

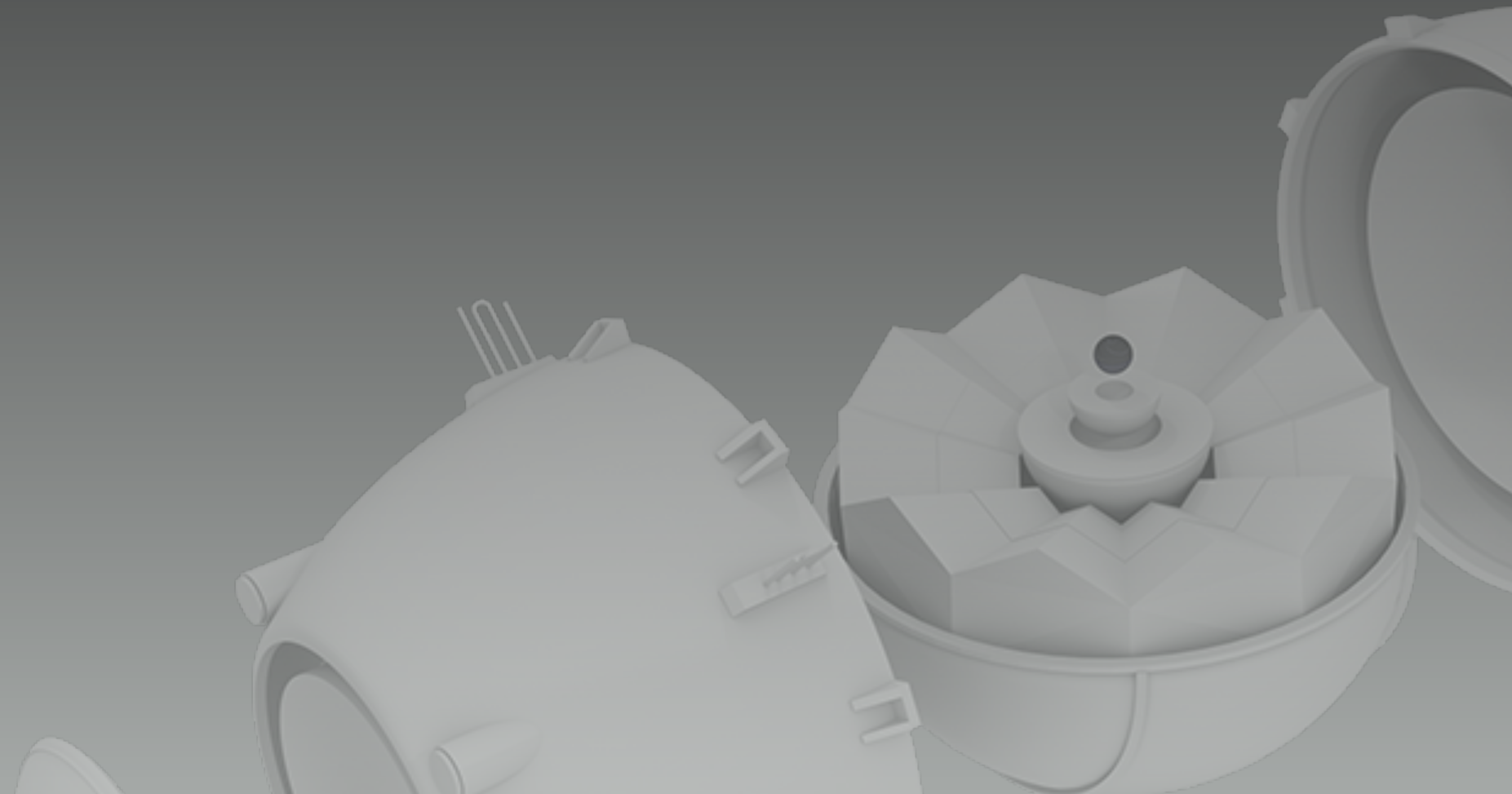
GLOBAL FISSILE MATERIAL REPORT 2015

NUCLEAR WEAPON AND FISSILE MATERIAL STOCKPILES AND PRODUCTION

Zia Mian
Alexander Glaser

IPFM Meeting
Washington, DC, March 15, 2016

NUCLEAR WEAPONS AND FISSILE MATERIALS



70 YEARS OF THE NUCLEAR AGE

HEU AND PLUTONIUM FIRST PRODUCED BY U.S. MANHATTAN PROJECT



Oak Ridge K-25 enrichment plant, 1945–2014

Source: *U.S. Department of Energy*

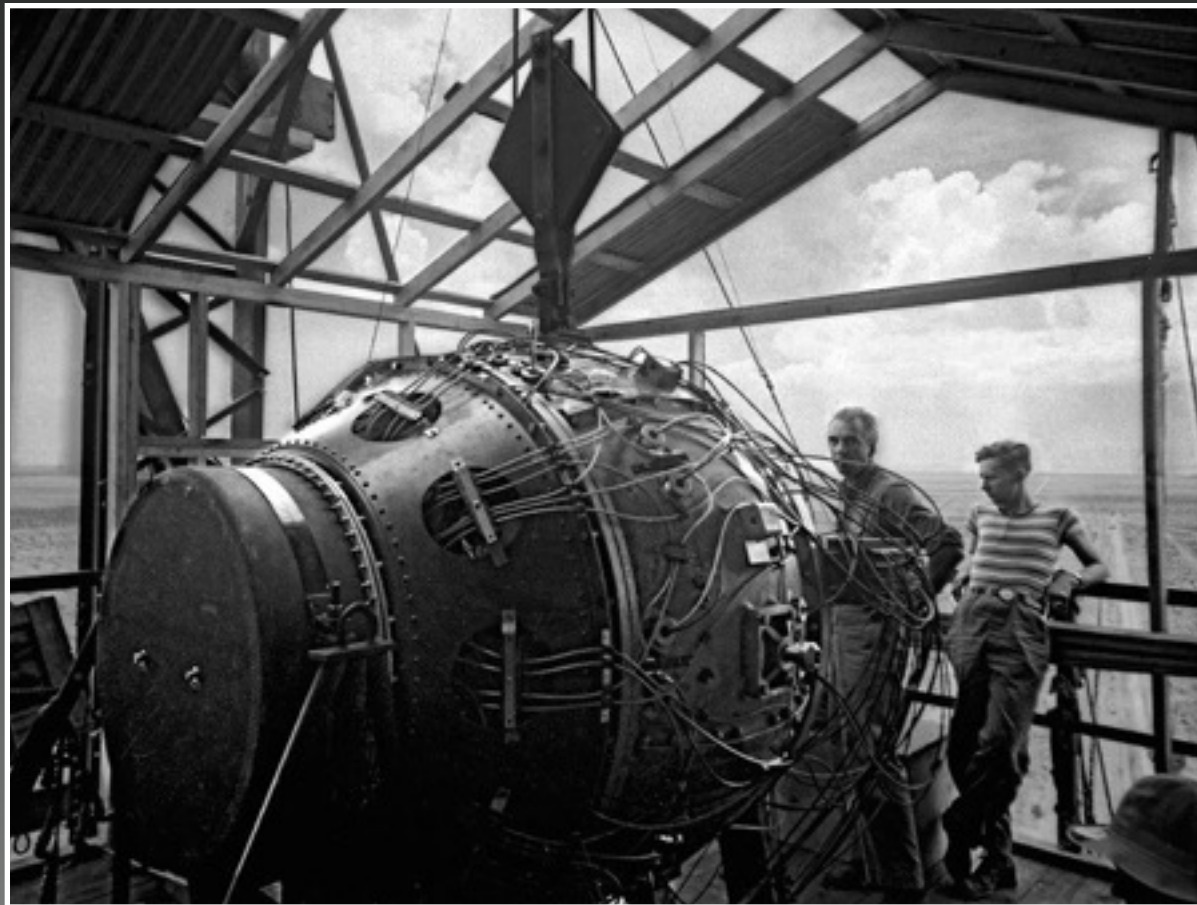


Hanford B plutonium production reactor, 1944–1968

Source: hanford.gov

