Climate On Tap at NAKED CITY PRESENTS

How Can Splitting the Atom Save the Planet?

Non-Carbon Energy To the Rescue!

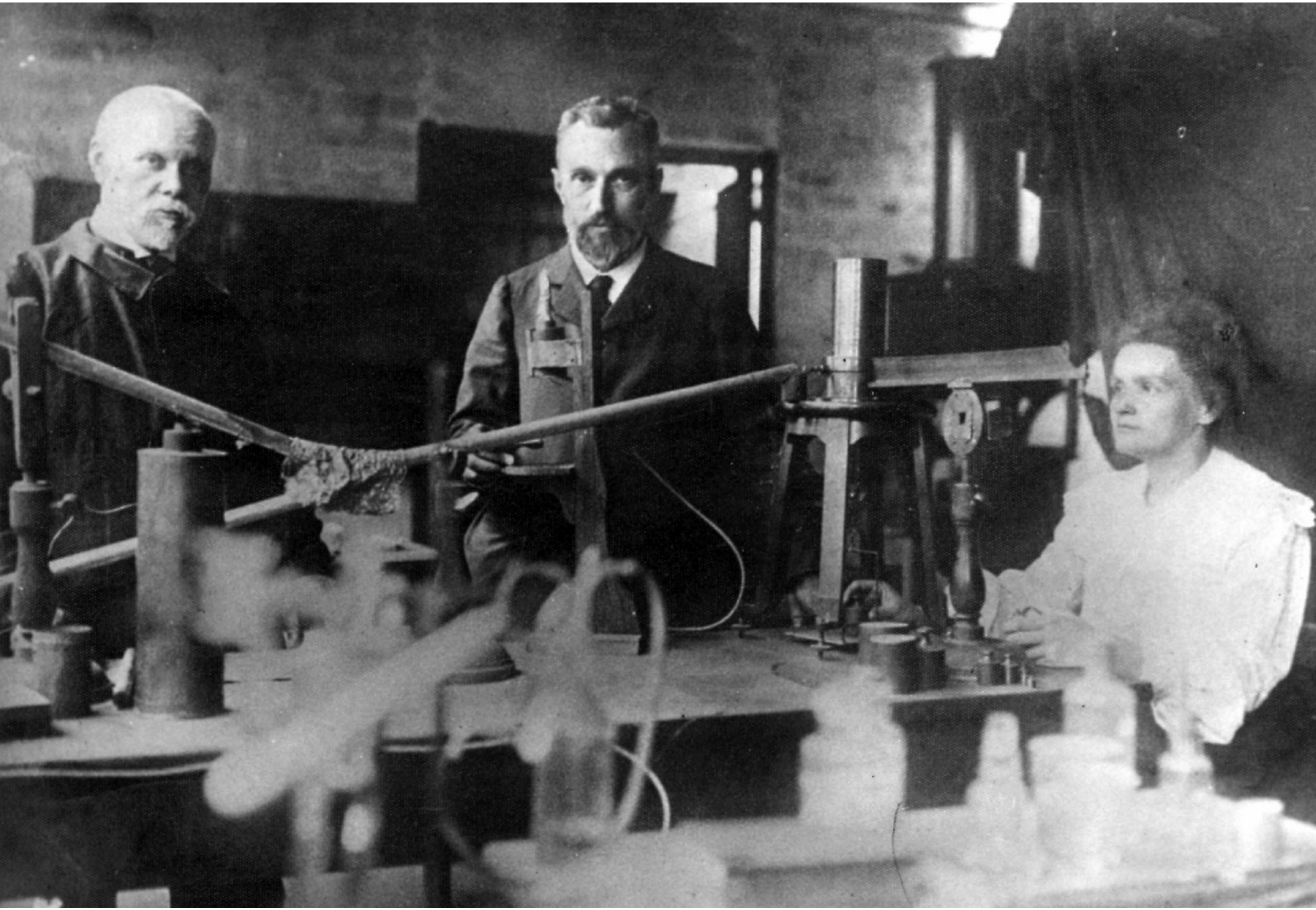
Featuring Nick Touran & Scott Montgomery

