The Threat from Weapon-grade Highly Enriched Uranium

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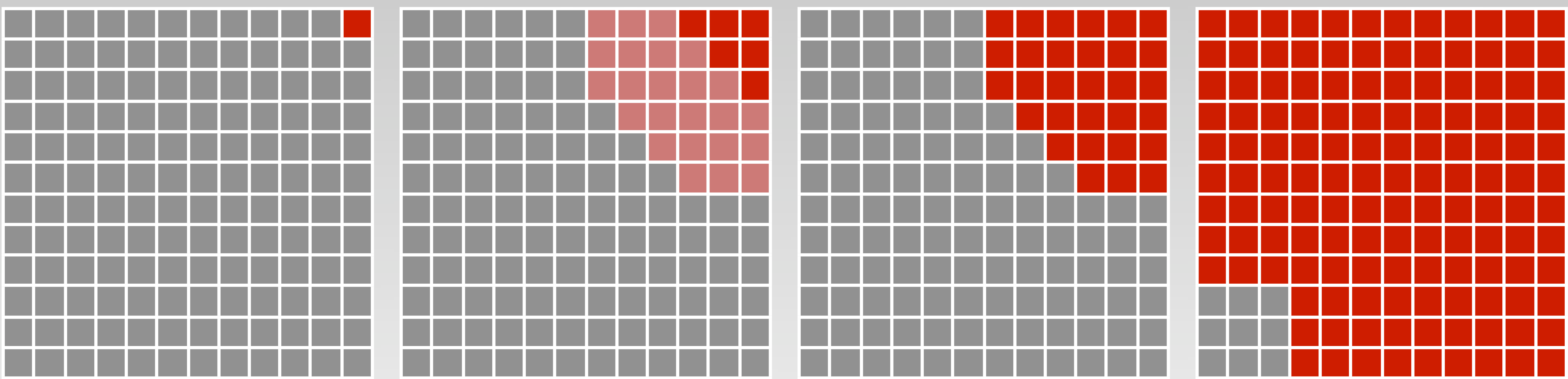
Revision 3

What is HEU ?

Highly Enriched Uranium

(visually)

HEU
(weapon-usable)



Natural uranium
0.7% U-235

Low-enriched uranium
typically 3-5%,
but less than 20% U-235

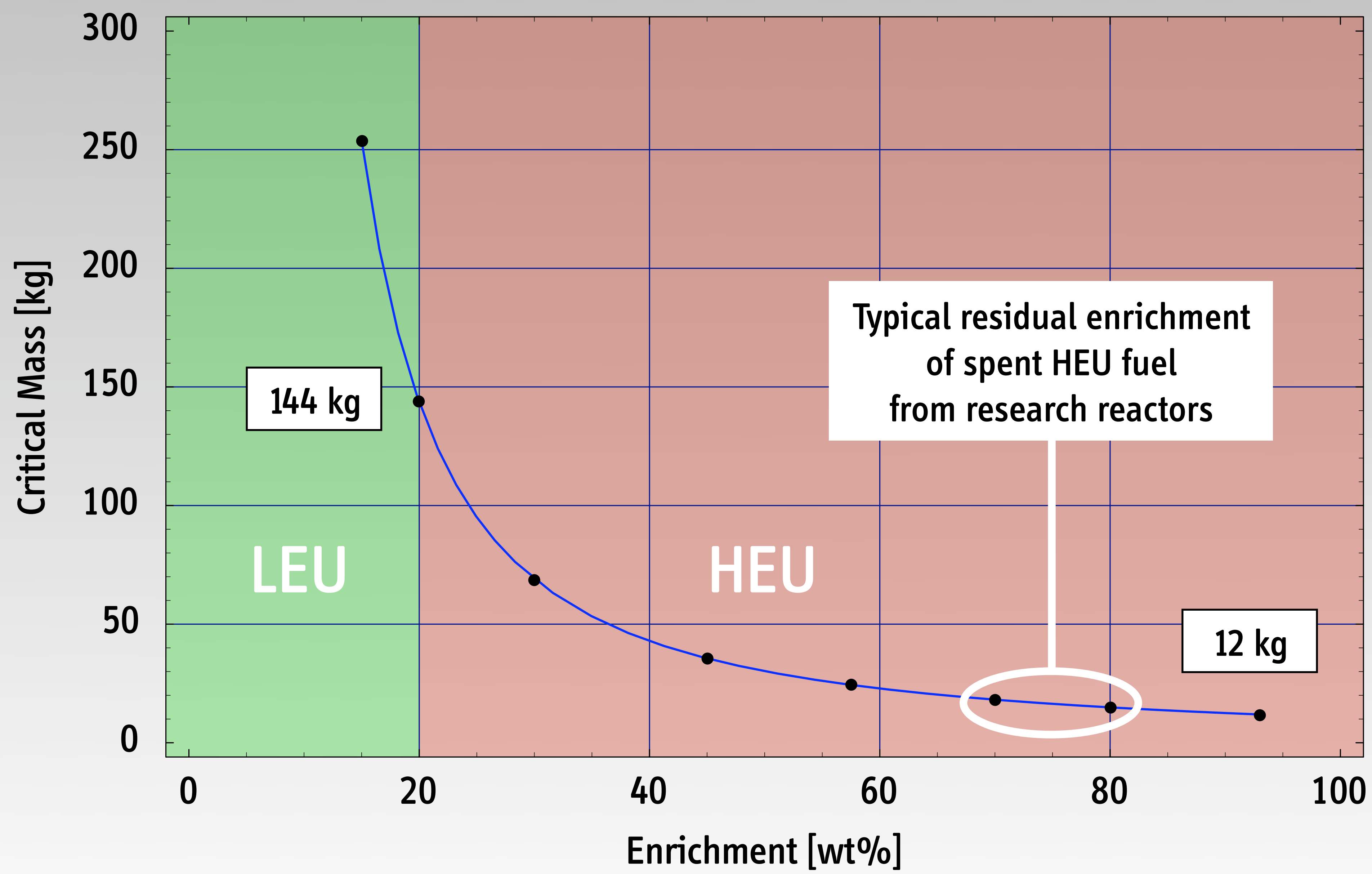
Highly enriched uranium
20% U-235 and above