70 YEARS OF THE NUCLEAR AGE

SMALLER, LIGHTER, MORE DESTRUCTIVE



First atomic bomb, July 1945

Source: Los Alamos National Laboratory and atomland-on-mars.com



U.S. W80-4 cruise missile warhead

Source: NNSA/Sandia National Laboratory

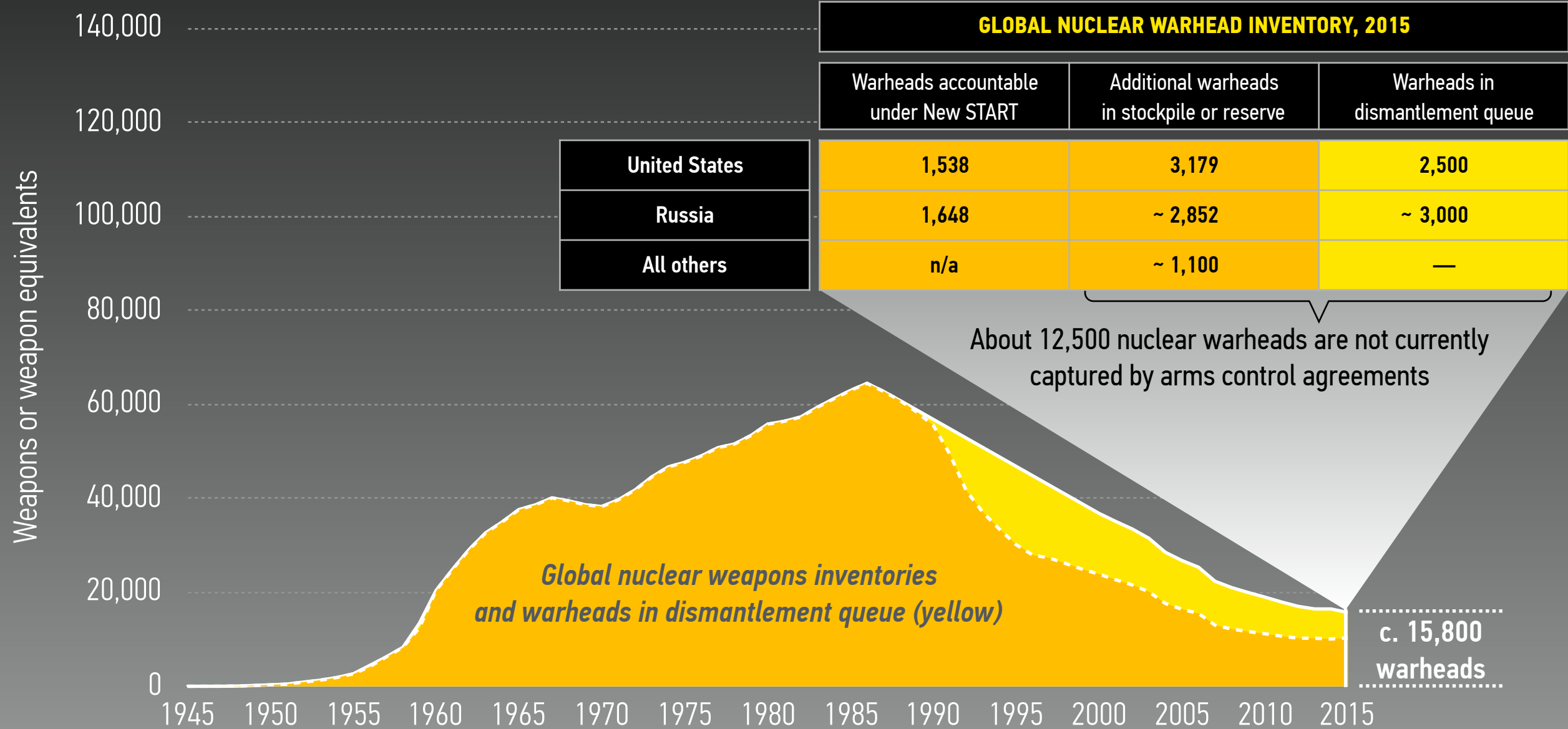
MEANWHILE IN NORTH KOREA



March 9, 2016
Source: KCNA/EPA

GLOBAL NUCLEAR WEAPON INVENTORY

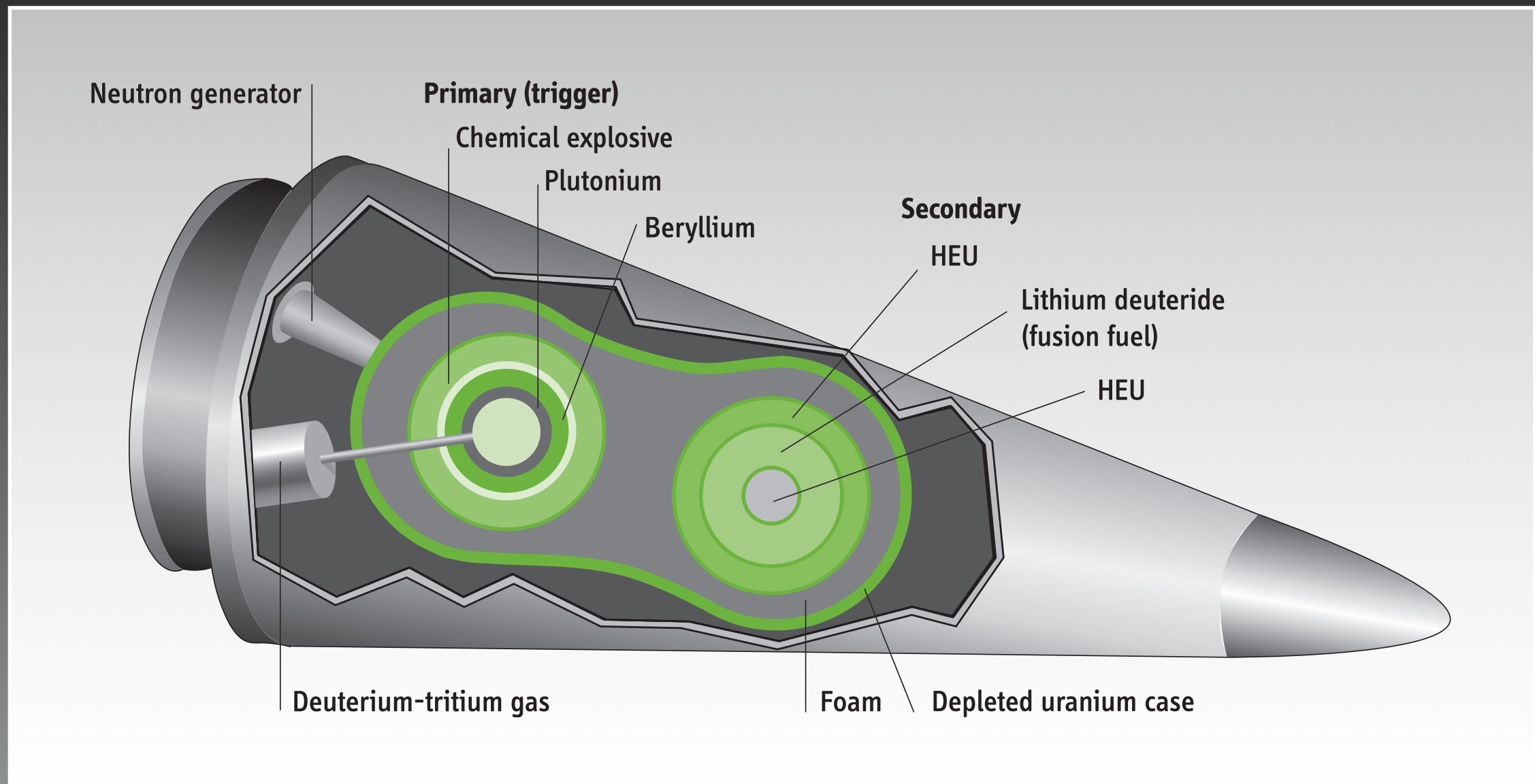
1945–2015



“Status of World Nuclear Forces,” *Federation of American Scientists*, fas.org, September 2015

