Radioactivity

Raw Radiation

Decay Rate

Curie (Ci)
3.7 x 10^{10} disint/s

Becquerel (Bq)
1 disint/s

Energy Absorbed

Absorbed Dose

Gray (Gy)
J/kg

Rads
= 0.01 Gy

Related:
Roentgen (Rg)
C/kg

Damage Done

Effective Dose

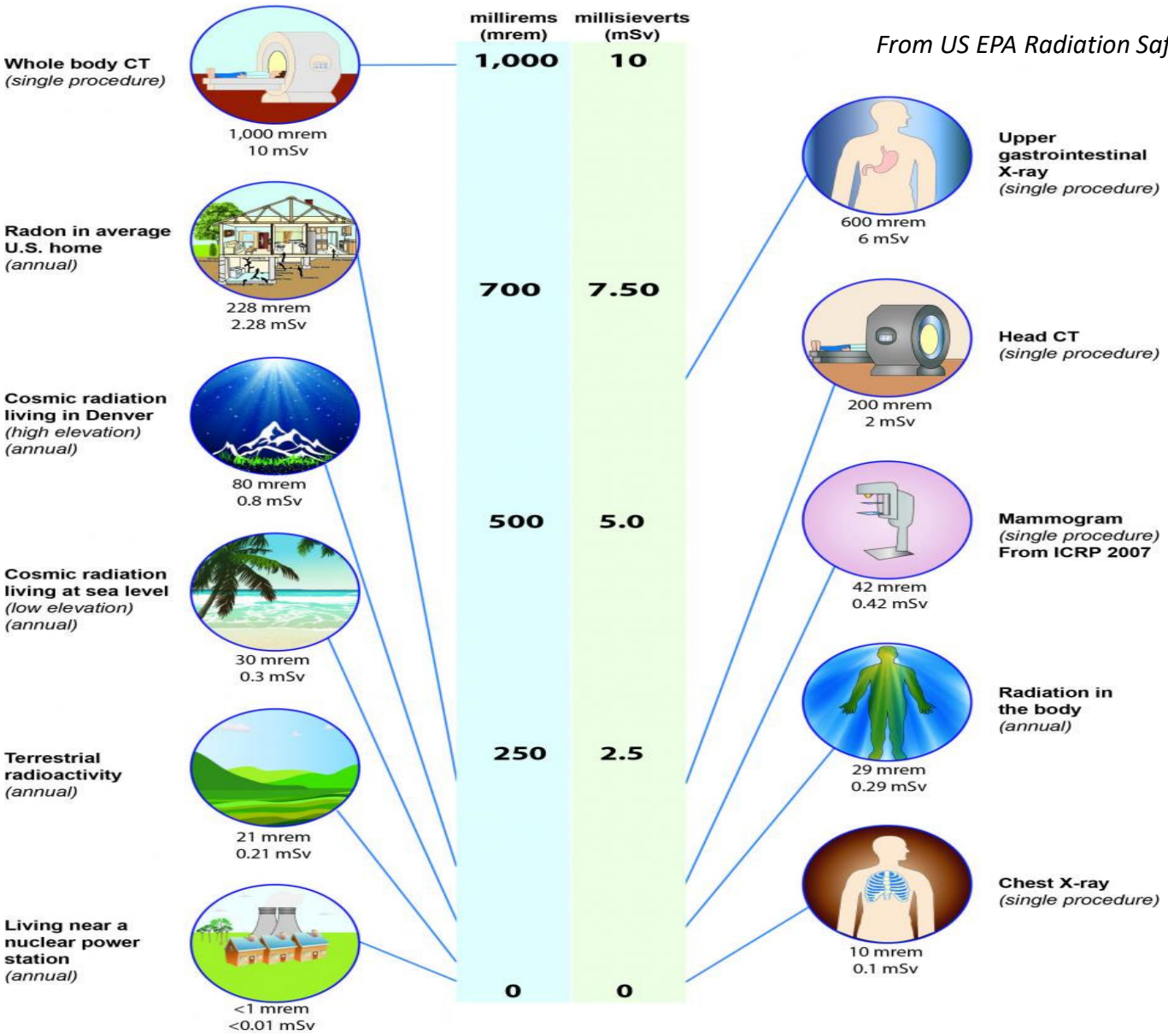
Sieverts (Sv)
weighted for damage:
1 for β, γ ; 20 for α