Weapon-grade uranium
more than 90% U-235

Uranium
- U-235
- U-238

Critical Mass of Uranium

(for a beryllium-reflected metallic sphere)

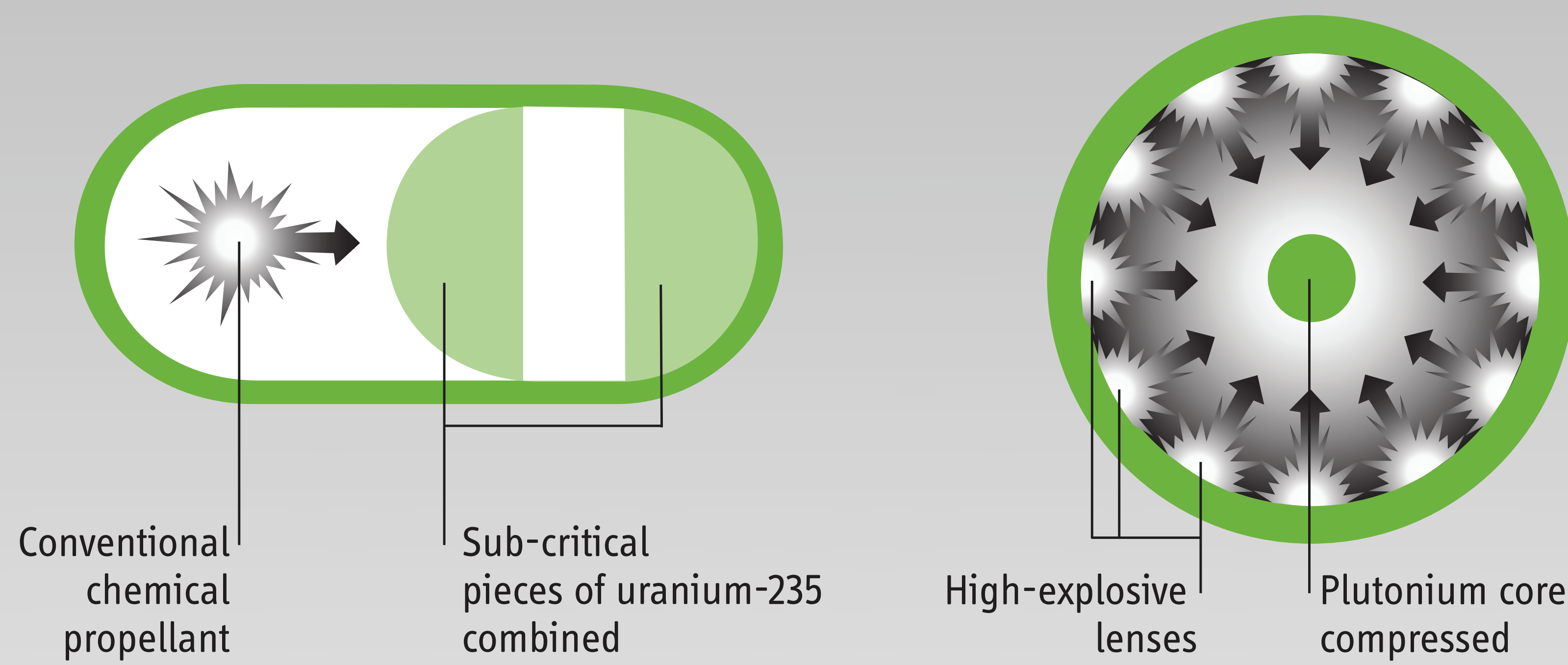


Characteristics of Highly Enriched Uranium

Easy to handle