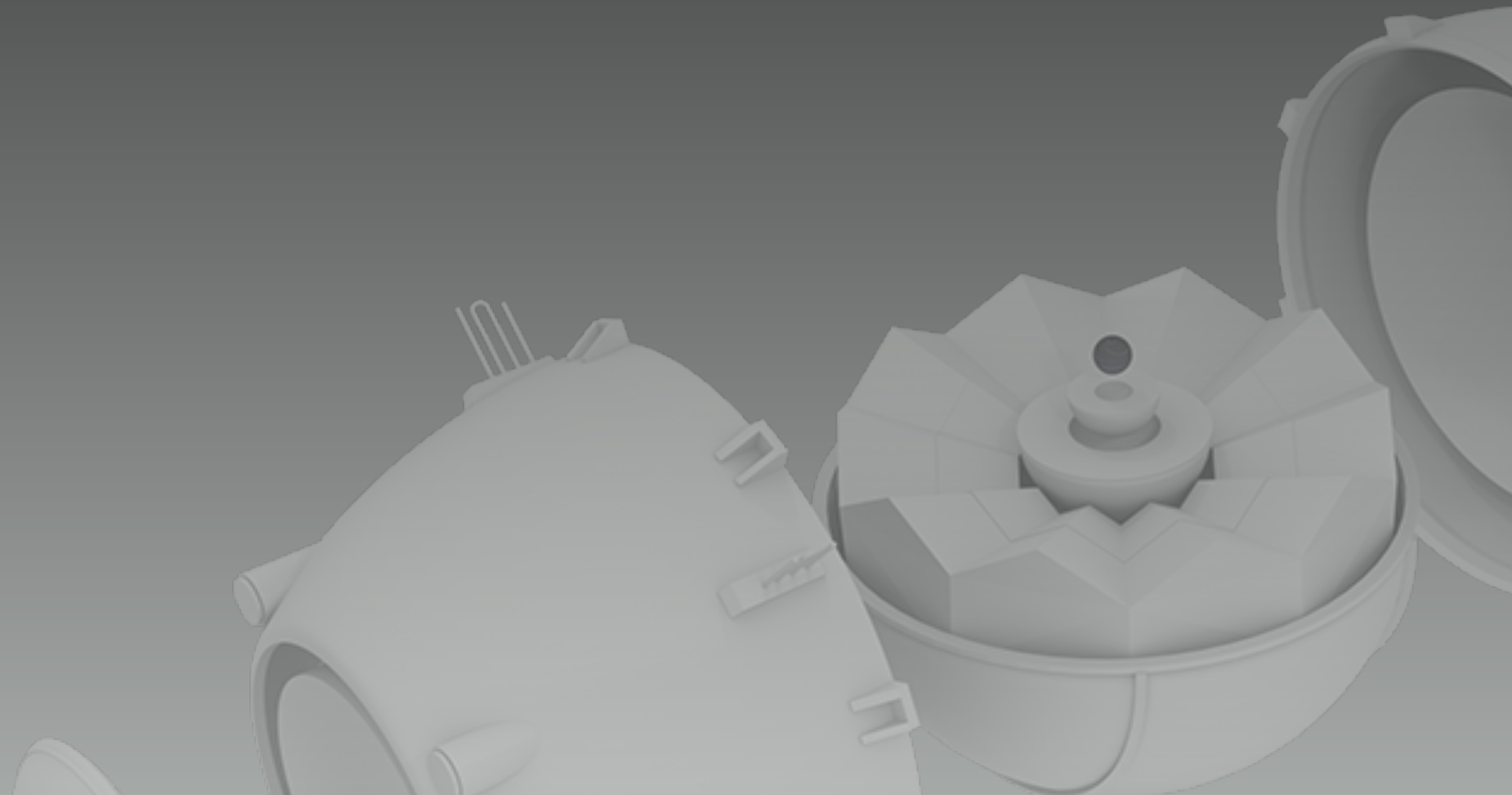
MODERN THERMONUCLEAR WARHEAD

TYPICALLY CONTAINS AN AVERAGE 3–4 KG OF PLUTONIUM
AND 15–25 KG HIGHLY ENRICHED URANIUM



Adapted from Final Report of the Select Committee on U.S. National Security and Military/Commercial Concerns
with the Peoples Republic of China ("Cox Report"), U.S. House of Representatives, 3 January 1999

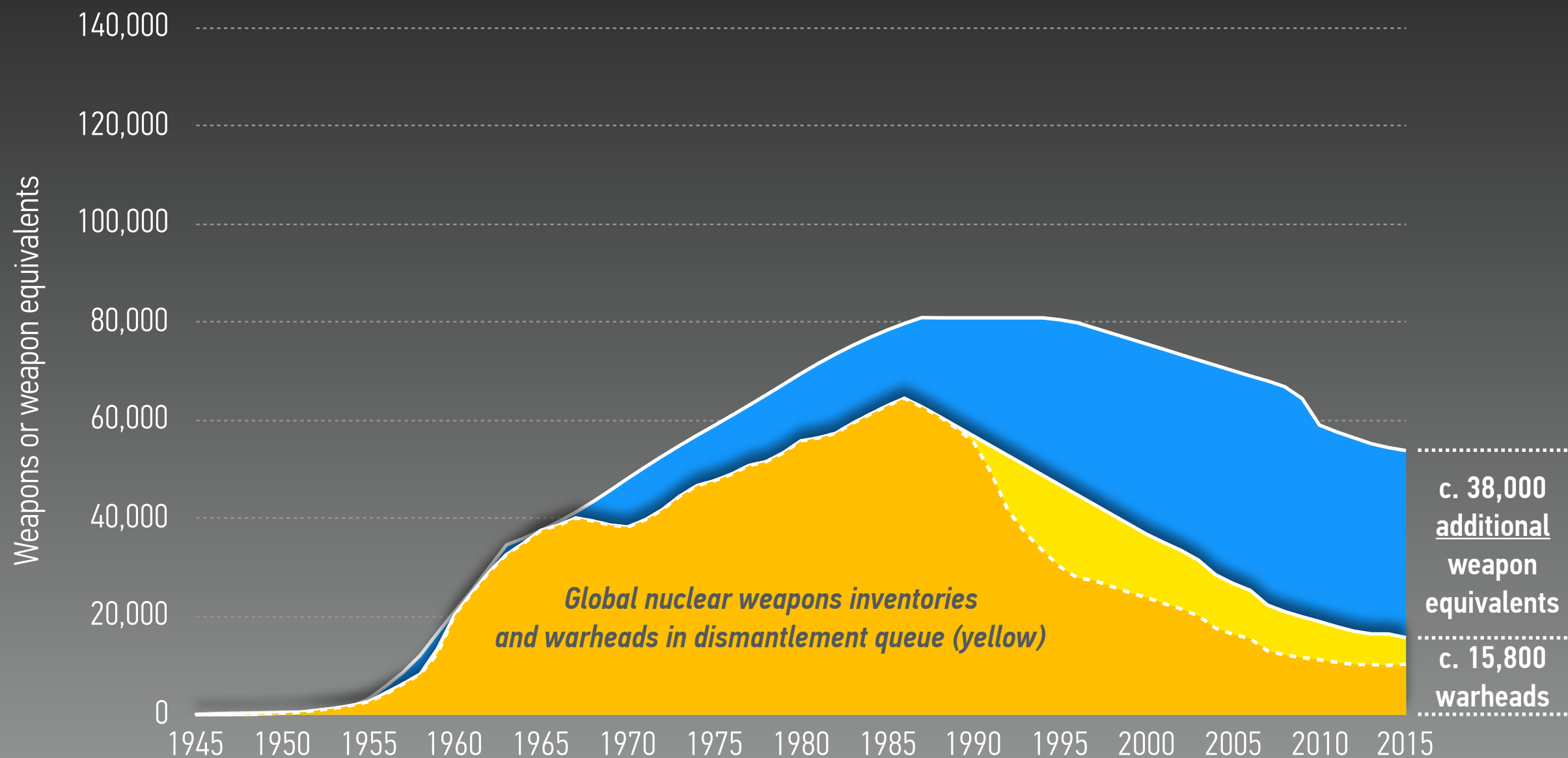
HIGHLY ENRICHED URANIUM



NUCLEAR WEAPONS AND FISSILE MATERIALS

GLOBAL INVENTORIES, 1945–2015

THE CASE OF HIGHLY ENRICHED URANIUM



“Status of World Nuclear Forces,” *Federation of American Scientists*, fas.org, September 2015

Fissile material estimates and weapon-equivalents are authors’ estimates; assuming an average of 25 kg of highly enriched uranium per weapon

HEU PRODUCTION FOR WEAPONS HAS LARGELY ENDED

BUT CONTINUES IN NON-NPT WEAPON STATES

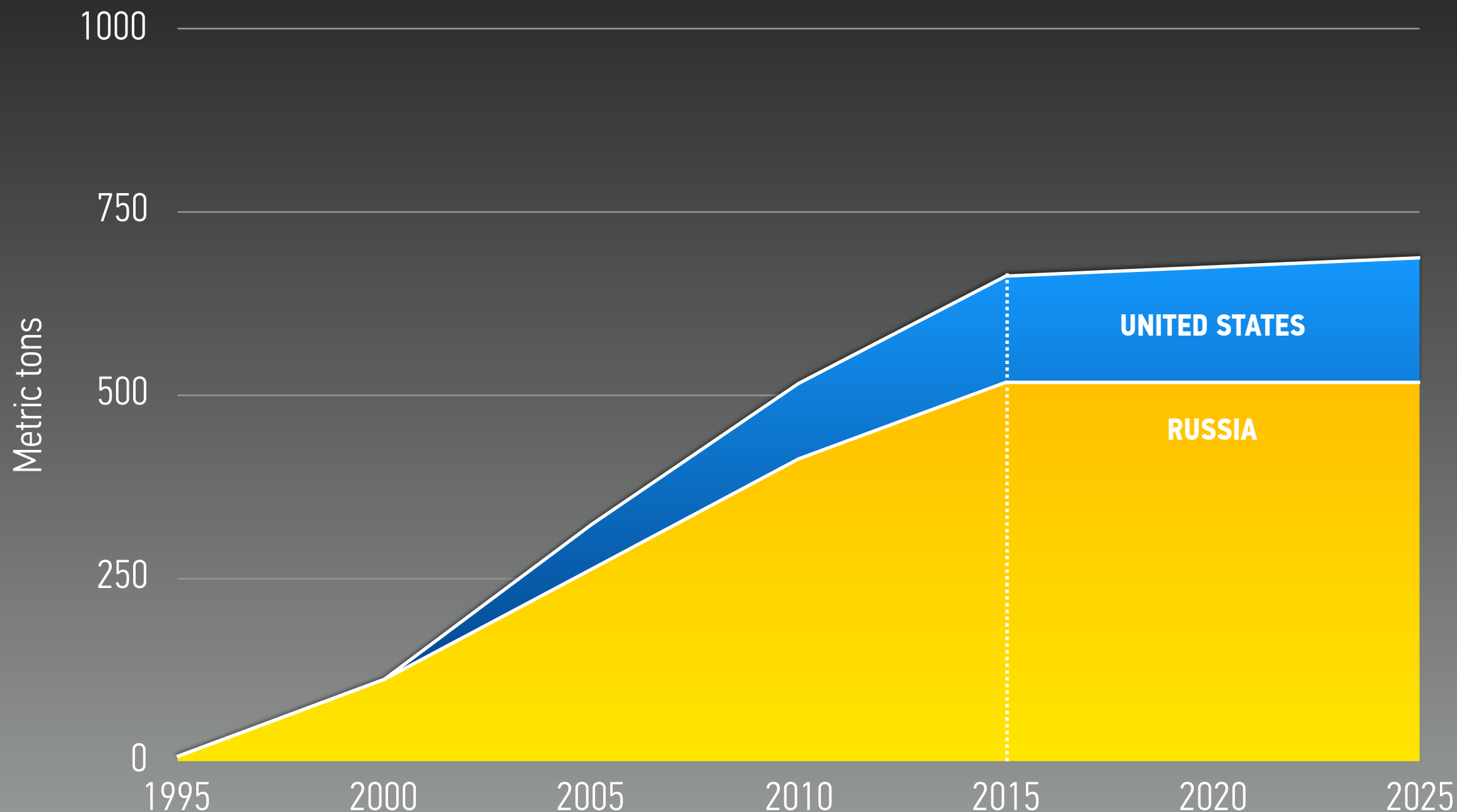
Country	Military HEU production
United States	1944–1992 <i>(since 1964 for naval fuel only)</i>
Russia	1949–1987/88 <i>(but restarted civilian in 2012)</i>
United Kingdom	1953–1963 <i>(but imports from United States)</i>
China	1964–1987/89 <i>(unofficial)</i>
France	1967–1996

Country	Military HEU production
South Africa	1978–1990
Pakistan	since 1983
India	since 1992
Israel	?
North Korea	?