Sponsored by CASCADIA CLIMATE ACTION

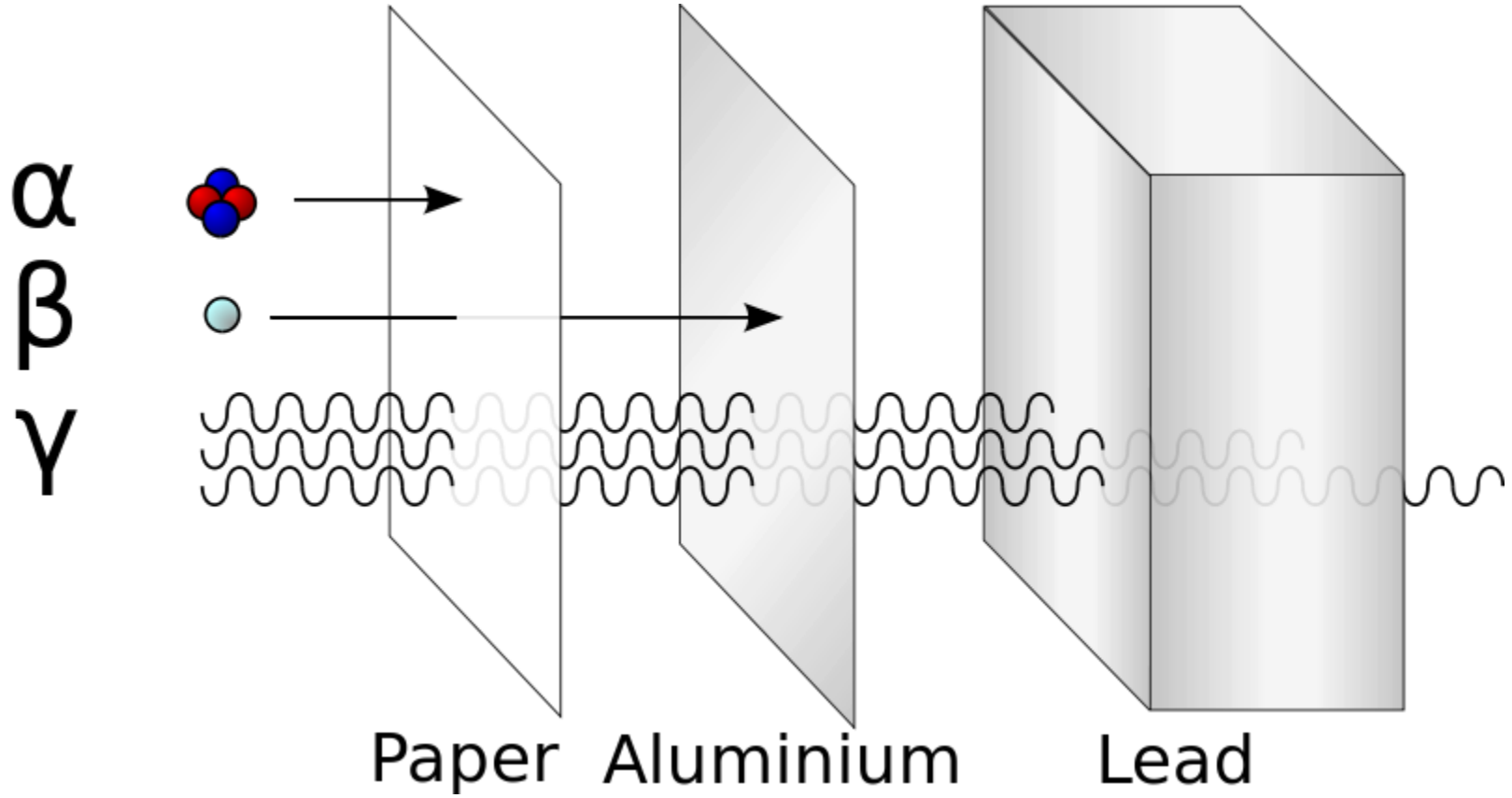
Enjoy beer, food & conversation!

What is nuclear energy?

How do we harness it?