Easy to use in nuclear weapon or nuclear explosive device

Difficult/Impossible to detect



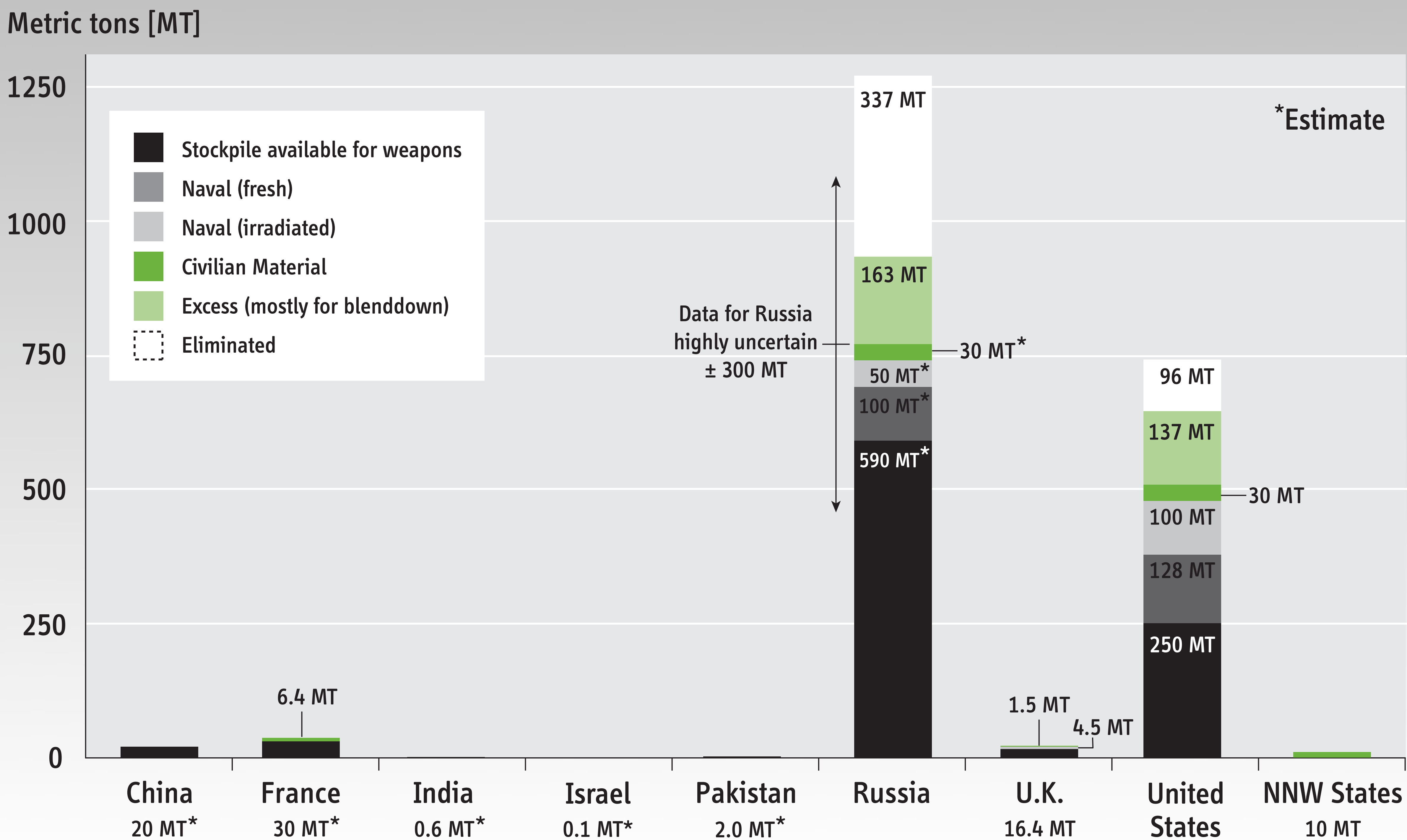
Difficult to produce

Highly Enriched Uranium Stockpiles

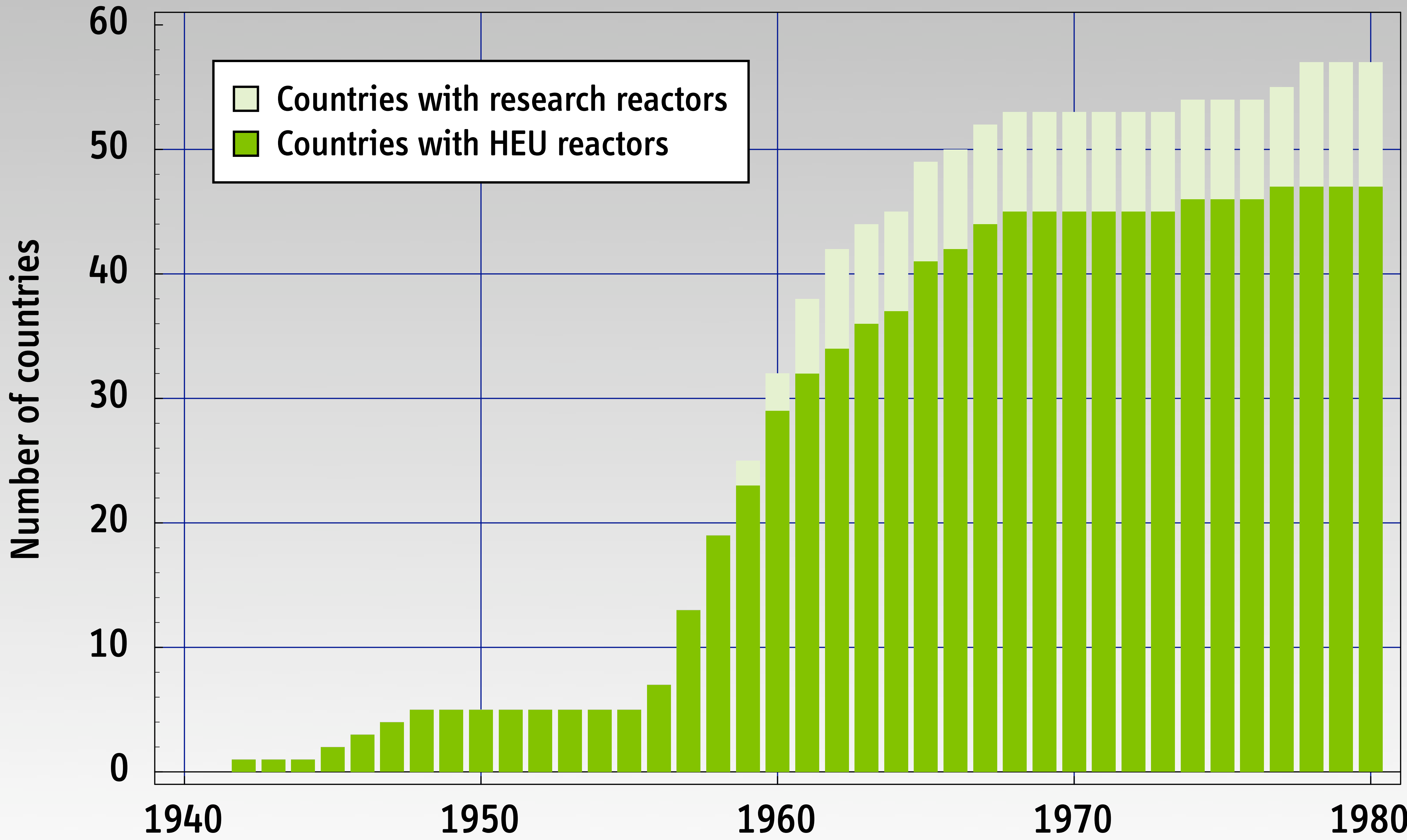
(and the Use of HEU in Research Reactors)

