Build Th Bridges!

Ancillary Technologies Like Actinium-225 Can Help Traverse Thorium Energy's Valley of Death

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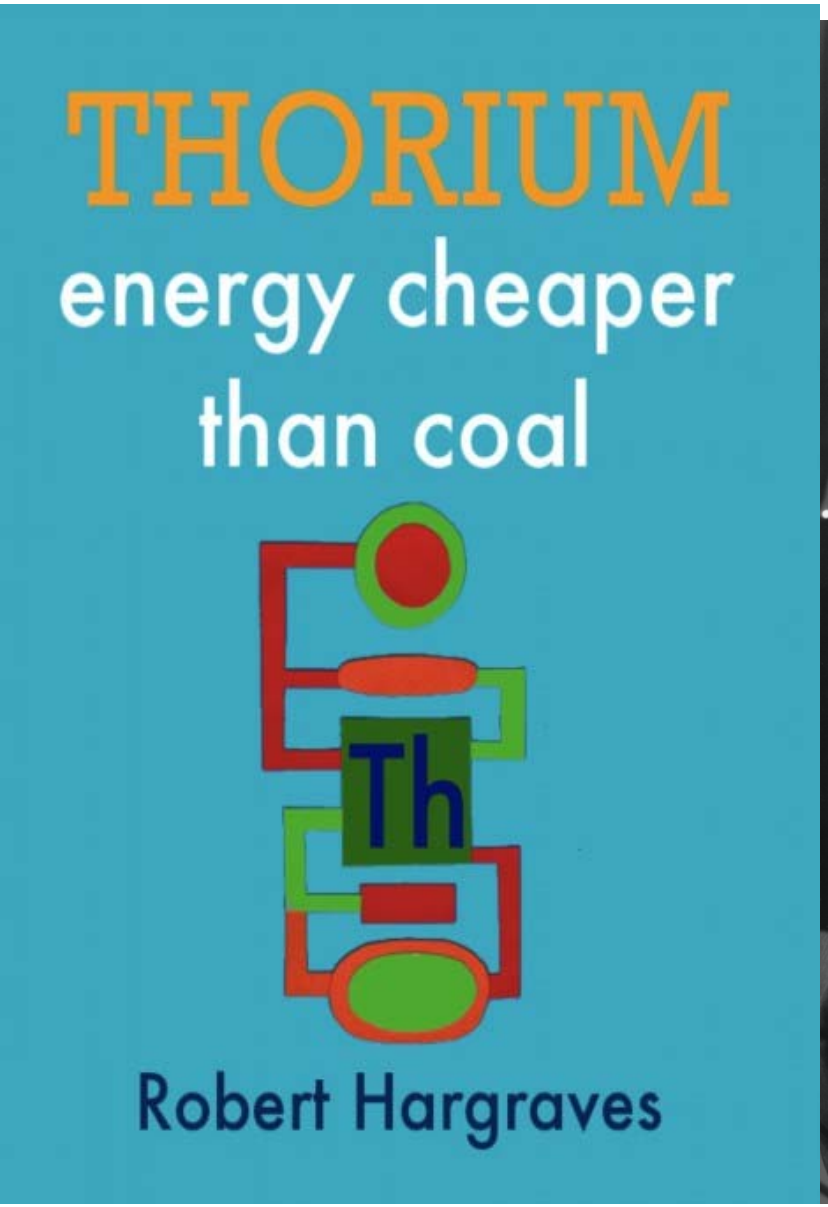
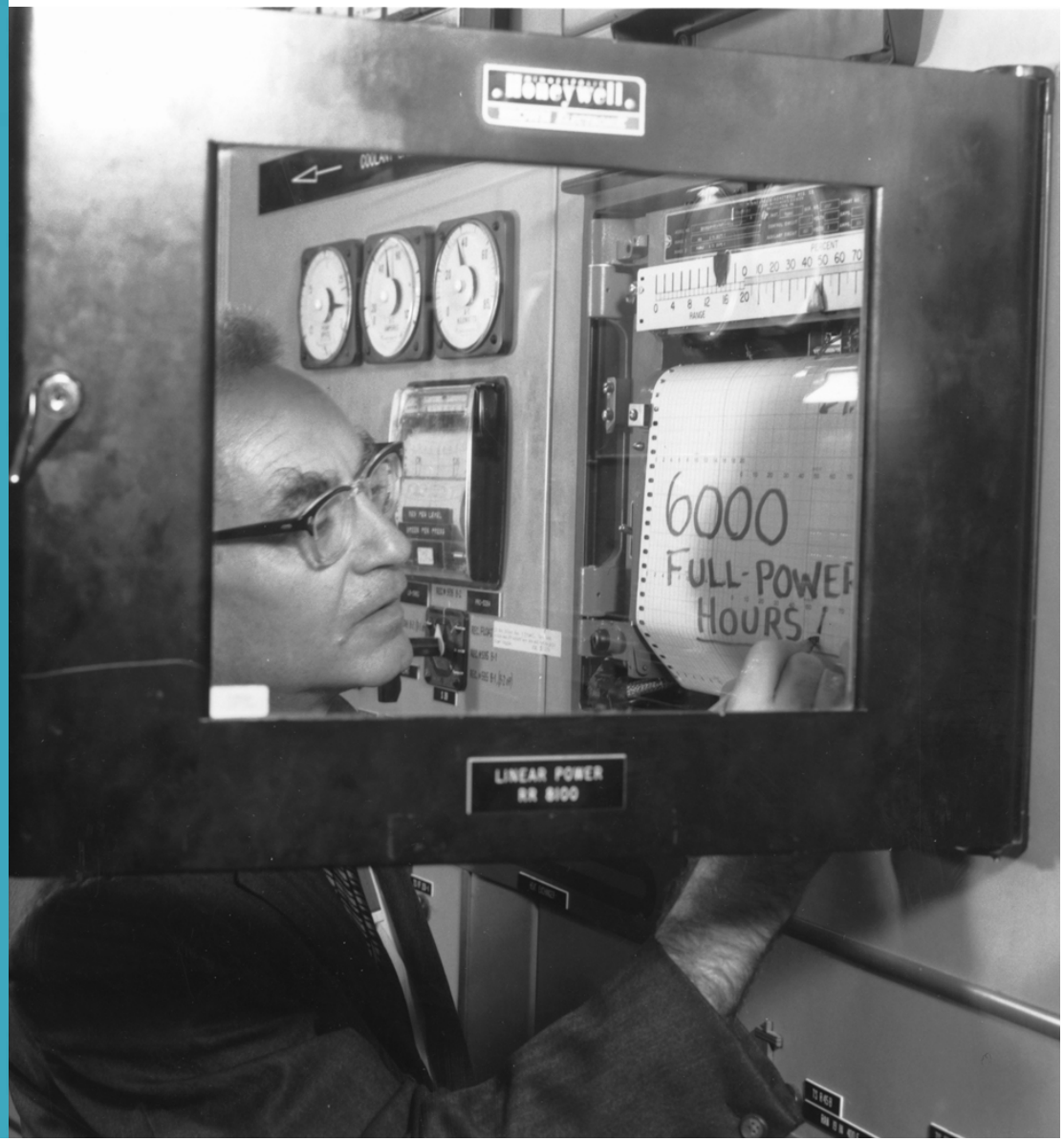
FARADAY GIVING HIS CARD TO FATHER THAMES

And we hope the Dirty Fellow will consult the learned Professor.

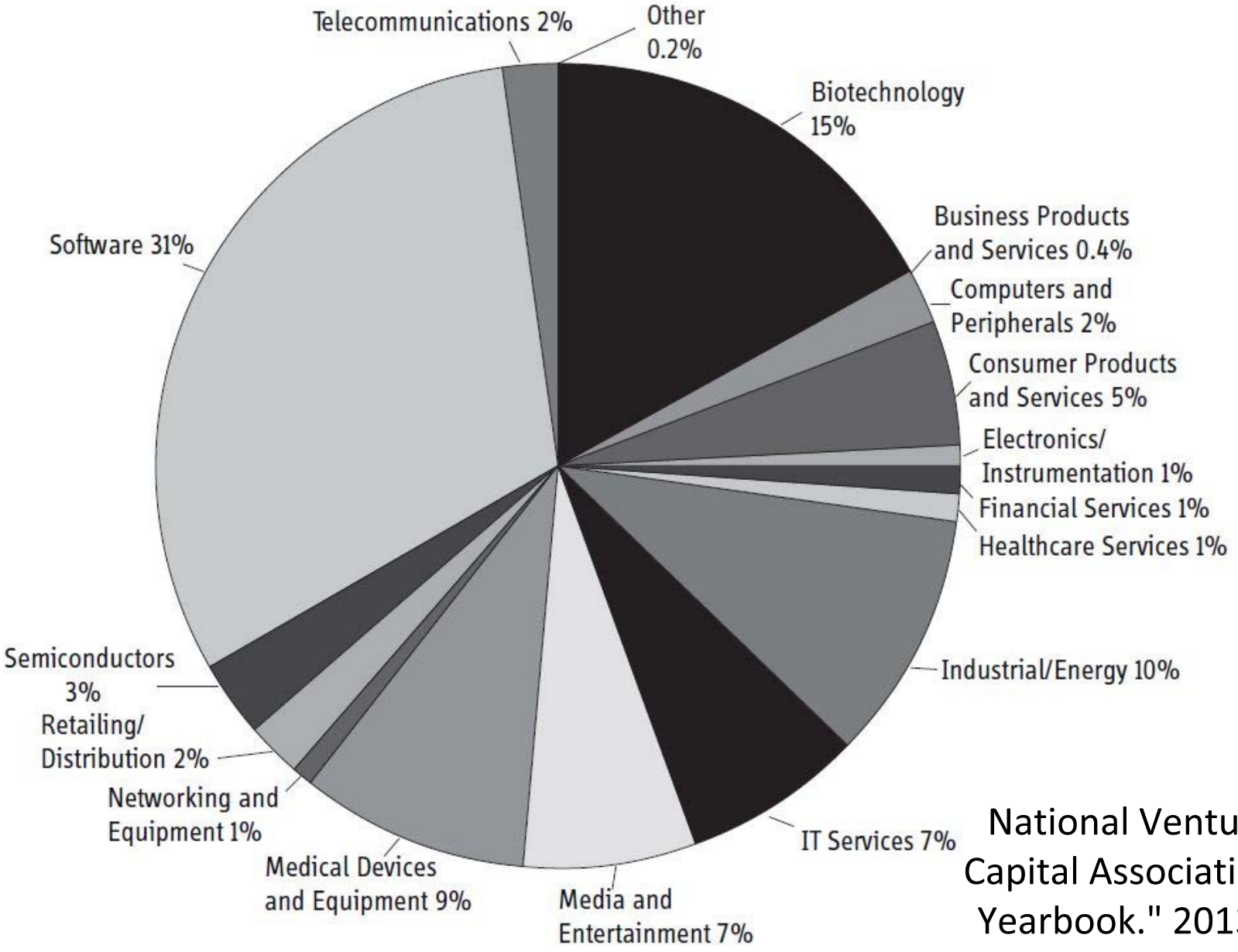
Thorium Energy Can Dominate the World Energy Market





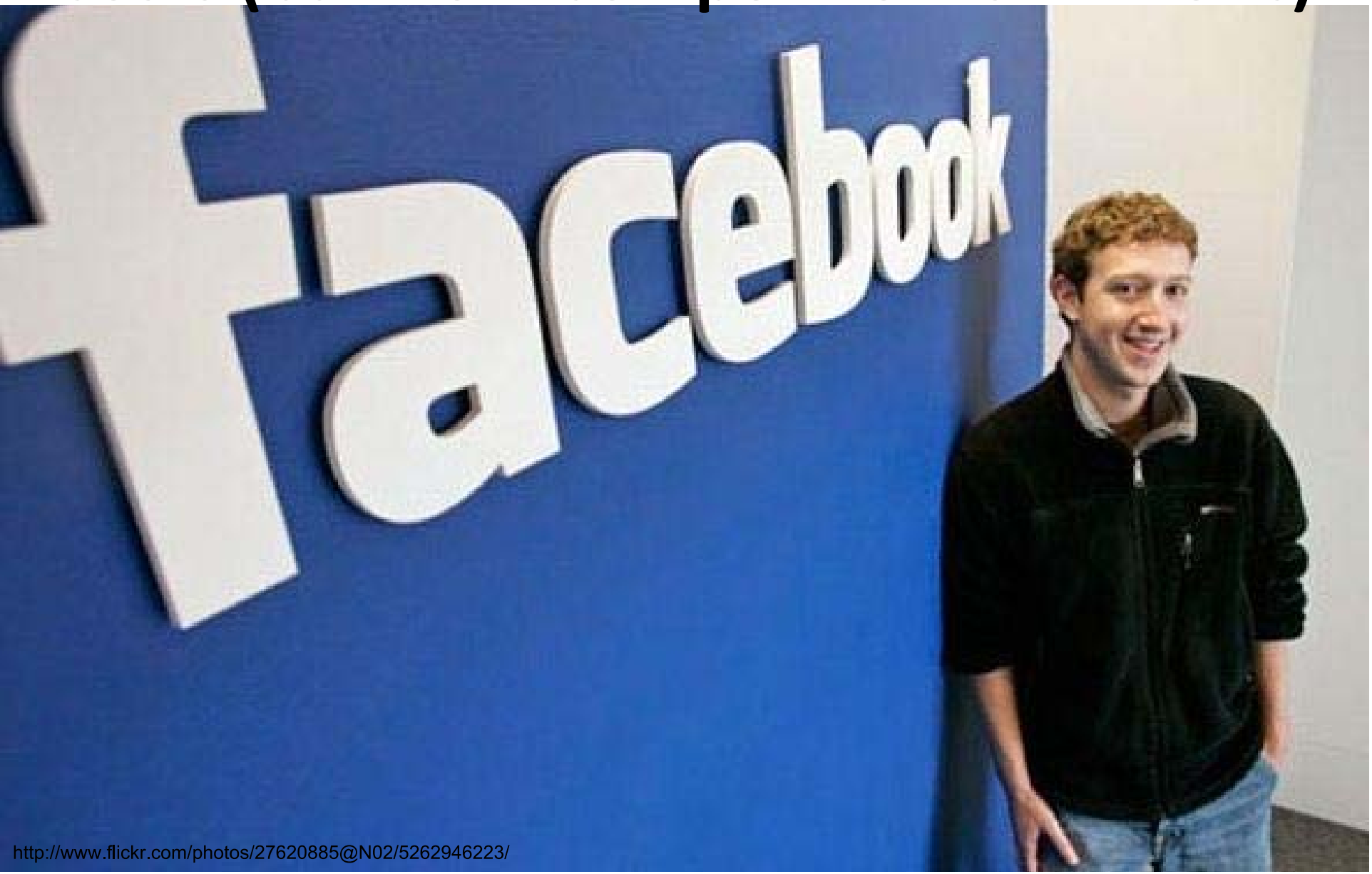
Pollyanna Plans Alienate Stakeholders

10% of 2012 VC Funding Went to Energy



National Venture Capital Association Yearbook." 2013. 10 May. 2013

Software is Popular Due to Small Initial Costs (but Now Competition is Mimetic)



http://www.flickr.com/photos/27620885@N02/5262946223/

A Straight Th Energy Moonshot has a Large “Valley of Death”

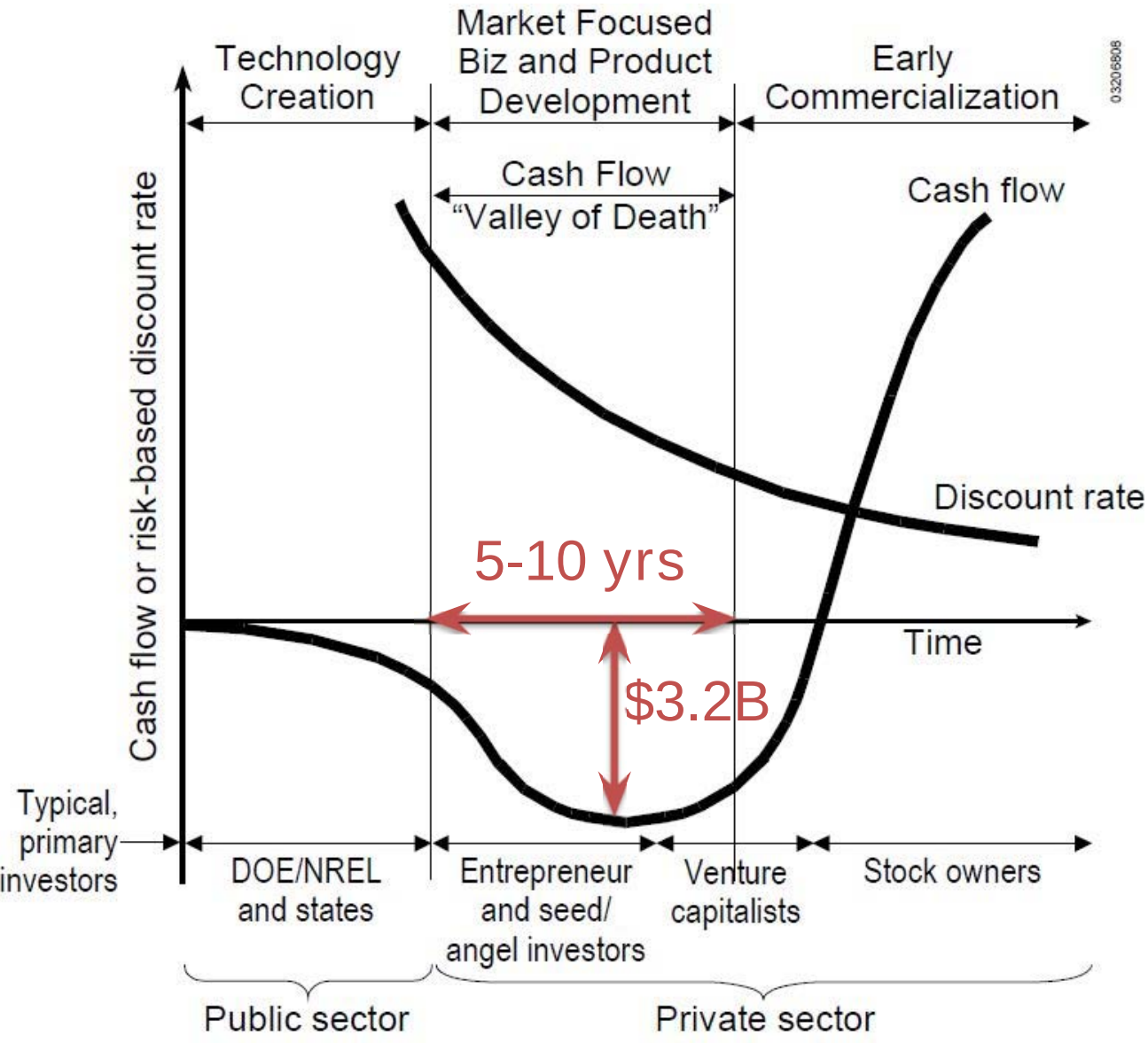
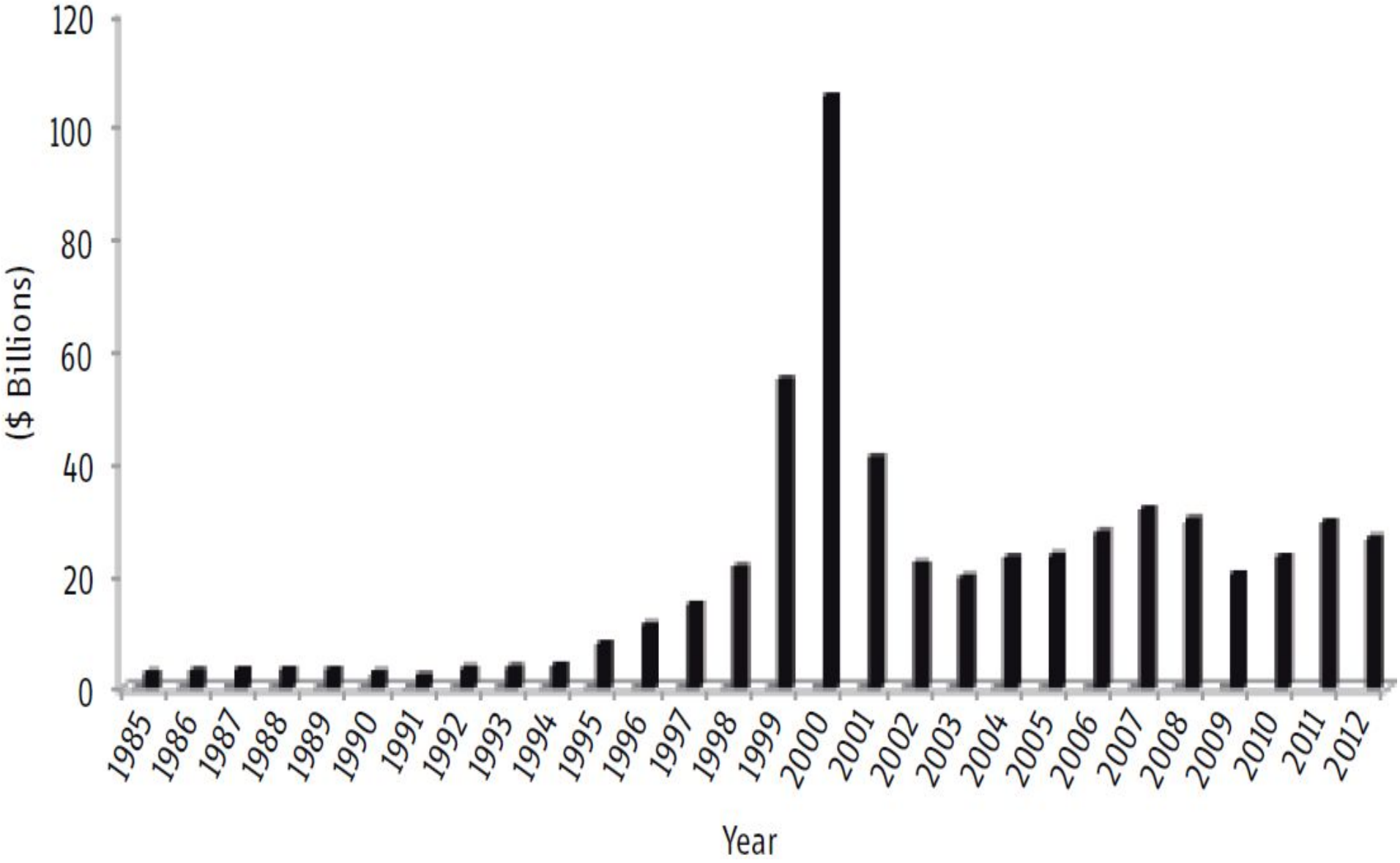


