



Nuclear Power and Nuclear Proliferation: Policy Priorities for the Next Decade

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Revision 5



Nuclear Energy

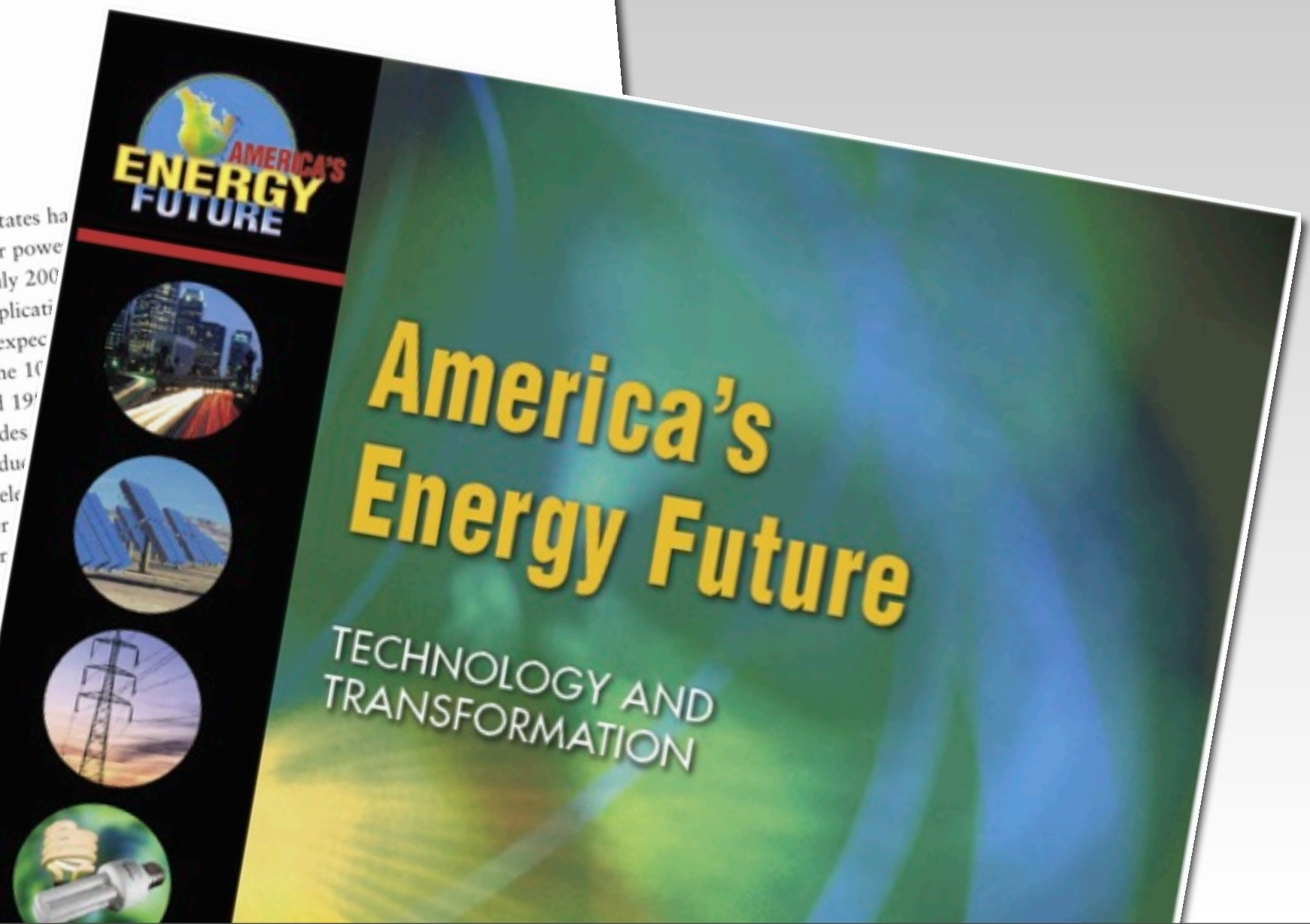
Utilities in the United States have been adding new nuclear power generation sources. As of July 2009, the USNRC had received 17 applications for licenses¹ for 26 units, and it expects to license units by the end of 2010.² The 10 units constructed in the 1970s and 1980s are still in supply: nuclear power provides about 70 percent of electricity production. These plants provide electricity with capacity factors greater than 90 percent, remain, and no new nuclear units are expected to be built in less than 30 years.

This chapter discusses the status of nuclear energy in the United States, including

¹Previously, the licensing process required a different license than the one required as part of the USNRC's new process.

²The USNRC's lists of reactors/new-reactors/expected-new-rx-applications.

³The net capacity factor.



Domestic Debates of Proliferation Risks

need to take into account the global challenges of nuclear power
more so than they usually do today

“The risk of proliferation is a controversial subject, and there are differing points of view about how it should affect technology trajectories within the United States.”

