



# Nuclear Energy Technology and its International Future:

## A Timely and Difficult Problem

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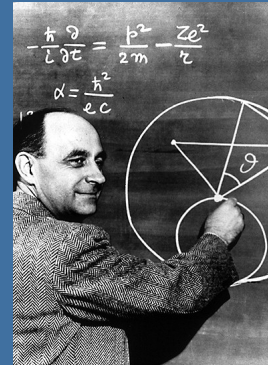


## Focus of This Presentation

- Political/Technical/Social Issues Surrounding Nuclear Energy
  - History
  - Current status
  - Pros and Cons
- International Issues:
  - Global energy demands are going to grow tremendously in coming decades
  - Reawakened interest in the international nuclear fuel cycle; US and Russia's possible roles
  - Other nations' interests
- I am not here to advocate any one answer to our global energy problems, but will review some of the critical issues that nuclear energy brings to this.

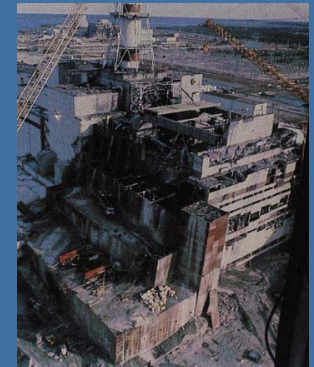
## History of Nuclear Energy

- First controlled nuclear chain reaction in Chicago, Fermi (1942)
- 1945 Soviet uranium-graphite reactor in Moscow
- WW II ends and prospect for int'l control of atomic energy arises
- Atoms for Peace - Eisenhower
- Great hope for nuclear energy; in 1950s nuclear was "too cheap to meter"
- 1957 IAEA formed
- Enthusiasm lasted into the 1970s
  - Environmental movement
  - Proliferation concerns grow
  - Three Mile Island, 1979
  - Deregulation of power generation in 1990s



## Chernobyl, April 1986

- Result of flawed technology and operator error
- Initial Soviet cover-up
- Harmful to region and people. Accident contained at cost to human life
- Sarcophagus unstable
- Exclusion Zone off limits indefinitely

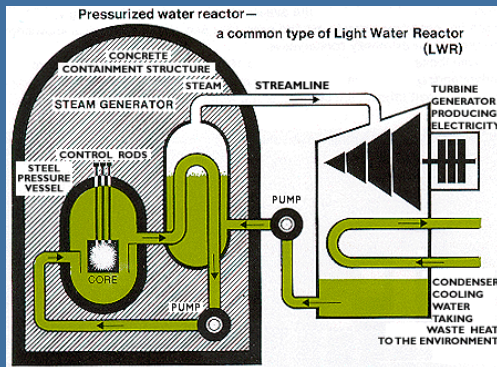




## Nuclear Power Today



- 104 commercial nuclear power reactors operating in the US. Last one to come on line was in 1996.
- 31 countries are operating 443 plants worldwide; 364,000 MWe total capacity
- 16% of world electricity is nuclear-generated
- Public perception and use vary globally, examples:
  - US is 20% nuclear
  - France is 75% nuclear
  - Germany is 33% nuclear
  - Ukraine is 49% nuclear
  - Russia 18% nuclear





## Increasing Global Energy Needs, Increasing Global Warming

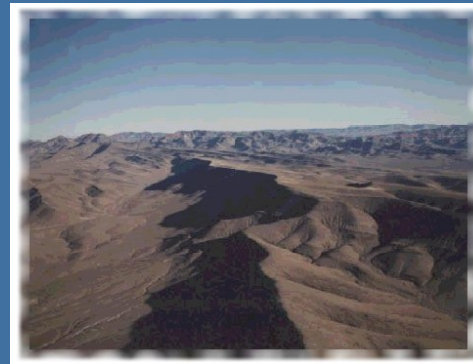
- More global electricity demand inevitable; population increasing
- Awareness of global warming, greenhouse gases
- Nuclear power can make an appreciable reduction in fossil fuel use only if implemented on a terawatt scale
- Tough to put a price on what this would cost; can nuclear be made more cost-effective than traditional fuels in future?
- Overwhelming number of factors to consider
- Renewable energies not typically cost-effective, although wind is looking better