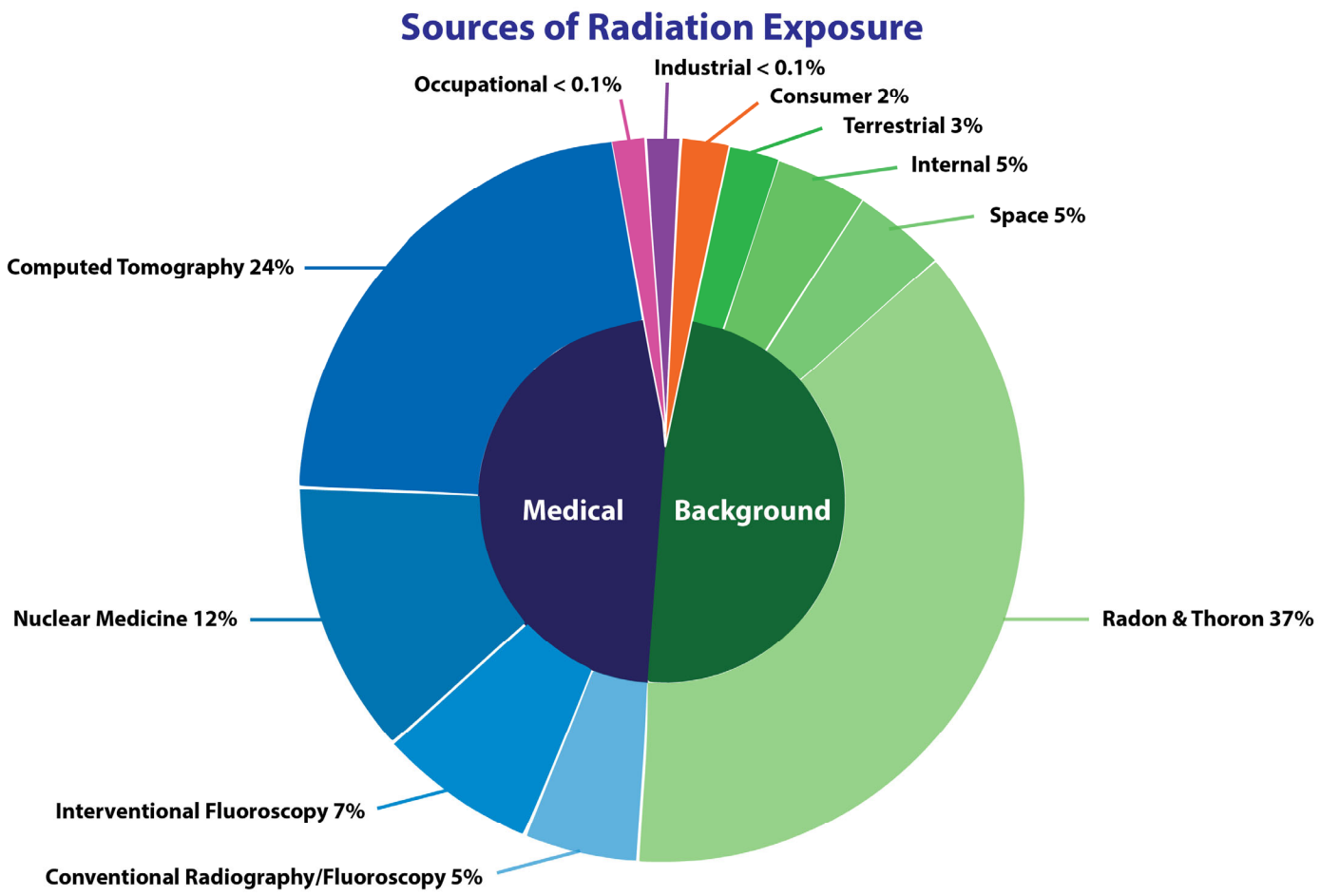
Rem
= 0.01 Sv

RELATIVE DOSES FROM RADIATION SOURCES

All doses from the National Council on Radiation Protection & Measurements, Report No. 160 (unless otherwise denoted)