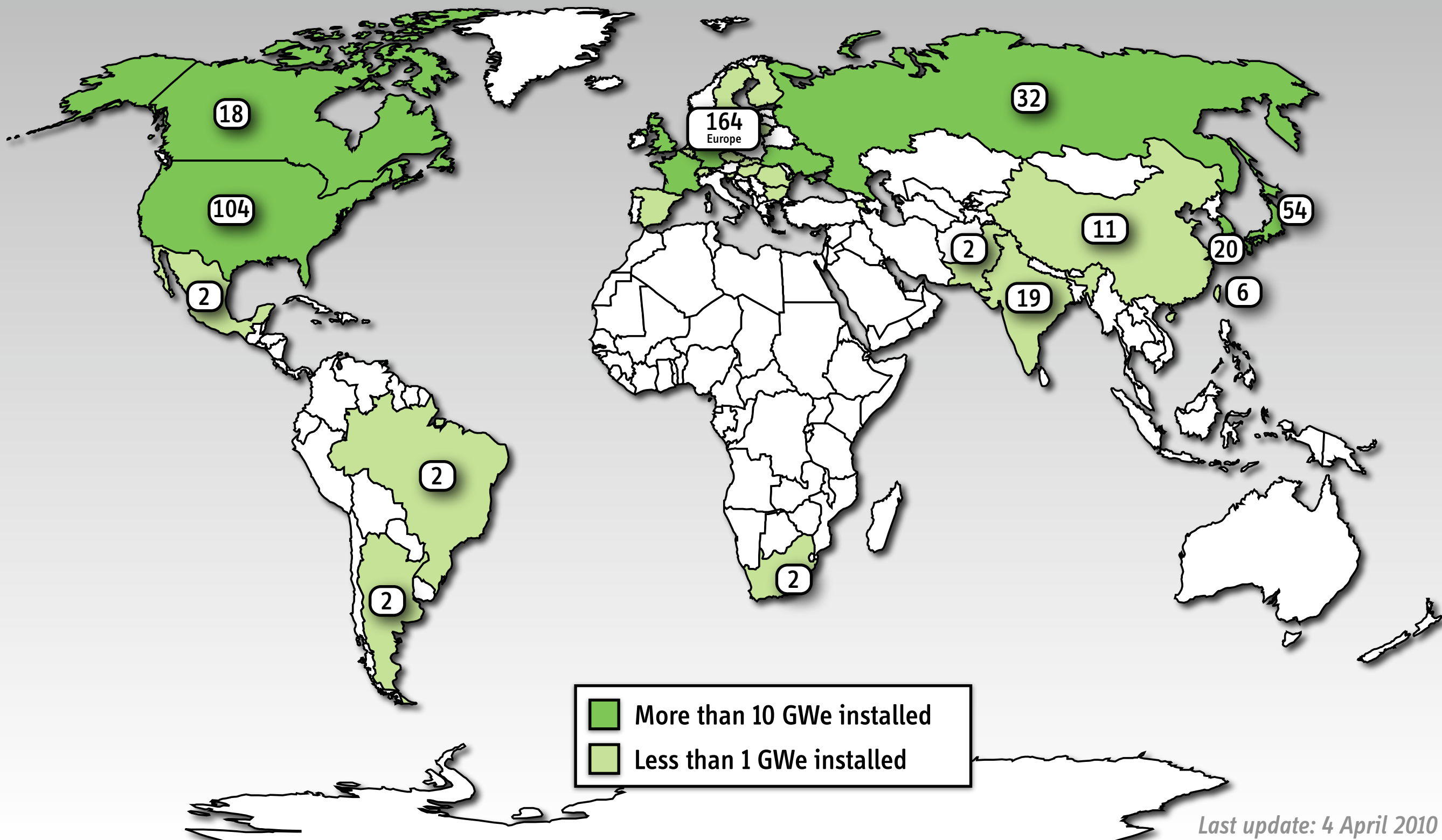
(AEF, Chapter 3, p. 111, Footnote 16)

“An expansion of nuclear power and associated fuel cycle technologies in this country does not directly affect the proliferation of nuclear weapons technology.”

(AEF, Chapter 8, Nuclear Energy, p. 491)

Nuclear Power Reactors in the World, 2010

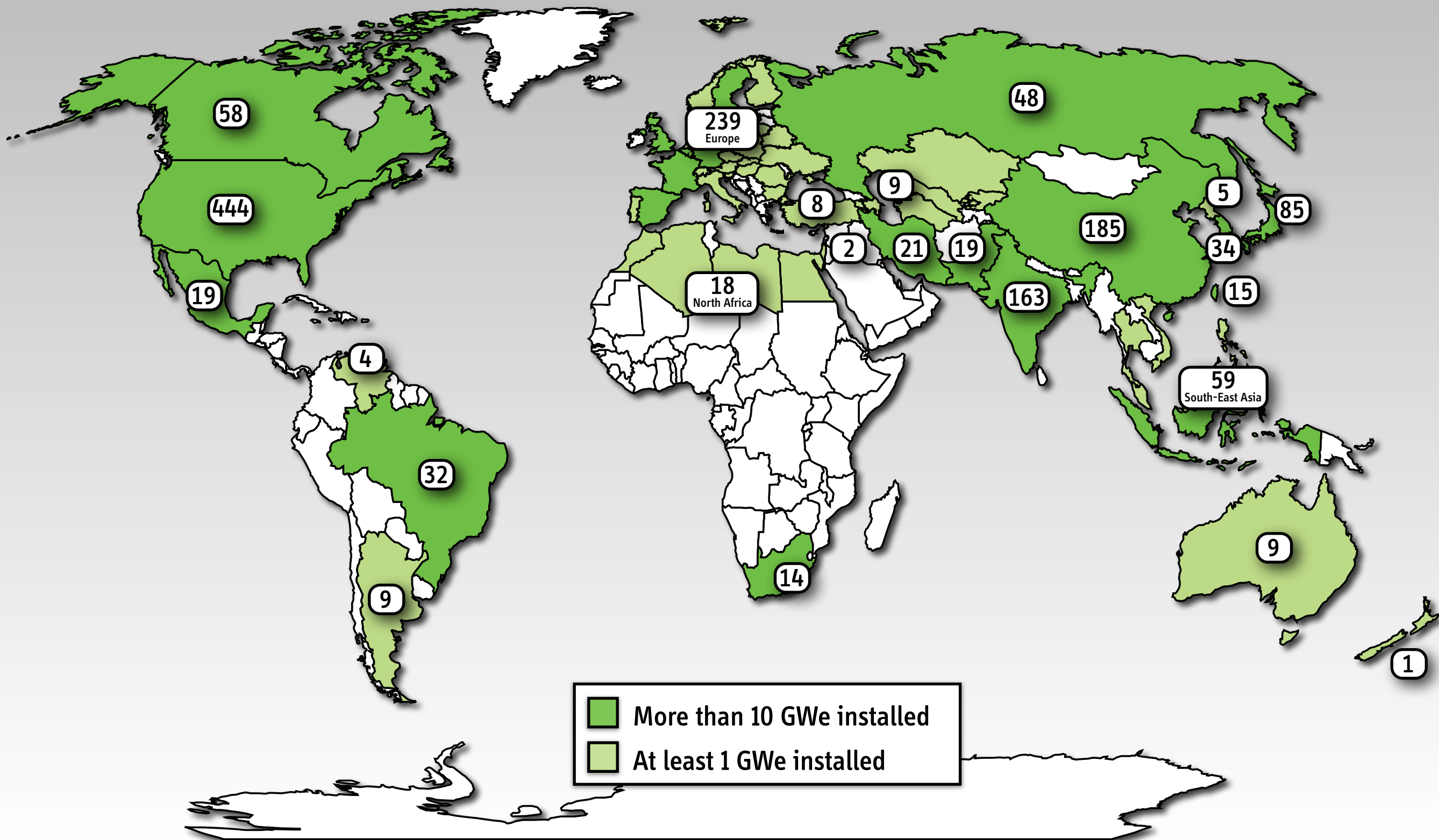
(438 reactors in 30 countries)