Figure From:
Murphy, LM. "Bridging the Valley of Death: Transitioning from Public to ... - NREL." 2003. <http://www.nrel.gov/docs/gen/fy03/34036.pdf>

Red Annotations from:
McNeese, LE et Al.. “Program Plan for Development of Molten-Salt Breeder Reactors. - ORNL." 1974.

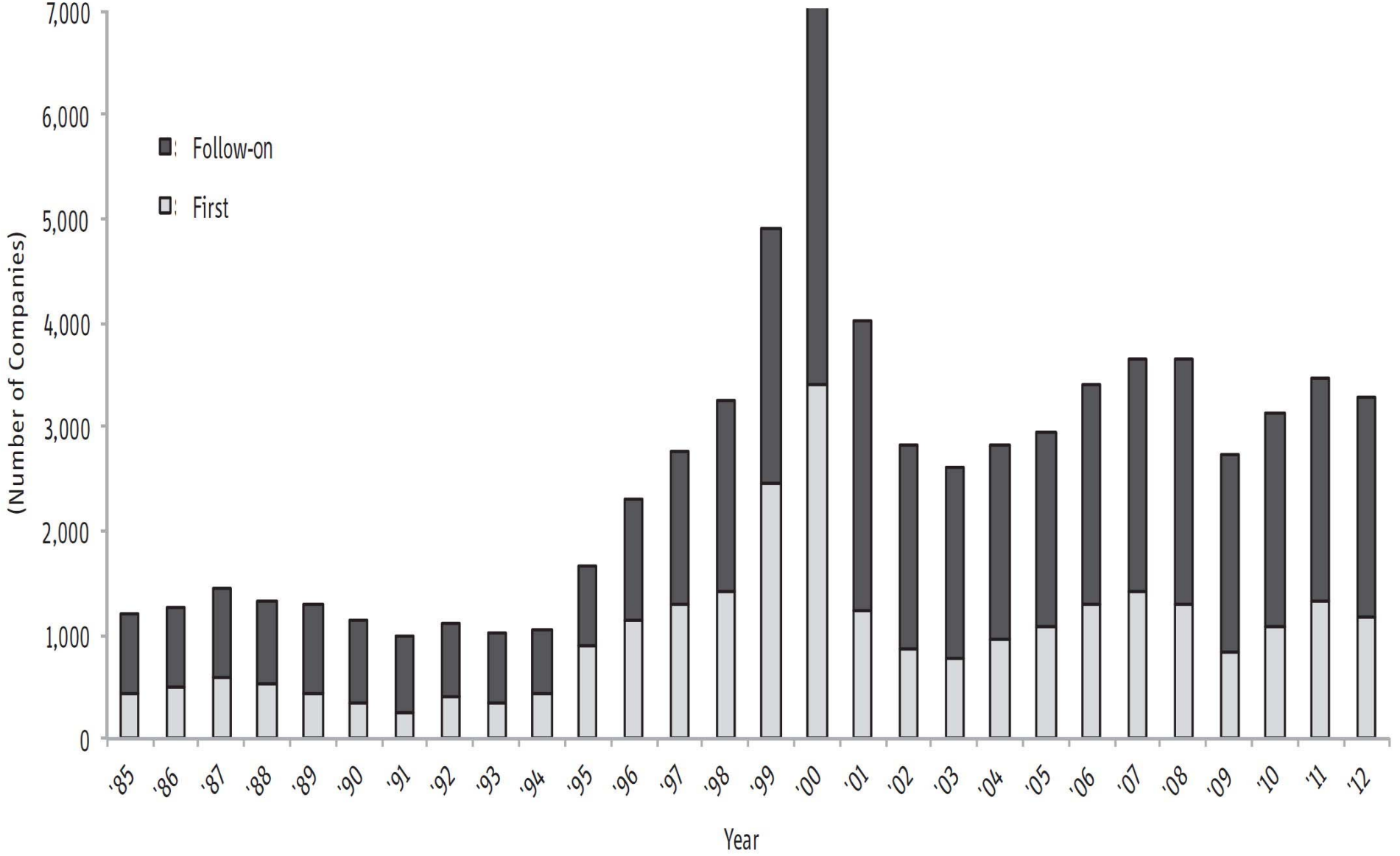
Costs in 2012 Dollars

Venture Investments are Trending $25B/yr



National Venture Capital Association Yearbook." 2013. 10 May. 2013

Spread Across 3200 Companies



National Venture Capital Association Yearbook." 2013. 10 May. 2013

Capitalization Rate=40x Mean/Venture

The JOBS Act Limits Crowd Equity Offerings to Less Than $1 Million per Year

The US Government is Worse Than Rip Van Winkle on Thorium Energy

Actor Joseph Jefferson as Rip van Winkle, by Napoleon Sarony in 1869.

NRC CFR Title 10, §171.11: Exemptions

(a) An annual fee is not required for:

…

(2) Federally-owned and State-owned research reactors used primarily for educational training and academic research purposes. For purposes of this exemption, the term research reactor means a nuclear reactor that

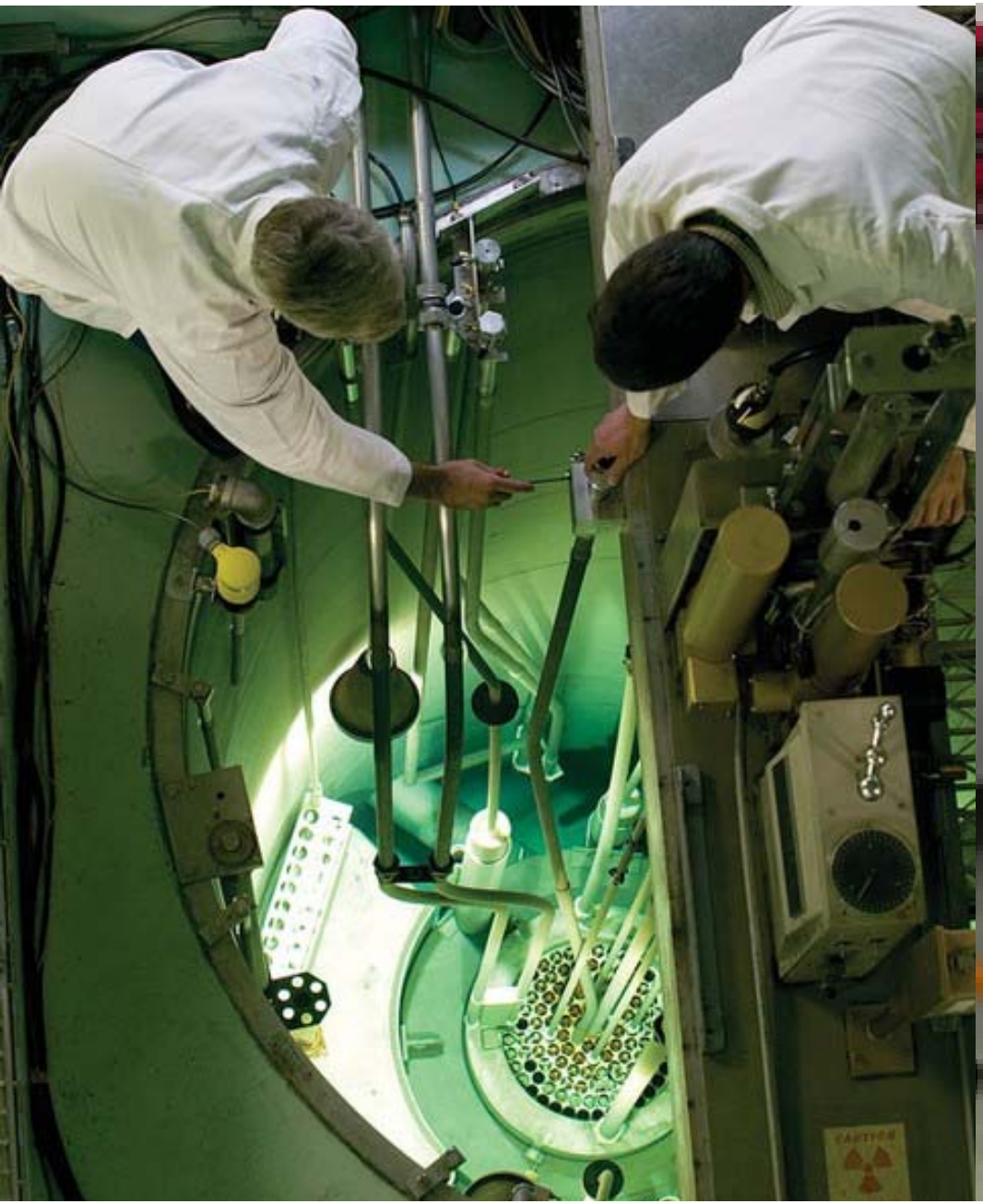
…

(ii) If so licensed for operation at a thermal power level of more than 1 megawatt, does not contain--

(A) A circulating loop through the core in which the licensee conducts fuel experiments;

(B) A liquid fuel loading; …

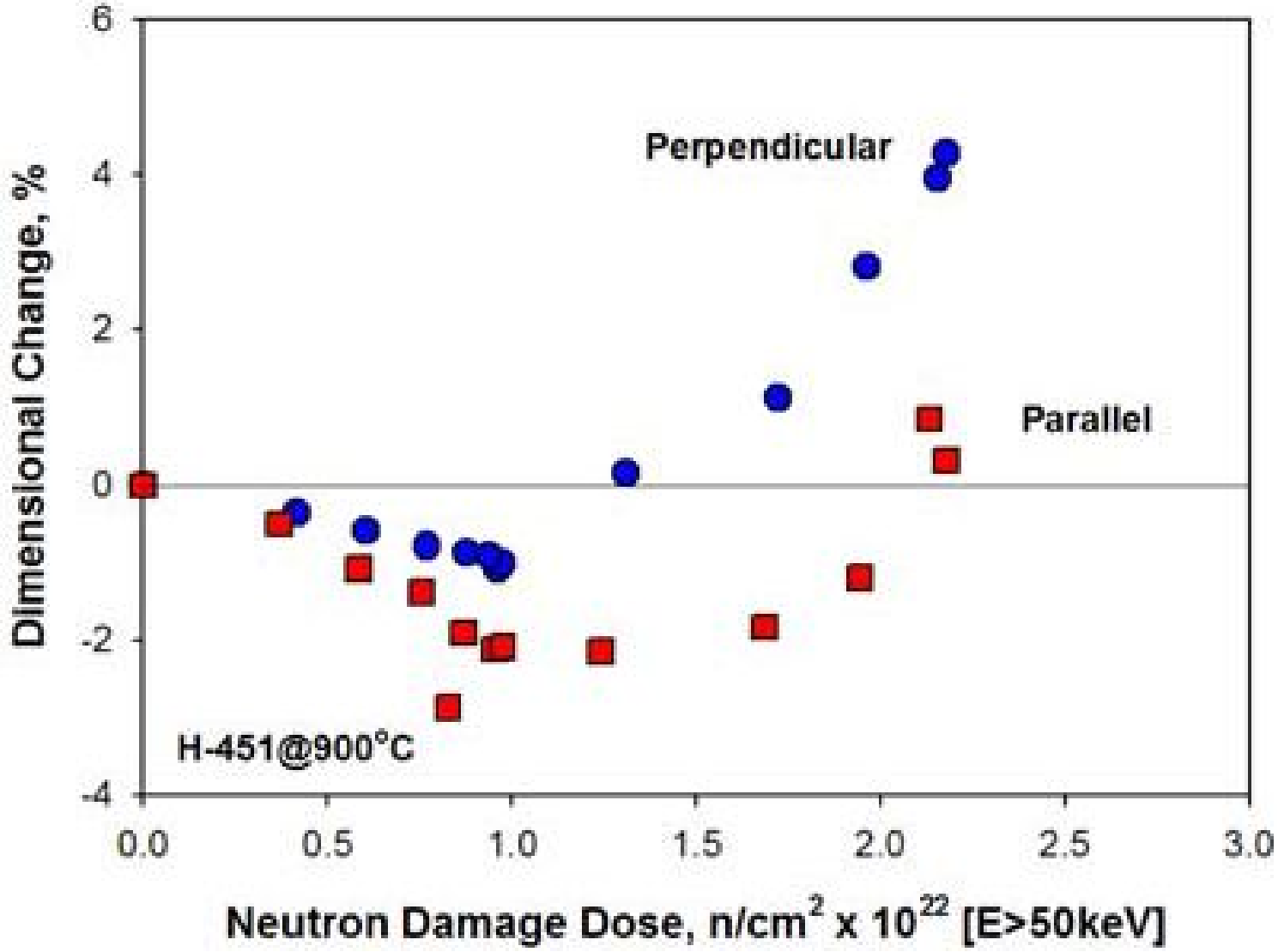
The TRIGA Reactor Makes >1 Megawatt



Licensing Th IP to Big Firms is Suboptimal

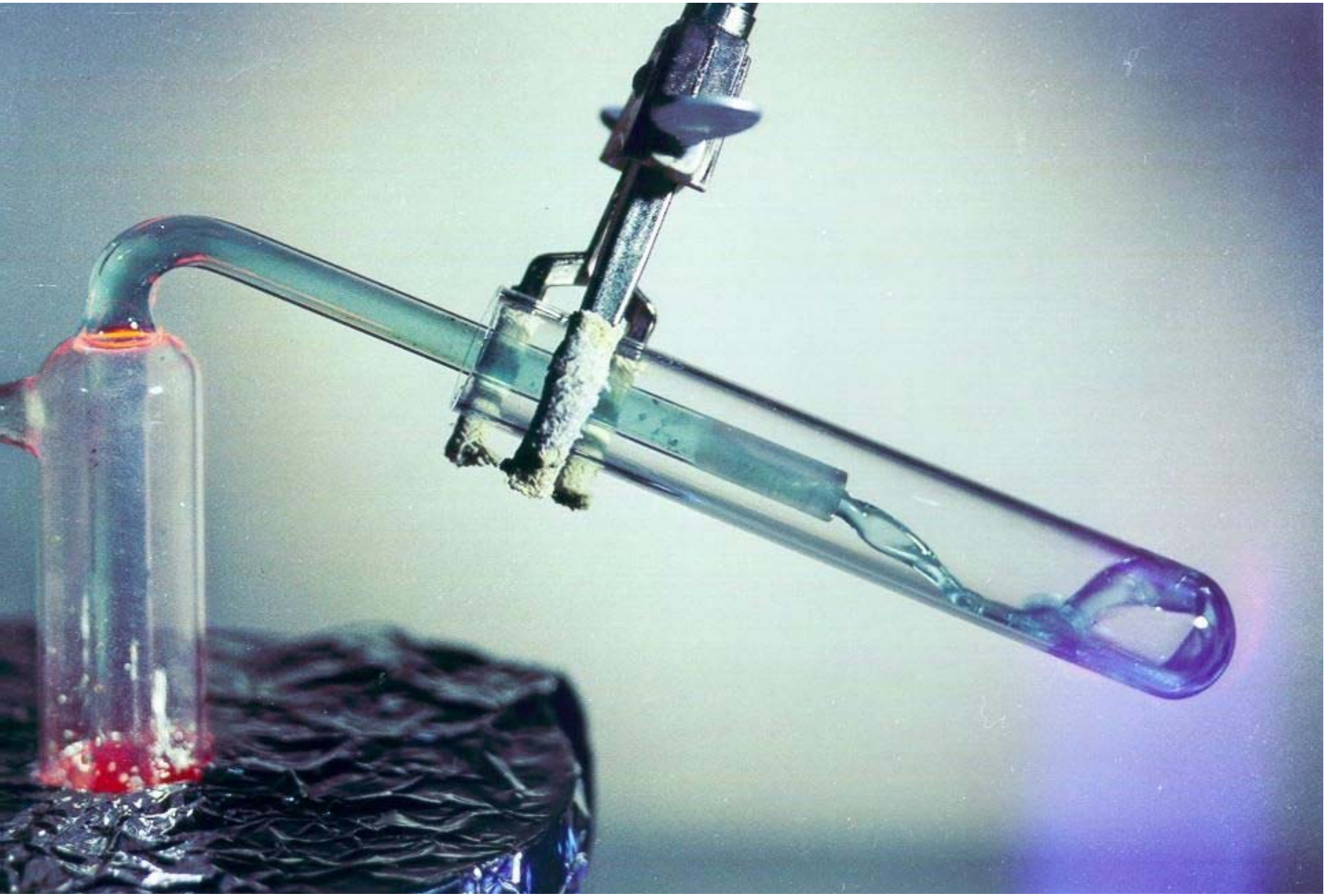
By Mike Knell from Zürich, Switzerland (Covent Garden - No Exit Uploaded by Oxyman) [CC-BY-SA-2.0 (http://creativecommons.org/licenses/by-sa/2.0)], via Wikimedia Commons

