What we have learned:

After 5 years, 2 senate REE bills and a proposed stand alone Thorium/REE bill- we know

1) There is no Federal money to fund this work (get over it…)
2) There is no Congressional will to sponsor alternative nuclear
3) The DoE opposes Th-MSR – it is a threat to the existing fleet
4) The National Labs will not challenge DoE on Th-MSR
    1) The DoE and National Labs are transferring Th-MSR to China
5) The U.S. financial sector will not fund Th-MSR without a regulatory pathway – *but they will acquire your IP…*
6) Developing Th-MSR as a Start-up Co. cannot compete with China -- it will take tens of billions and faces regulatory road blocks.

In summary

There is insufficient support for Th-MSR in Washington

- on a stand alone basis -

TEA and ThREE Consulting – The Alternative Approach

1) Congress has accepted that China's rare earth monopoly is a National Security threat.
2) Rare earths and Thorium are linked at the mineralogical level and at the policy level: you cannot fix rare earths without dealing with Thorium
3) Overcoming China's rare earth monopoly requires a cooperative effort: this is also true for Th-MSR

TEA and ThREE have "packaged" these two issue for Congress as a Rare Earth Bill & Thorium Bank

The problem is that Congress has become ideologically opposed to cooperative efforts, or aka: *industrial policy*

Unfortunately this is also true for some proponents of Th-MSR / LFTR

Why? Oddly, some think-

- they can develop Th-MSR all alone (somehow defeating China).
- that the financial markets will trust *'them'* with billions of dollars in a race against the Chinese Government, with a DoE that is openly hostile to the technology, with NO REGULATORY PATHWAY…

This is just silly… and not how things get done.

Taking a Walk Down Memory Lane

U.S. Economic History – 101

How things got done in the USA

AN INQUIRY INTO THE NATURE AND LOSS OF THE WEALTH OF OUR NATION

THE SUCCESS OF THE FIRST 200 YEARS

The Failure of the last 40 Years

The first 200 years of free market capitalism in the USA was nothing like the last 40 years

‘Free markets’ as defined today would have made America’s historical rise to greatness impossible

The first 200 years of American greatness generally followed the guiding principles of free markets as defined by Adam Smith…

Tariffs protected burgeoning enterprises and industry and the government provided free land for agriculture / homesteading, mining claims & rail roads.

These were subsidies, handouts and the unabashed promotion of private infrastructure, – all part of a National Industrial Policy

These policies continued as the U.S. maintained tariffs to protect various industries and the formation of cooperatives to stabilize & strengthen the Nation's agricultural industry.

The rail roads, with access to free land (to use and sell for capital) were linked with grain elevators and small towns to enhanced wealth creation and trade.

Later came Federal support for the energy industry: including military intervention on behalf of big oil

[suggested reading: The Prize, by Daniel Yergin]

A Federally supported AT&T monopoly made the creation of Bell Labs possible.

Bell Labs was the origin of more basic science and applied commercial technology than all of today's National Labs combined.

The rural electrification program helped to create our energy and communications grid.

All forms of public education and much of the tax-code are forms of Industrial Policy

Finally, the military and space programs provided the hub for most of the economic progress of the 20th century.

Military Technology Subsidies:

- Interstate Highway System = Auto Industry & Commerce
- Aircraft & Space Program = Metallurgy & Electronics
- Nuclear Program = Nuclear Energy & Applied Physics

For decades aircraft and agriculture were our greatest exports. Both enjoyed the benefits and protection of U.S. Industrial Policy.

The Subordination of Capital

Milton Friedman and the Chicago School of Economics, beholden to the financial industry, began to re-define *free market capitalism* (circa 1970) as we know it today…

This coincided with the U.S.'s abrupt exit from the gold standard – putting the U.S. and the world on a fiat *monetary-capital system*

Capital became subservient to debt -- debt, leverage and engineered financial instruments replaced the roll of capital in the economy – capital was subordinated to the position of the underlying "security interest"

This ideology has no place in U.S. developmental history and its inception marks our Nations decline.