From US EPA Radiation Safety website





Average Annual Radiation Dose

Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/ Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
Units											
mrem (United States)	228 mrem	147 mrem	77 mrem	43 mrem	33 mrem	33 mrem	29 mrem	21 mrem	13 mrem	0.5 mrem	0.3 mrem
mSv (International)	2.28 mSv	1.47 mSv	0.77 mSv	0.43 mSv	0.33 mSv	0.33mSv	0.29 mSv	0.21 mSv	0.13 mSv	0.005 mSv	0.003 mSv

(Source: National Council on Radiation Protection & Measurements, Report No. 160)

Annual Radiation Dose

Adult: 50,000 μSv
Considered safe

Chemistry in Context 6th Edition, ACS, McGraw-Hill

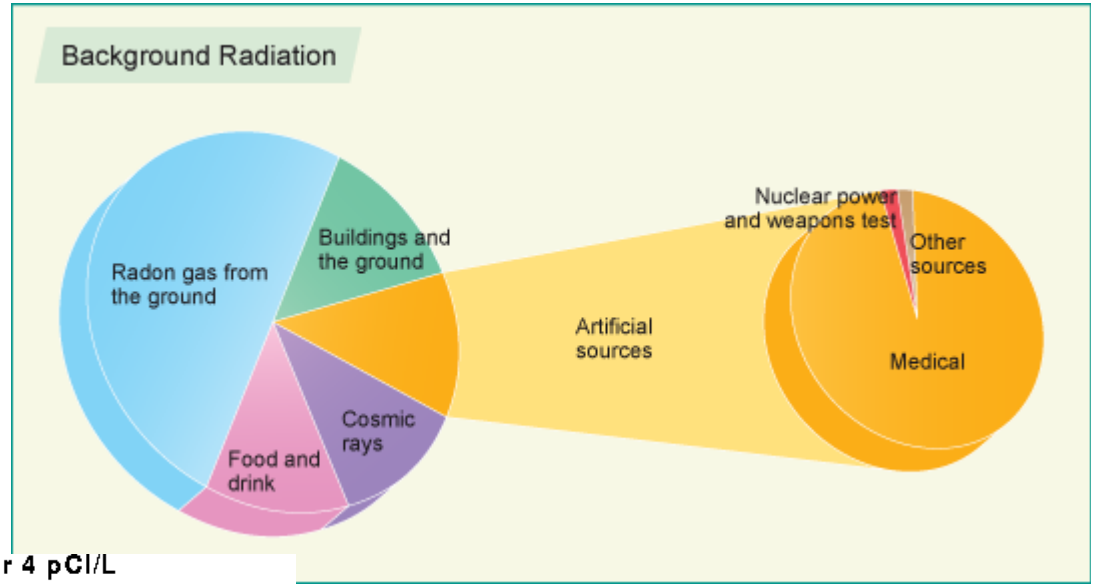
Table 7.3 Annual Radiation Dose (Sample Calculation)*

Sources of Radiation	(μSv/yr)
1. Cosmic radiation	
a. Sea level (U.S. average)	260
b. Additional dose if you are above sea level	
up to 1000 m (3300 ft) add 20 μSv	20
1000 to 2000 m (6600 ft) add 50 μSv	
2000 to 3000 m (9900 ft) add 90 μSv	
3000 to 4000 m (13,200 ft) add 15 μSv	
4000 to 5000 m (16,500 ft) add 21 μSv	
2. Building material(s) used in your dwelling	
Stone, brick or concrete add 70 μSv	
Wood or other add 20 μSv	20
3. Rocks and soil	460
4. Food, water, and air (K and Rn)	2400
5. Fallout from nuclear weapons testing	10
6. Medical and dental X-rays	
a. Chest X-ray, add 100 μSv each	0
b. Gastrointestinal tract X-ray, add 5000 μSv each	0
c. Dental X-rays, add 100 μSv each	100
7. Airplane travel	
5-hour flight at 30,000 feet, add 30 μSv/flight	300
8. Other	
a. Live within 50 miles of a nuclear plant, add 0.09 μSv	0.09
b. Live within 50 miles of a coal-fired power plant, add 0.3 μSv	0.3
c. Use a computer terminal, add 1 μSv	1
d. Watch TV, add 10 μSv	10
e. Smoke one pack of cigarettes/day, add 10,000 μSv	0
Total Annual Radiation Dose	**3581**
U.S. annual average = 3600 μSv	