Viable Th IP Needs a Plumbing Solution

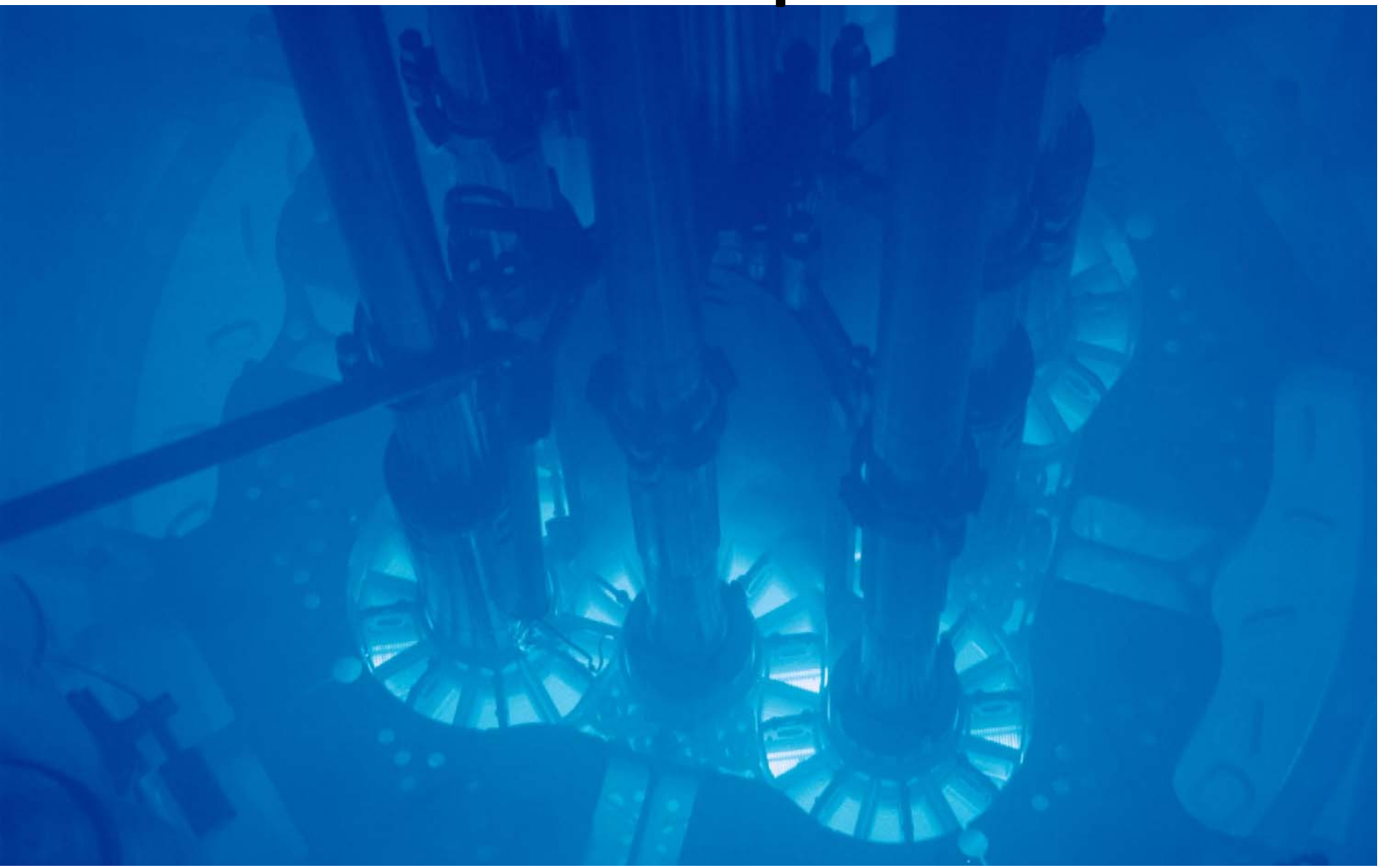


Burchell, T. "Neutron Irradiation Damage in Graphite and Its Effects on Properties." 2005. <http://www.ornl.gov/~webworks/cppr/y2001/pres/114924.pdf>