HEU Stockpiles, 2008

IPFM Global Fissile Material Report 2008, www.ipfmlibrary.org/gfmr08.pdf

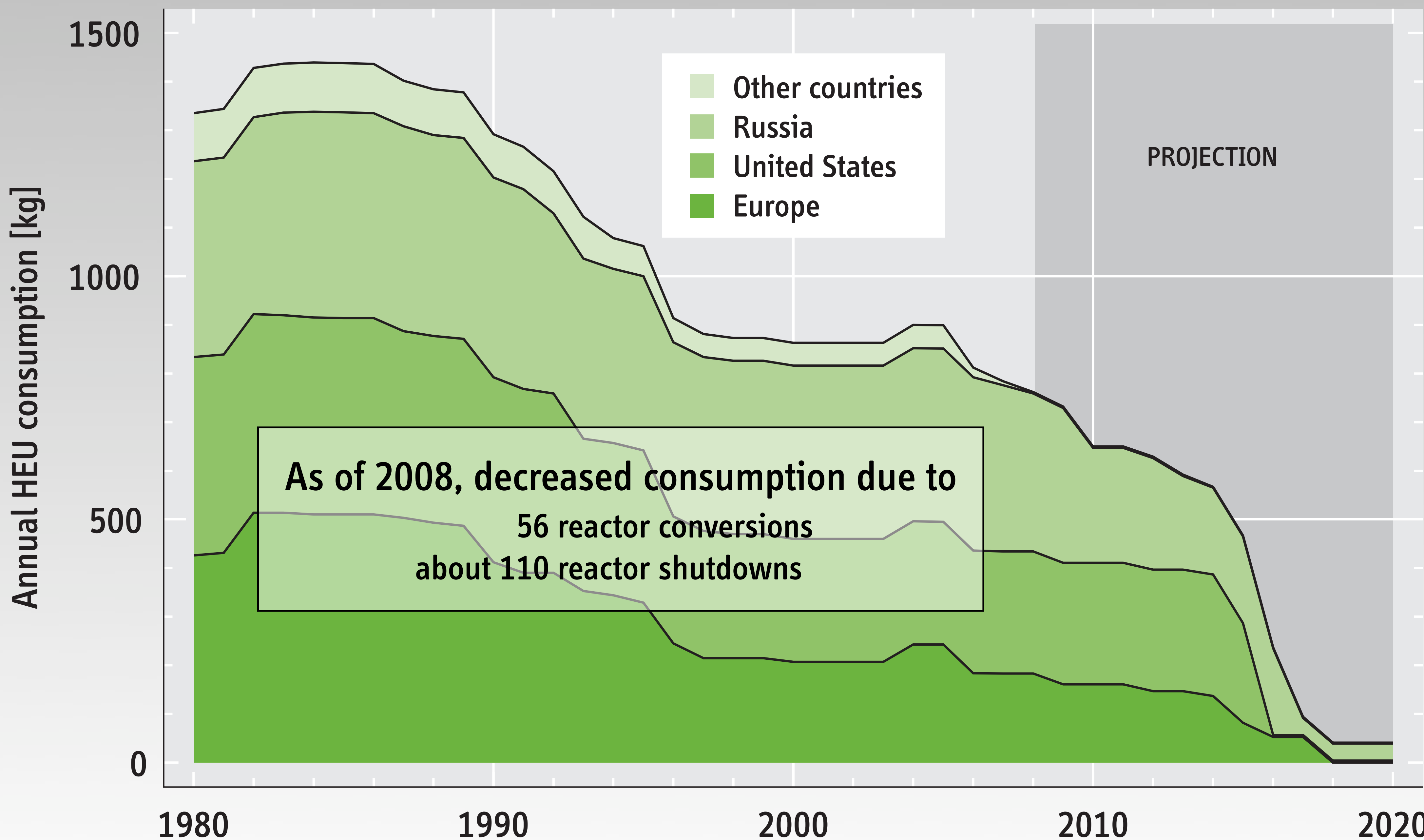