Global Fissile Material Report 2015, International Panel of Fissile Materials, Princeton, December 2015, www.ipfmlibrary.org/gfmr15.pdf

HEU BLENDDOWN

RUSSIA IN 2013 COMPLETED 20-YEAR 500 TONS EXCESS HEU BLENDDOWN PROGRAM
UNITED STATES HAS 36 TONS EXCESS HEU REMAINING TO DOWN-BLEND BY 2030

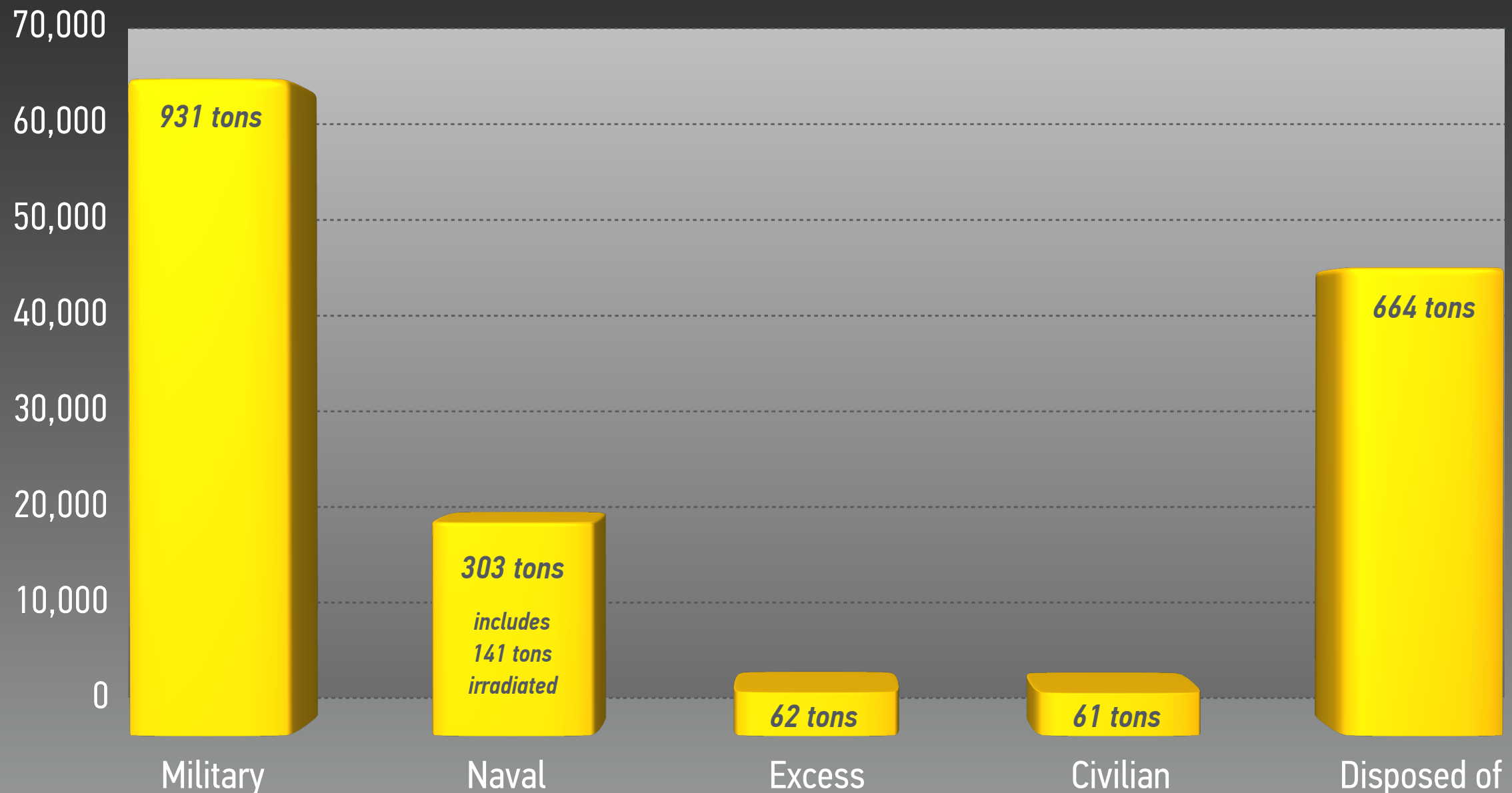


Global Fissile Material Report 2015, International Panel of Fissile Materials, Princeton, December 2015, www.ipfmlibrary.org/gfmr15.pdf

GLOBAL HEU STOCKPILE BY CATEGORY, 2015

REDUCING CIVILIAN USE HEU STOCKPILE FOCUS OF THREE NUCLEAR SECURITY SUMMITS
NAVAL HEU FUEL STOCKPILE IS FIVE TIMES LARGER THAN CIVILIAN STOCKPILE

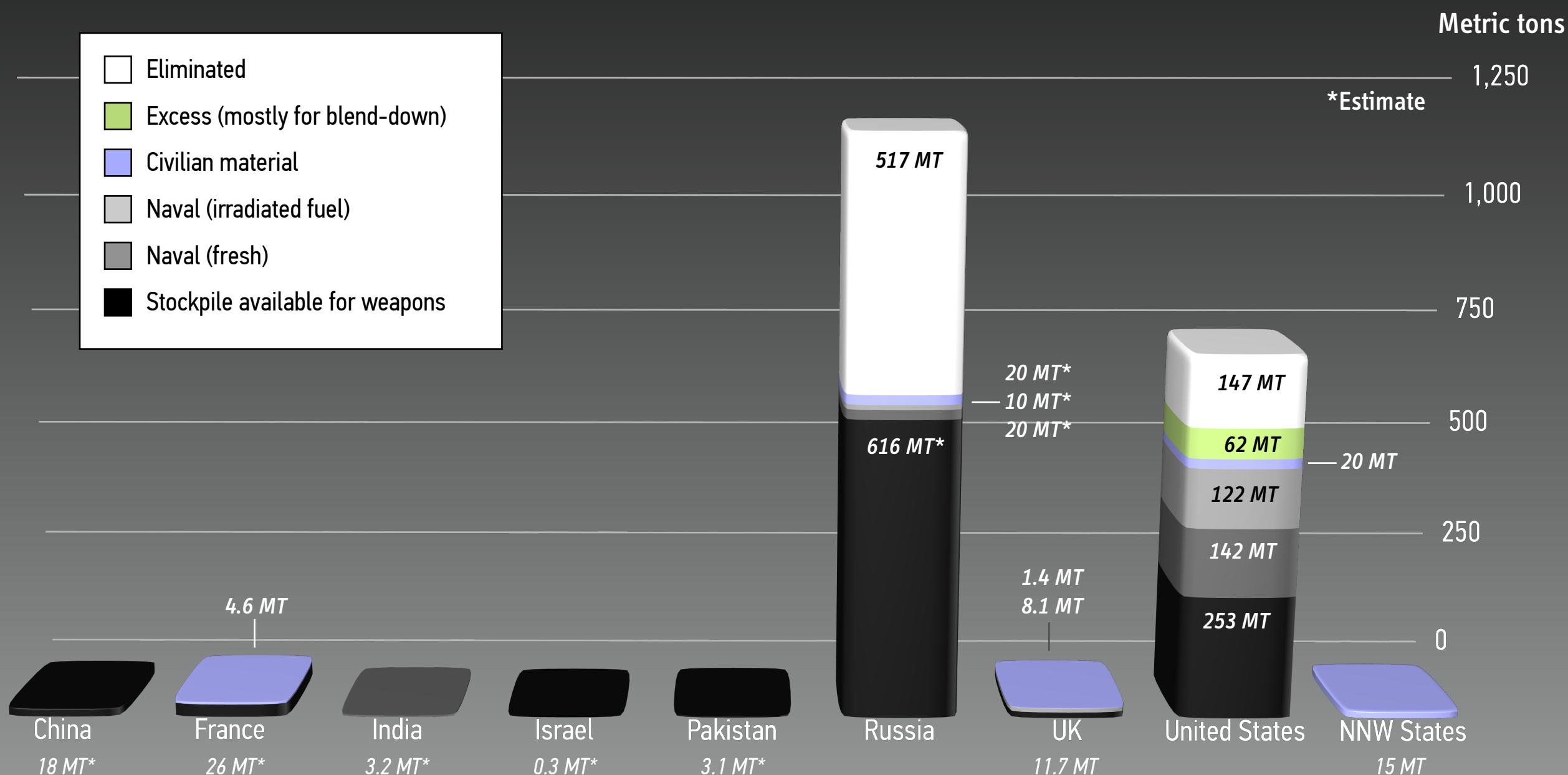
Weapon equivalents



Assumes 15 kg of highly enriched uranium per weapon equivalent

HIGHLY ENRICHED URANIUM, 2015

GLOBAL STOCKPILE IS ABOUT 1357 TONS, ALMOST 99% IS IN WEAPON STATES



Global Fissile Material Report 2015, International Panel of Fissile Materials, Princeton, December 2015, www.ipfmlibrary.org/gfmr15.pdf