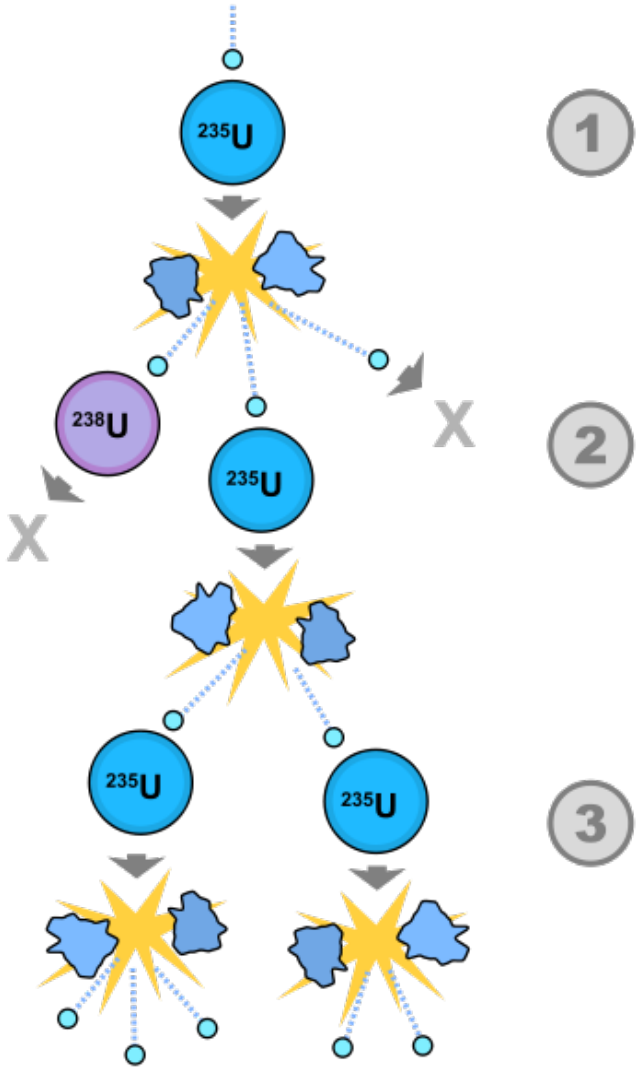


Types of radiation

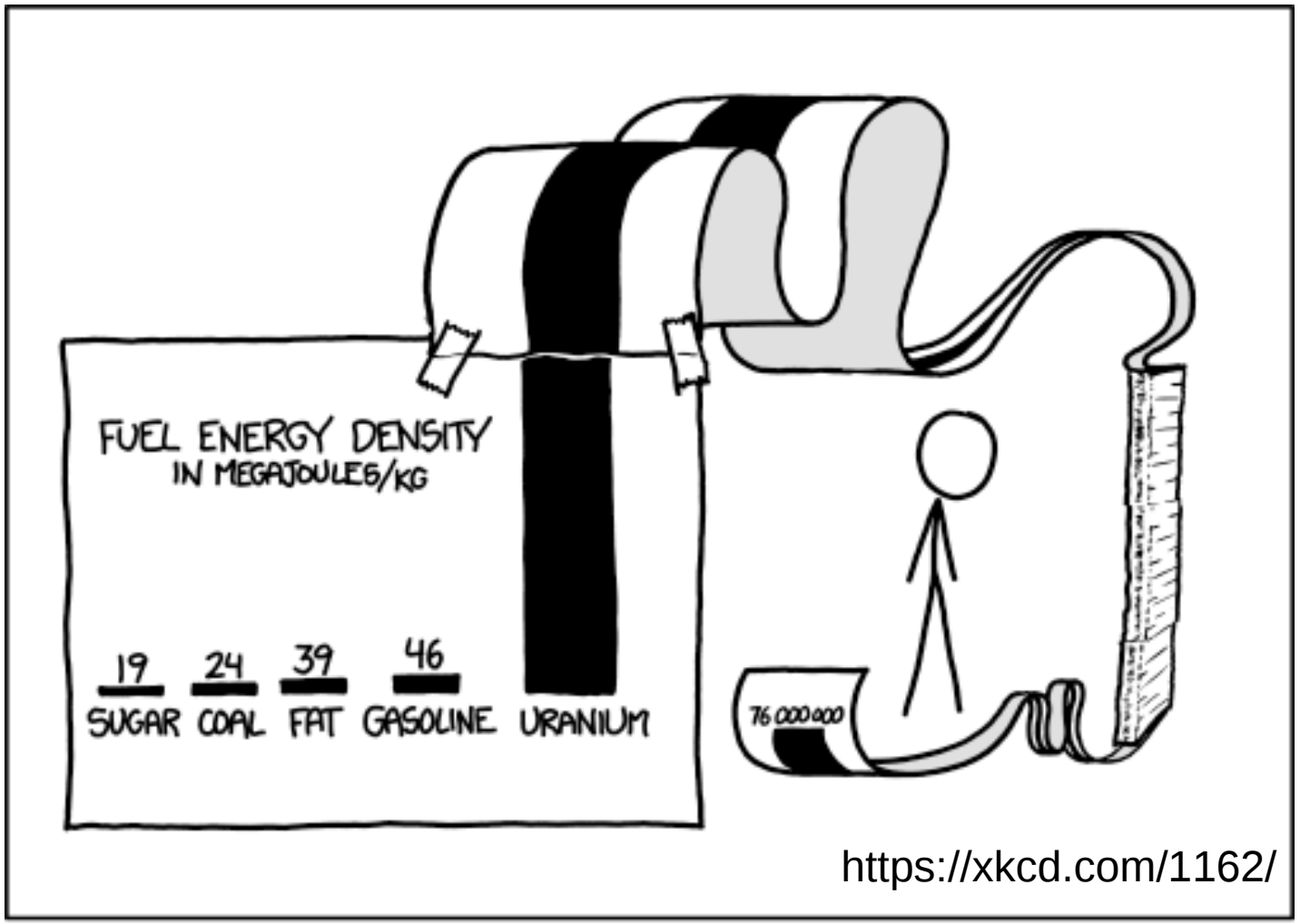


https://en.wikipedia.org/wiki/File:Alfa_beta_gamma_radiation_penetration.svg

Nuclear chain reaction



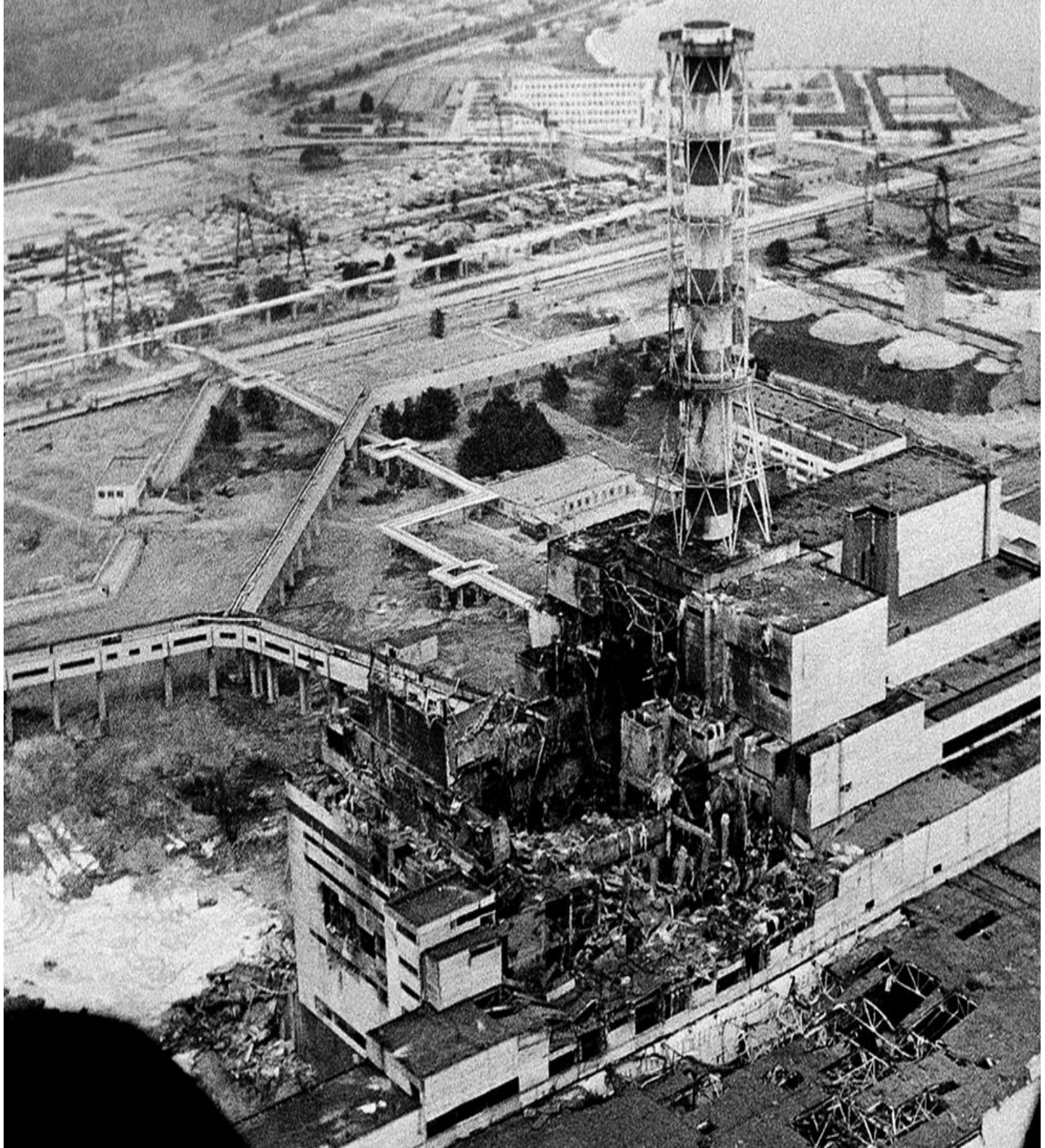
World capacity: 5.5 hopper cars of coal per second
or 1.5 hopper cars/week of uranium