Last update: 4 April 2010

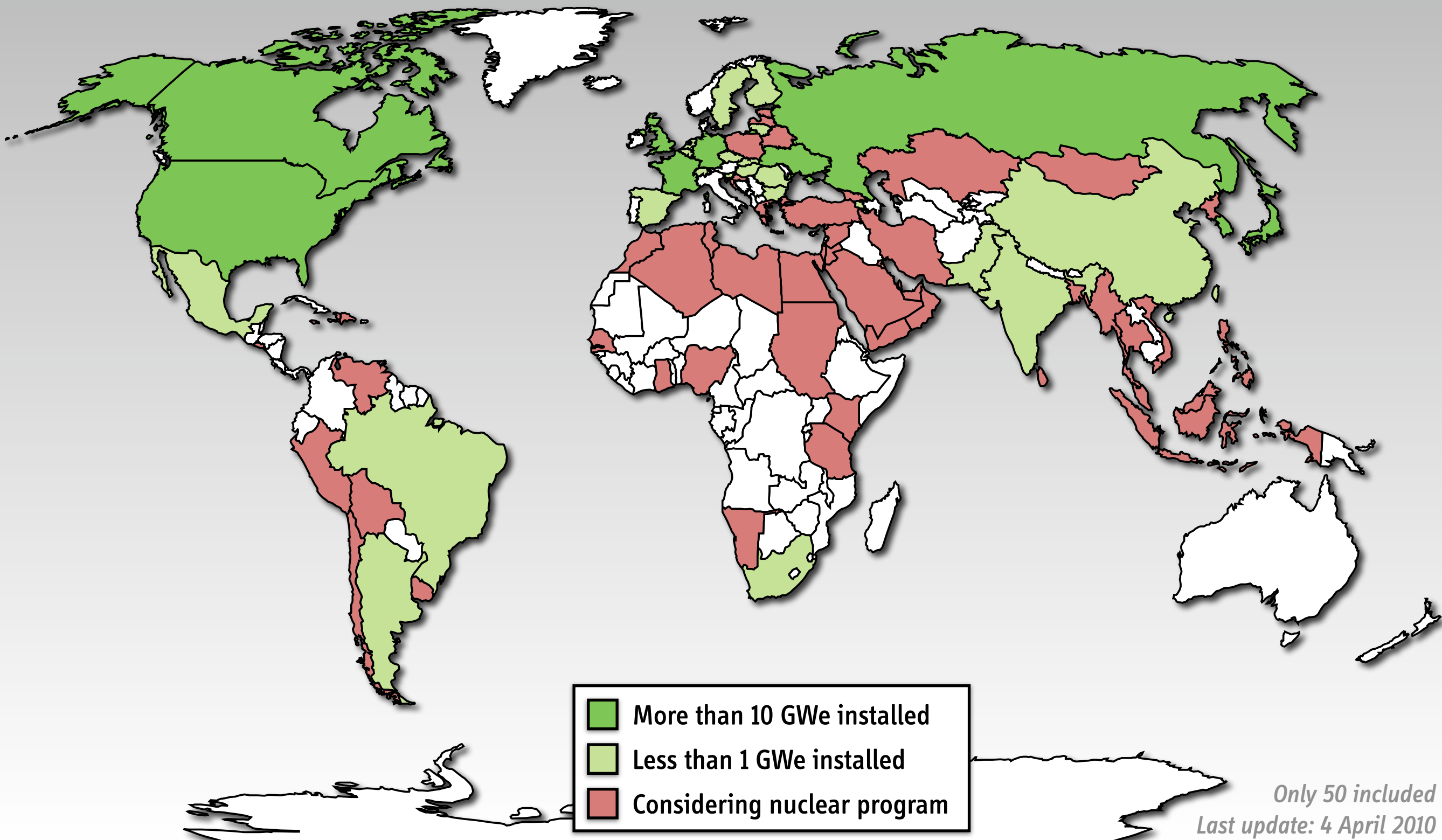
Global Nuclear Expansion Scenario

(1500 GWe in 58 countries, based on 2003 MIT study)