HEU CHALLENGES

GLOBAL PRODUCTION RATE LESS THAN RATE OF DOWN-BLENDING FOR NOW



CONTINUING PRODUCTION OF HEU

For military use: Pakistan, India, and possibly North Korea

For civilian use: Russia, reportedly restarted in 2012



HEU REACTOR FUEL

United States, United Kingdom, Russia, and India use HEU naval fuel

United States has over half of all HEU naval reactors

Russia has over half of all HEU research reactors

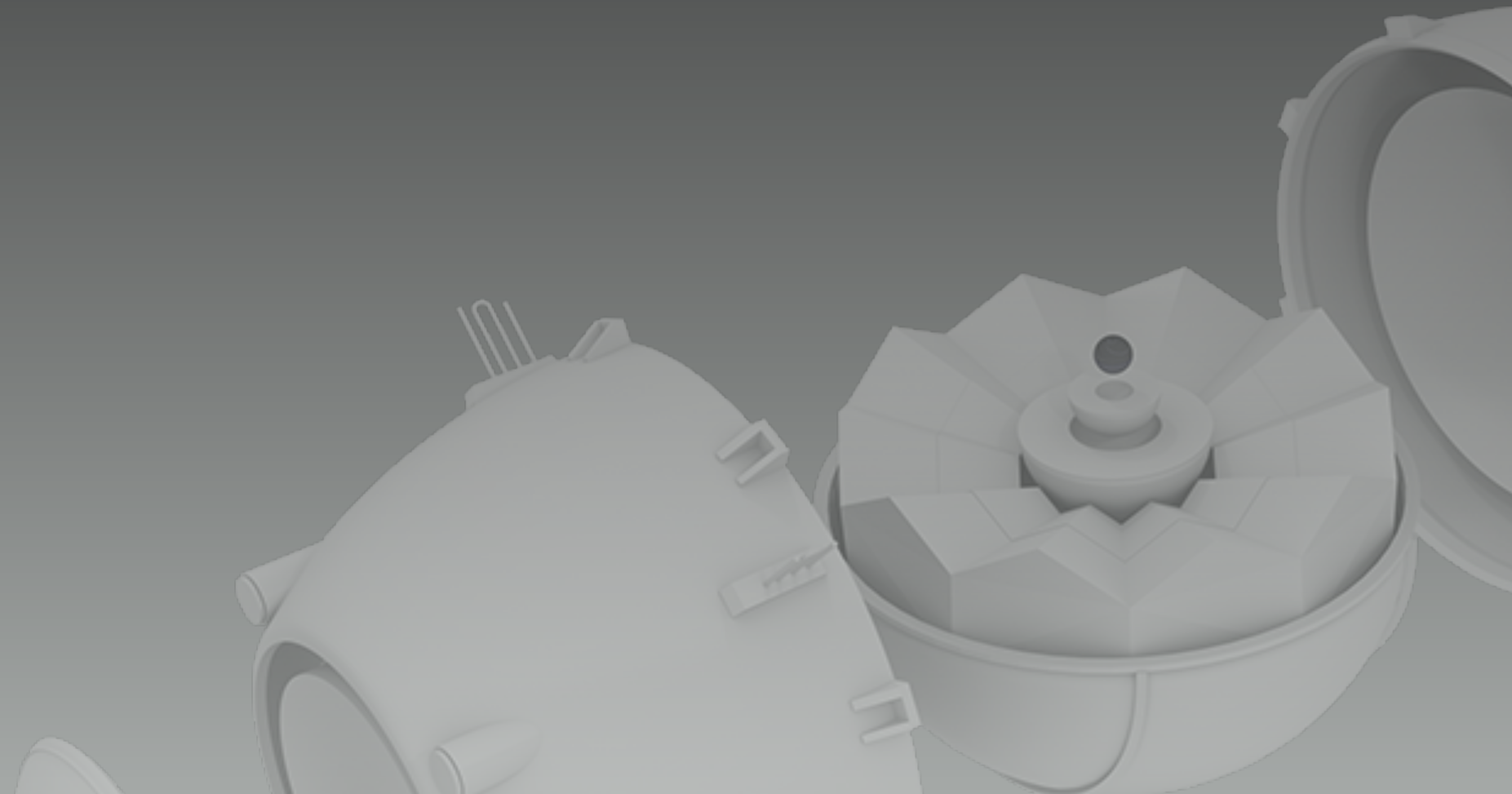
Sources: U.S. DOE and U.S. Navy

WHO CAN MAKE FISSILE MATERIAL TODAY

ENRICHMENT AND REPROCESSING FACILITIES WORLDWIDE



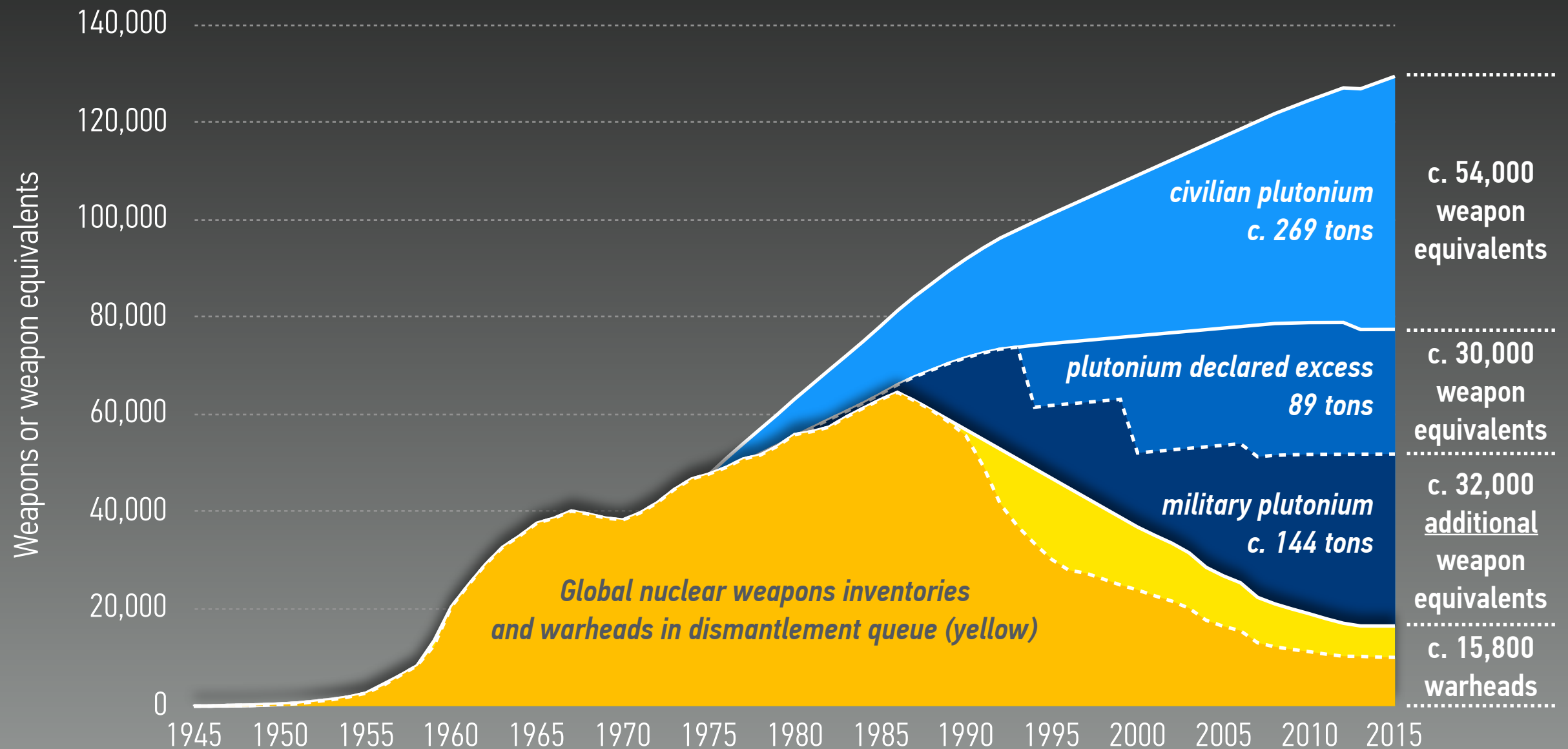
PLUTONIUM



NUCLEAR WEAPONS AND FISSILE MATERIALS

GLOBAL INVENTORIES, 1945–2015

THE CASE OF SEPARATED PLUTONIUM



“Status of World Nuclear Forces,” *Federation of American Scientists*, fas.org, September 2015