SCIENCE TIP: LOG SCALES ARE FOR QUITTERS WHO CAN'T FIND ENOUGH PAPER TO MAKE THEIR POINT *PROPERLY.*

Source: TVA

Major Issues



Chernobyl Health Effects

56 documented fatalities to date; ~4,000 thyroid cancers

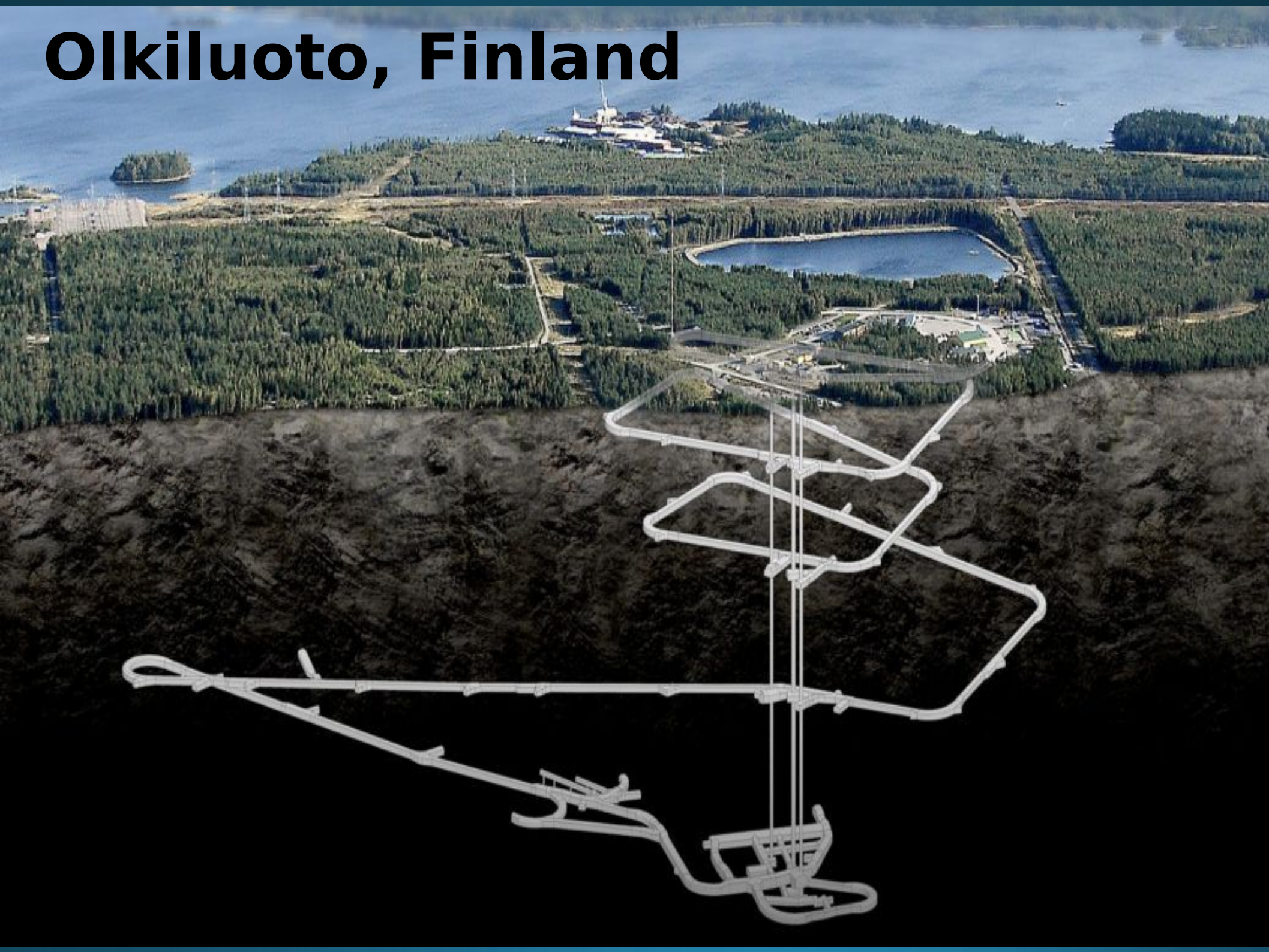
Possibly 4,000 – 14,000 eventual deaths among 600,000 "liquidators" (0.7% - 2.3%)