By Friedman's definition *free markets,* or lets just call it monetary-capitalization, require the subordination of all capital – including access to the assets associated with all forms of Industrial Economic Policy

Friedman's monetary-capital system has resulted in the financialization and monetizing of our Nation's capital base – it is unsustainable.

Why?

By deconstructing and monetizing these institutions the financial sector could enrich itself on the collective investments of a Nation, made over generations.

They called it “wealth creation”, but is was just a highly leveraged form of wealth transfer – glorified looting… nothing more.

What happened to Bell Labs happened to the USA

The tradition of industrial policy in the U.S. was sacrificed on the alter of *free markets* and share holder value (read: transient capital).

Once great corporations like AT&T's Bell Labs morphed into Lucent Technology who quickly sold off all of its legacy IP, making fortunes for shareholders and *'management',* the residual corporation was a worthless shell.

The Last Man Standing
Winner Take All

Through its control of the last standing U.S. monopoly, the financial institutions have gutted the entire U.S. economy -- primarily by re-defining *free market capitalism* and U.S. economic policy by extension.

The past 40 years of U.S. economic policy is the story of Lucent Technology over and over again…

A return to traditional free market capitalism is long over due.

Other Great U.S. Labs that were Off-Shored, sold off, de-funded, eliminated or parceled out to 'the market' to boost stock prices: Polaroid, IBM, KODAK, Bell and Howell, GE, Texas Instruments, Hewlett Packard, Motorola, Xerox PARC, National instruments, Childress, ARDC, Procter & Gamble, DOW, 3M.

Great research institutions do not live in a vacuum – the market cannot do this work…

Traditional free market capitalism

as defined by Adam Smith

is the basis of China's success

Remember, Smith was a Mercantilist. He just promoted alternative strategies to help English merchants outperform their rivals…

Why Tell you this? Why does This Matter ? How is it Relevant ?

Lets look at China's recent economic gains from its Industrial Policy in rare earths…

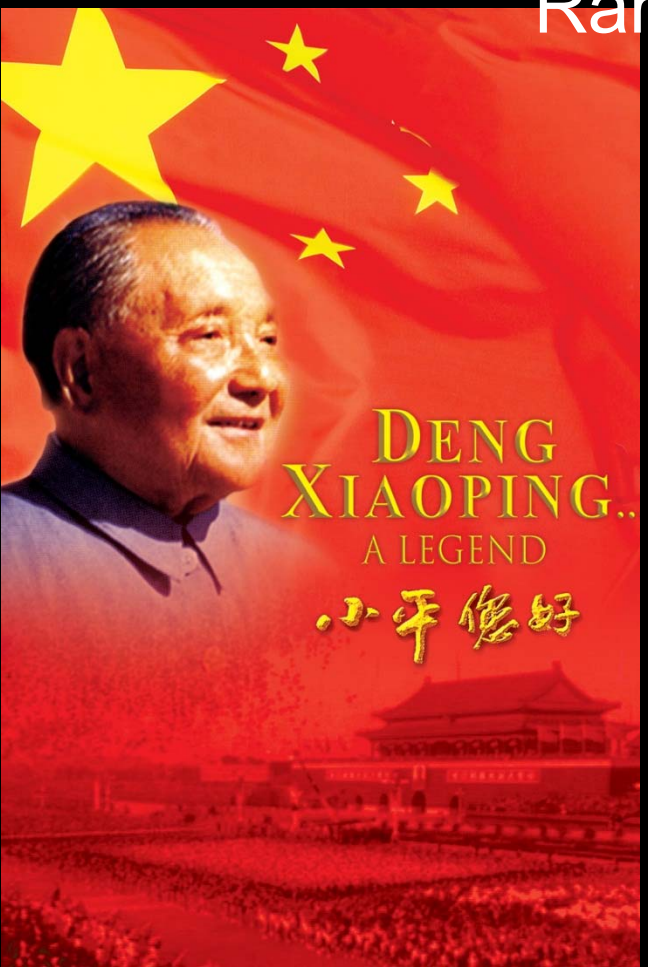
by controlling just $3 billion per year in rare earths China controls $4.6 trillion in value added goods – and has sucked much of the worlds IP and high-value manufacturing inside China