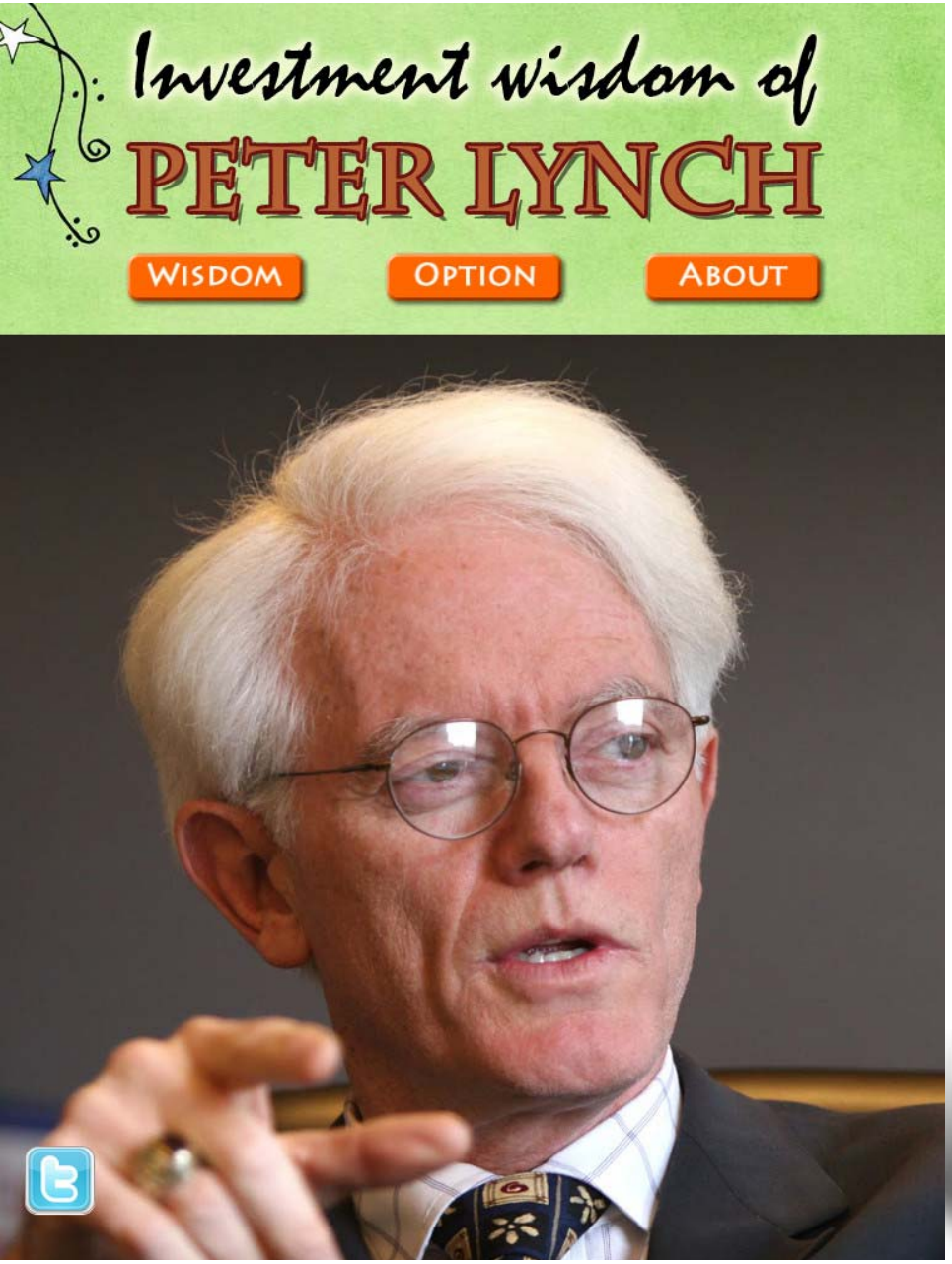
Solution Must Play Well With Fluorides

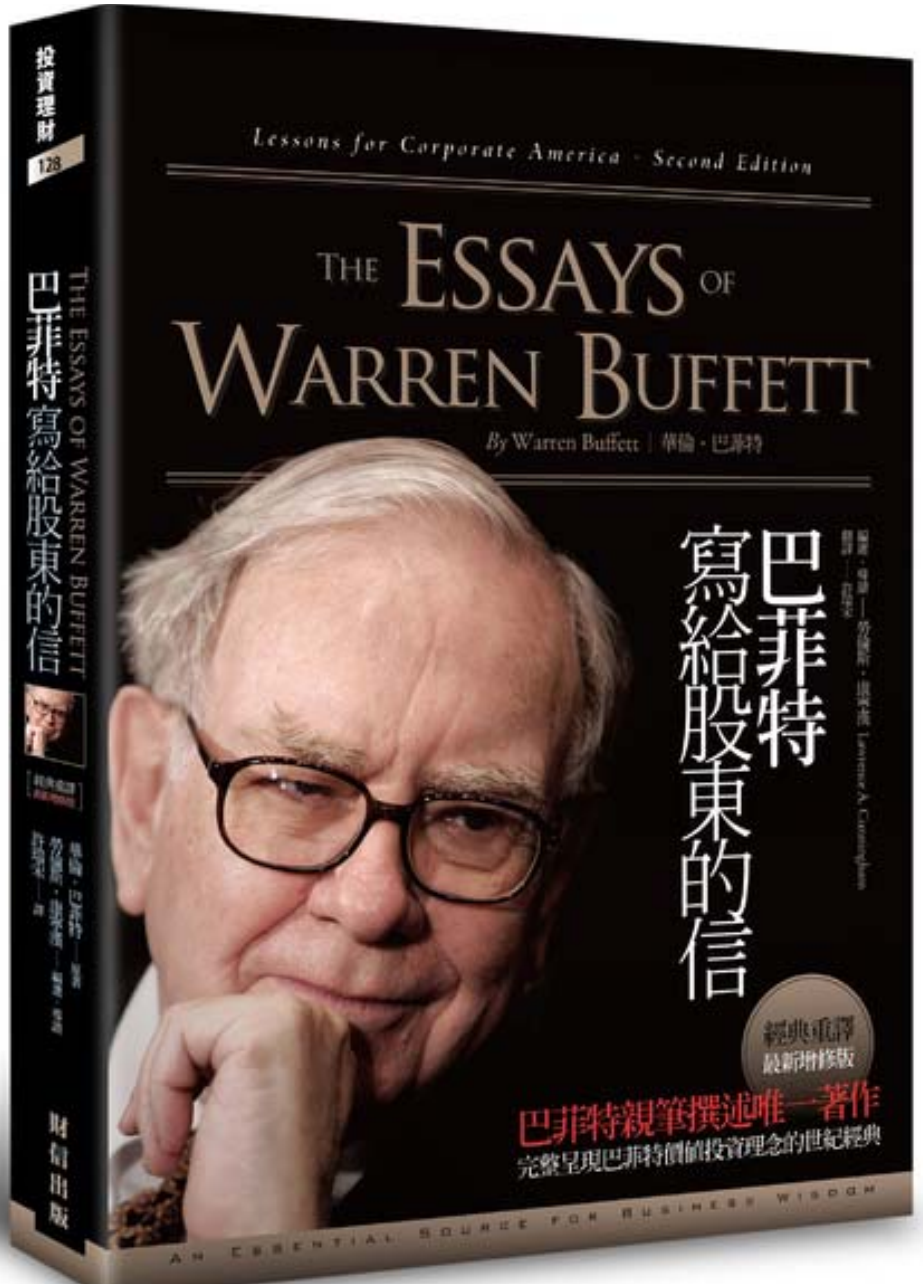


Without Proof of Concept, Buyer Assumes Risks and Expenses

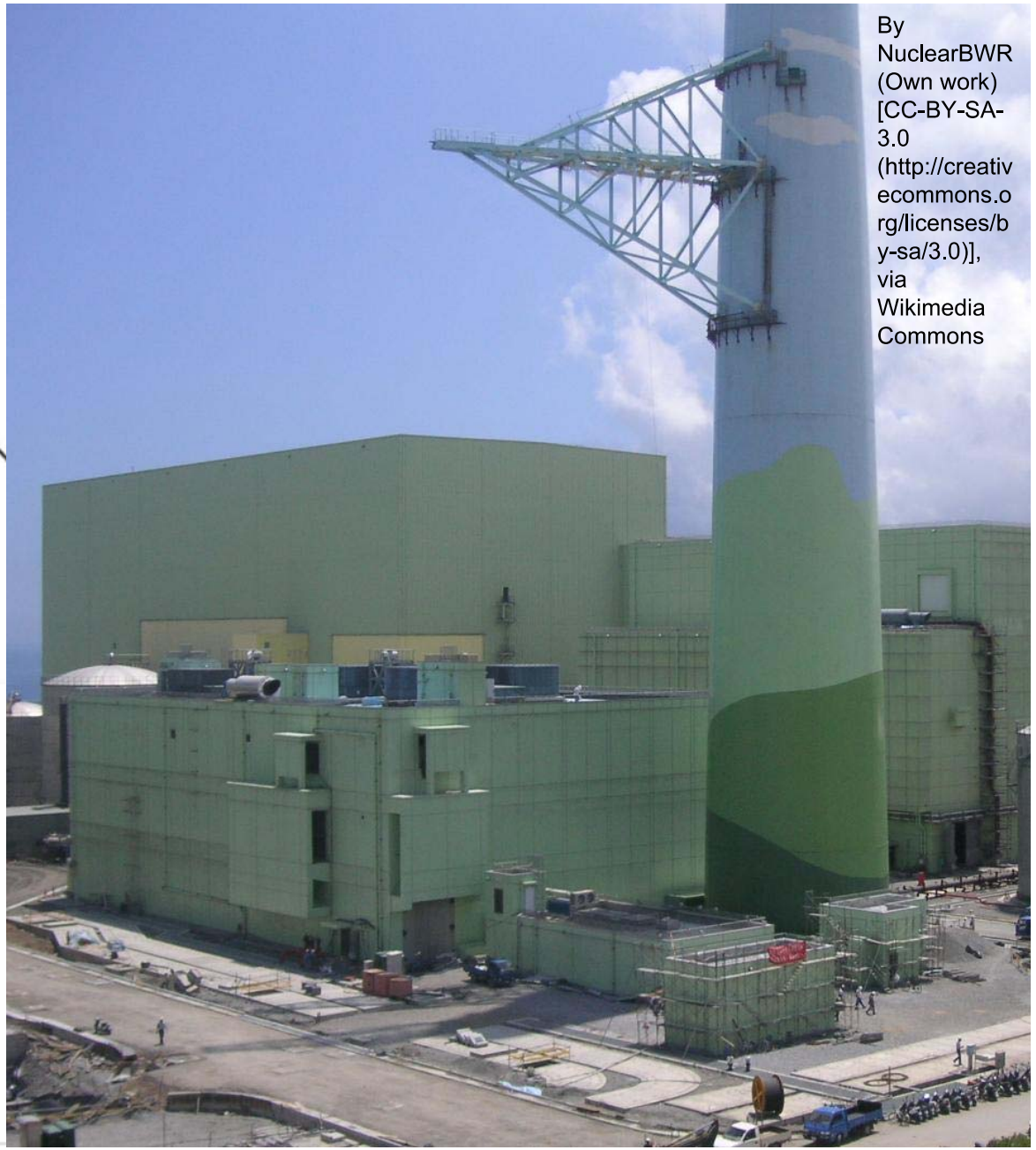


Firms Speculate in Fields They Know





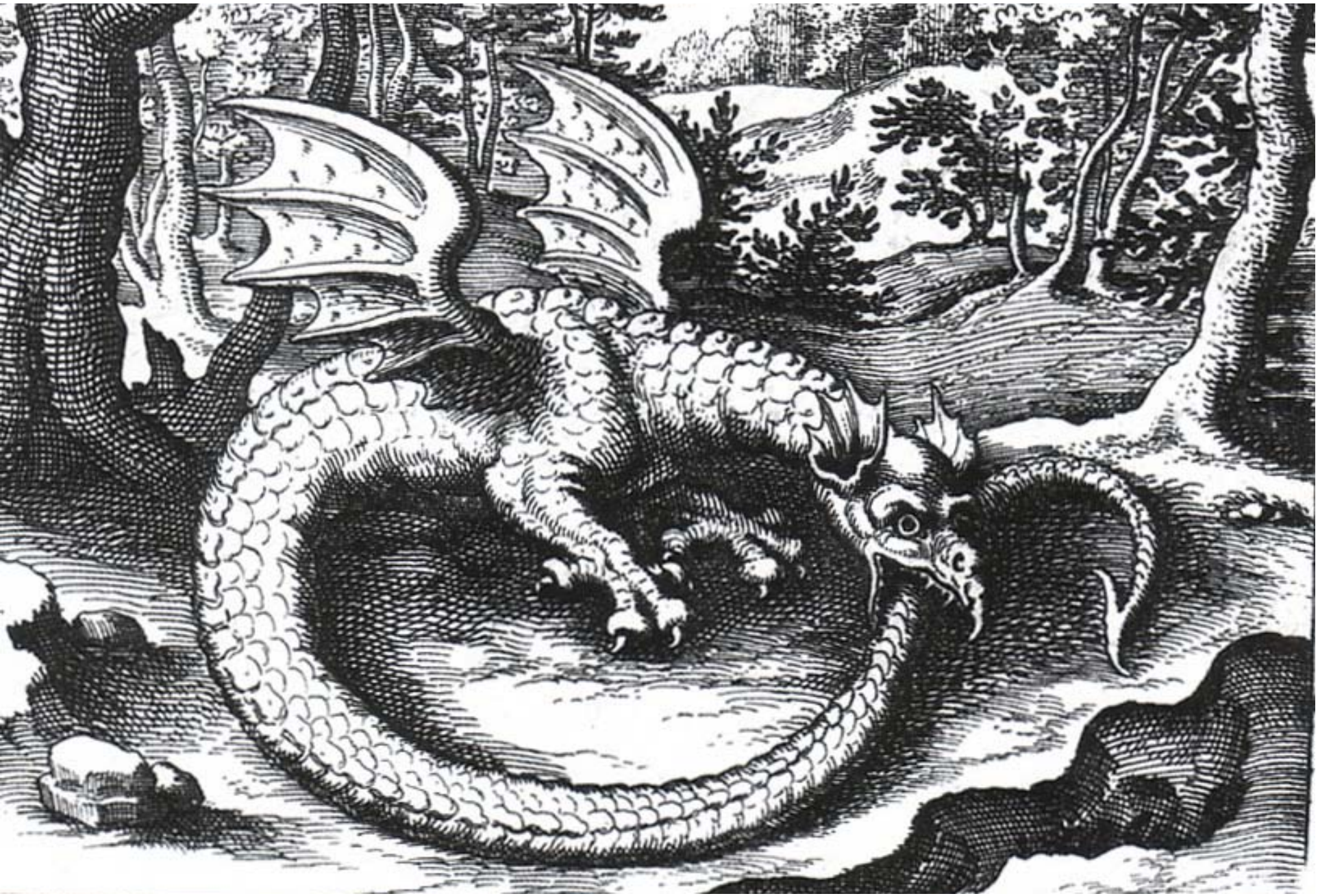
General Electric is 1 of 2 Candidates



By NuclearBWR (Own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

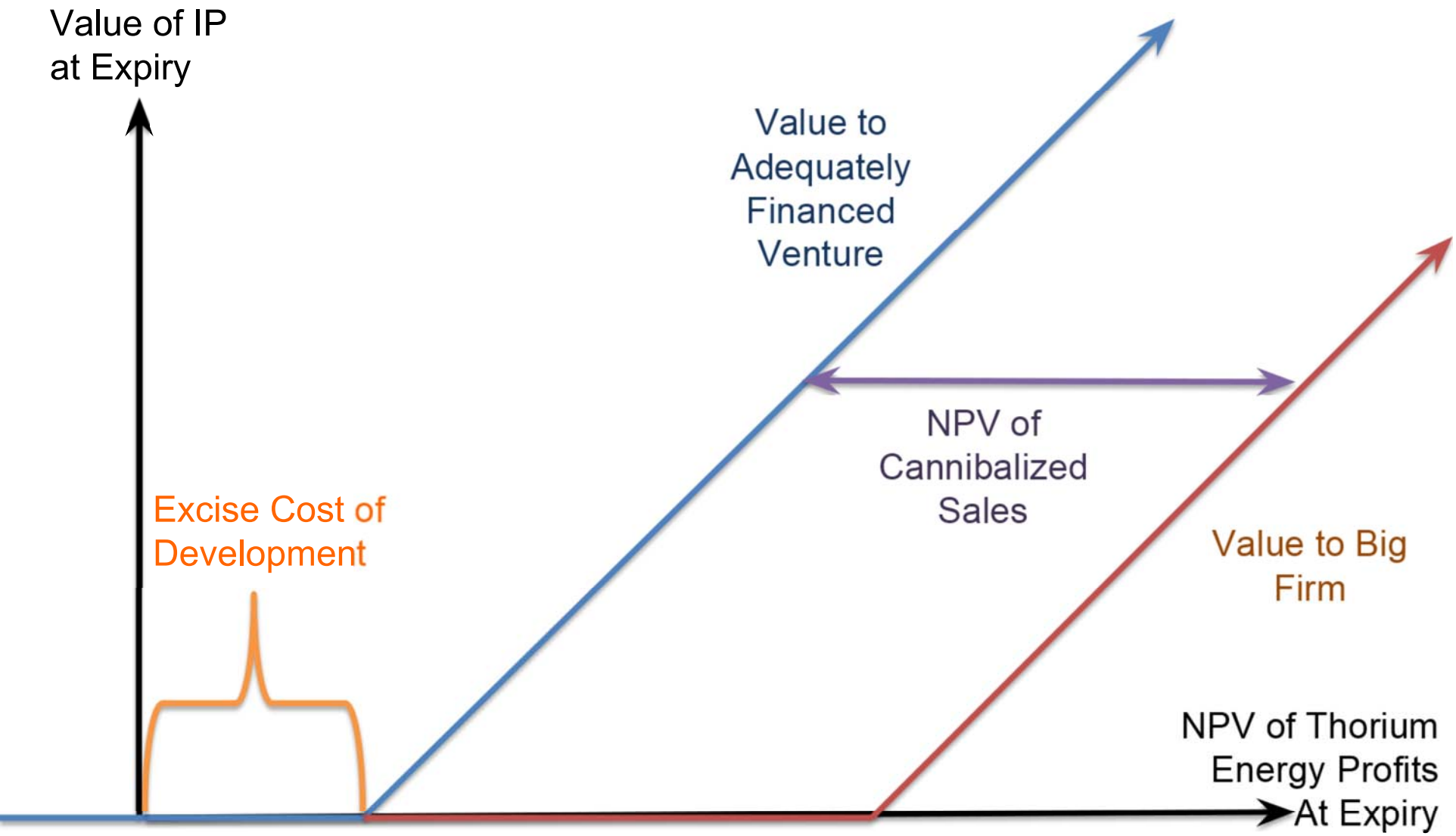
Westinghouse is the Other Candidate

Thorium Energy Cannibalizes Their Profits



Thorium Energy Cannibalizes Their Profits

Th IP Has More Moneyness to Startups



No Perceived Energy Crisis = No Pressure

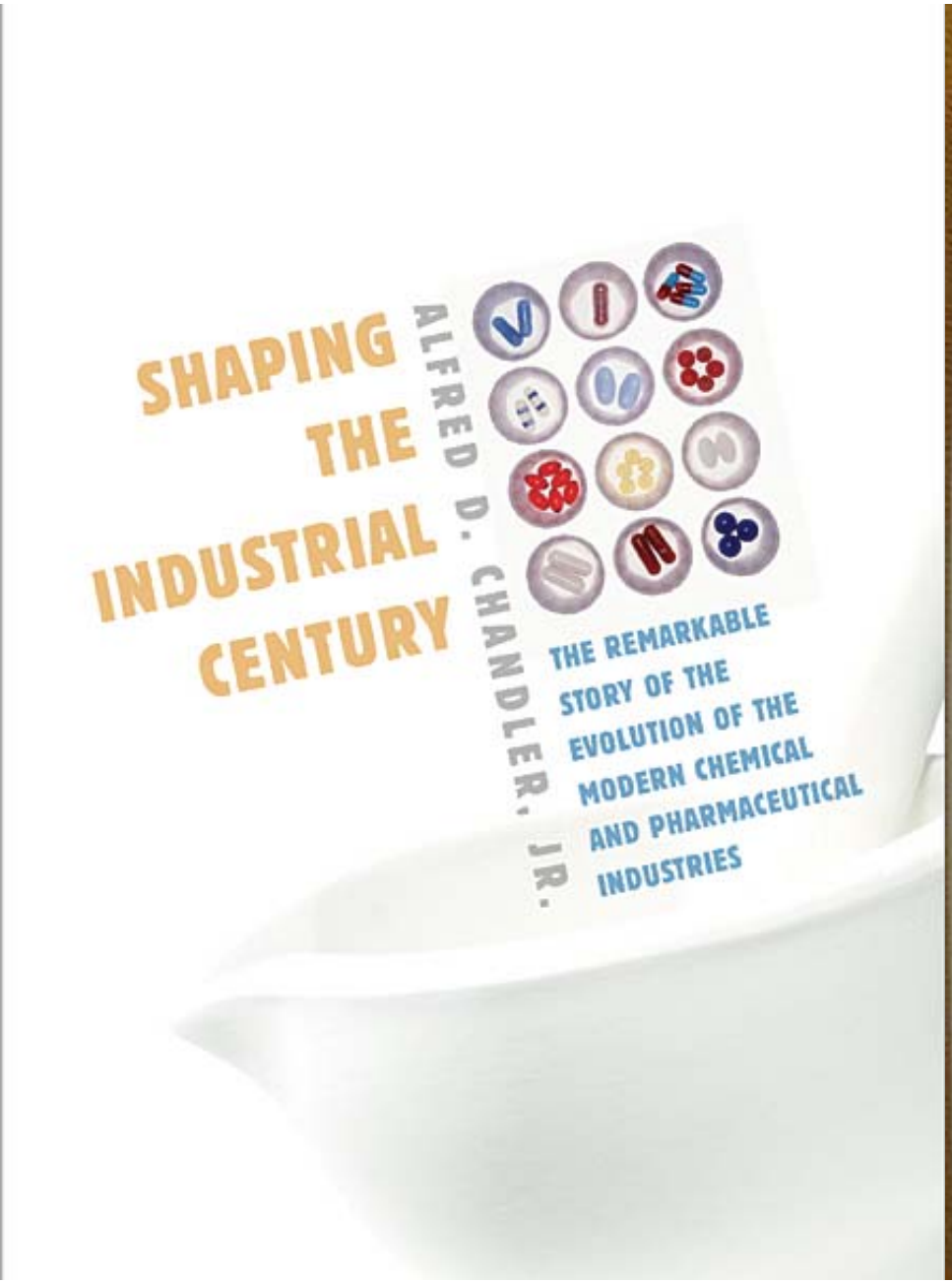
By Steve Jurvetson from Menlo Park, USA (T.Boone Pickens Uploaded by scillystuff) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons

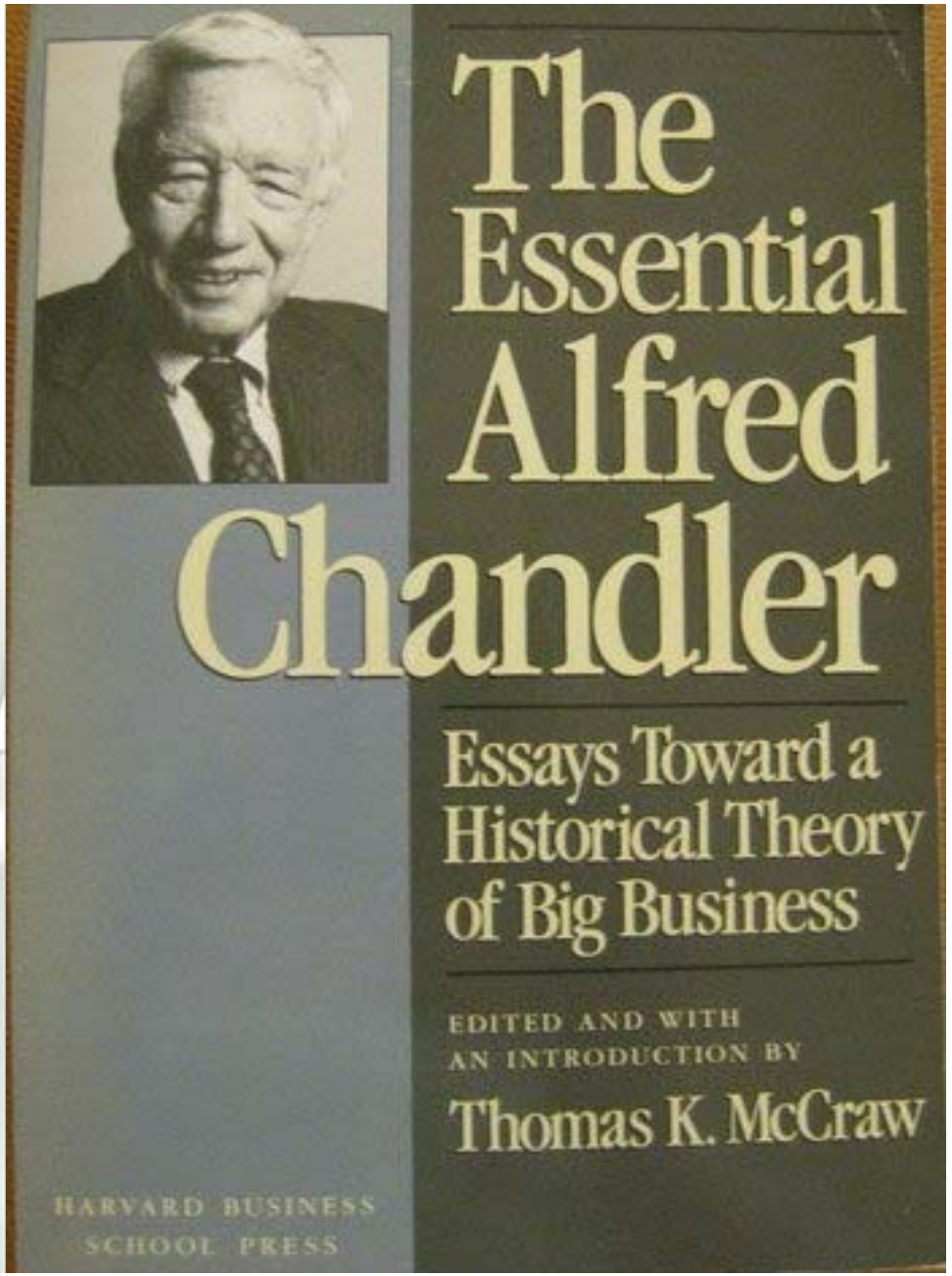
No Credible Threat of Market Entry, No Leverage to Negotiate

Big Firms Can Lay Siege to IP Fortresses

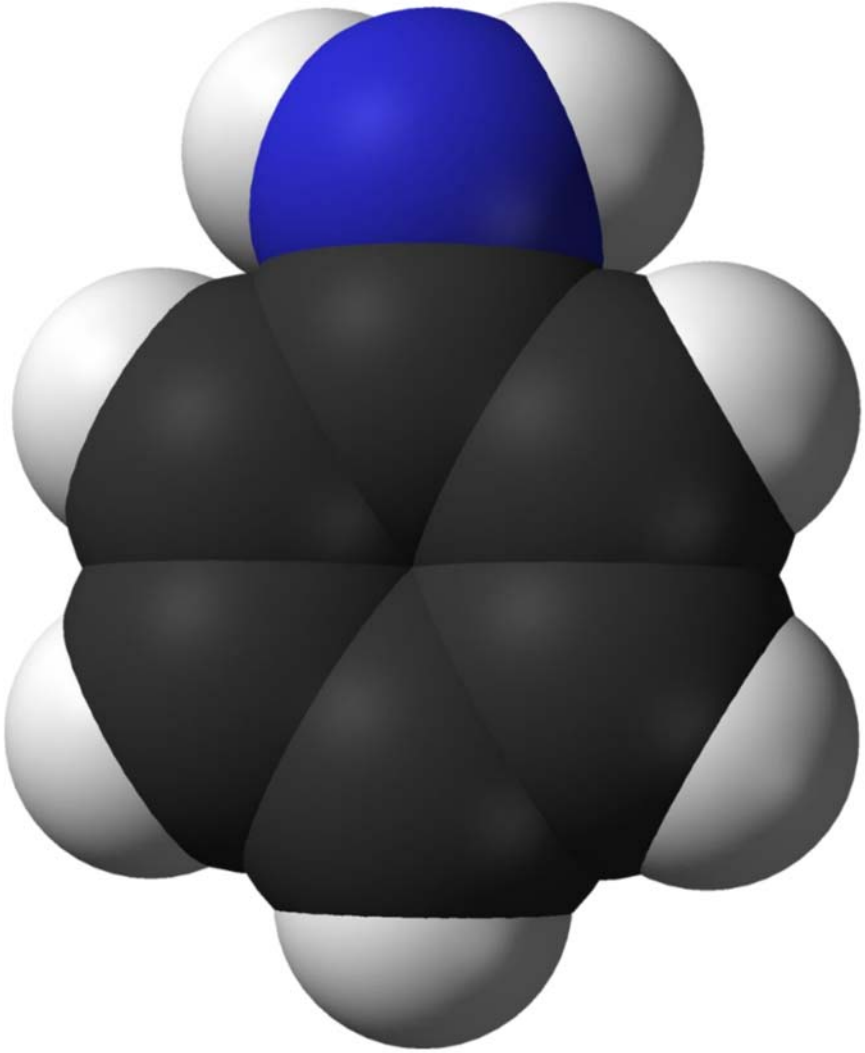
By JAN-PEETERS-I [Public domain], via Wikimedia Commons

Instead, Imitate the Chemical Industry





Bayer, Aventis and BASF all Started w/ Aniline Dye Derived from Coal Tar



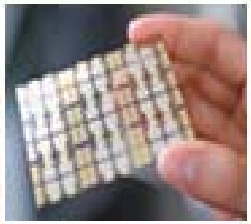
BASF Named Their Company After It

Aniline Established a “Learning Base” that Supported Further Innovation

Organizational Capability to Go from Lab Bench to Commercial Product

Resources, environment and climate	Food and nutrition	Quality of life

Chemistry as enabler

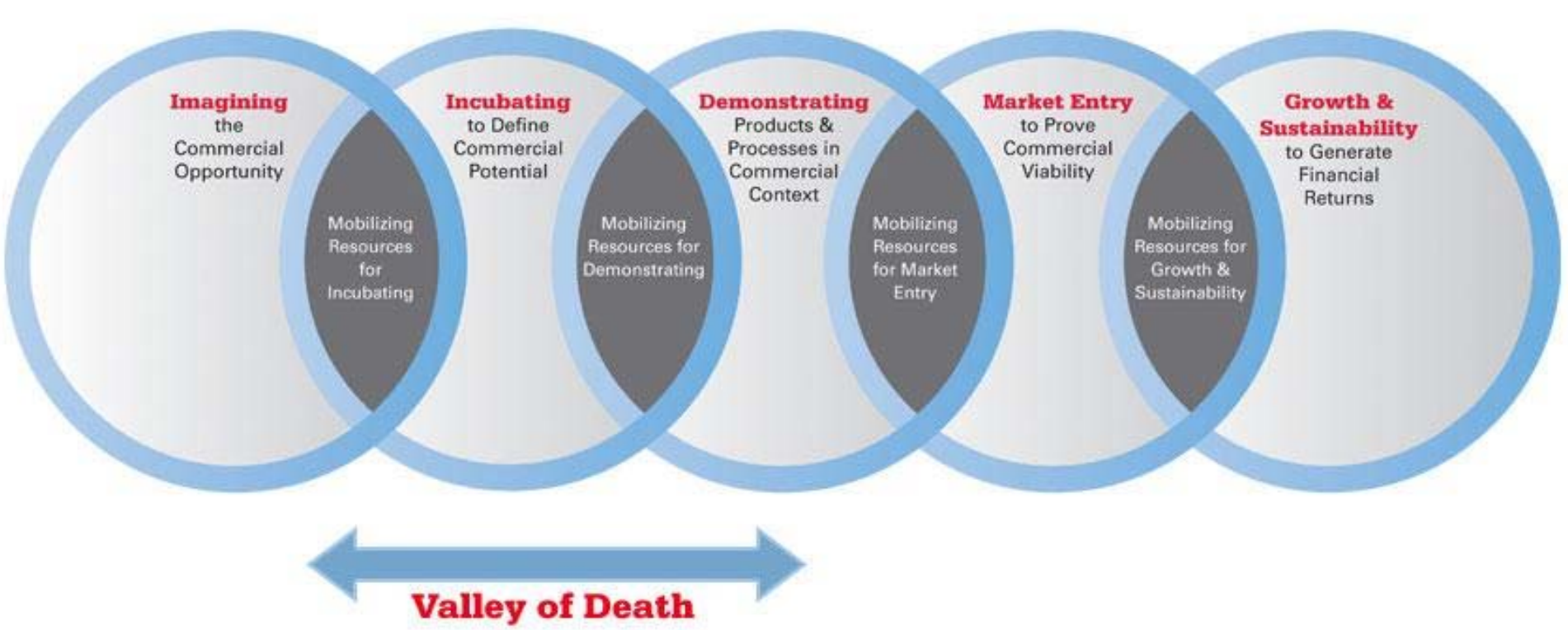
Customer industries	Transportation	Construction	Consumer Goods	Health & Nutrition	Electronics	Agriculture	Energy & Resources
							