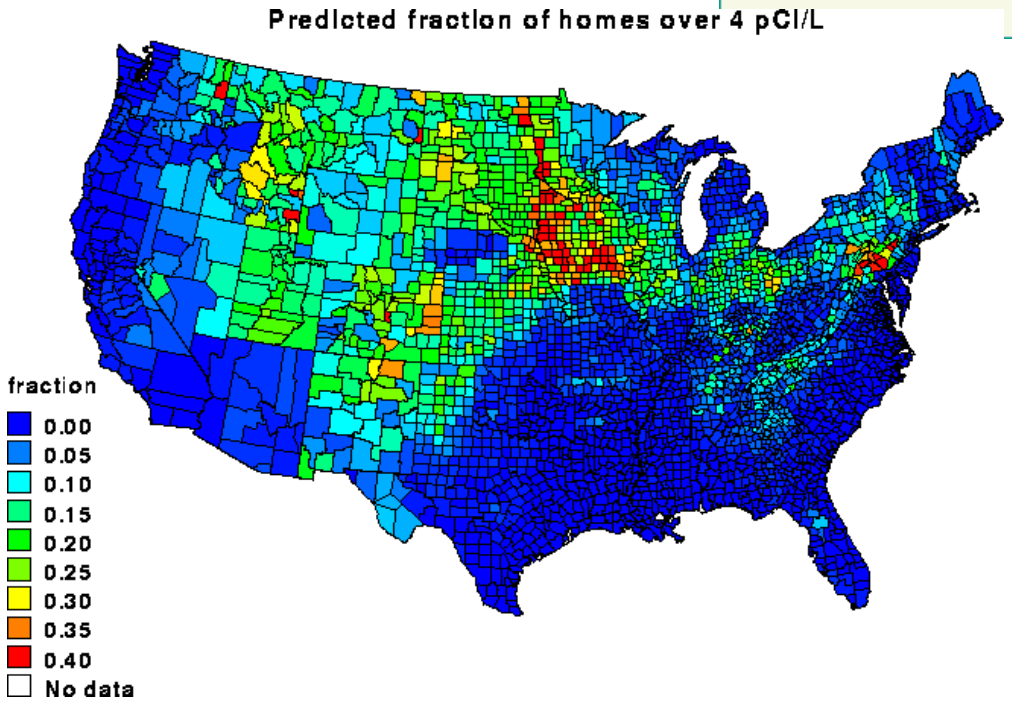
*Sample calculation is for an adult nonsmoker living in the Midwest.
Sources: U.S. Environmental Protection Agency, American Nuclear Society.

Radon gas

Leading cause of lung cancer in non-smokers



http://www.world-nuclear.org/education/ral.htm



From US EPA Radiation Safety website

See also: Radon and Your Health from The BC Lung Association

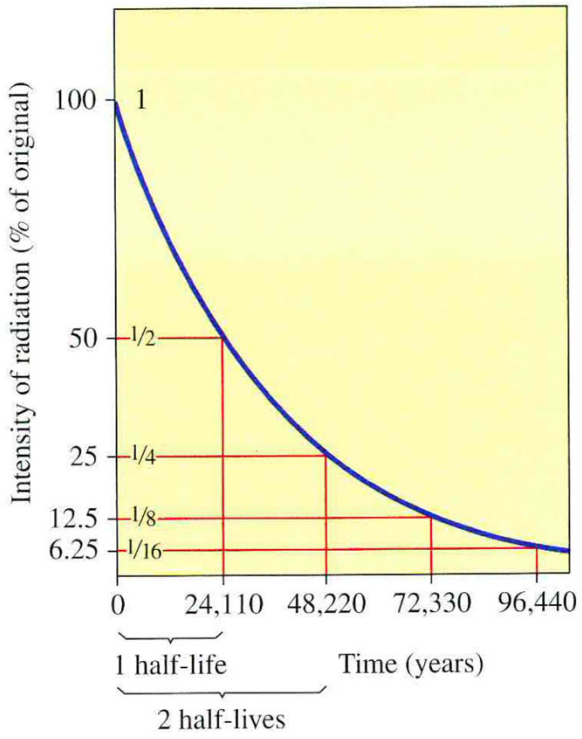
Nuclear waste

Half-life is the time it takes for the radioactivity to decay by ½.