Let's just look at one example:

Aircraft Carriers vs. Rare Earths

Projected Power vs. Industrial Policy

Under Deng Xiaoping, China began subsidizing the Rare Earth industry in 1986



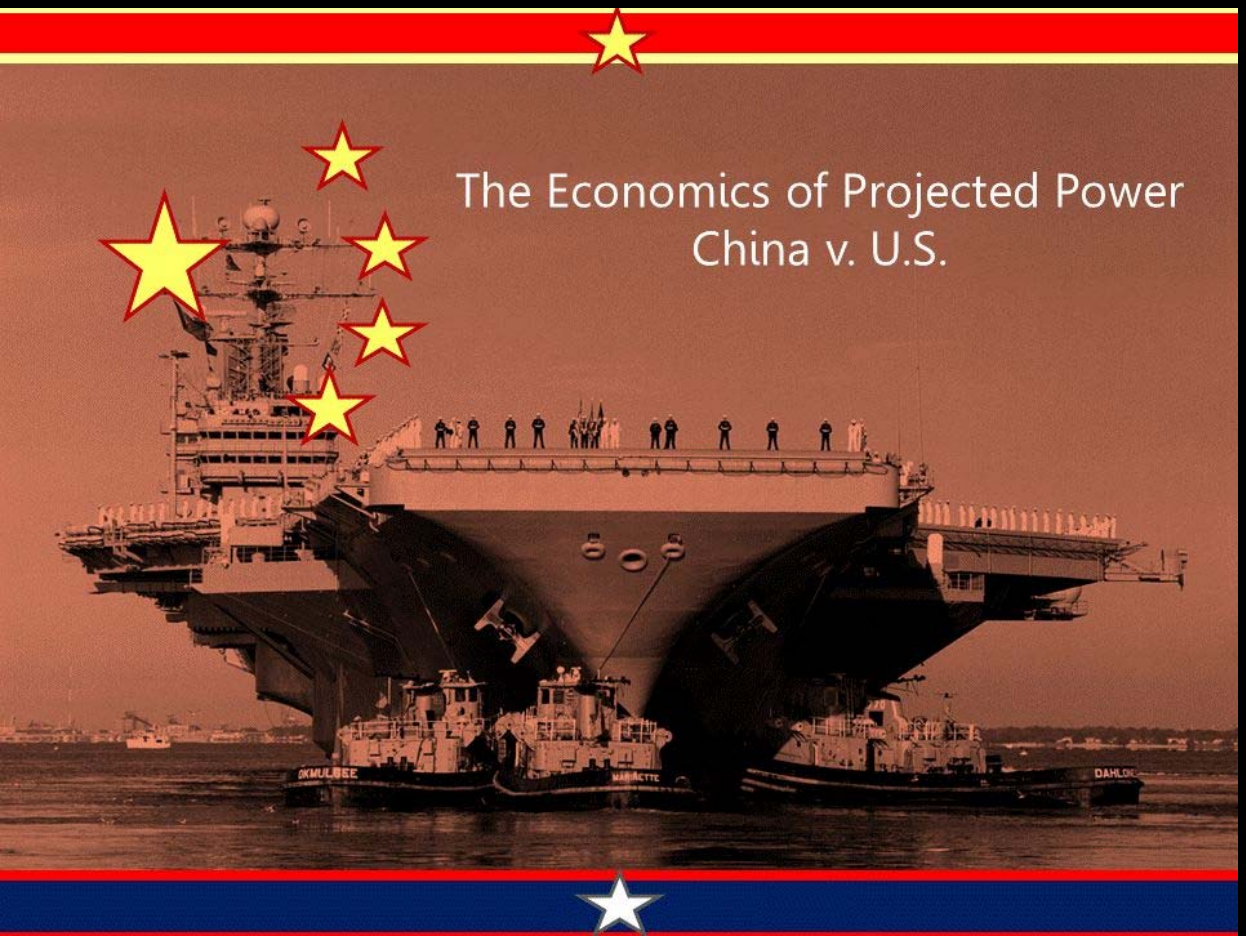
China gained monopoly control over what became a $3 billion per year market (mining, oxides, metals & alloys)