Growth Fields*	Batteries for mobility	Heat management	Enzymes	Medical	Organic Electronics	Plant biotechnology	Energy management
	Lightweight composites					Functional crop care	Rare earth metals recycling
	Heat management						Wind energy
							Water solutions

Ongoing inflow of new growth fields

* Including growth fields still under evaluation

http://www.basf.com/group/corporate/en/about-basf/strategy/innovationen/index

Organizational Capability to Capture Value from Those Products



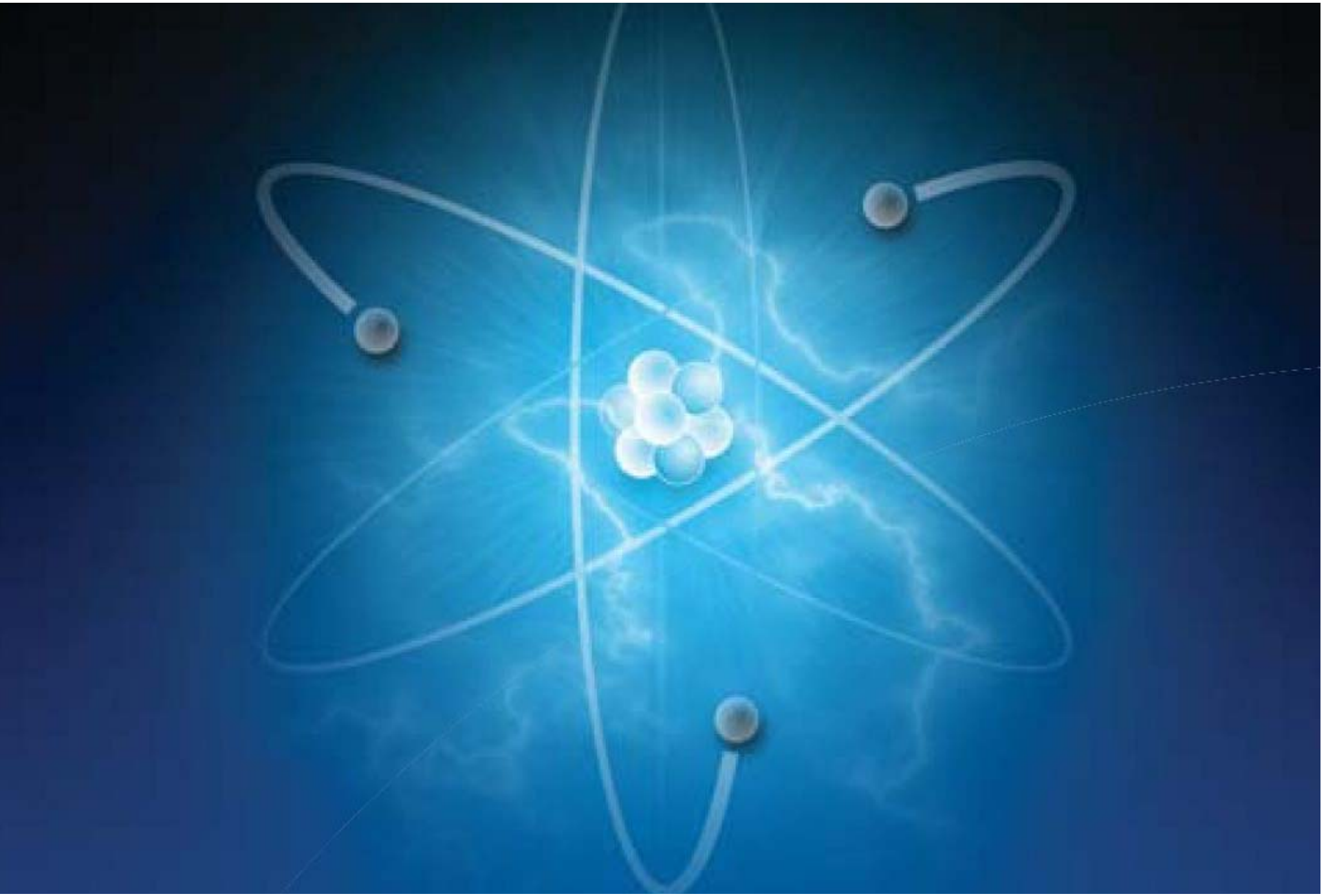
Organizational Capability to Manage Mass Production

Organizational Capability to Understand Customers and Distribute to Them

Furthermore, Retained Earnings are the Cheapest Source of Capital

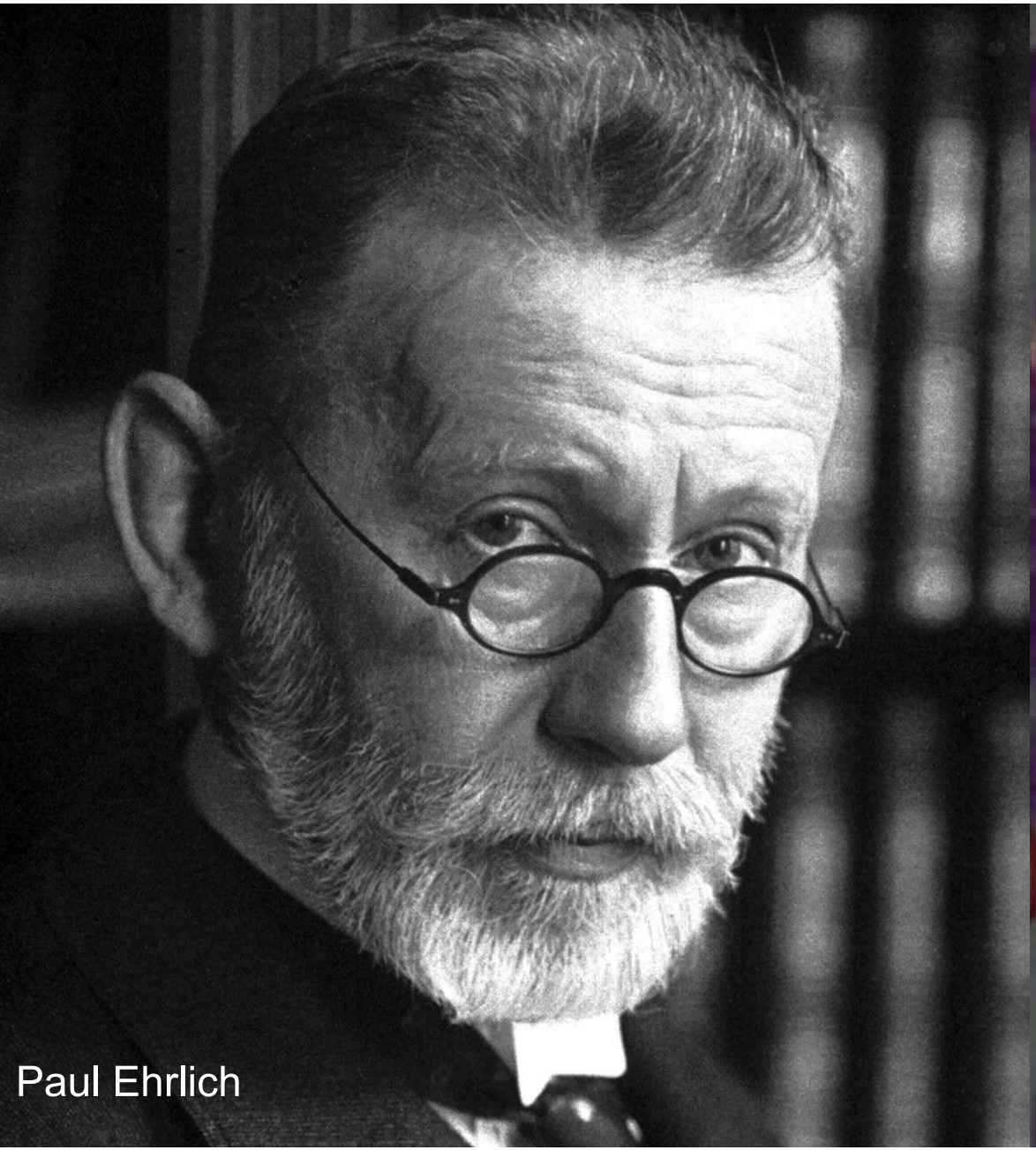
Possessing These Capabilities in Any Given Field is a Superior Barrier to Entry