Countries with Research Reactors



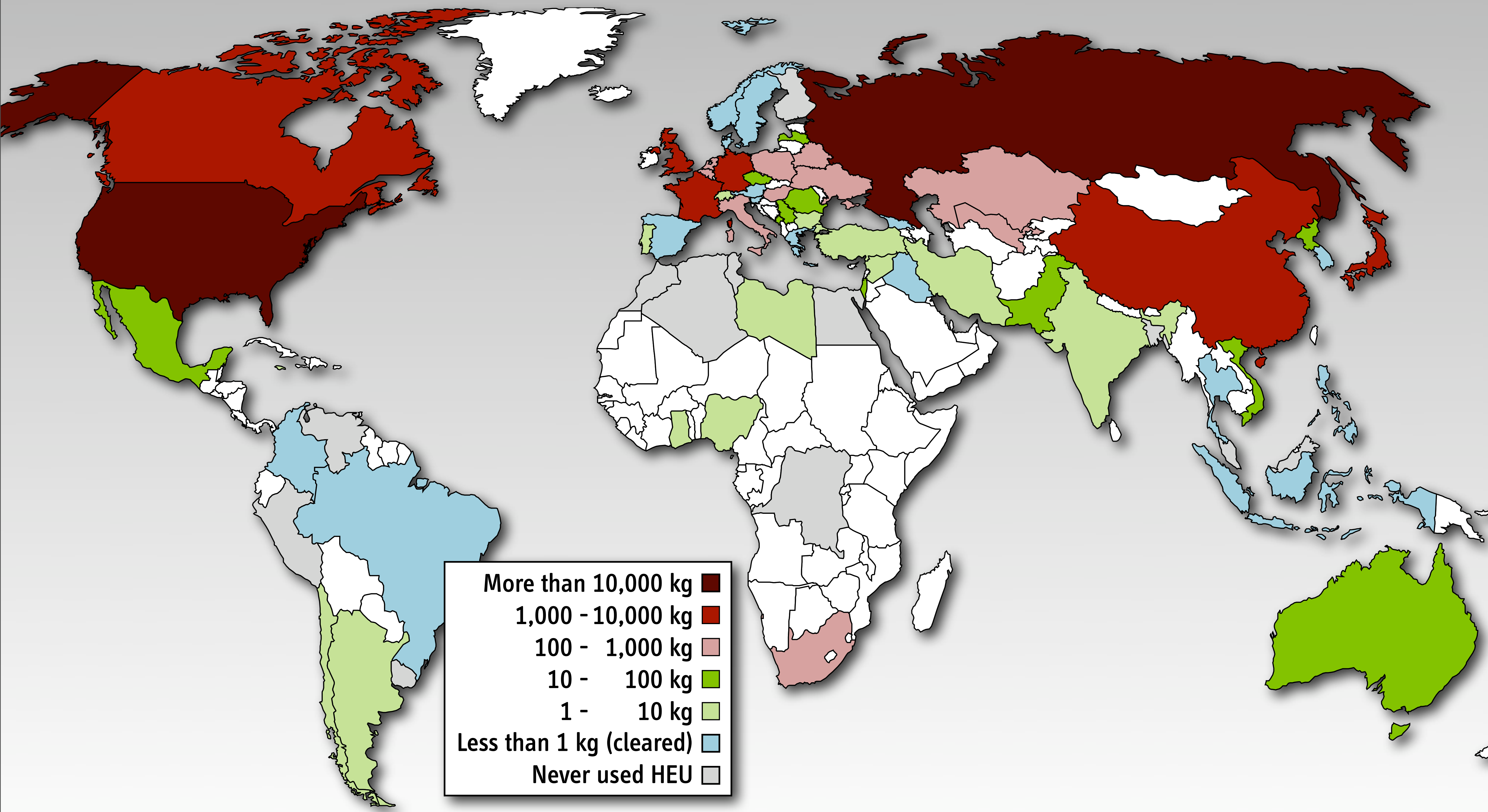
Annual HEU Consumption

(in the civilian nuclear fuel cycle since 1980)