Control over this relatively small market gave China control over all value added components, manufacturing and the future of technology for over $4.6 trillion in finished goods

Economics of Projected Power

The U.S. seeks economic advantage via Projected Power
The cost of a single aircraft carrier is $10 billion

Just one part of a Naval group, that makes up a fleet, that makes up our Navy, that is part of our military that includes an Army, Air Force, Marines, CIA and NSA



The U.S. defense budget is about $800 billon per year

The U.S. spent about $2 trillion for control over mid-east oil -- a $2 trillion per year market

This action only strengthened China, Russia and Iran -- the U.S. gained nothing

Projected Power vs. Industrial Policy

In The End, It Always Comes Down To The Math

U.S. Mid-East War over Oil

-$2 Trillion + (- $800 Billion)

Where Did This Get the U.S.

Wars in Iraq, Afghanistan, Pakistan
Related conflict in Libya, Syria, etc.

The massive accumulation of debt from China to fund these endless wars, a loss of respect and higher oil prices - or less control over oil

What Has This Earned the U.S.

Body bags, wounded soldiers and enemies where we once had none

- $2.8 trillion (how much more for Syria & Iran)

China's Rare Earth Monopoly

$3 Billion + $4.6 Trillion

Where Did This Get China

Relocation and control over all Rare Earth Technologies and more shelf space at Wal-Mart, Best Buy, etc.

The massive accumulation of U.S. debt translated into Chinese 'control' over U.S. policy

What Has This Earned China

Control over $4.6 Trillion in value added Technologies and a flood of western IP into China's mainland

+ $4.9 trillion (what is the value of acquired IP)

WHAT HAPPENS WHEN CHINA CONTROLS GLOBAL ENERGY via Th-MSR

In 2011 China announced it would control Th-MSR IP

& commercial development on a global basis

China will do with Th-MSR what it did with Rare Earths

Why worry?
China will Share…

China's Rare Earth monopoly will be comically insignificant when compared to China holding monopoly control over the commercial distribution of Th-MSR

And no, China WILL NOT SHARE IT, they will "LEASE IT" on a kwh basis…

ECONOMIC EMPIRE

The economics of Th-MSR will lend itself to nearly every part of the industrial value chain on a global basis

Whoever controls Th-MSR will be able to extract revenues from every part of the value chain, and every kwh used by every man, woman and child, regardless of nationality

Control over Th-MSR will equate to a Global Empire, a tax on everyone and anything that uses energy

Beyond Electricity

Th-MSR will produce safe, clean, low cost, high temperature Process Heat that will change nearly all heavy industrial processes

Everything created or sustained with energy will spring from Th-MSR water desalinization, hydrogen, C02 free steel production, liquid fuel from tar sands & coal, CO2 free formation of fertilizers, a new age of heavy industries with low or no emissions, etc.,

Th-MSR will initiate a new ‘carbon-free’ industrial age – delivered via China, not the USA

Invented in the USA - Produced and sold by China

China is rapidly developing Th-MSR with help from the U.S. DoE, our U.S. National Labs, MIT, UC Berkley and the U.S. Taxpayer

China has publicly stated that they intend to control the commercial development and IP of Th-MSR on a global basis

This technology was invented and proven within our own National Labs…

Why is the DoE transferring it to China?

Q: what is the first word that comes to mind… ?