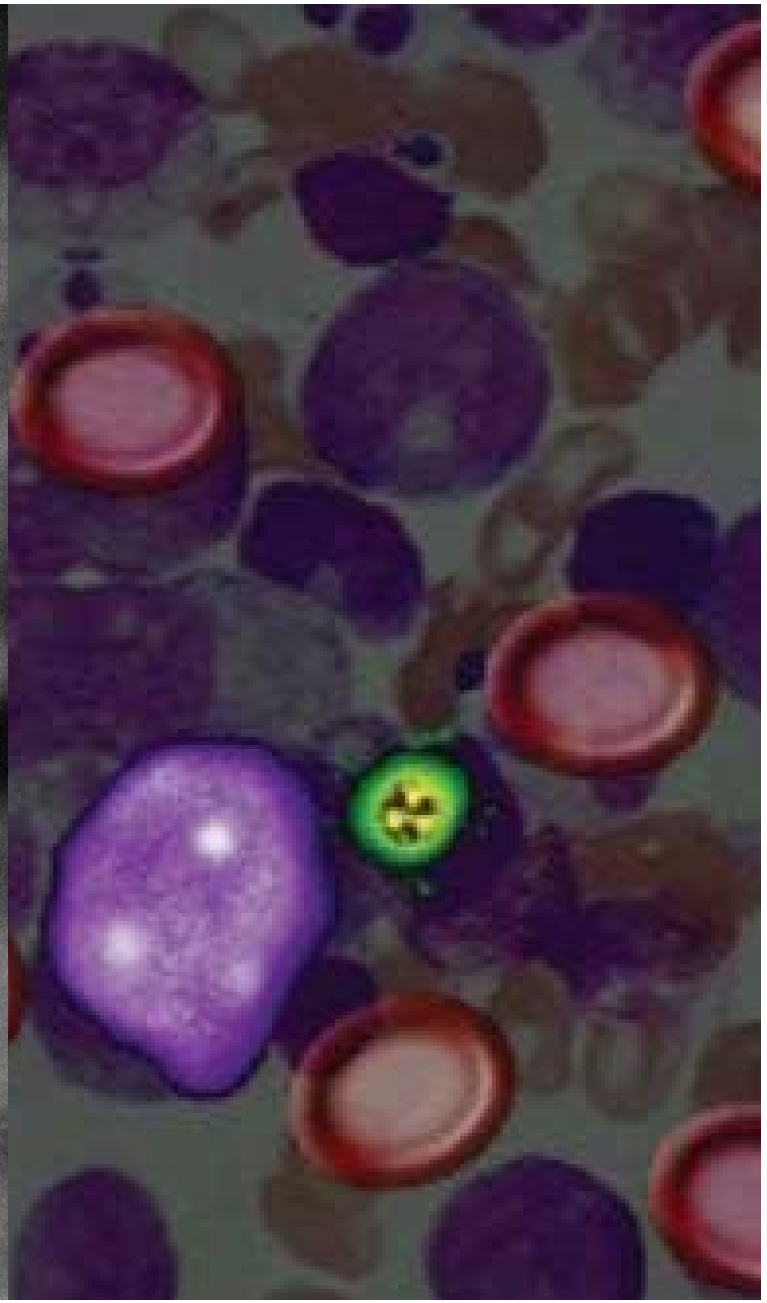
Actinium 225 Can Be Our Aniline Dye



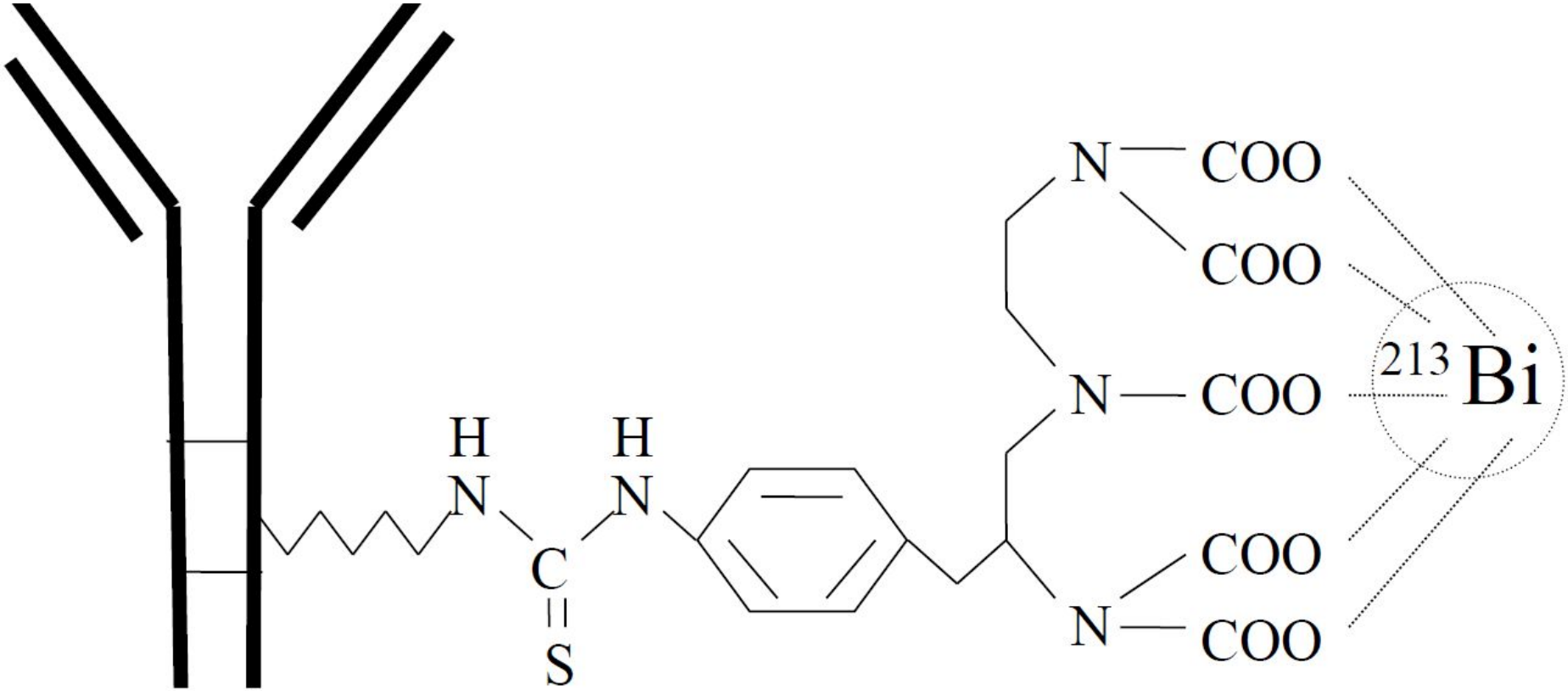
Ac Produces Short-Lived Bismuth 213

Bi 213 Creates Medicine's Magic Bullet

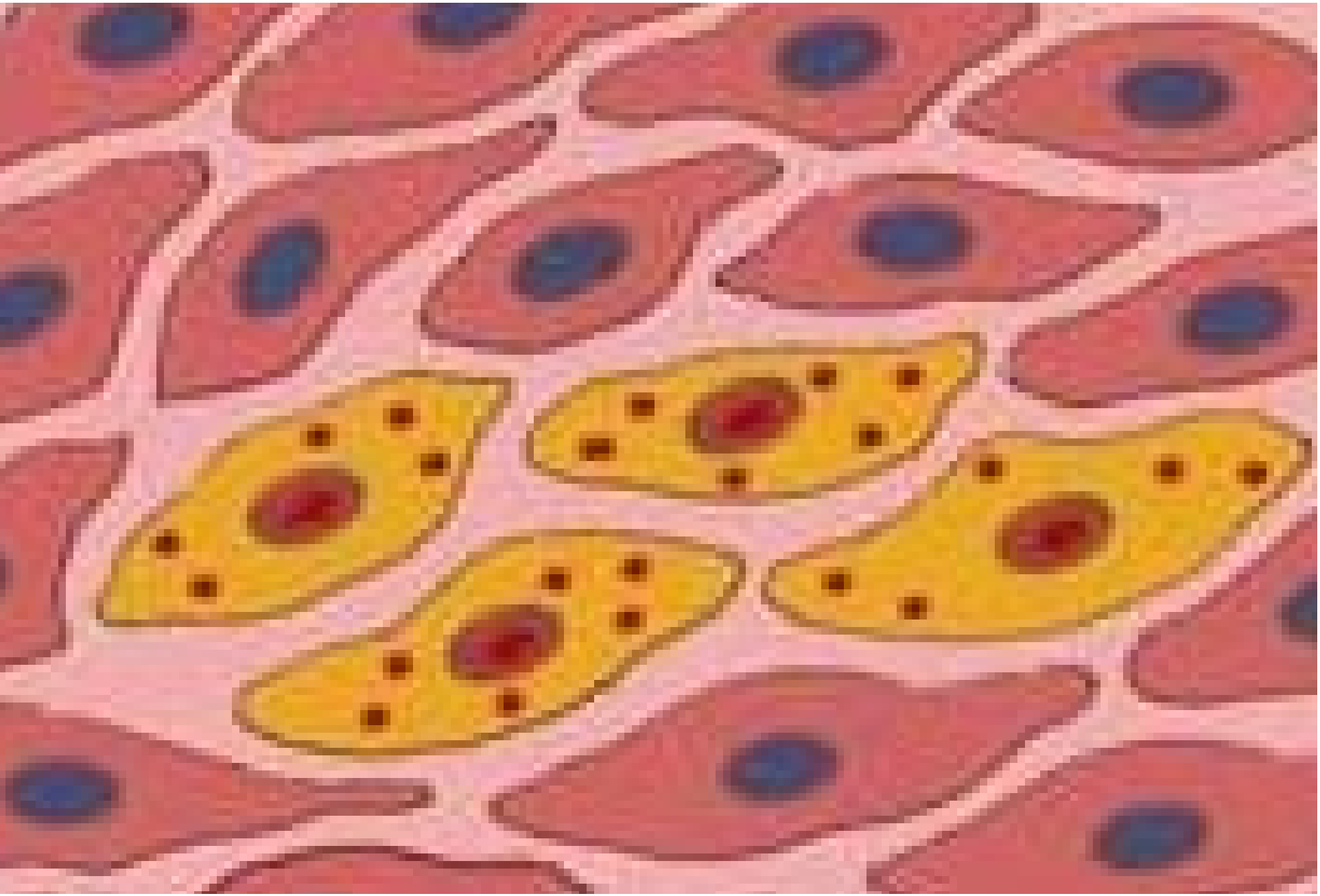




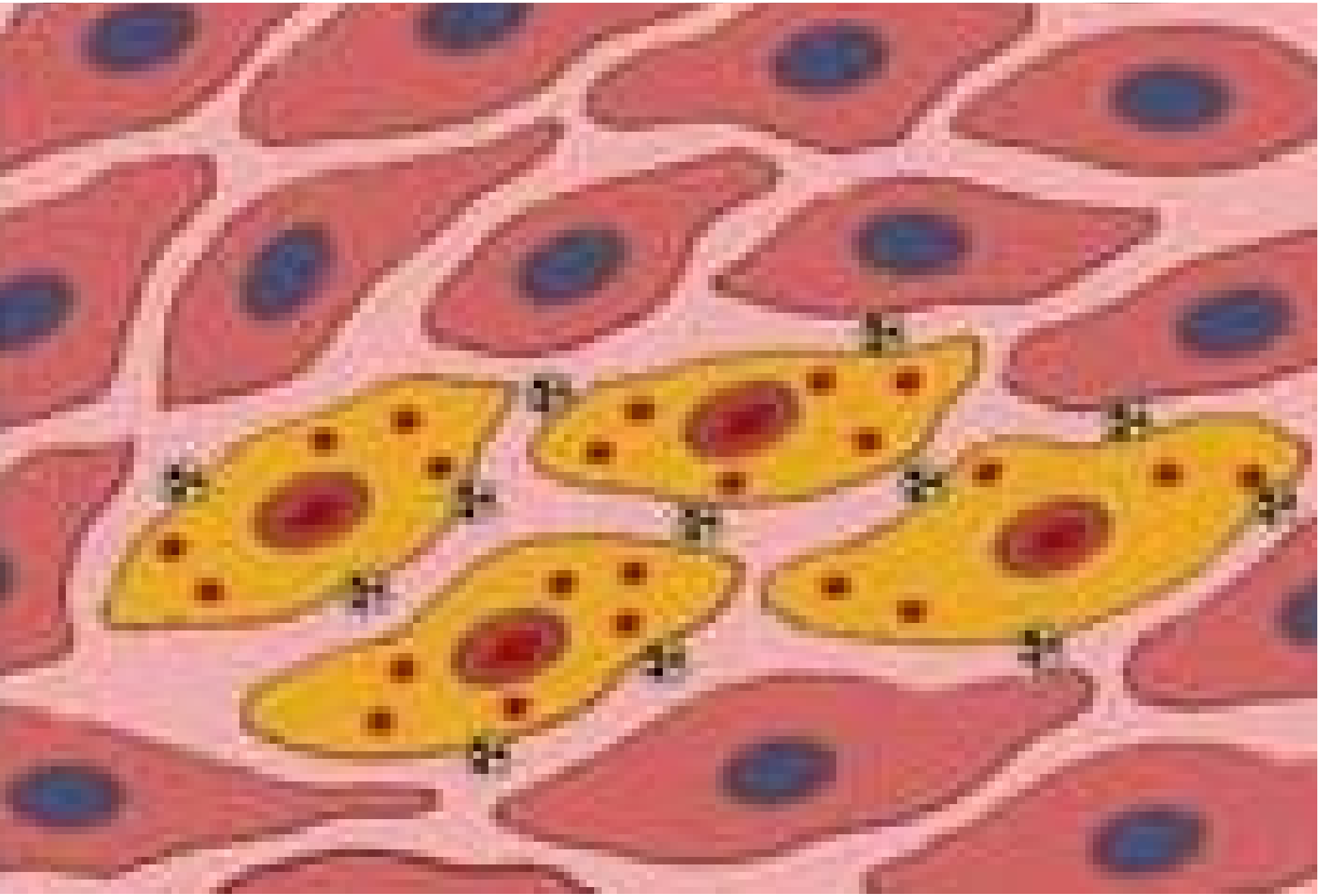
Cancer Targeting Antibody Bonds to Isothiocyanatobenzyl-DTPA-Bi-213



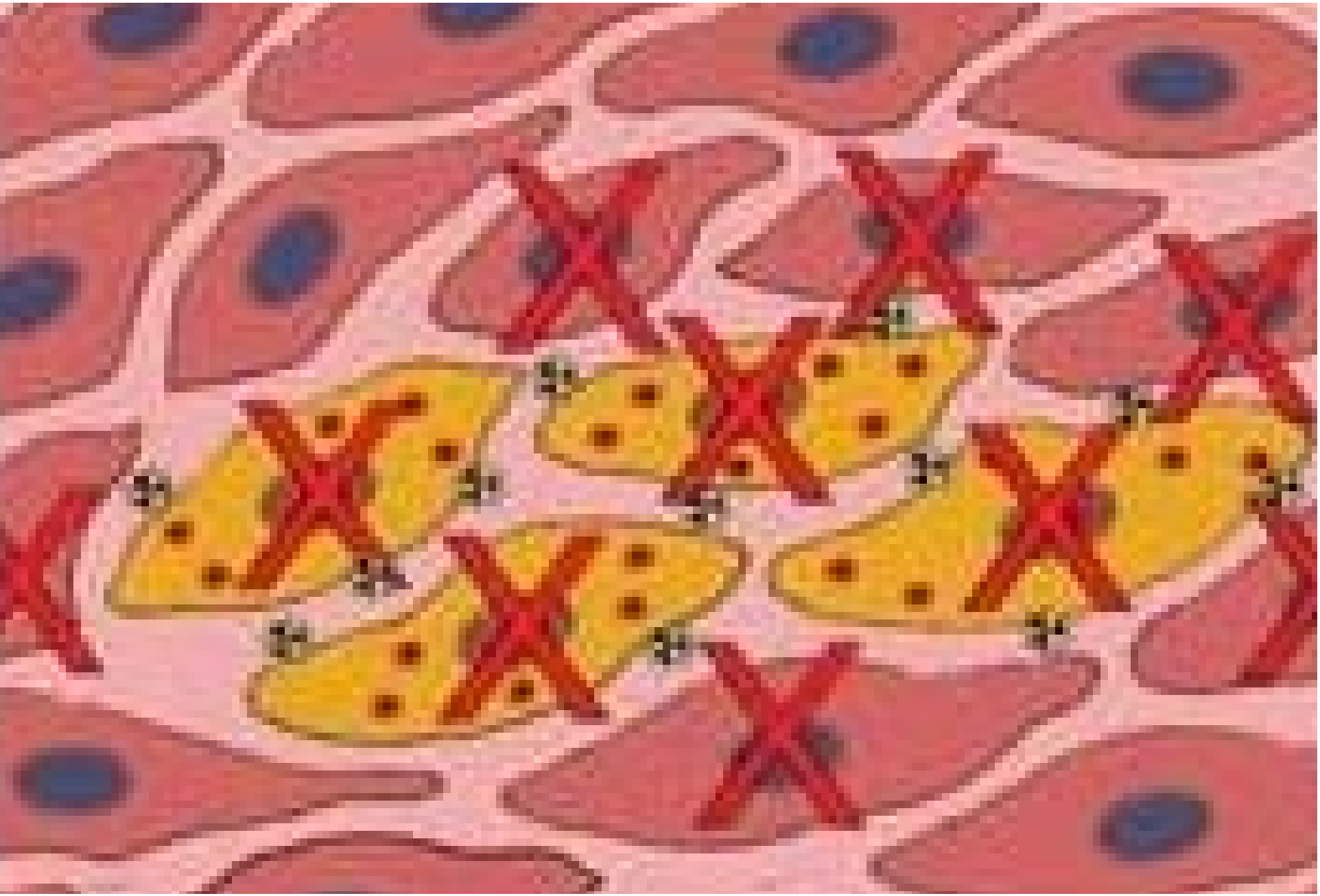
Bi 213+Antibody Injected into Patient



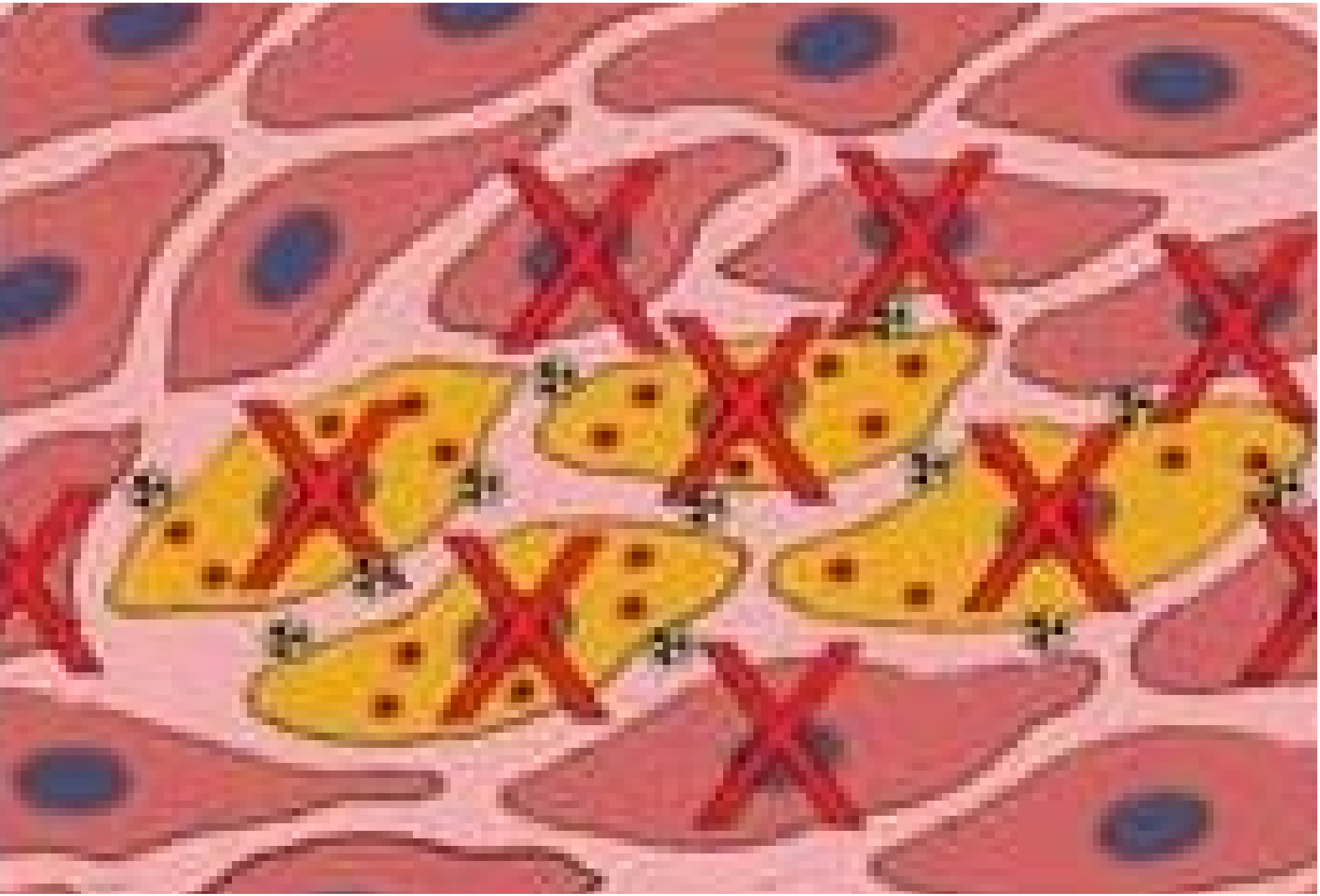
Drug Selectively Attaches to Cancer



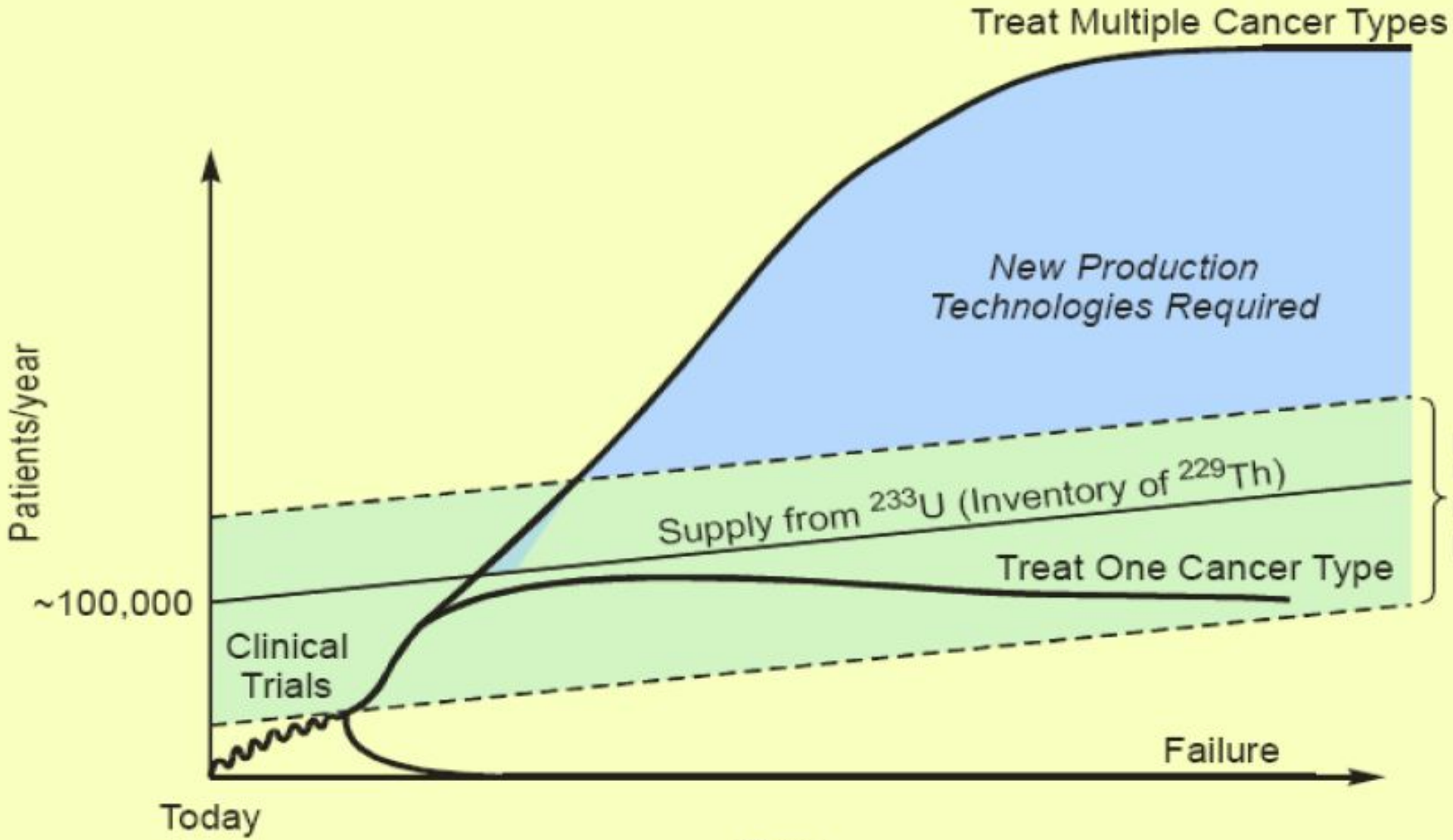
The Cancer is Killed by Alpha Radiation



With Minimal Collateral Damage



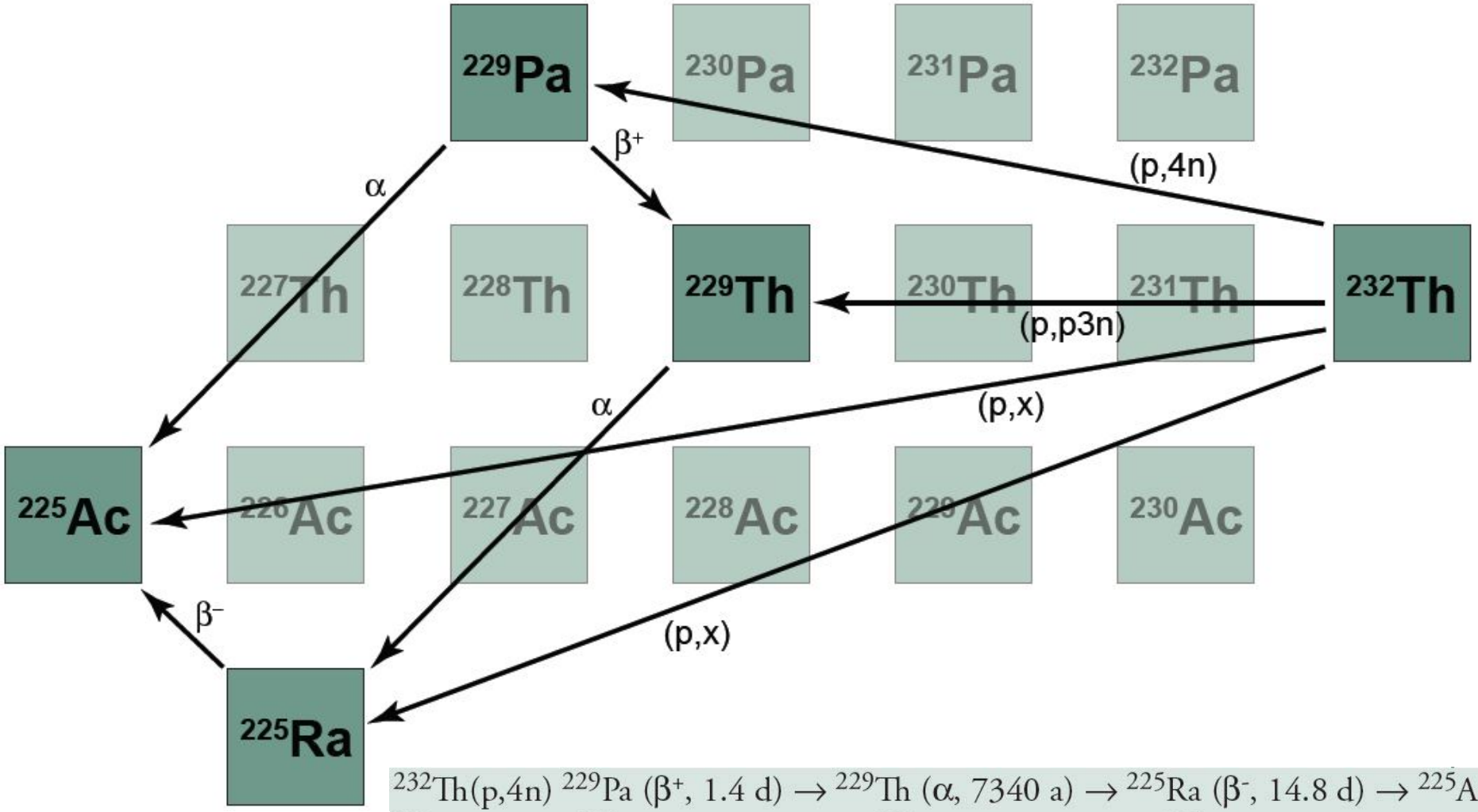
Could Be a $50M/Year Market by 2014



Graph: Forsberg, C.W., Uses for U233, Briefing for USDOE, March 22, 2000

Data: Forsberg, C.W., Uses for U233, Briefing for USDOE, March 22, 2000

Ac-225 Produced w/ Protons + Th 232



^{232}Th(p,4n) ^{229}Pa (β^+, 1.4 d) → ^{229}Th (α, 7340 a) → ^{225}Ra (β^-, 14.8 d) → ^{225}Ac