For Europe: modeling estimates 22,800 radiation cancers for 570 million people. This is 22.8K in addition to the 194 million *expected*

*"*However, in the course of years, the most significant problems have become the severe social and economic depression of the affected …regions and the associated serious psychological problems of the general public and emergency workers." *Chernobyl Forum*


SEAHAWKS

Olkiluoto, Finland



Radiation: Some Key Facts

My day? Well, first I went to the tanning salon. Then I had an appointment at the doctor's for a CT scan of my back, *finally*. For lunch, I microwaved some left-overs, and then, of course, I rushed down to the pharmacy to get some iodine pills because of Fukushima!

Ramsar, Iran

Direct Federal Subsidies in Energy

Table ES2. Quantified energy-specific subsidies and support by type, FY 2010 and FY 2013

million 2013 dollars

Beneficiary	Direct Expenditures	Tax Expenditures	Research and Development	DOE Loan Guarantee Program	Federal and RUS Electricity	Total	ARRA Related
2013							
Coal	74	769	202	-	30	1,075	129
Refined Coal	-	10	-	-	-	10	-
Natural Gas and Petroleum Liquids	62	2,250	34	-	-	2,346	4
Nuclear	37	1,109	406	-	109	1,660	29
Renewables	**8,363**	**5,453**	**1,051**	**-**	**176**	**15,043**	**8,603**
Biomass	332	46	251	-	-	629	369
Geothermal	312	31	2	-	-	345	312
Hydropower	197	17	10	-	171	395	216
Solar	2,969	2,076	284	-	-	5,328	3,137
Wind	4,274	1,614	49	-	-	5,936	4,334
Other	209	-	380	-	5	594	229

U.S. Energy Info. Admin. “Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013”; 2015

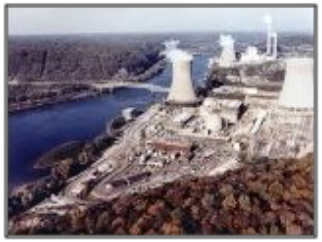
Advanced Reactors

The nuclear generations

Generation IV: Nuclear Energy Systems Deployable no later than 2030 and offering significant advances in sustainability, safety and reliability, and economics