Table 7.5 Half-Lives for Selected Radioisotopes

Radioisotope	Half-life ($t_{1/2}$)
uranium-238	4.5×10^9 years
potassium-40	1.3×10^9 years
plutonium-239	24,110 years
carbon-14	5715 years
cesium-137	30.2 years
strontium-90	29.1 years
thorium-234	24.1 days
iodine-131	8.04 days
radon-222	3.82 days
plutonium-231	8.5 minutes
polonium-214	0.00016 seconds

Decay of Pu-239



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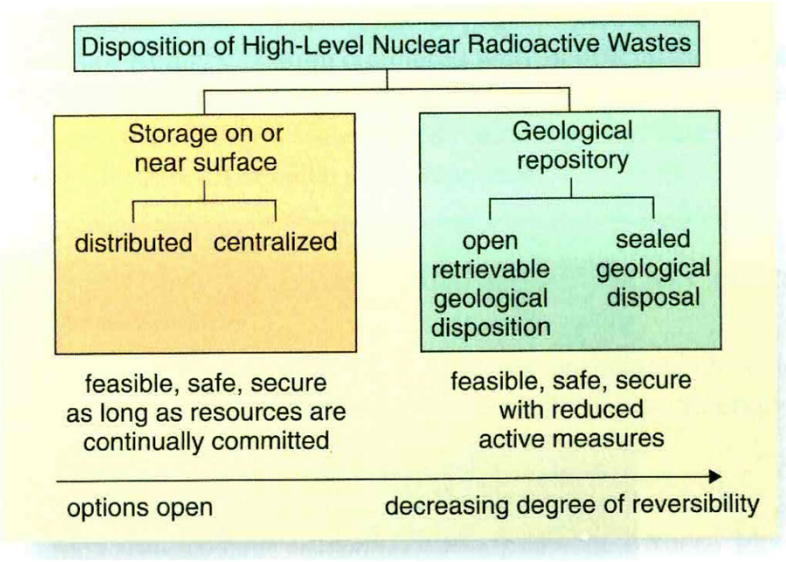
Options for nuclear waste disposal



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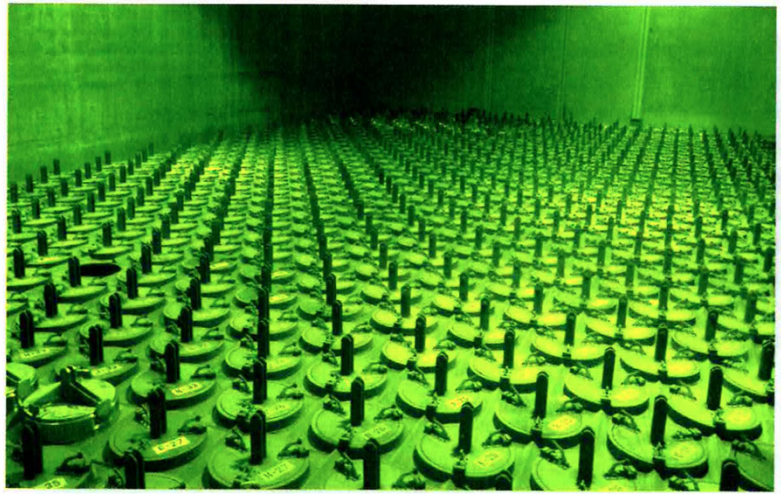