^{232}Th(p,p3n) ^{229}Th (α, 7340 a) → ^{225}Ra (β^-, 14.8 d) → ^{225}Ac

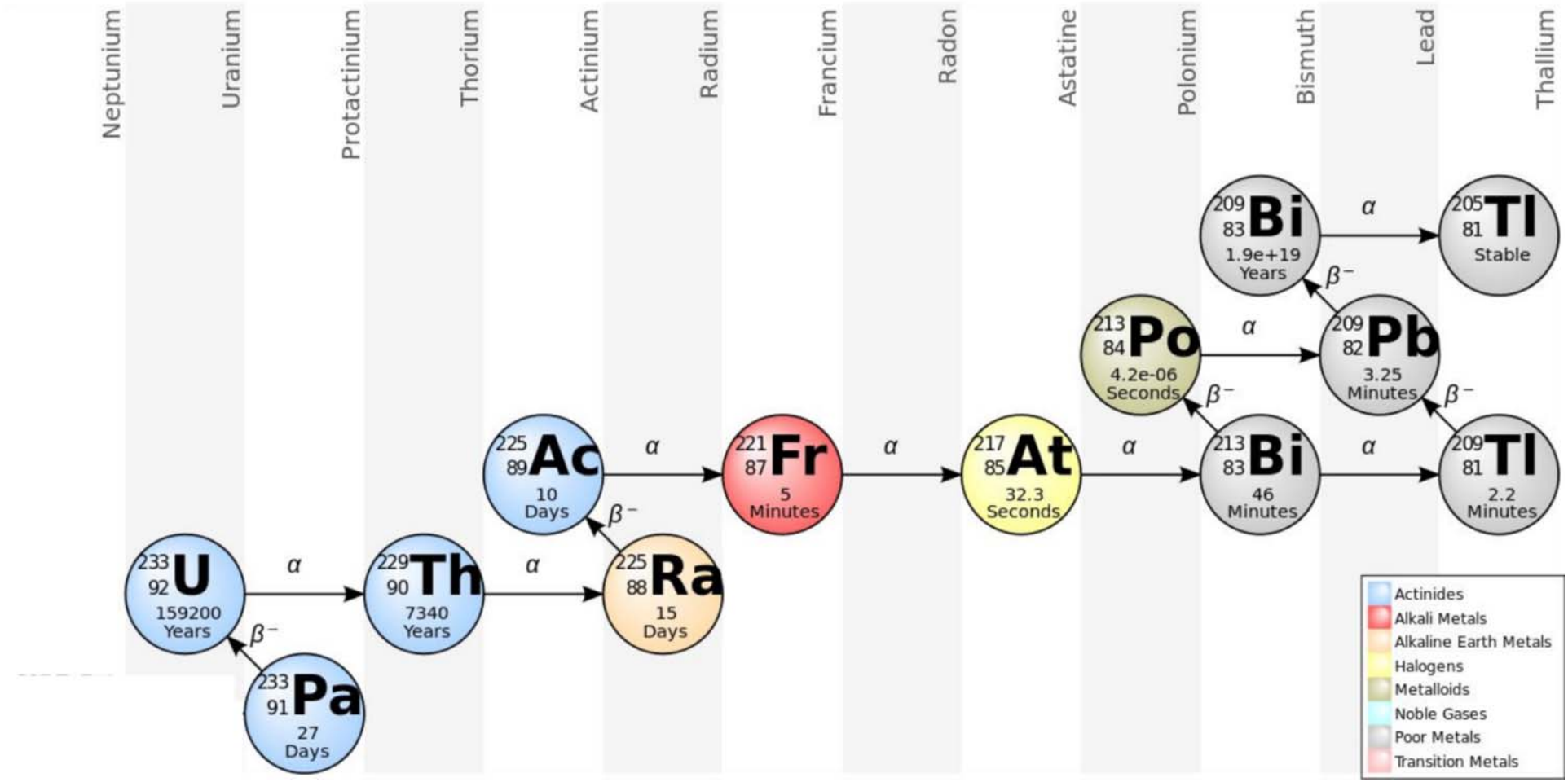
^{232}Th(p,4n) ^{229}Pa (α, 1.4 d) → ^{225}Ac

^{232}Th (p,x) ^{225}Ac

^{232}Th(p,x) ^{225}Ra (β^-, 14.8 d) → ^{225}Ac

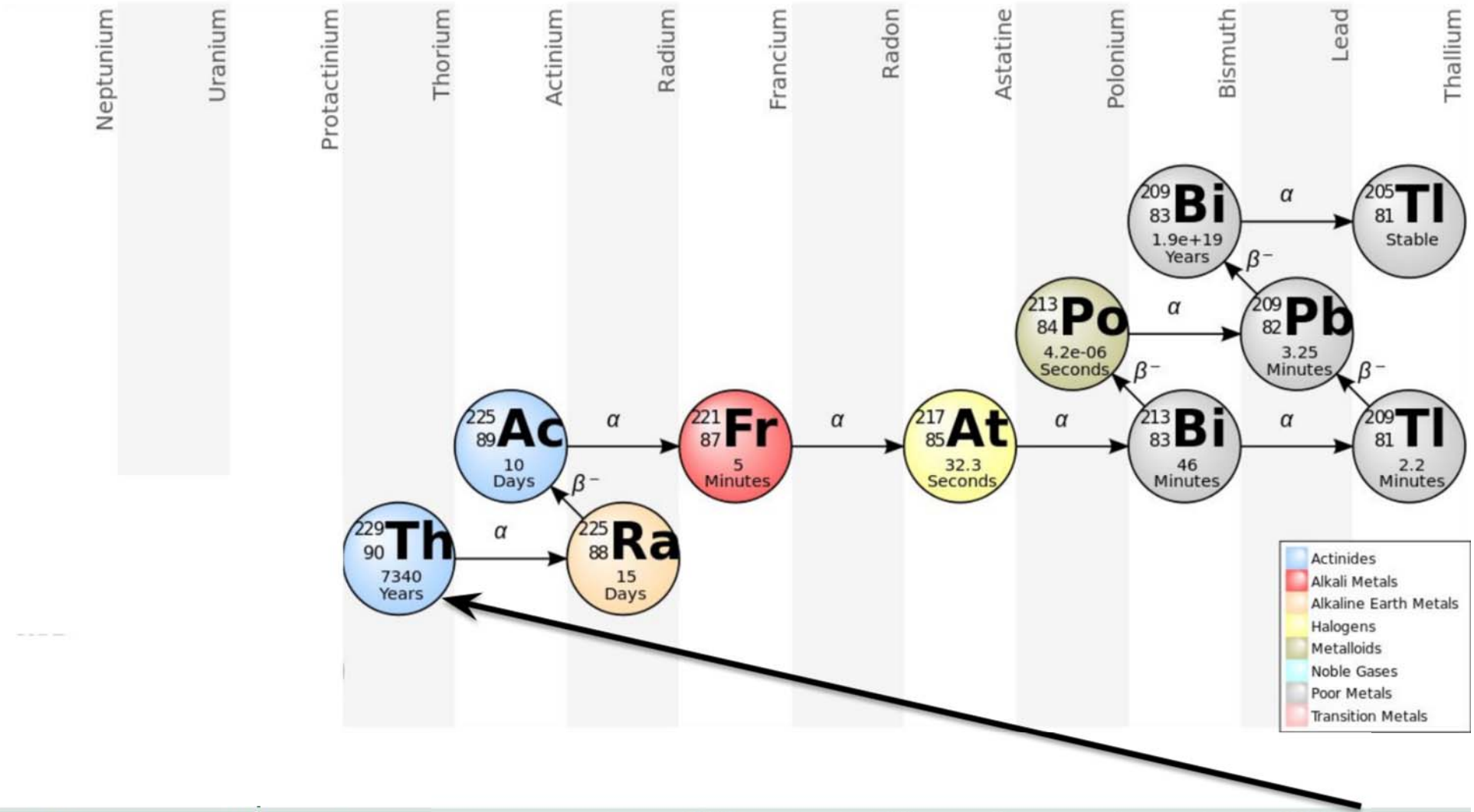
http://arq.lanl.gov/source/orgs/nmt/nmtdo/AQarchive/AQhome/issues/ARQ09-10.pdf

Ac-225 Produced with Neutrons and Thorium 232



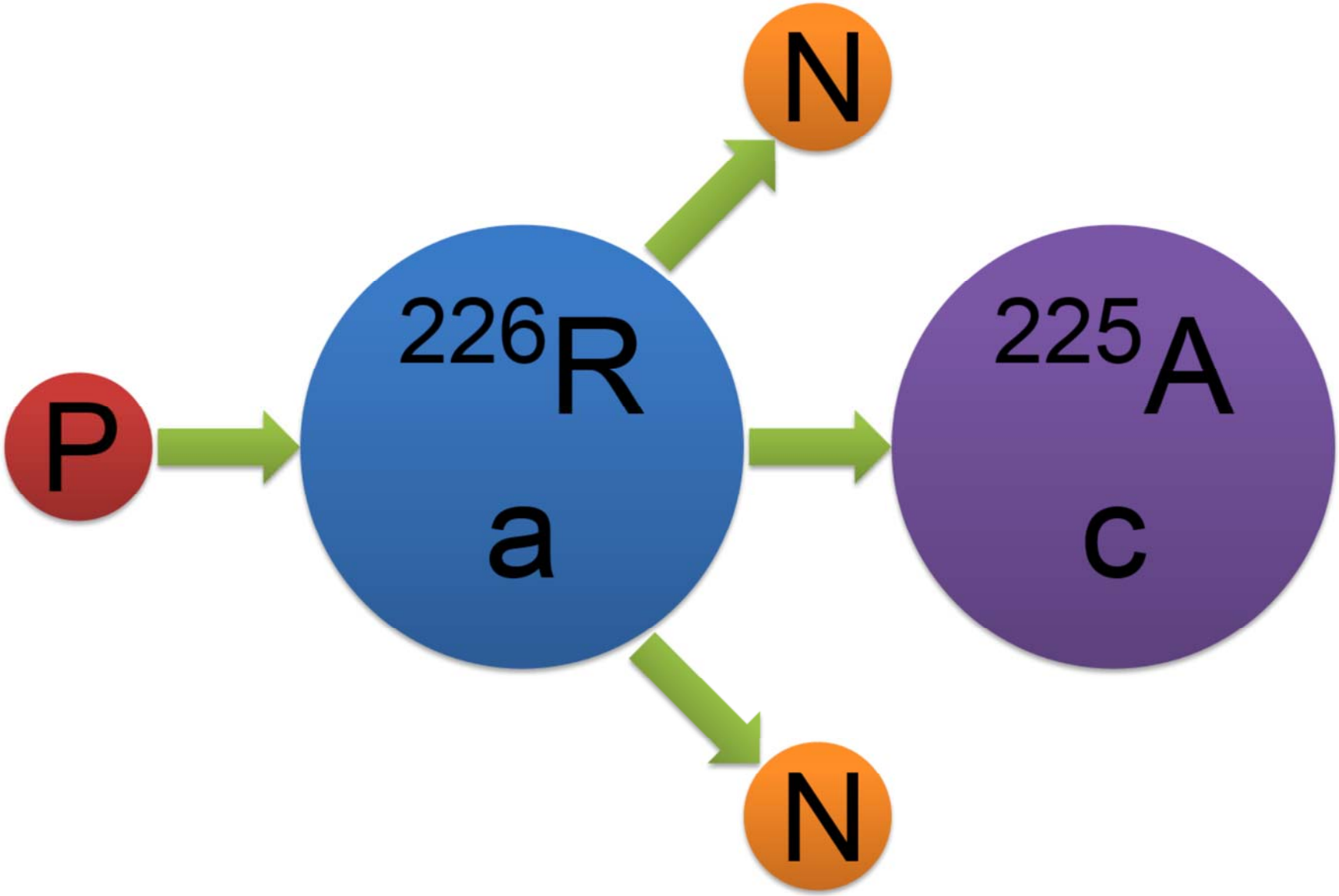
$^{232}Th\ (n,\gamma)\ ^{233}Th\ (\beta^-,\ 22.3\ minutes)$

Ac-225 Produced with Neutrons and Radium-226

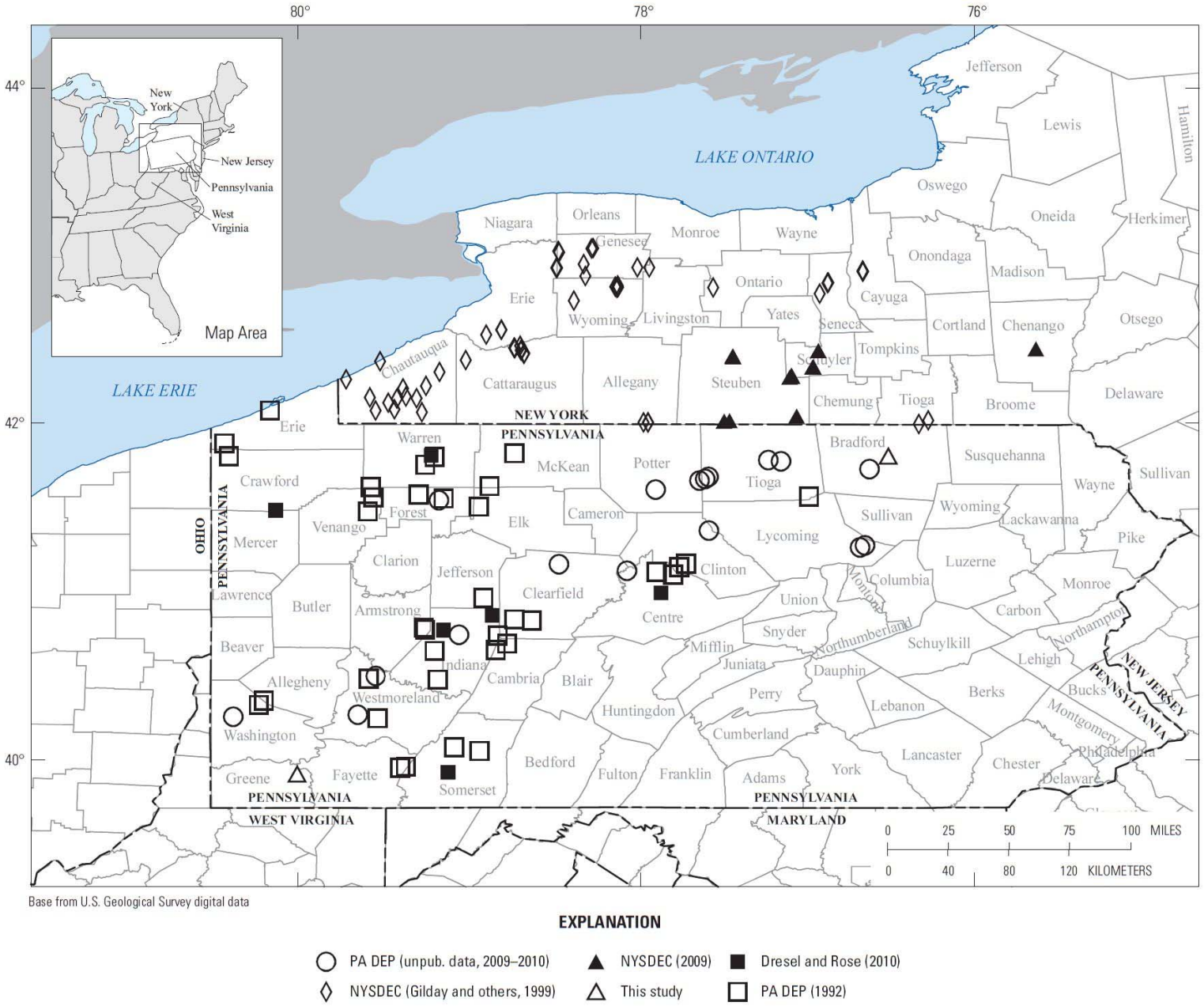


$^{226}Ra\ (n,\gamma)\ ^{227}Ra\ (\beta^{-},\ 42.2\ minutes) \rightarrow\ ^{227}Ac\ (n,\gamma)\ ^{228}Ac\ (\beta^{-},\ 6.1\ hours) \rightarrow\ ^{228}Th\ (n,\gamma)$