Fissile material estimates and weapon-equivalents are authors’ estimates; assumes an average of 3 kg for weapon-grade and 5 kg for reactor-grade plutonium per weapon

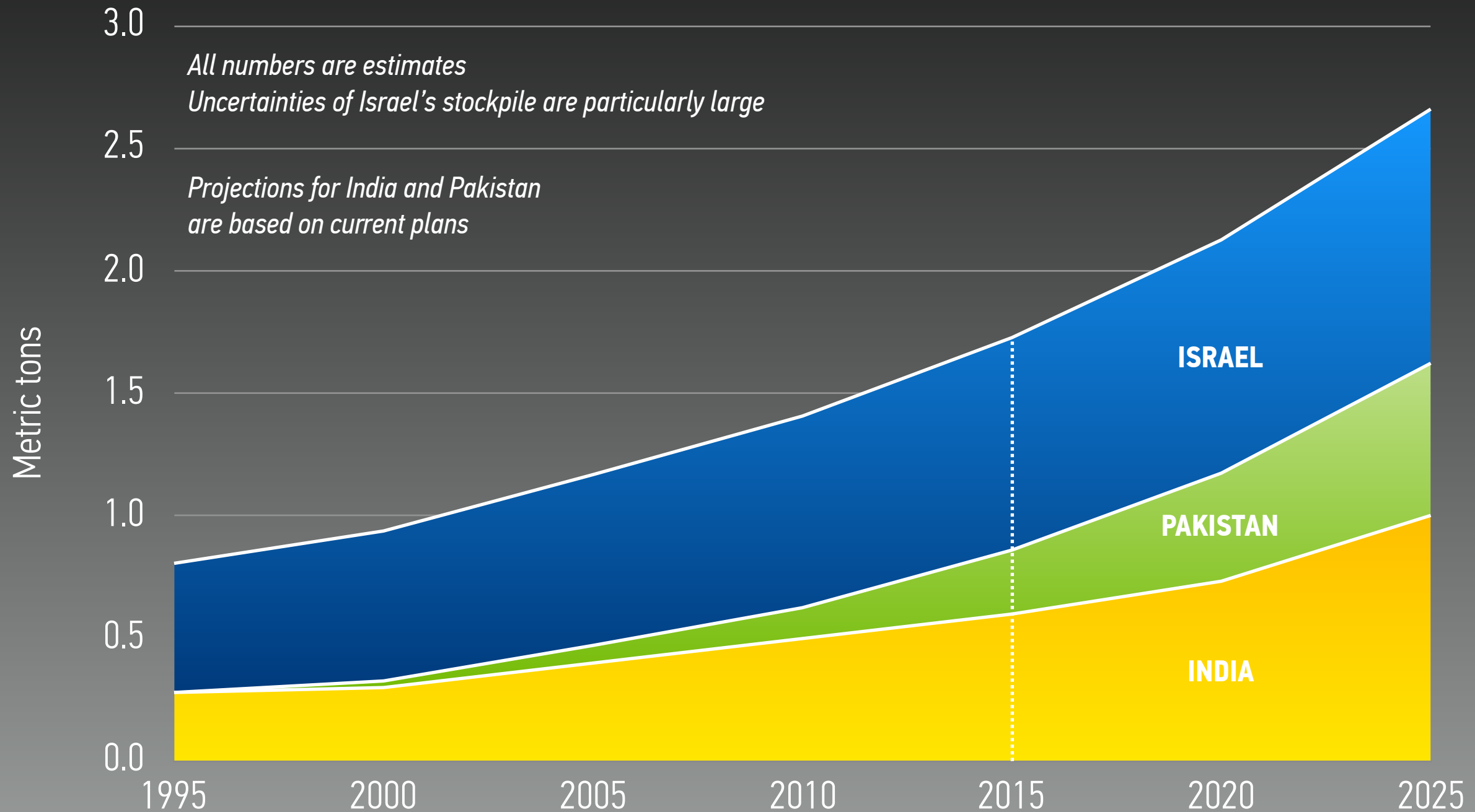
PLUTONIUM PRODUCTION FOR WEAPONS HAS ENDED IN NPT WEAPON STATES

BUT CONTINUES IN ISRAEL, INDIA, PAKISTAN, AND POSSIBLY NORTH KOREA

Country	Plutonium production for weapons
China	stopped 1991 <i>(unofficial)</i>
France	stopped 1992
Russia	stopped 1994
United Kingdom	stopped 1995
United States	stopped 1988

Global Fissile Material Report 2015, International Panel of Fissile Materials, Princeton, December 2015, www.ipfmlibrary.org/gfmr15.pdf

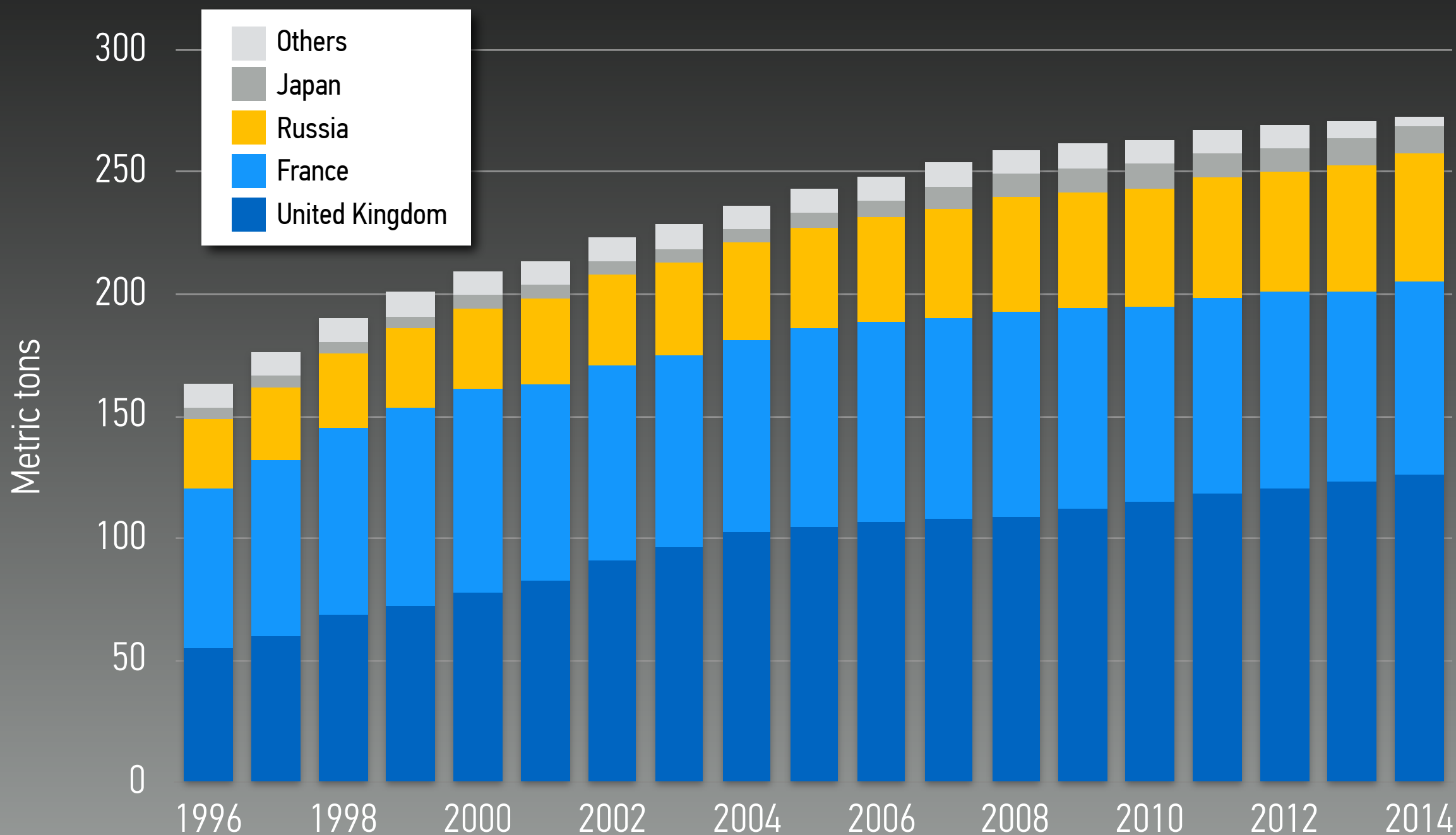
WEAPONS PLUTONIUM PRODUCTION CONTINUES IN NON-NPT WEAPON STATES



Global Fissile Material Report 2015, International Panel of Fissile Materials, Princeton, December 2015, www.ipfmlibrary.org/gfmr15.pdf