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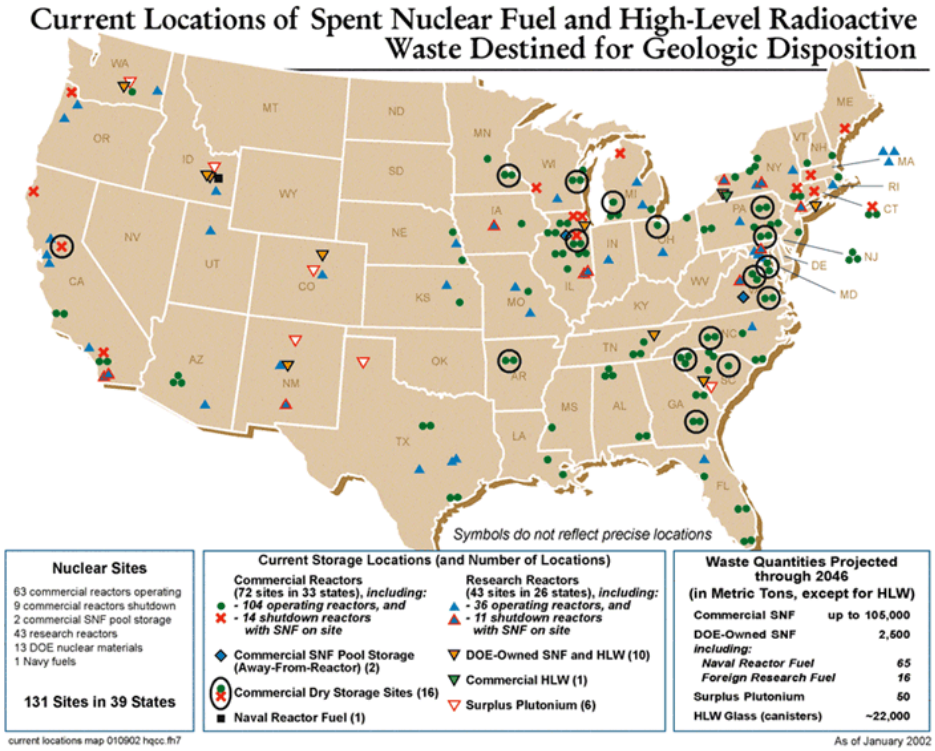
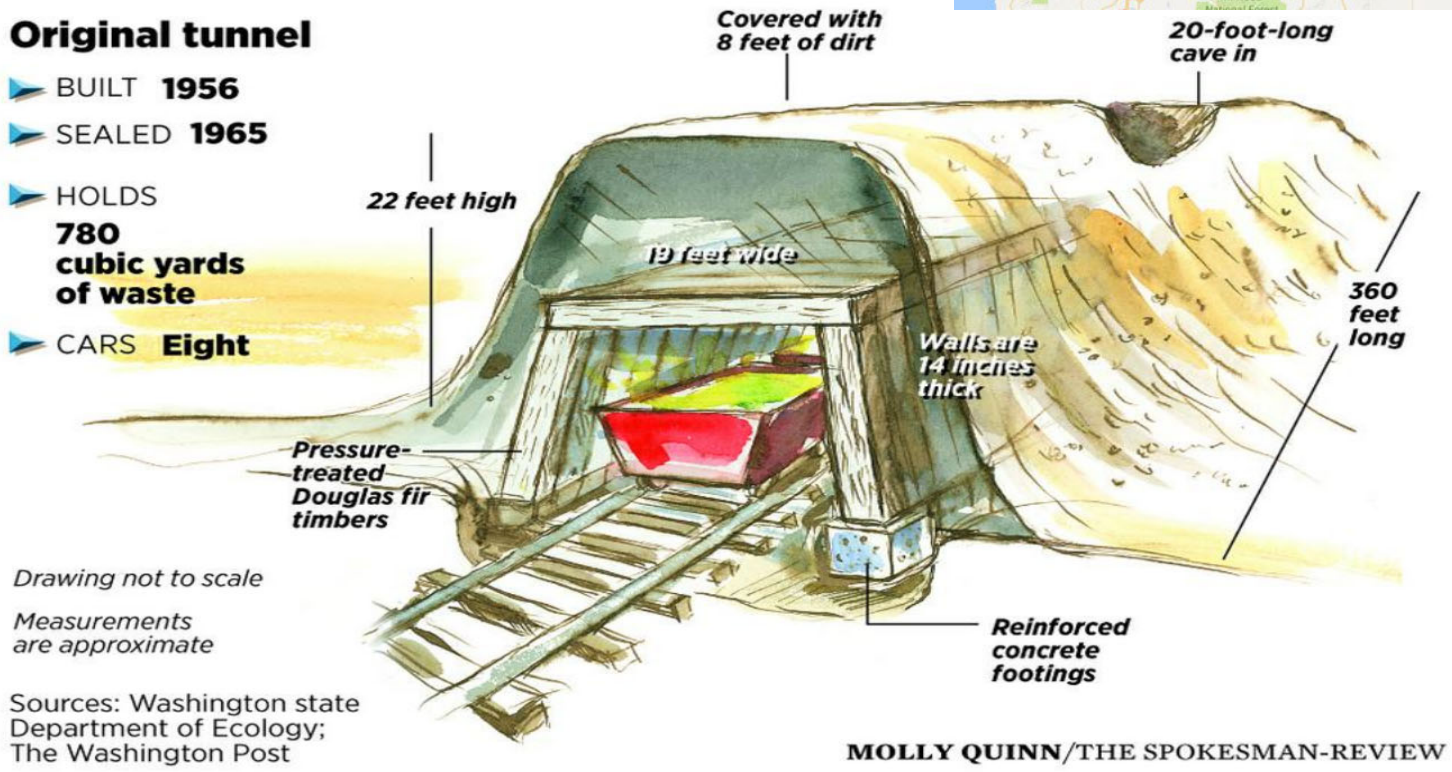