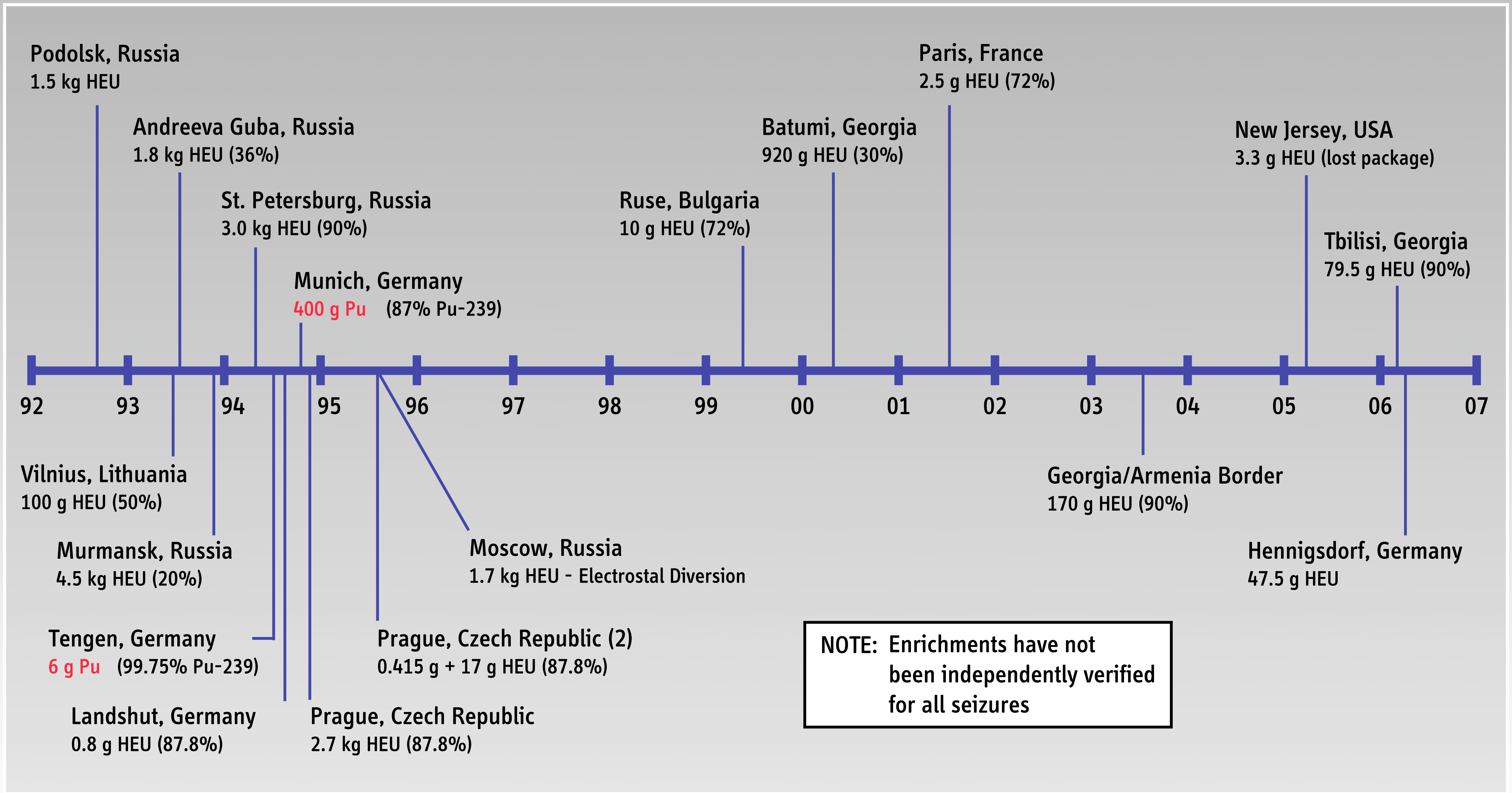
Source: O. Reistad and S. Hustveit, *The Nonproliferation Review*, Vol. 15, No. 2, July 2008