Nuclear “Newcomer” Countries

According to the IAEA, 60+ countries are currently considering nuclear programs



The Decade Ahead

**Little new capacity will be added in the United States
and (even less so) in Western Europe**

Little (if any) capacity will come online in “newcomer” countries

**By the end of the decade, we will understand better the
economics and some other constraints for both nuclear and its competitors**

We may take options off the table at that point

**In particular, nuclear power may have to be taken off the table
if “global deployment scenario” remains unacceptable**

*What Should Be Done
In the Meantime?*

Refrain From Reprocessing

Pros and Cons of Reprocessing

Theoretically, large reduction in uranium demand when combined with deployment of fast breeder reactors

Access to directly weapon-usable material

Reprocessing facilities are difficult and expensive to safeguard

Environmental concerns (liquid and gaseous emissions)

Reprocessing is expensive

Reprocessing is Expensive

and will remain so for the next decades



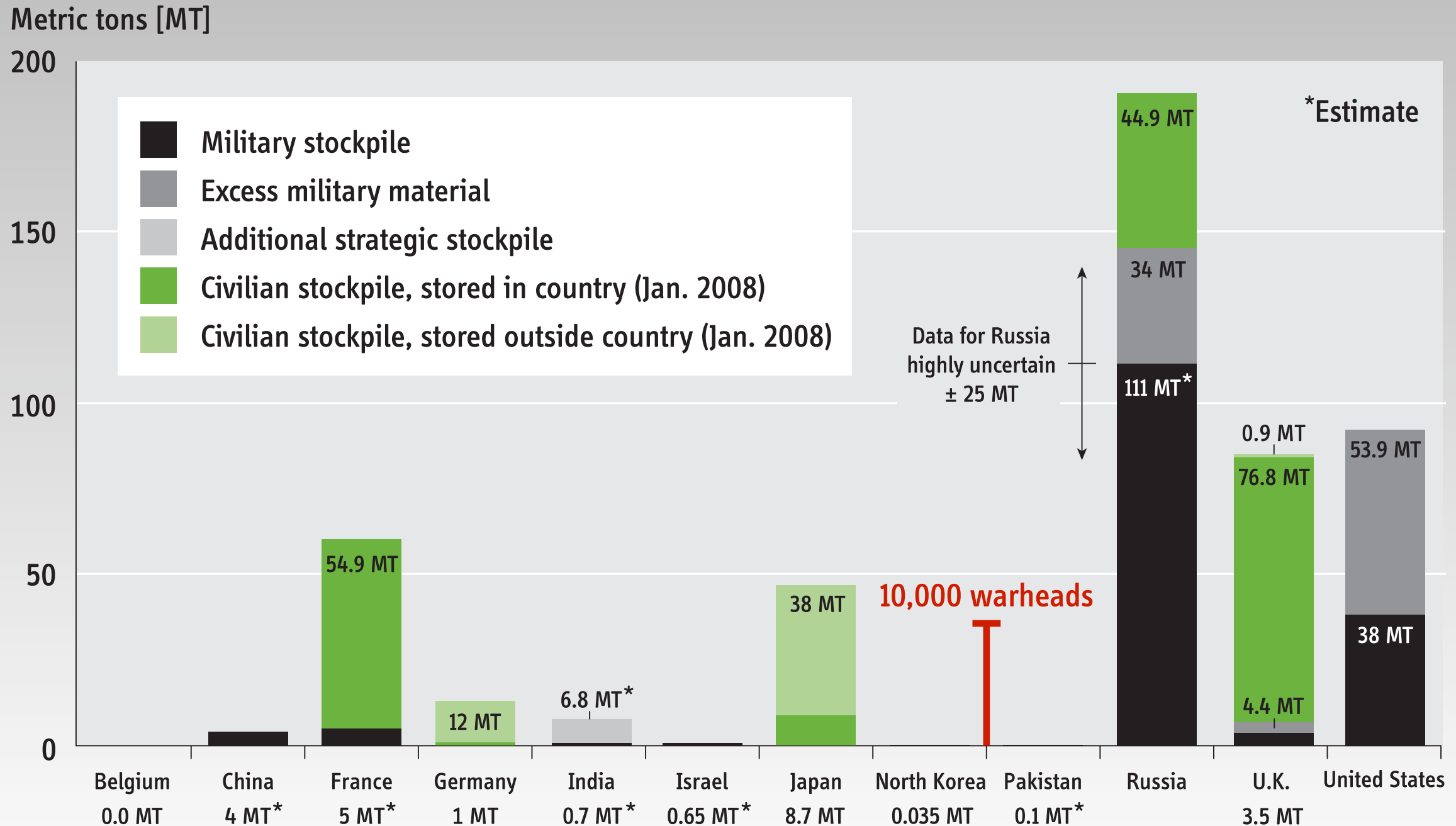
La Hague Reprocessing Plant, July 2005
Source: Wikipedia

Plutonium fuel is about 3x more expensive than standard uranium fuel today
(more than \$10,000/kg of MOX fuel compared to about \$3,500/kg of low-enriched uranium fuel)