Ac225 Produced with P+Ra226

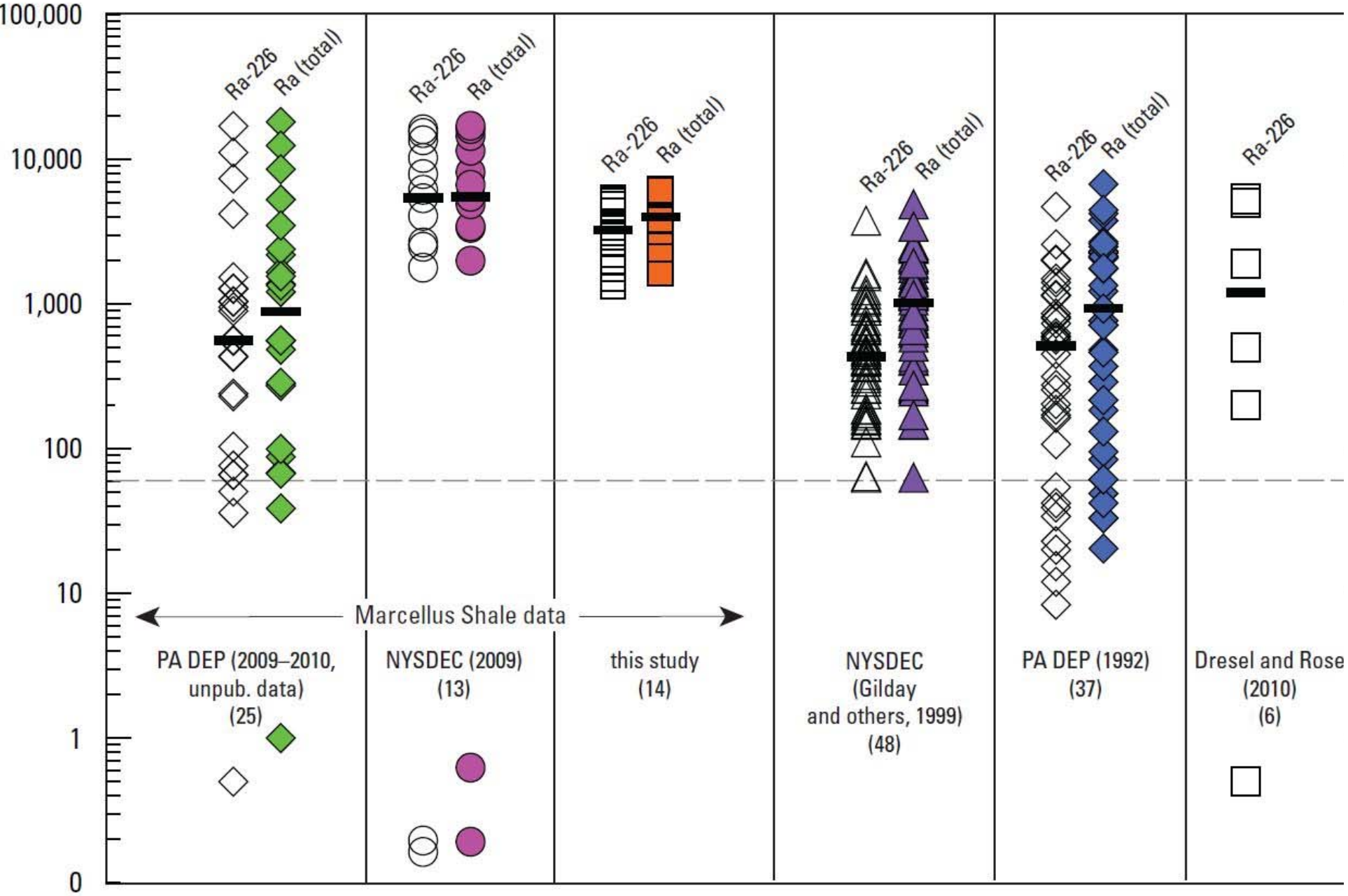


Radium “Bridges” Off the Shale Gas Boom

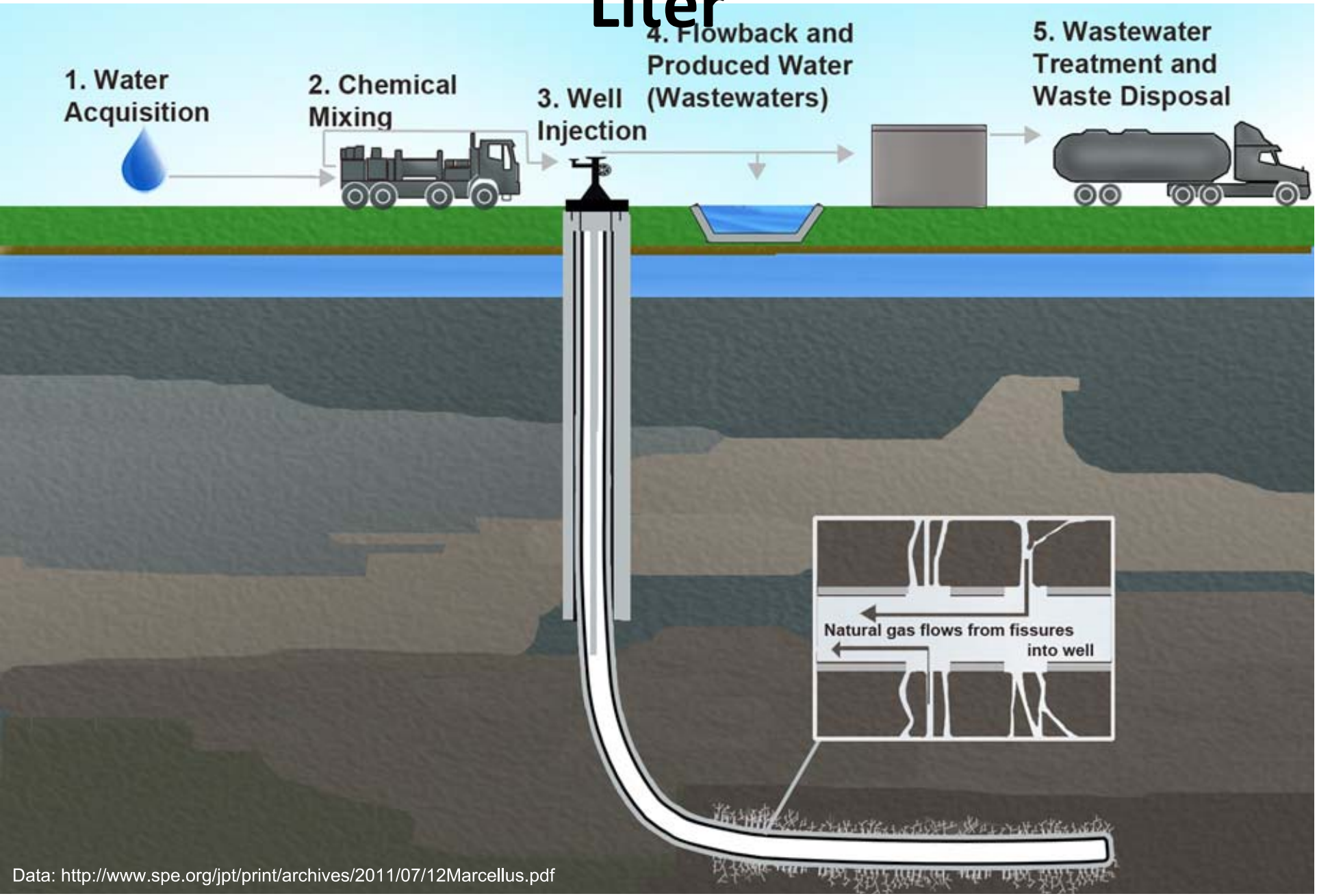


Rowan, EL. "Radium Content of Oil- and Gas-Field Produced Waters in the Northern Appalachian Basin (USA): Summary and Discussion of Data" 2011. <http://pubs.usgs.gov/sir/2011/5135/>

Rowan, EL. USGS Results (PiC/L)



Produced Water Disposal Costs $.50 / Liter



Data: http://www.spe.org/jpt/print/archives/2011/07/12Marcellus.pdf

Obama Promoted Ac in 2012 SOTU

US Regulation is Far More Reasonable for Subcritical Particle Sources

A nuclear reactor is defined in 10 CFR 50.2 as “an apparatus, other than an atomic weapon, designed or used to sustain nuclear fission in a self-supporting chain reaction.” The 4 conventional target process of producing Mo-99 and the aqueous homogeneous reactor are nuclear reactors under this definition. They are therefore subject to the licensing requirements of 10 CFR Part 50. The subcritical multiplier solution tank does not sustain a chain reaction and is therefore not a reactor under this definition and is treated differently…

ML113260607 - 12/05/2011 Paper for LANL Mo-99 Topical. - NRC." 2011. 27 May. 2013 <http://pbadupws.nrc.gov/docs/ML1132/ML113260607.pdf>

Agreement States Have Some Regulatory Leeway Outside of Critical Reactors

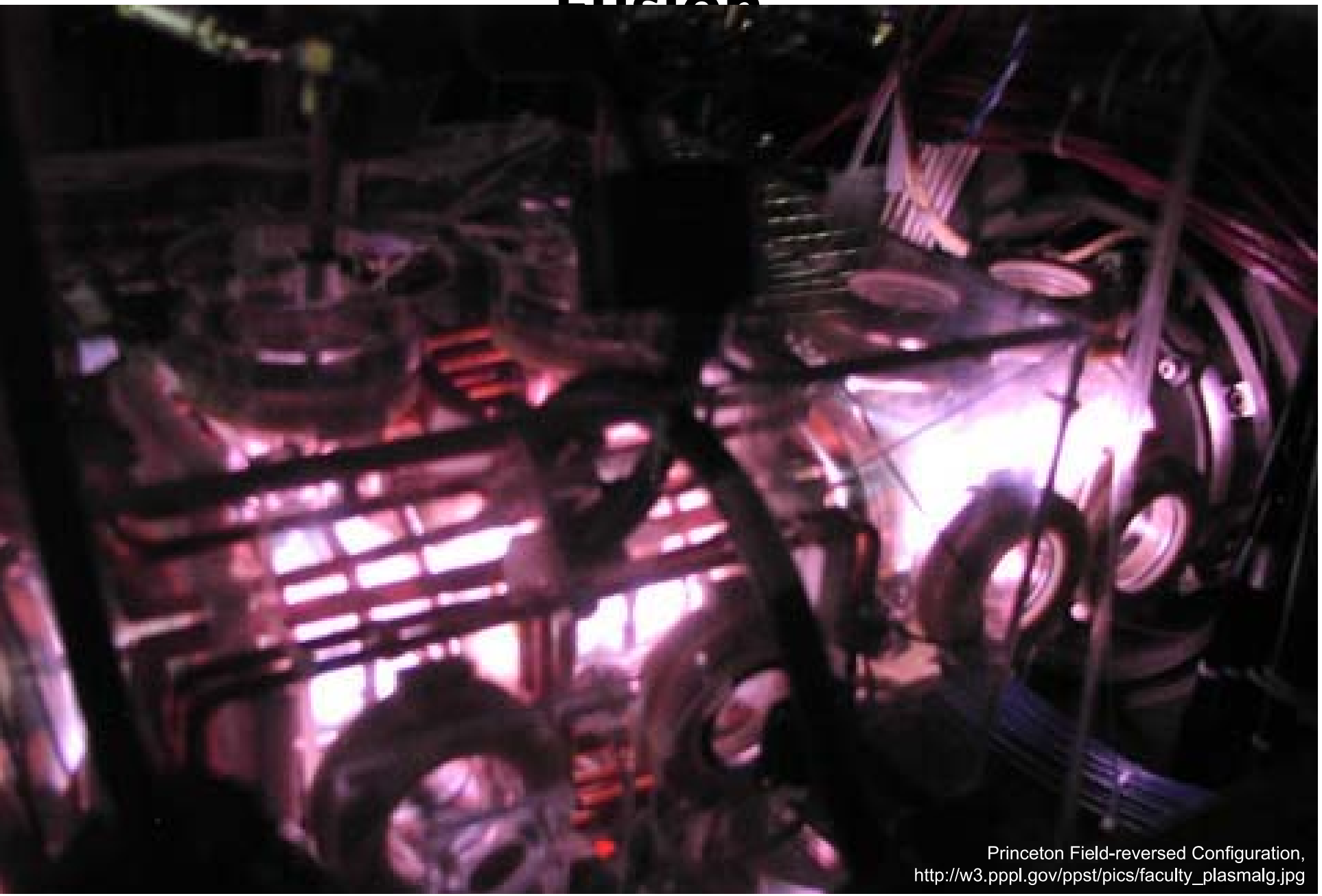
PA Agreement State Program FAQ

Q: Given the Energy Policy Act of 2005 and the new definition of byproduct material, who will regulate it, Pennsylvania or NRC?
A: Pennsylvania has licensed Naturally Occurring and Accelerator Produced Radioactive Materials (NARM) for decades and will continue to as an Agreement State. The Energy Policy Act of 2005 allows for the same transfer of regulatory authority to Agreement States for accelerator-produced isotopes and discrete sources of radium as previous by-product materials. Non-discrete radium sources will continue to be regulated by the states and not the NRC.

Q: Are the fees going to change?
A: Yes. The day Pennsylvania becomes an Agreement State the fees in Chapter 218 Appendix A identified as by-product material will replace the current NARM fees. The Pennsylvania by-product material fees are higher than the previous NARM fees but less than the corresponding fee categories of the NRC.

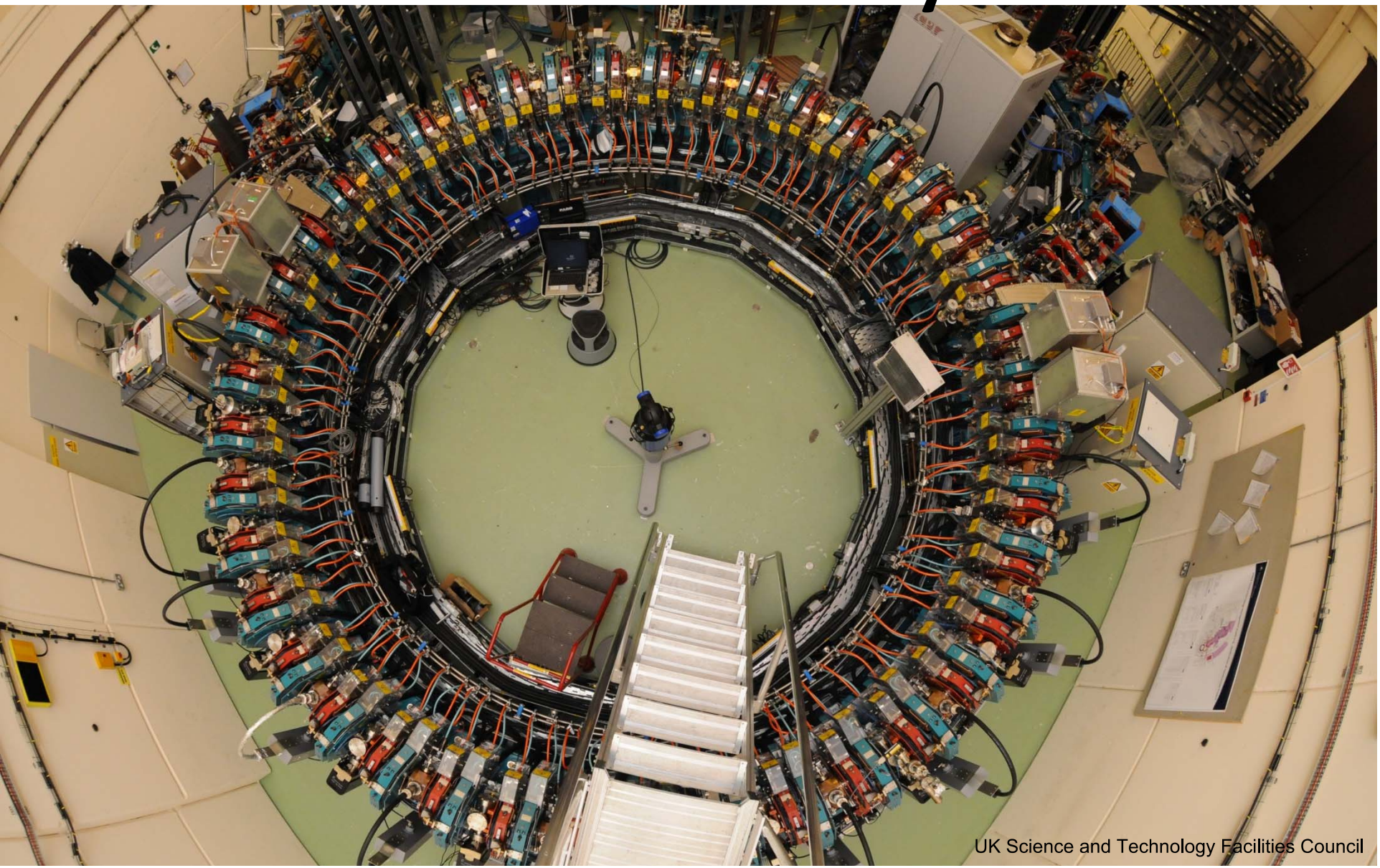
Q: Does Pennsylvania plan to have a small business fee category?
A: Yes, there are reduced fees for small businesses and certain small non-medical educational institutions (fee categories SB1 and SB2) with one exception. No licensee that is required to have Financial Assurance can claim the Small Business fee category.

It's Prudent to Build Bridges with Fusion



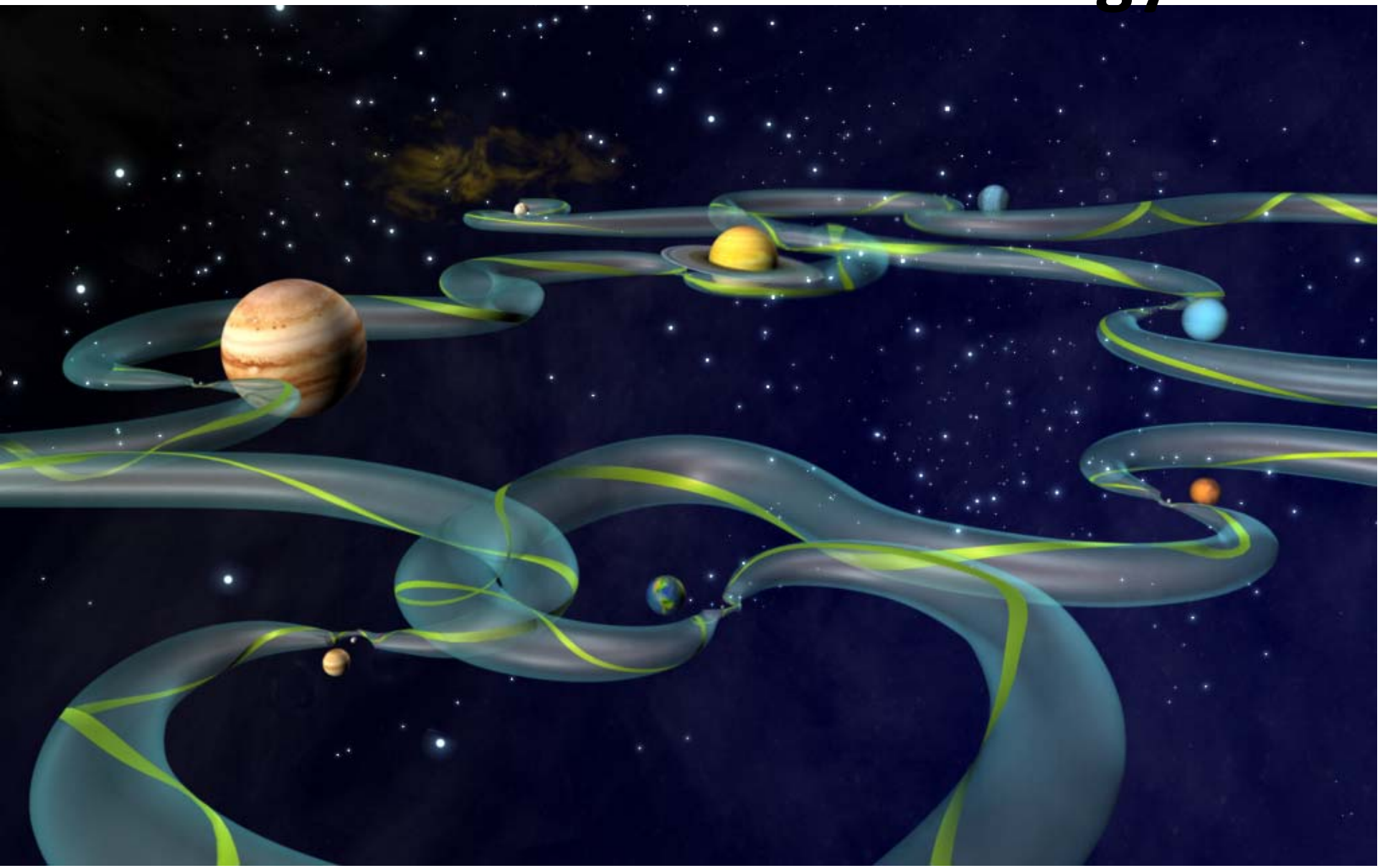
Princeton Field-reversed Configuration,
http://w3.pppl.gov/ppst/pics/faculty_plasmalg.jpg

It’s Prudent to Build Bridges with Accelerator Driven Systems



Gain from Regulatory Simplicity Must Offset Loss from Technical Complexity

By Building Bridges We Can Overcome Obstacles to Thorium Energy



Thank You!