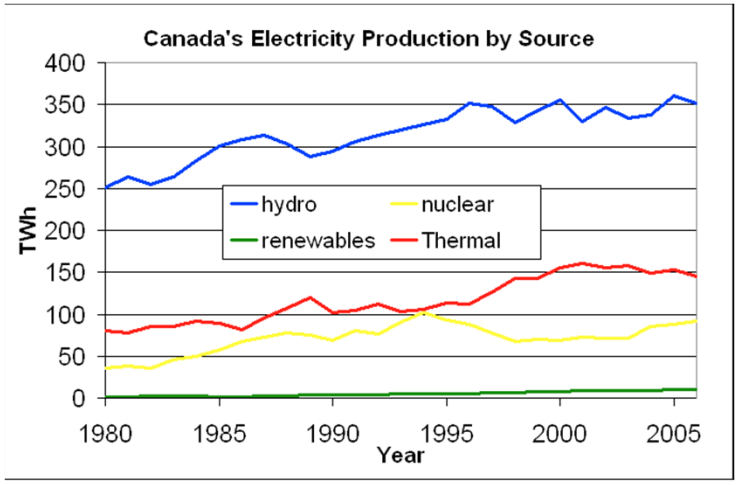
From democraticunderground.com

Tunnel collapse renews safety concerns about Hanford nuclear site in Washington state **THE ASSOCIATED PRESS**

May 10, 2017 (Headline in Vancouver Sun)



See also: https://ecology.wa.gov/Waste-Toxics/Nuclear-waste/Hanford-cleanup/PUREX



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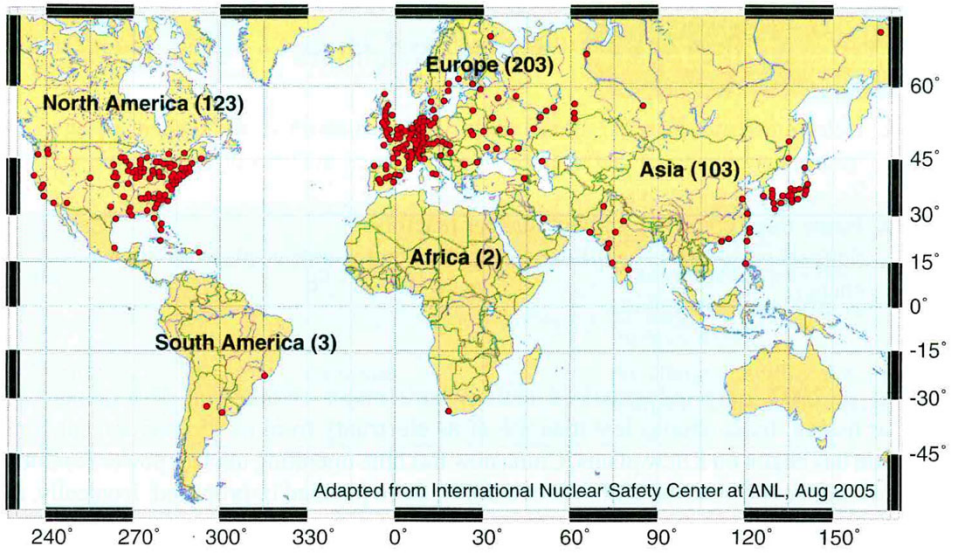
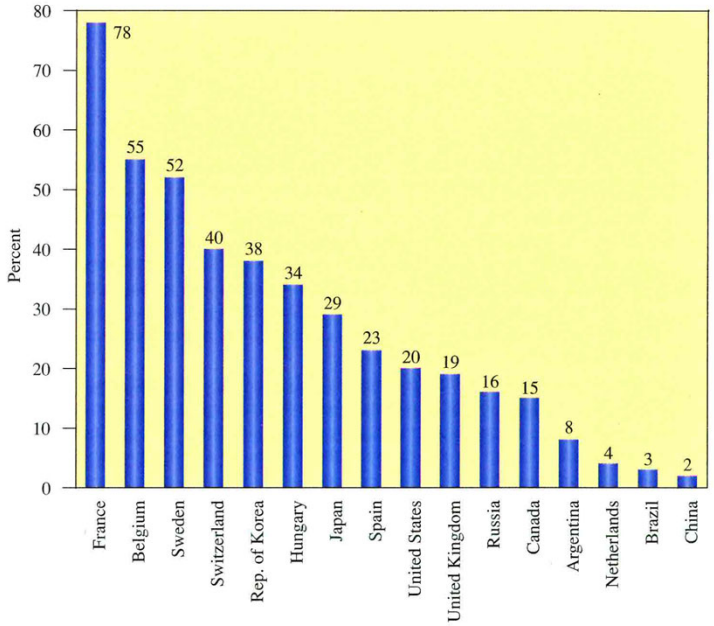