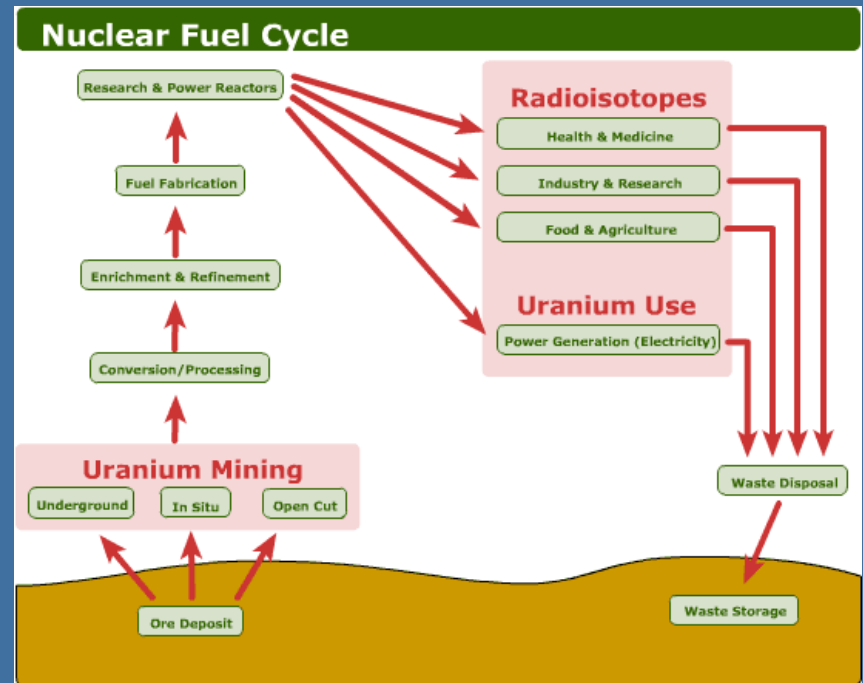
## Nuclear Waste: What to Do?

- All waste today in **temporary storage**
- Types of storage:
  - Temporary storage pools
  - Dry cask storage
  - Vitrification
- Permanent Storage Ahead?
  - Yucca Mountain is a huge political problem
  - A solution?: let private industry compete to develop stable, mined geologic repositories for spent fuel or vitrified fission products
- Popular culture images of nuclear energy negative in recent years, such as on *The Simpsons* TV show.



## International Nuclear Fuel Cycle - Prospects and Problems

- All of what I have just discussed is a global problem, and may be best dealt with (one way or another) globally. One of the biggest issues is the fuel cycle.
- What is the nuclear fuel cycle?
  - Not a new idea. End of World War II and Baruch Plan. Eisenhower suggested a “uranium bank.” Transparency of process.
- IAEA Chief Mohammed El Baradei 2003 speech
- Global landscape today: Can/should the big powerful countries control who can have nuclear facilities?
- Monitoring problems. Non-state actors.





## Why US-Russia Collaboration is Key to the Fuel Cycle



- One item that I will advocate is increased US-Russia collaboration and leadership in this area. Should set examples and act as leaders in setting sound policy
- Balance of power. US and Russia have largest nuclear arsenals and stores of materials
- Will Russia accept spent fuel for storage, with payment and international monitoring?
- Organized, well managed international monitoring of waste sites could help slow down proliferation
- **Nuclear waste is not going to go away whether we build more reactors or phase nuclear power out eventually.**



## Conclusions

No one can say for sure where nuclear energy technology is headed in next several years, but...

- Lots of new plant models in prospect, domestic and foreign; generation IV reactor; portable reactor
- Threat of nuclear terrorism on the increase
- Will need the cooperation of many nations and the IAEA
- Science and technology policy specialists will need to address our global energy issues with an international perspective in mind



## Abstract

- Increasing concern about the damage to our climate caused by carbon-based energy production, its escalating costs, and a growing crisis in the international nuclear nonproliferation regime is leading to a major re-examination of the role of nuclear power. Soon, national and international policy may actively encourage nuclear power production around the world. The United States and the Russian Federation - as the two largest nuclear powers and major suppliers of nuclear power technology - are going to be key to any international regime: these nations should be encouraged to work closely together to promote well-managed, truly international civilian nuclear fuel cycle and long-term spent fuel storage programs. In this seminar Fitzpatrick will talk about the possibilities and difficult challenges that these efforts will face.
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