Organizational Overview

The Chinese Academy of Sciences (CAS) and U.S. Department of Energy (DOE) Nuclear Energy Cooperation Memorandum of Understanding (MOU)

MOU Executive Committee Co-Chairs

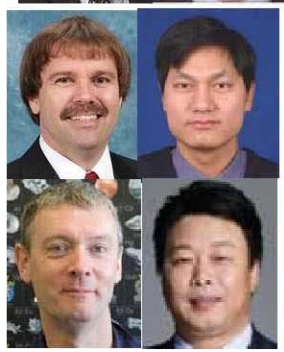
China – Mianheng Jiang (CAS) 江绵恒
U.S. – Pete Lyons (DOE)

Technical Coordination Co-Chairs
China – Zhiyuan Zhu (CAS) 朱志远
U.S. – Stephen Kung (DOE)

Nuclear Hybrid Energy Systems *
- Zhiyuan Zhu (CAS) 朱志远
  Yuhan Sun (SARI,CAS) 孙予罕
- Steven Aumeier (INL)

Molten Salt Coolant Systems
- Hongjie Xu (SINAP, CAS) 徐洪杰
  Weiguang Huang (SARI,CAS) 黄伟光
- Cecil Parks (ORNL)
  Charles Forsberg (MIT)

Nuclear Fuel Resources
- Zhimin Dai (SINAP, CAS) 戴志敏
  Biao Jiang (SARI,CAS) 姜标
- Phil Britt (ORNL)
  John Arnold (UC-Berkeley)



* **Work scope governed by DOE-CAS Science Protocol Agreement**

SINAP :Shanghai Institute of Applied Physics
SARI: Shanghai Advanced Research Institute
ORNL: Oak Ridge National Laboratory
INL: Idaho National Laboratory
MIT: Massachusetts Institute of Technology
UC-Berkeley: University of California at Berkeley

Ending China's RE Monopoly
Developing Th-MSR on a Global Platform

Rare Earth Cooperative

Federally Chartered Multi-National Cooperative Refinery

The Co-op accepts Thorium bearing Rare Earth Resources

Owned and funded by OEMs and end-users – investment equals off-take

Offers purchase contracts and tolling services to all rare earth producers

Thorium Bank

Federally Chartered, Privately Funded, Multi-National Corporation

Accepts all Thorium and Uranium liability of the Co-op on a pre-processing basis

Has Congressional authority to develop uses and market for Thorium, including energy

Provides regulatory structure for commercial development of Th-MSR

The Alternative
How Does it Work

The Thorium Bank has Congressional Authority to "develop uses and markets for Thorium, including energy"

The Thorium Bank offers :

1) Multi-national investment / development platform
2) Open to private, public and foreign participation
3) A "big tent" format with equity for IP contributors

The only rational way to challenge China…

Multiple mining companies provide Monazite, Apatite & other Thorium bearing RE byproducts to the Co-operative

Multiple RE Suppliers – RE is a byproduct

Thorium liability

Thorium Bank holds all Actinide liabilities, but has Congressional authority to develop "Uses & Markets for Thorium, including Energy"

RE Refinery Co-op / oxides, metals, alloys, etc.

Potential Co-operative Owners

Ford

SIEMENS

MOTOROLA

MITSUBISHI MOTORS

HITACHI

U.S. Aerospace

Rolls-Royce

JOGMEC

European Commission

LG

RE users own and control the Co-operative and off-take, but share profits with suppliers