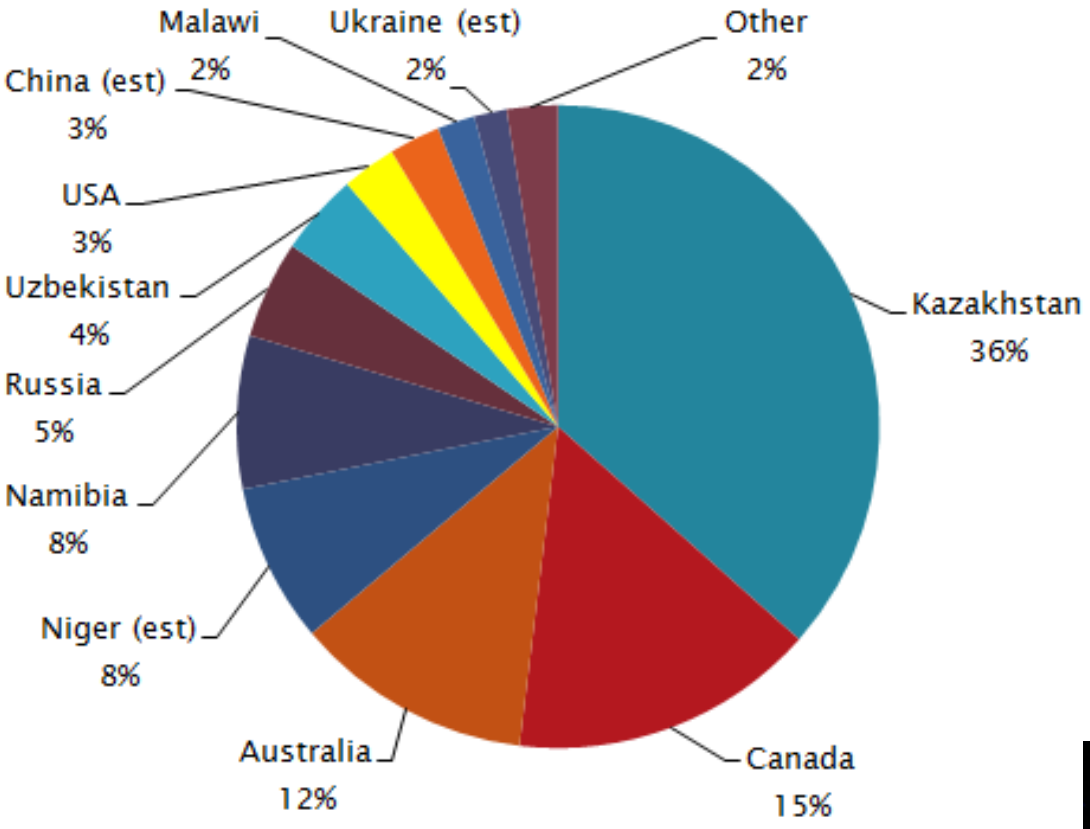
Figure 7.10 *Chemistry in Context 6th Edition, ACS, McGraw-Hill*

Number of reactors in operation worldwide, as of December 2005. Some sites have more than one reactor.

Source: http://www.insc.anl.gov/pwrmaps/map/world_map.php



From businessinsider.com



World Uranium Mining Production 2012

Uranium glass