Civilian HEU Inventory, 2008



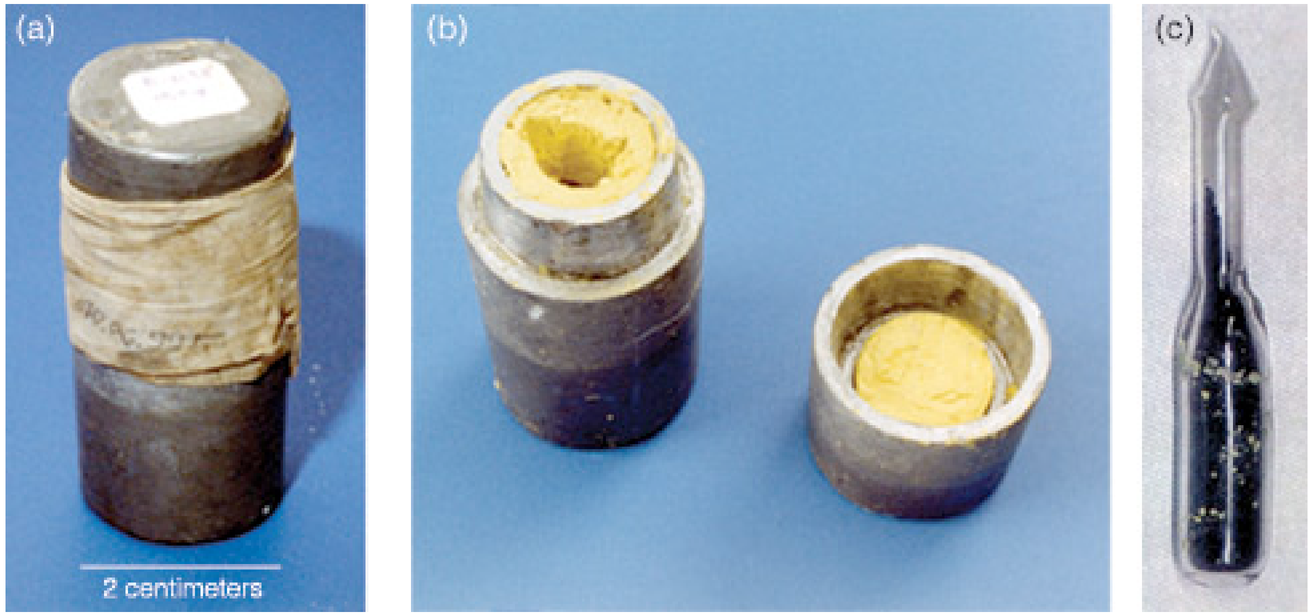
Revision: October 2008

Confirmed Seizures and Incidents Involving Weapon-usable Nuclear Materials



Source: Chart adapted from DHS briefing (Nuclear Smuggling); Data from IAEA International Trafficking Database (ITDB)

1999 Bulgarian HEU



Intercepted at Turkish-Bulgarian border in May 1999

- 10 grams of HEU (72% U-235)
- High U-236 content (13%)

Findings of 9-month forensic analysis:

- Reprocessed uranium from high-burnup fuel
- Original U-235 content: 90%

"[This investigation] was the most thorough and far-reaching analysis of illicit nuclear material ever conducted."

"The attribution of the Bulgarian HEU [...] remains incomplete. Despite the comprehensive forensic investigation and wealth of data, neither the original source of the HEU nor the point at which legitimate control was lost has yet been unambiguously identified."