Uranium price would have to increase 4-5 fold to make reprocessing and plutonium-use competitive

Stockpiles of Separated Plutonium, 2009

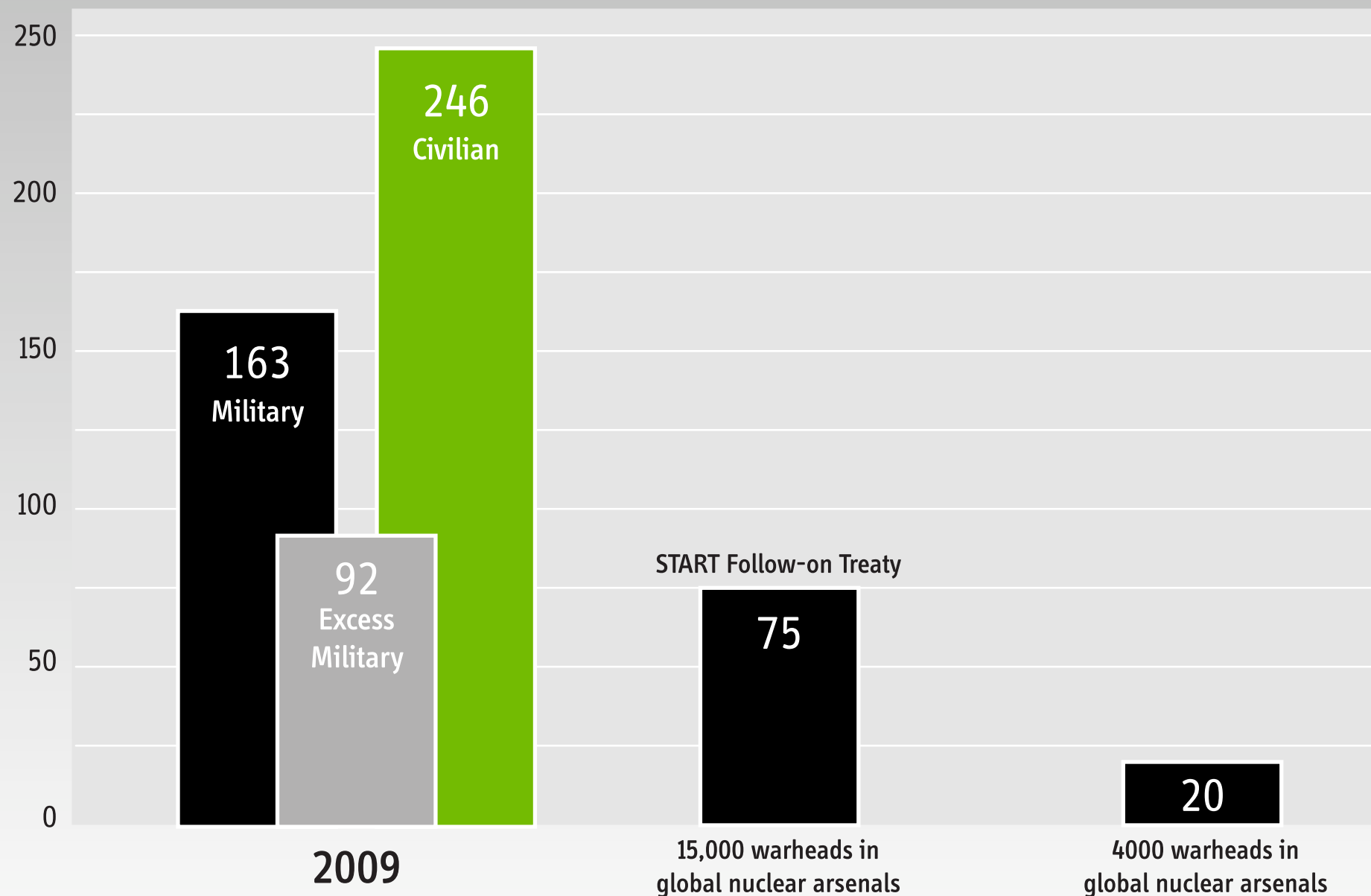
Global stockpile is 500 tons, half is civilian and this stock is growing



Global Fissile Material Report 2009, International Panel on Fissile Materials, Princeton, NJ, 2009, www.ipfmlibrary.org/gfmr09.pdf

