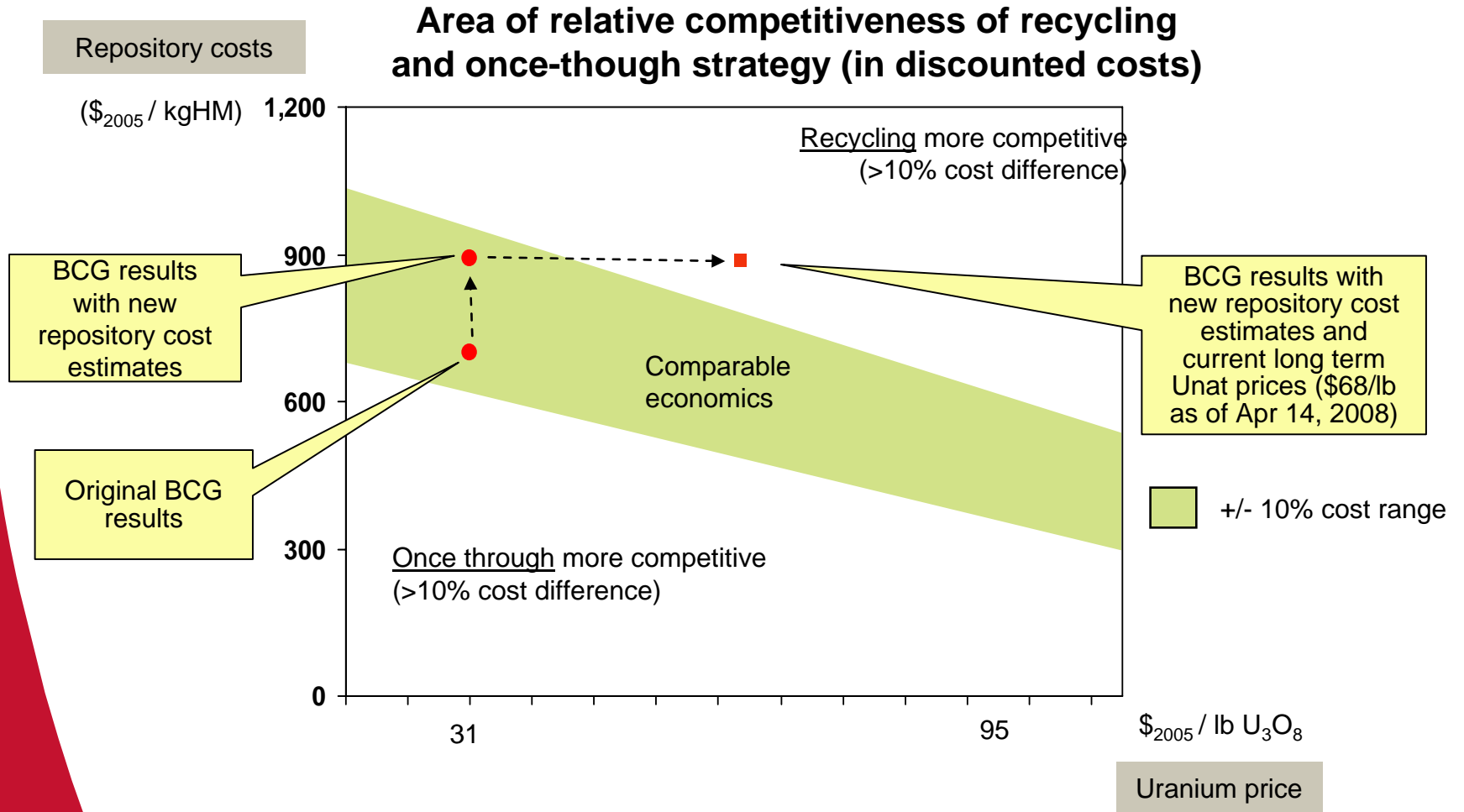
Recycling Facility

# In Short...

## Volume Reduction of Used Fuel as Compared to Direct Disposal



# With Today's Conditions, Recycling Economics Further Improve





- ▶ **Industry has technology available**
  - ◆ to address some the most difficult cleanup challenges facing DOE
  - ◆ as they reduce the footprint
  
- ▶ **There are still areas where Research and Development is needed**
  - ◆ engaging industry together with the national labs
  - ◆ to ensure most efficient transfer while adapting technologies to DOE needs