Completing the task left to us by Eugene Wigner and Alvin Weinberg

And as recommended by Glenn Seaborg to

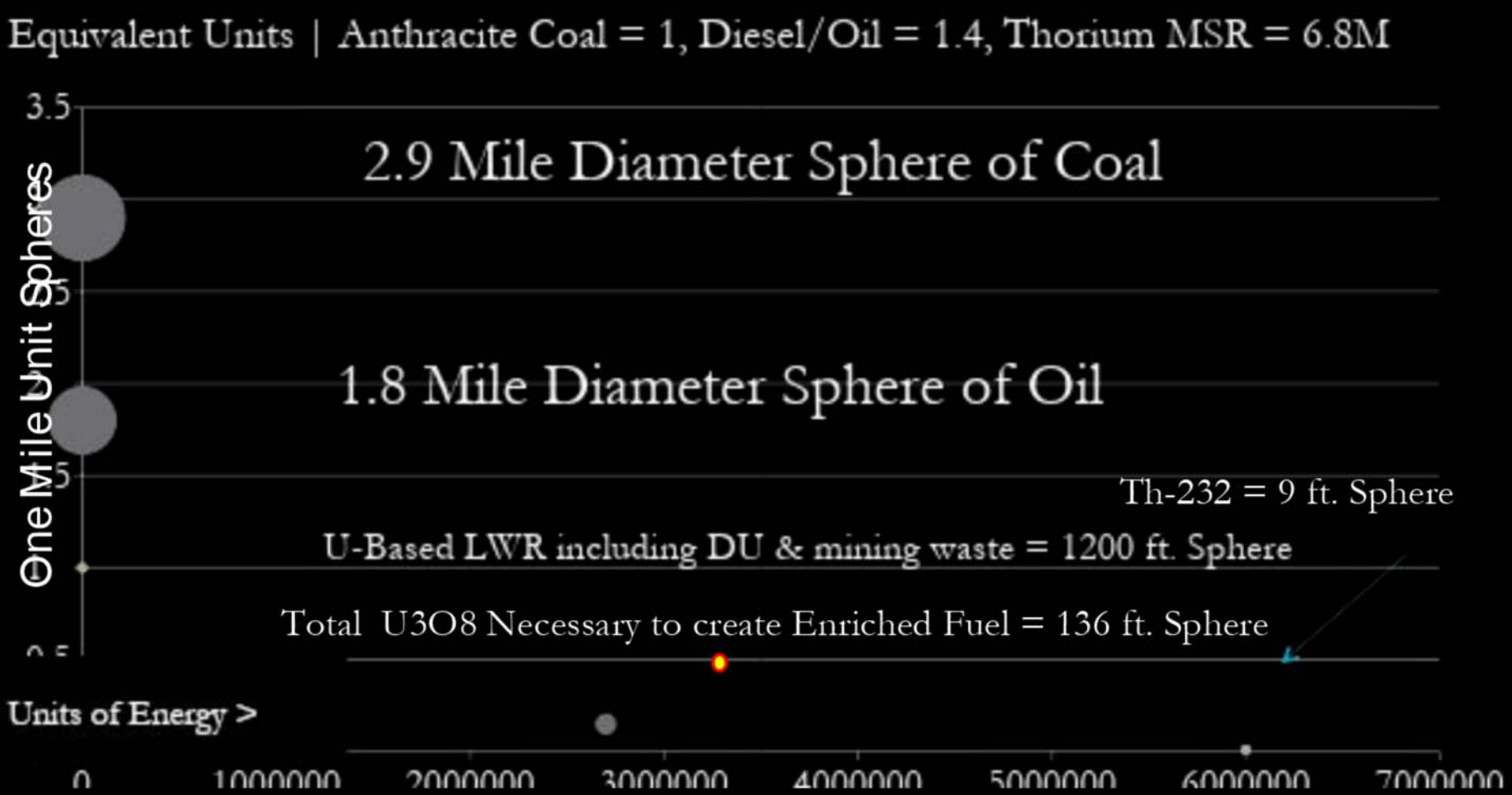
President John F. Kennedy in the

1962 Atomic Energy Commission Report

END OF PRESENTATION

Technical Slides Follow

2009 Global Energy Demand To Energy Density



<u>Measure of single source energy supply</u> | Pollution: Coal & Oil result in massive CO, CO2 & S. U = spent fuel, DU & mining waste. Th = near zero waste.