Civilian Separated Plutonium in a Disarming World

Metric tons separated plutonium



R. Socolow and A. Glaser, "Balancing Risks: Nuclear Energy and Climate Change," *Daedalus*, 2009

Dry Cask Storage of Spent Fuel

is a simple and proven strategy for the next decades



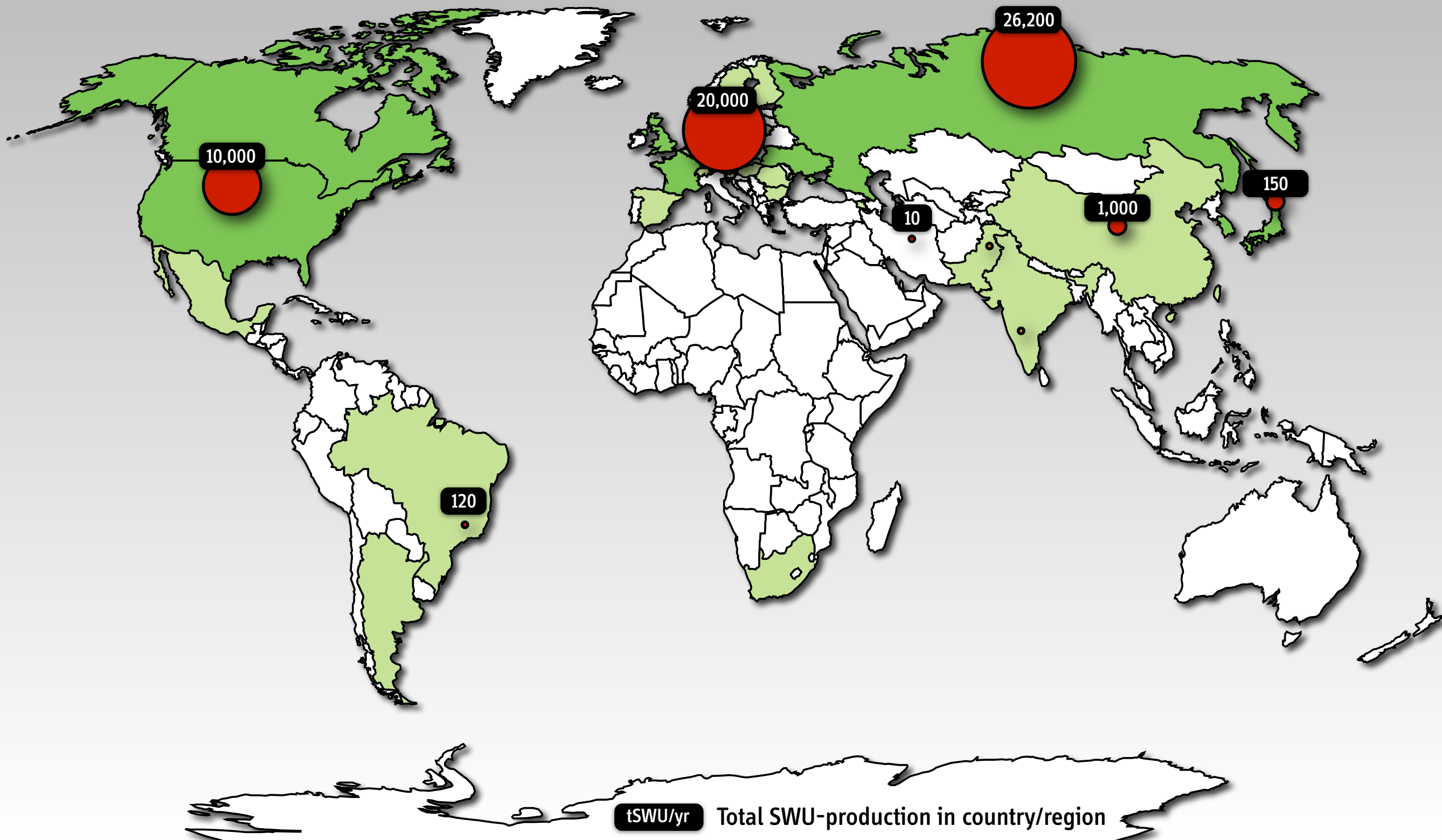
Source: Department of Energy

See for example: www.nrc.gov/reading-rm/doc-collections/fact-sheets/dry-cask-storage.pdf