Moody, Hutcheon, and Grant, 2005, p. 402 and p. 418

Security at University Reactors

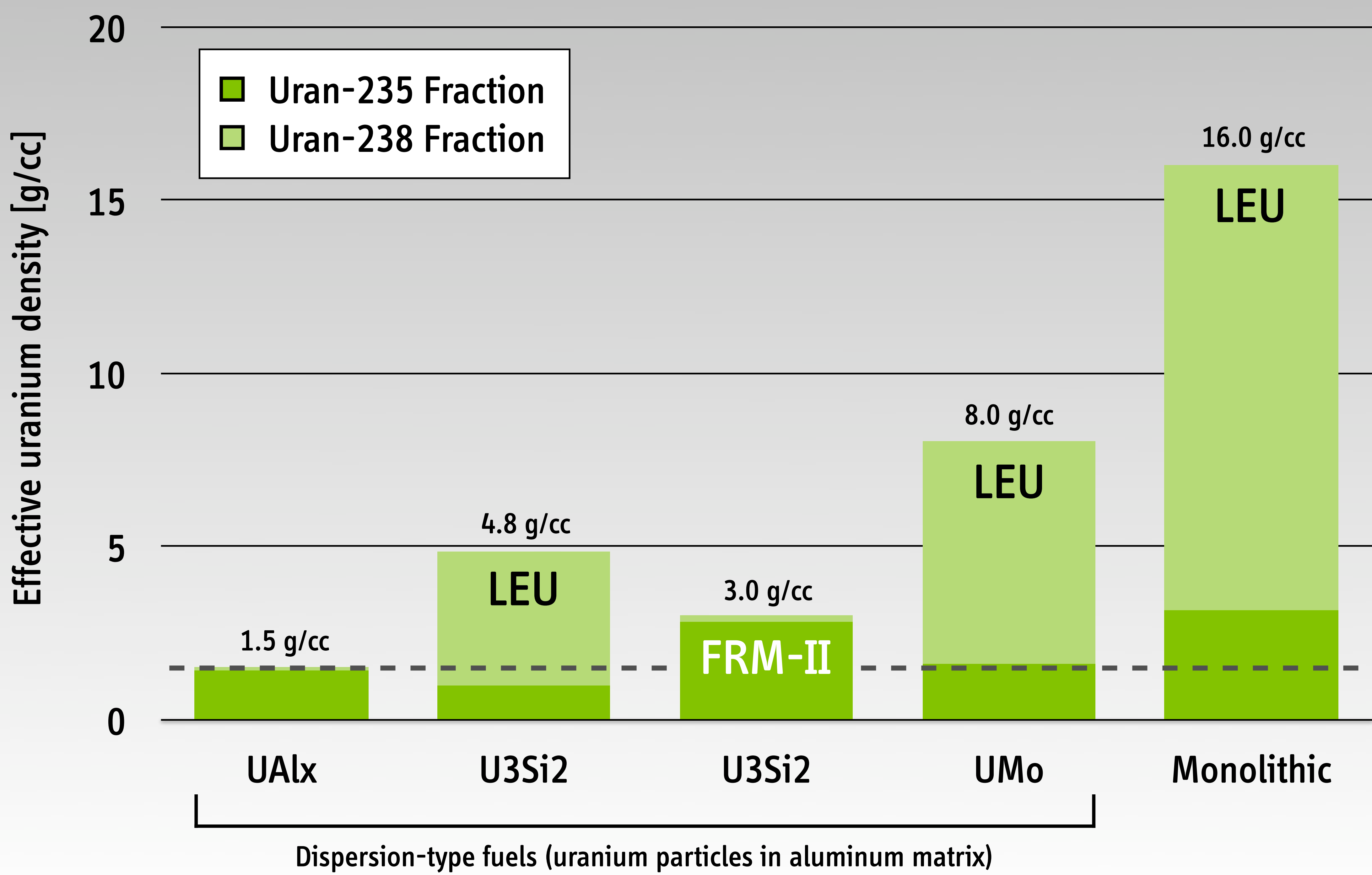
(from a 2005 ABC News Investigation)

"A four-month ABC News investigation found gaping security holes at many of the little-known nuclear research reactors operating on 25 college campuses across the country. Among the findings: unmanned guard booths, a guard who appeared to be asleep, unlocked building doors and, in a number of cases, guided tours that provided easy access to control rooms and reactor pools that hold radioactive fuel."

www.abcnews.go.com/Primetime/LooseNukes/Story?id=1206529

Conversion of Research Reactors to Low-Enriched Fuel (LEU)

Effective Uranium Density in Advanced Research-Reactor Fuels



What Do We Have to Lose From Giving Up the Use of HEU?

Some research reactors have experienced a small reduction (10-15%) in neutron flux as a result of conversion to LEU

(but some have also increased performance with advanced fuel-types or core-reconfiguration)

"Convert and Upgrade" strategies for High-flux reactors