CIVILIAN PLUTONIUM, 1996–2015

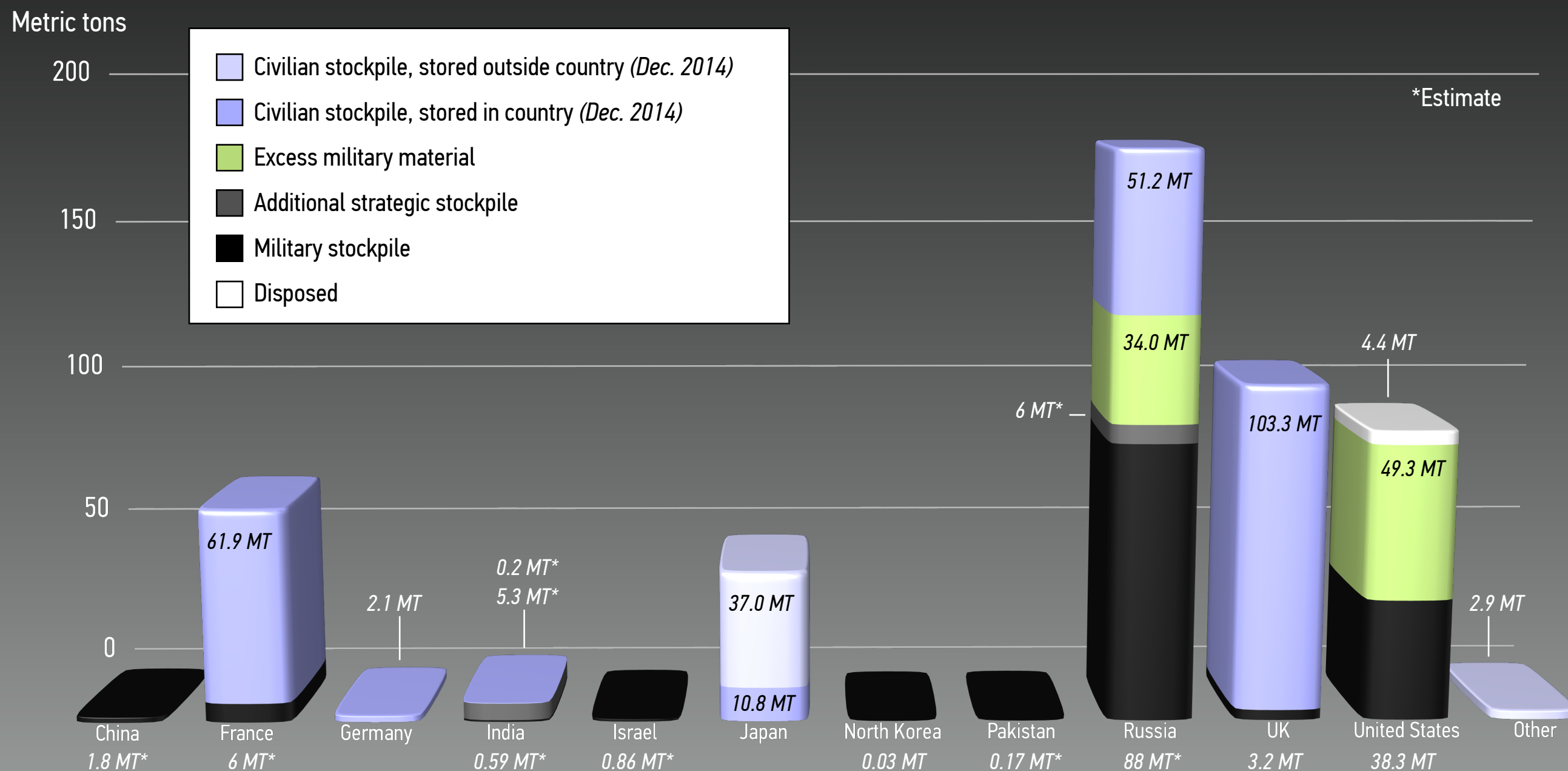
EVOLUTION OF DECLARED STOCKPILE (BY LOCATION)



Numbers are based on the annual INFCIRC 549 Declarations and are for the end of the reported year

SEPARATED PLUTONIUM, 2015

GLOBAL STOCKPILE IS ABOUT 503 TONS, MORE THAN HALF IS CIVILIAN AND THIS STOCK IS GROWING



Global Fissile Material Report 2015, International Panel of Fissile Materials, Princeton, December 2015, www.ipfmlibrary.org/gfmr15.pdf

PLUTONIUM CHALLENGES



MILITARY AND CIVILIAN PLUTONIUM PRODUCTION CONTINUES

Civilian production, use, and stockpiling would not be covered by FMCT
Upcoming nuclear security summit could focus more on
minimizing (civilian and excess military) plutonium stockpiles



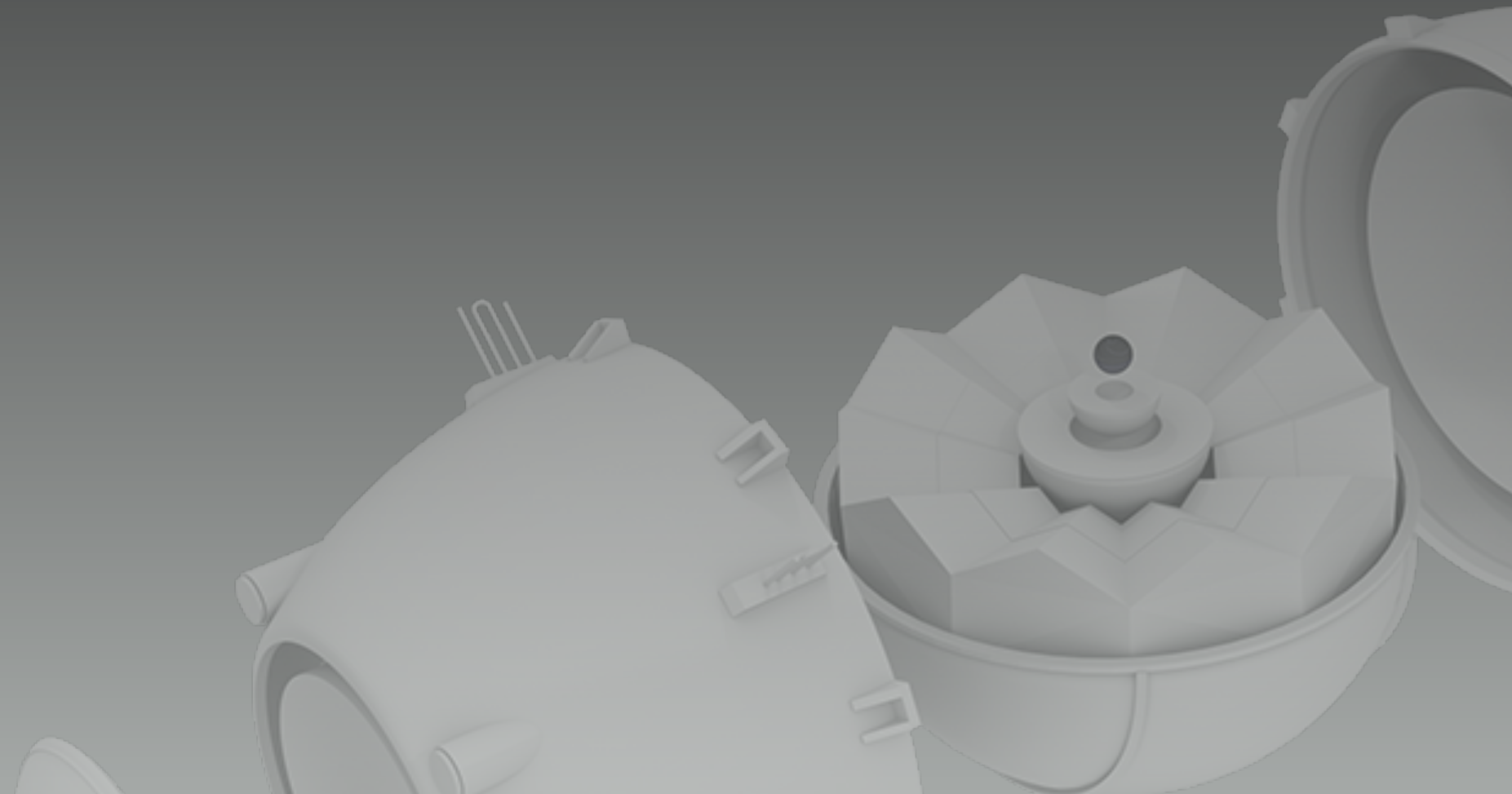
IMPLEMENTING VIABLE PLUTONIUM DISPOSAL OPTIONS

MOX disposition path has proven extremely expensive
Need alternative disposition options for both civilian and excess military
material (based on cost, irreversibility, security, and verifiability)

Sources: Getty Images (top) and UK Nuclear Decommissioning Authority (bottom)