Shale Gas Glut Is Killing Nuclear Power

Written by Dr. Benny Peiser, GWPF | February 08 2013

Killingholme Gas Fired Power Station (Centrica) (Photo credit: Wikipedia)

Duke Energy's decision to dismantle a Florida nuclear power plant rather than undertake the costliest- ever U.S. atomic repair shows how rapidly cheap natural gas is remaking the U.S. power industry, hastening a shift from traditional fuels such as coal and uranium.

Duke's Crystal River Unit 3 plant in Florida joins Dominion Resources Inc.'s Kewaunee reactor in Wisconsin as the first to be shuttered in the U.S. because of growing shale gas supplies, serving as signposts for utilities from Japan to Belgium also considering decommissioning reactors. At least four other U.S. reactors are also at risk of early retirement due to new power market economics --Julie Johnsson & Jim Polson, Bloomberg, 7 February 2013

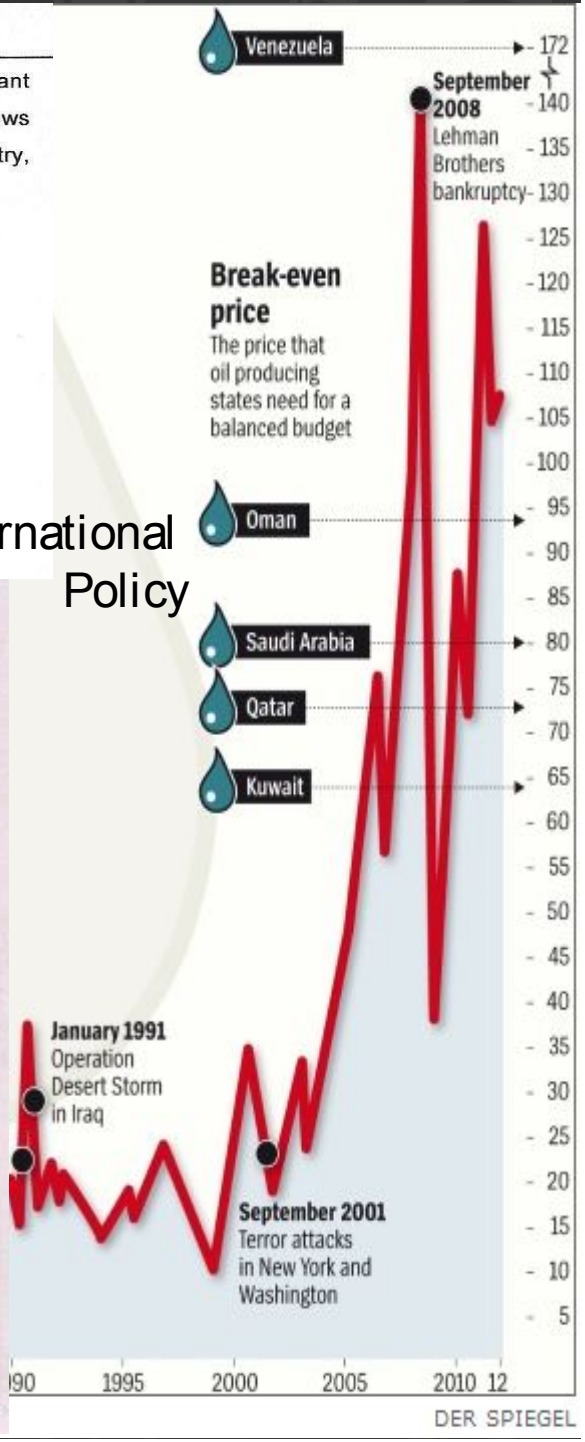
Oil drives National & International Policy