Generation I

Early Prototype Reactors



–Shippingport
–Dresden, Fermi I
–Magnox

Generation II

Commercial Power Reactors

–LWR–PWR, BWR
–CANDU
–VVER/RBMK

Generation III

Advanced LWRs

–ABWR
–System 80+
–AP600
–EPR

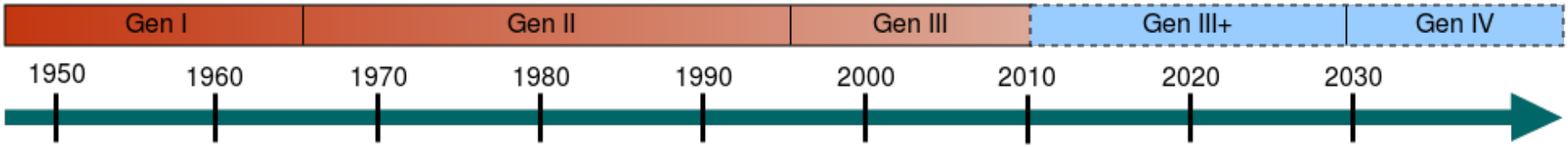
Near-Term Deployment

Generation III+ Evolutionary Designs Offering Improved Economics

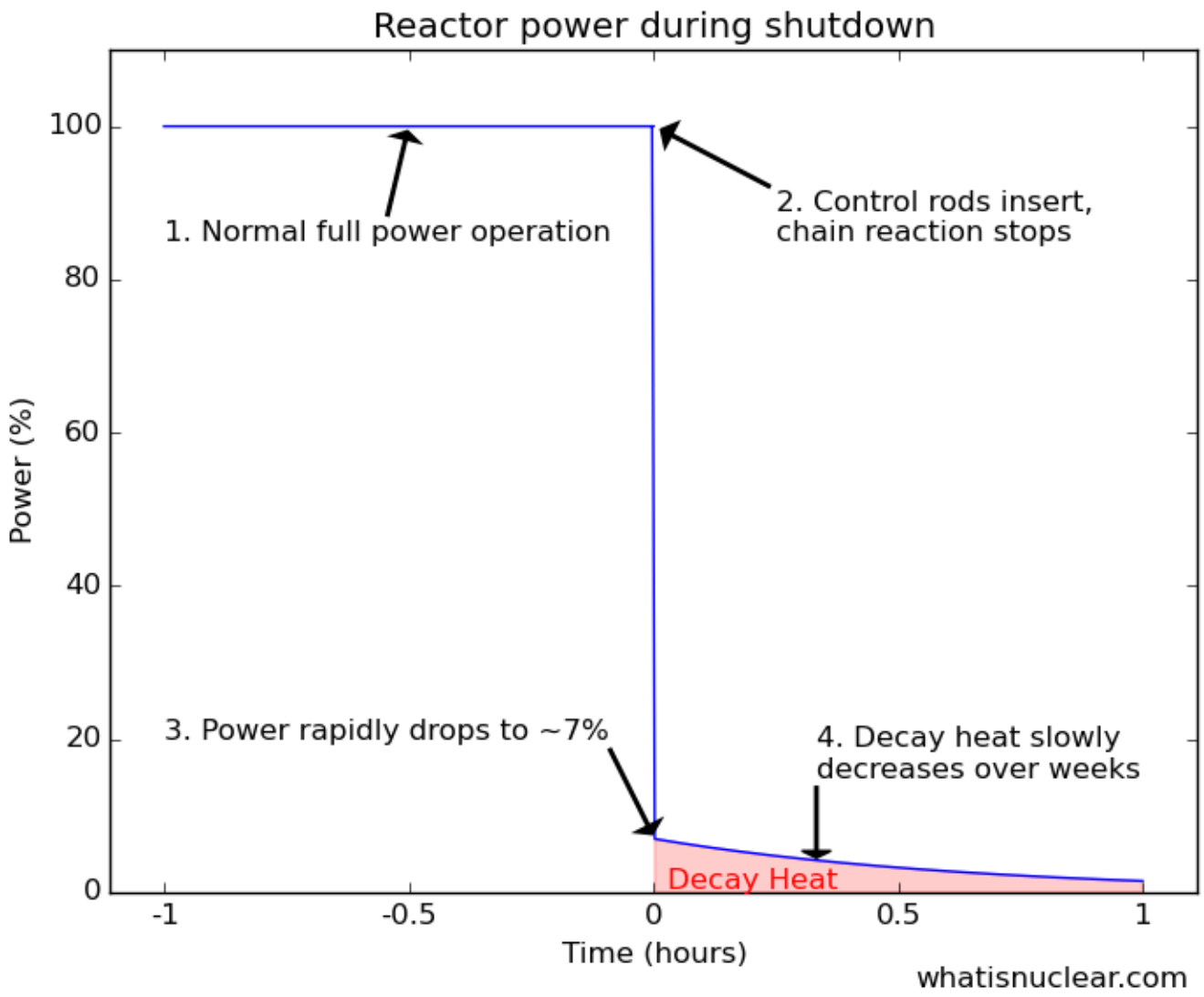
.....

Generation IV

–Highly Economical
–Enhanced Safety
–Minimal Waste
–Proliferation Resistant



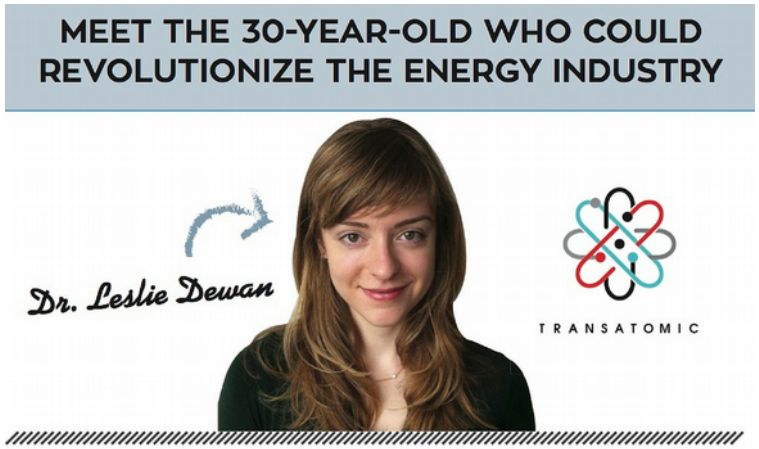
Not all the energy comes out at once

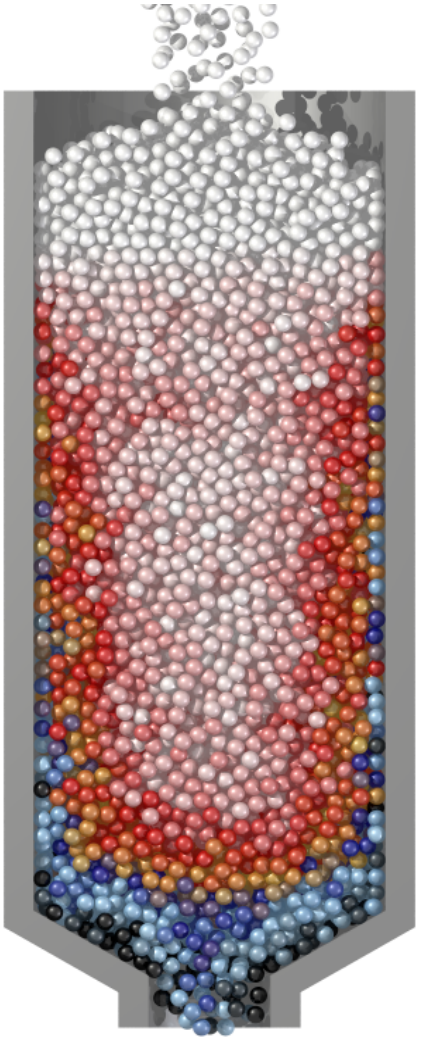


Natural safety demonstration

EBR-II By Argonne National Laboratory-West - www.anlw.anl.gov/divisions/facilities/EBR_II_Page/EBRII_Frameset.htm