LOOKING FORWARD

A FISSILE MATERIAL AGENDA



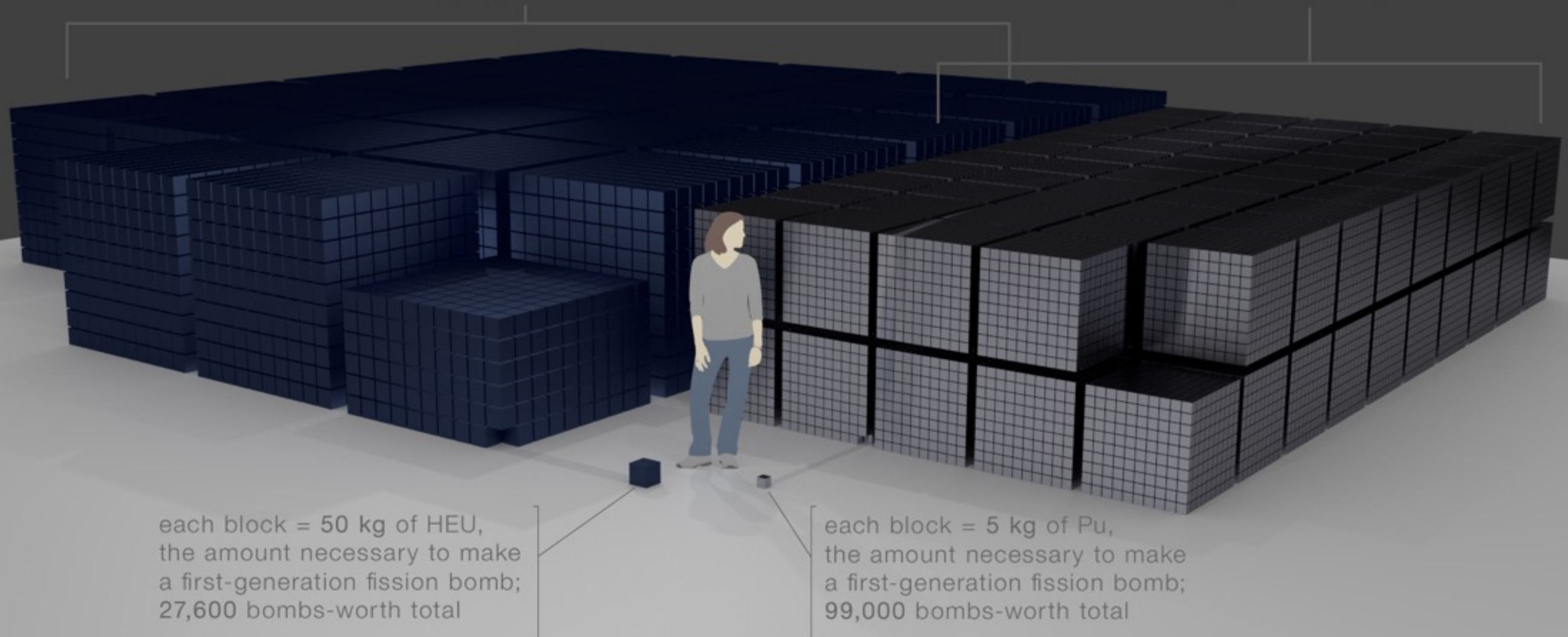
World Stockpiles of Fissile Materials

~~1380~~
1357

tons of highly-enriched uranium

~~495~~
503

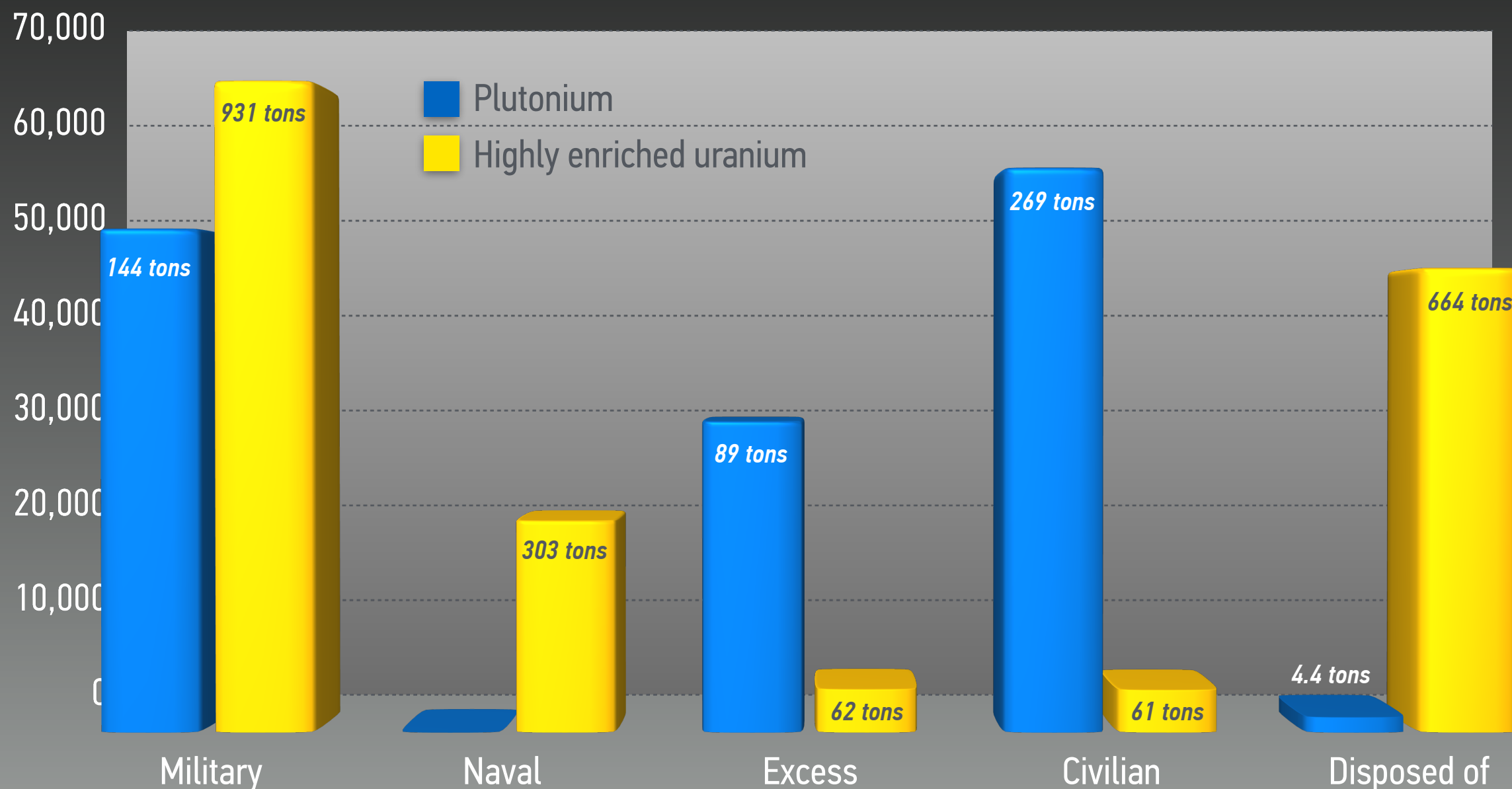
tons of separated plutonium



FISSILE MATERIALS BY CATEGORY

GLOBAL STOCKPILE OF PLUTONIUM AND HIGHLY ENRICHED URANIUM, 2015

Weapon equivalents



Assumptions for weapon equivalents: 3 kg of weapon-grade plutonium, 5 kg of reactor-grade plutonium, 15 kg of highly enriched uranium
(As of 2015, more than 220,000 weapon-equivalents in the global stockpile of fissile material)

LOOKING FORWARD

A FISSILE MATERIAL AGENDA TO SUPPORT NUCLEAR DISARMAMENT AND NONPROLIFERATION



ABOUT 1860 TONS OF FISSILE MATERIAL ARE IN THE GLOBAL STOCKPILE

Major reductions of Cold War stockpiles of HEU have been accomplished

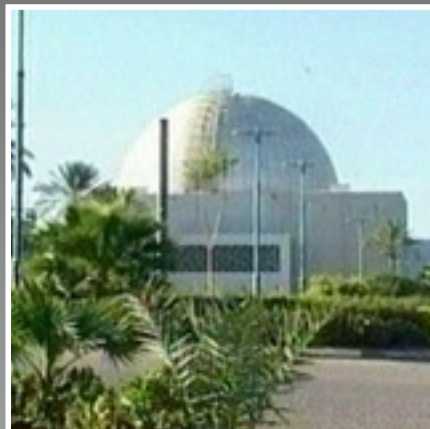
The stockpile of civilian plutonium is growing



DECLARING MORE MATERIAL EXCESS AND PRIORITIZING DISPOSAL

Despite warhead reductions, no new material declared excess in past 10 years

HEU blend-down is slow and plutonium disposal has stalled



ENDING PRODUCTION AND USE — AND CREATE NUCLEAR TRANSPARENCY

End HEU and plutonium production for weapons and non-weapon purposes

Make fissile material declarations to establish baselines

TRANSPARENCY SCORECARD, 2016

INFORMATION ON NUCLEAR WARHEAD AND FISSILE MATERIAL INVENTORIES AND STATUS

	United States	Russia	Britain	France	China
Number of total warheads	Approximate	No	Yes (upper limit)	Yes (upper limit)	Relative (out of date)
Number of deployed warheads	Yes (strategic only)	Yes (strategic only)	Yes (planned)	Yes	No
Dismantlements	Yes	No	Yes (no details)	Yes (no details)	No
Verification	Partial	Partial	No	No	No
Fissile material stockpiles	Yes	No	Yes (no details)	No	No
Production histories	Yes	No	No	No	No
Excess/Disposal	Yes (nothing new)	Yes (nothing new)	Yes (nothing new)	No	No
Verification	Partial	Partial (but no longer)	Partial (some plutonium)	No	No
International R&D Activities	Yes	No	Yes	No	Some

GLOBAL FISSILE MATERIAL REPORT 2015

NUCLEAR WEAPON AND FISSILE MATERIAL STOCKPILES AND PRODUCTION