Build a New Framework for the Nuclear Fuel Cycle

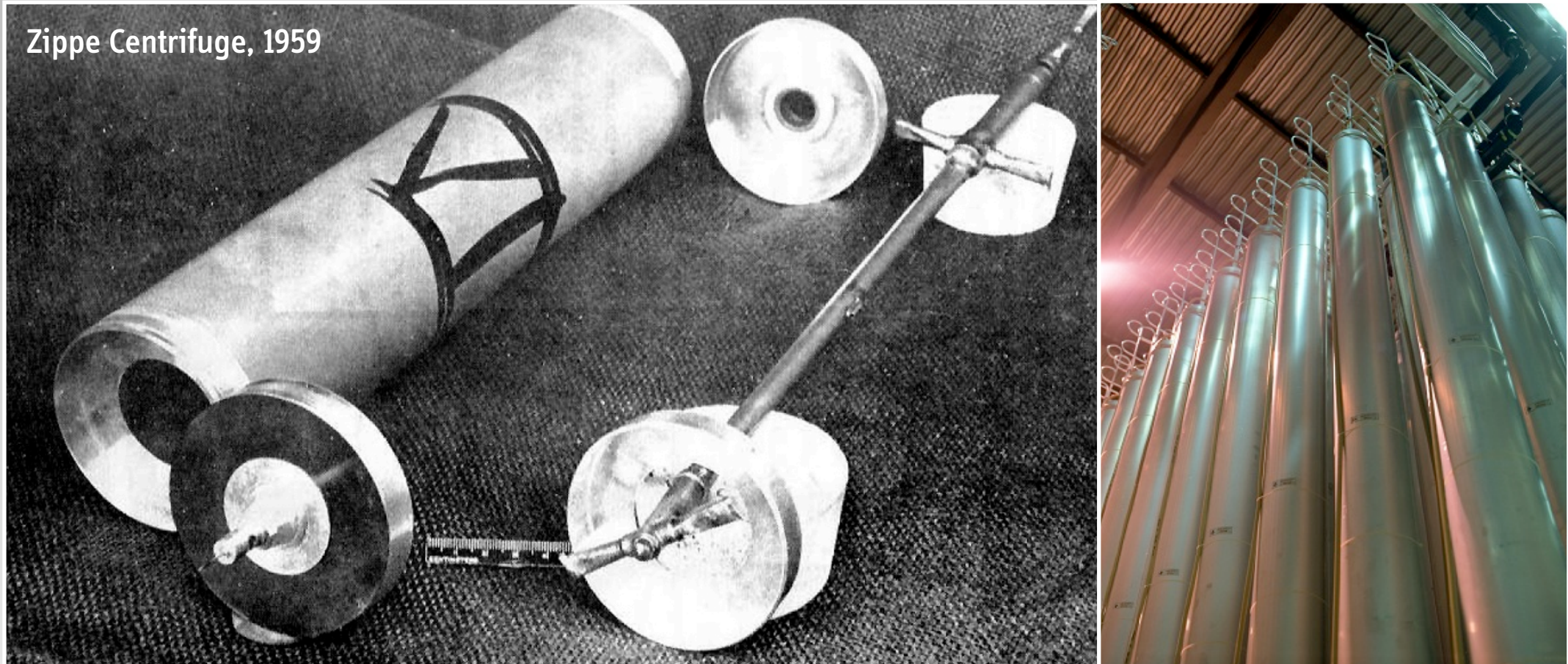
Global Enrichment Capacities, 2010

(14 operational plants in 10 countries, not including two military plants)



Why Centrifuges Are Different

Zippe Centrifuge, 1959



Characteristics of centrifuge technology relevant to nuclear proliferation

Rapid Breakout and Clandestine Option

Iran's Second Enrichment Site, near Qom

(Fordow Plant, revealed in September 2009 at 34.885 N, 50.996 E)

Image © 2010 GeoEye
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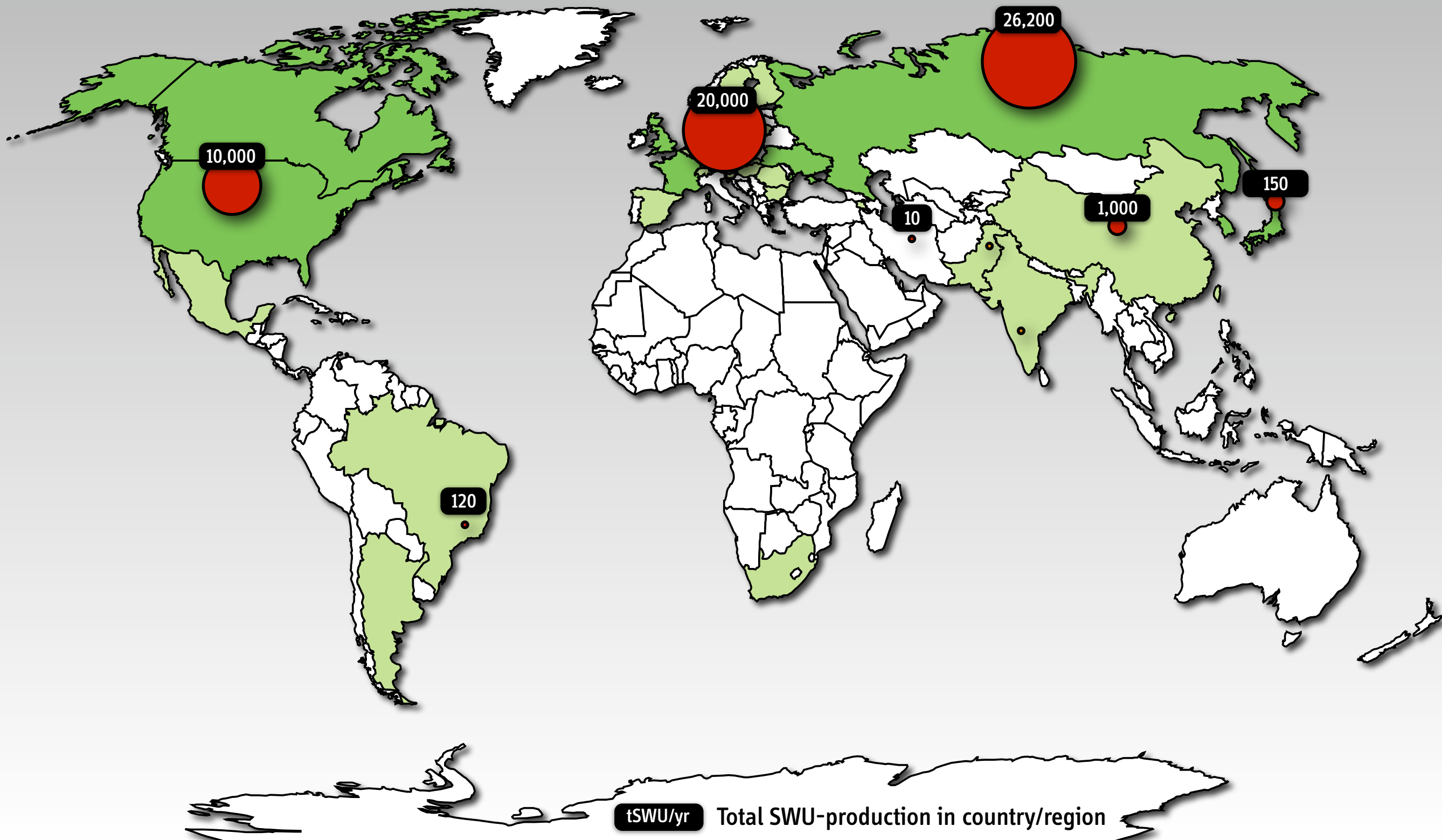
Imagery Date: Oct 4, 2009