More advanced reactors

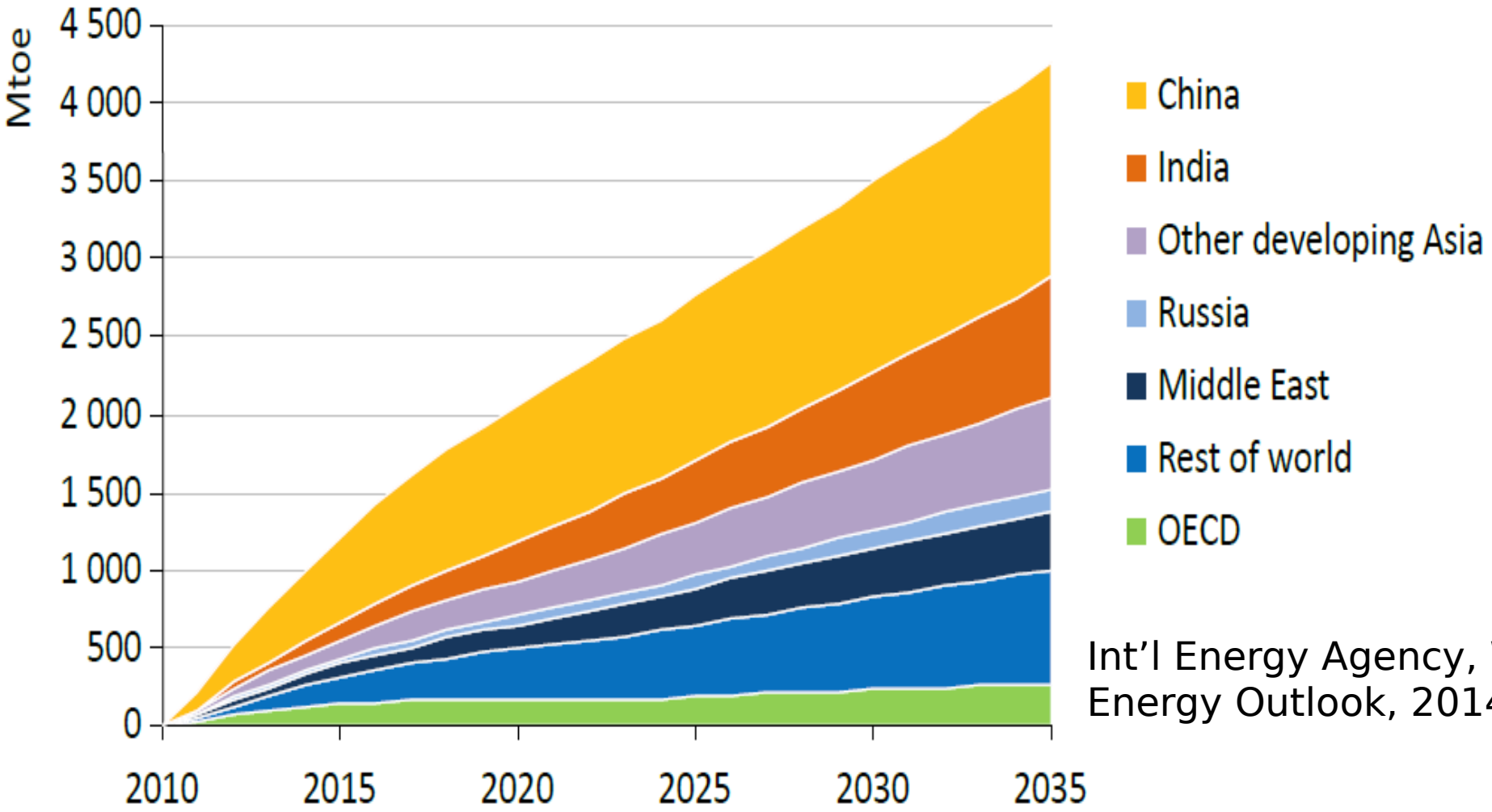




http://people.seas.harvard.edu/~chr/research/granular/

Nuclear Energy in the World

Future Demand for Electricity

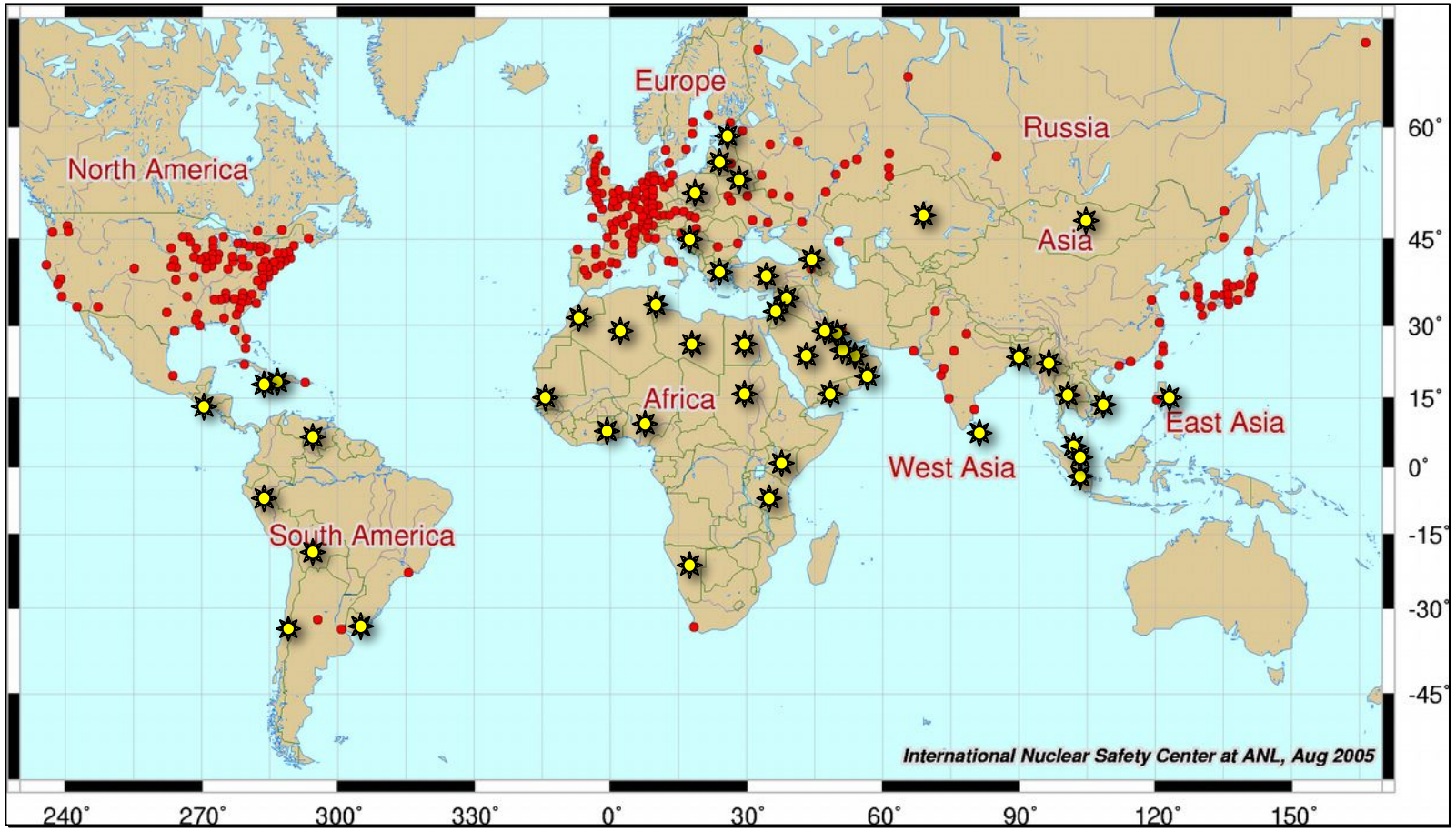


Int'l Energy Agency, World Energy Outlook, 2014

A Globalizing Energy Source

409 reactors operating in 30 nations

60 new reactors being built (Oct 2016); 513 planned



Nuclear power plants in the world, 2005

How to help & get more info

Help out

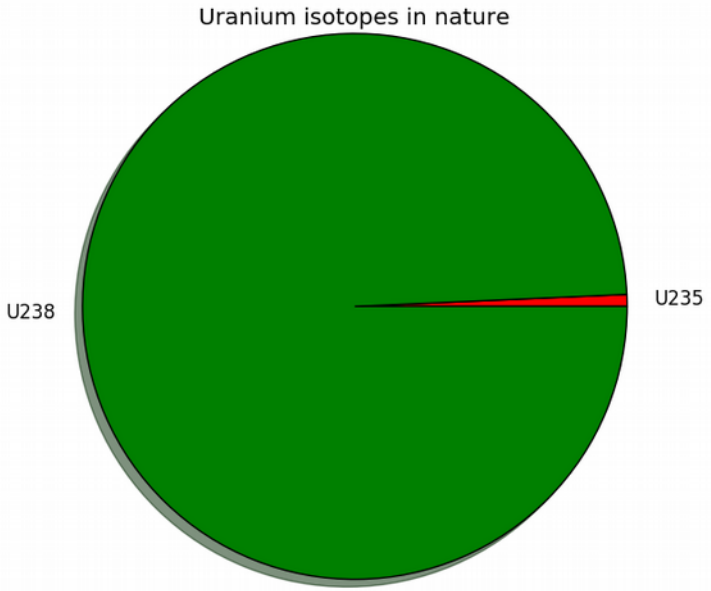
- Price carbon
- Tell friends
- Learn more

More Info

- whatisnuclear.com
- world-nuclear.org
- International Atomic Energy Agency (iaea.org)
  - Chernobyl forum
  - Fukushima info
- US Energy Info Administration (eia.gov)
- Pandora’s Promise (on Netflix!)

Thank you!

Key Nuclear Physics: Isotopes



92
U
238.02

Only tiny amounts (<0.006%) of U found in nature is U-234

0.7% of U found in nature is U-235

99.3% of U found in nature is U-238

Many more unstable nuclides exist on each side	92p 141n U-233 1.6E5 yr	92p 142n U-234 2.4E5 yr	92p 143n U-235 7.0E8 yr	92p 144n U-236 2.3E7 yr	92p 145n U-237 6.7 days	92p 146n U-238 4.5E9 yr	92p 147n U-239 23 mins