34°53'14.10" N 50°59'44.96" E elev 889 m

Eye alt 2.77 km

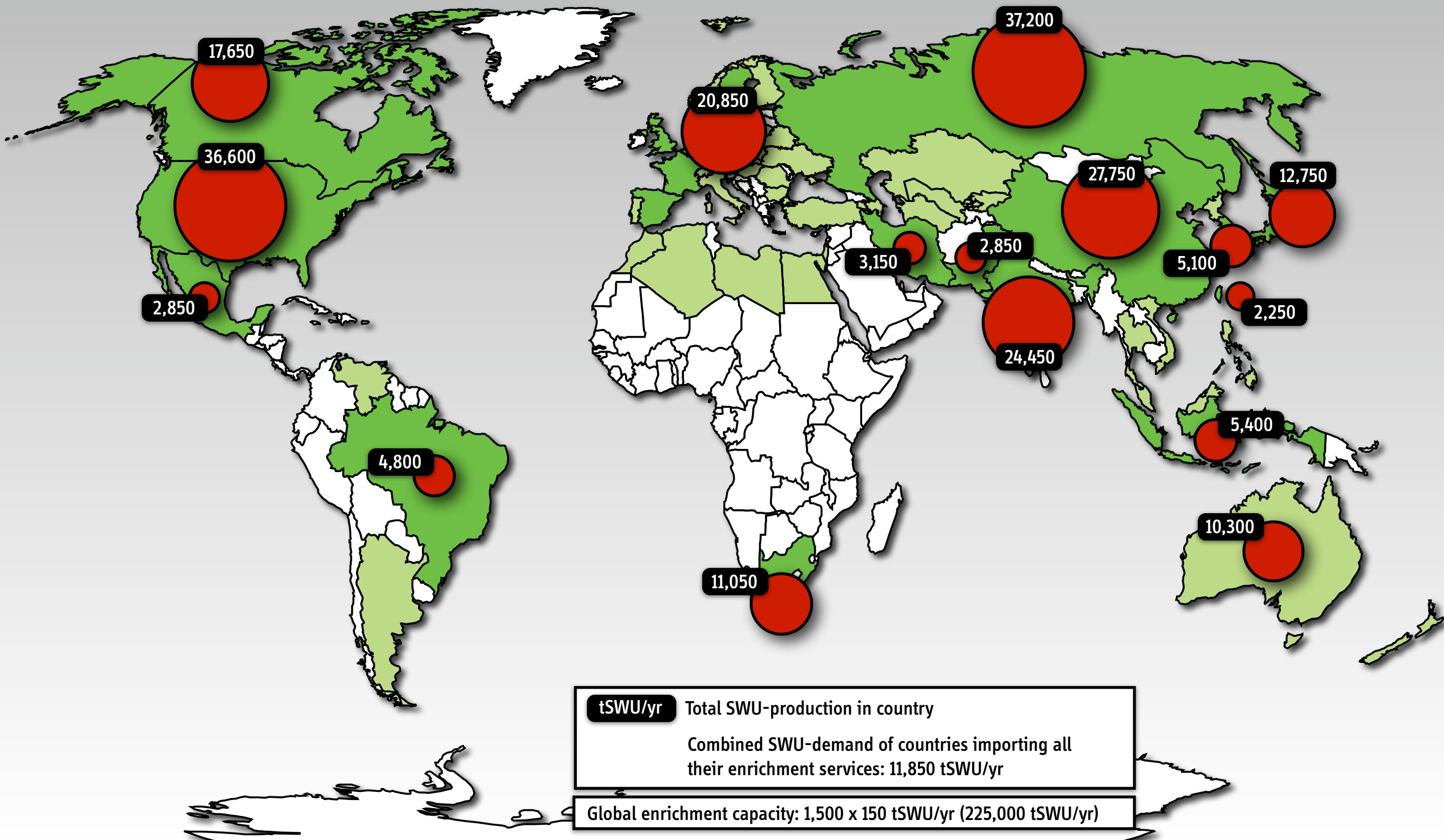
Global Enrichment Capacities, 2010

(14 operational plants in 10 countries, not including two military plants)



Enrichment Demand and Distribution

(for 1500 GWe Global Nuclear Expansion Scenario based on light-water reactors)



Remarks of U.S. President Obama

Hradcany Square, Prague, Czech Republic, April 5, 2009

“We should build a new framework for civil nuclear cooperation, including an international fuel bank, so that countries can access peaceful power without increasing the risks of proliferation. That must be the right of every nation that renounces nuclear weapons, especially developing countries embarking on peaceful programs. No approach will succeed if it is based on the denial of rights to nations that play by the rules.”

Multilateral Approaches to the Nuclear Fuel Cycle

involving Joint Ownership of Enrichment Plants

Nonproliferation Objectives

Prevent the further spread of sensitive nuclear technologies
Assure the peaceful use where they remain

Multinational Plants Can Help Achieve These Objectives

Regional plants as a confidence-building measure
Reduce the number of plants worldwide
Implementation of modern and effective international safeguards
Over time, ease concerns about clandestine enrichment programs
once a strong norm against national research and development
of sensitive nuclear technologies emerges



The United States ought to:

- seriously explore the possibility of multilateral approaches for its own (new) enrichment plants; and
- facilitate IAEA safeguards in these plants, also to help establish state-of-the-art safeguards approaches

Concluding Remarks

**Nuclear power could make a significant contribution
to climate-change mitigation**

but the world is not now safe for a rapid and global expansion of nuclear power

The next decade will be critical

**Not much new nuclear capacity will be added in the United States and Europe
Time to establish economics, adequate technologies, and new norms of governance**

U.S. leadership would make a decisive difference

**The once-through fuel cycle must become the norm again
To move forward, multilateral approaches need support of major nuclear suppliers**