Exelon CEO: Wind subsidies could doom nuclear plants

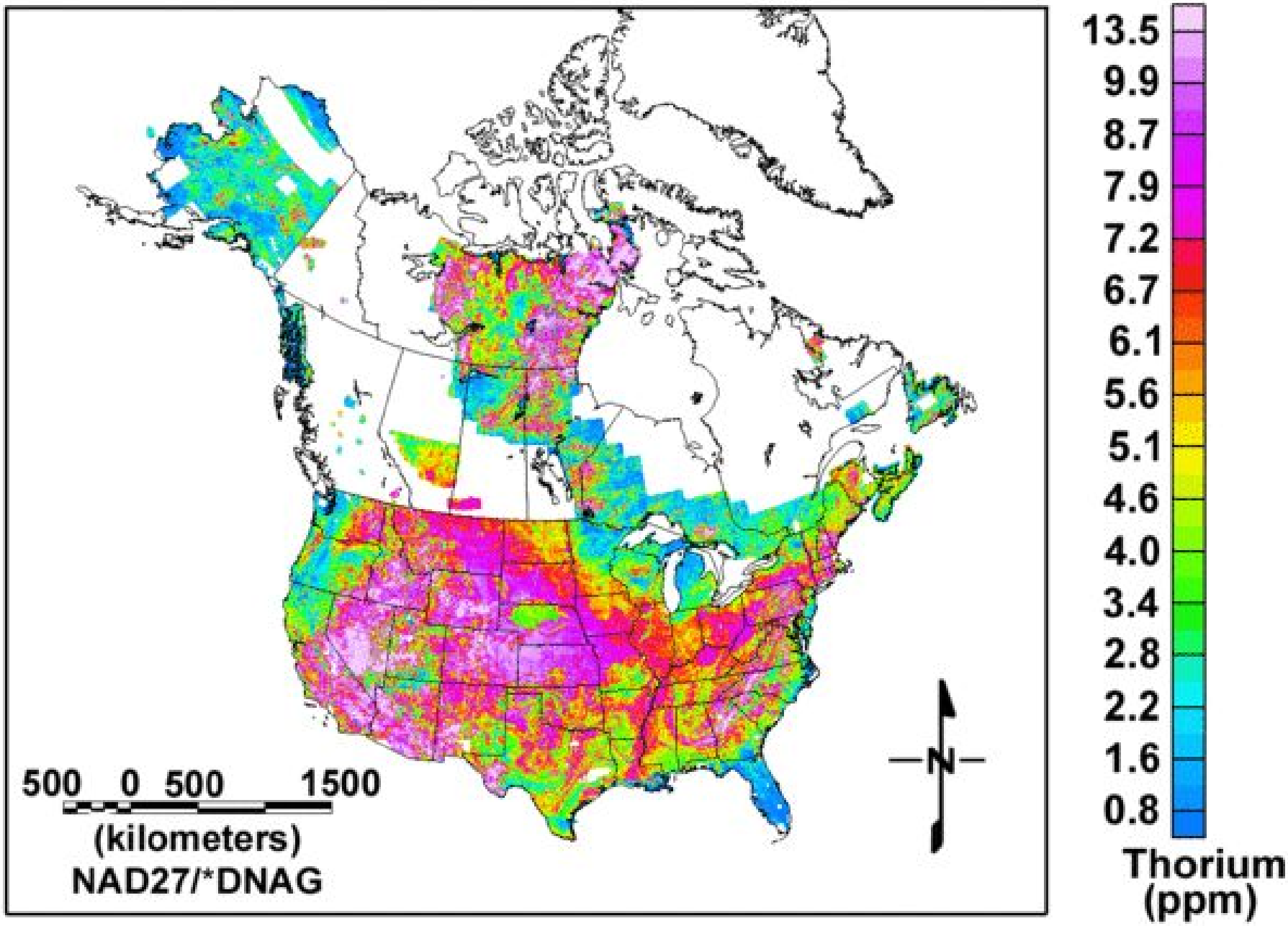
In an interview with the Chicago Tribune last week, Christopher Crane, CEO of Exelon (NYSE: EXC), said the breakneck pace of growth in subsidized wind power generation capacity could force the company to shut down some of its nuclear power plants.

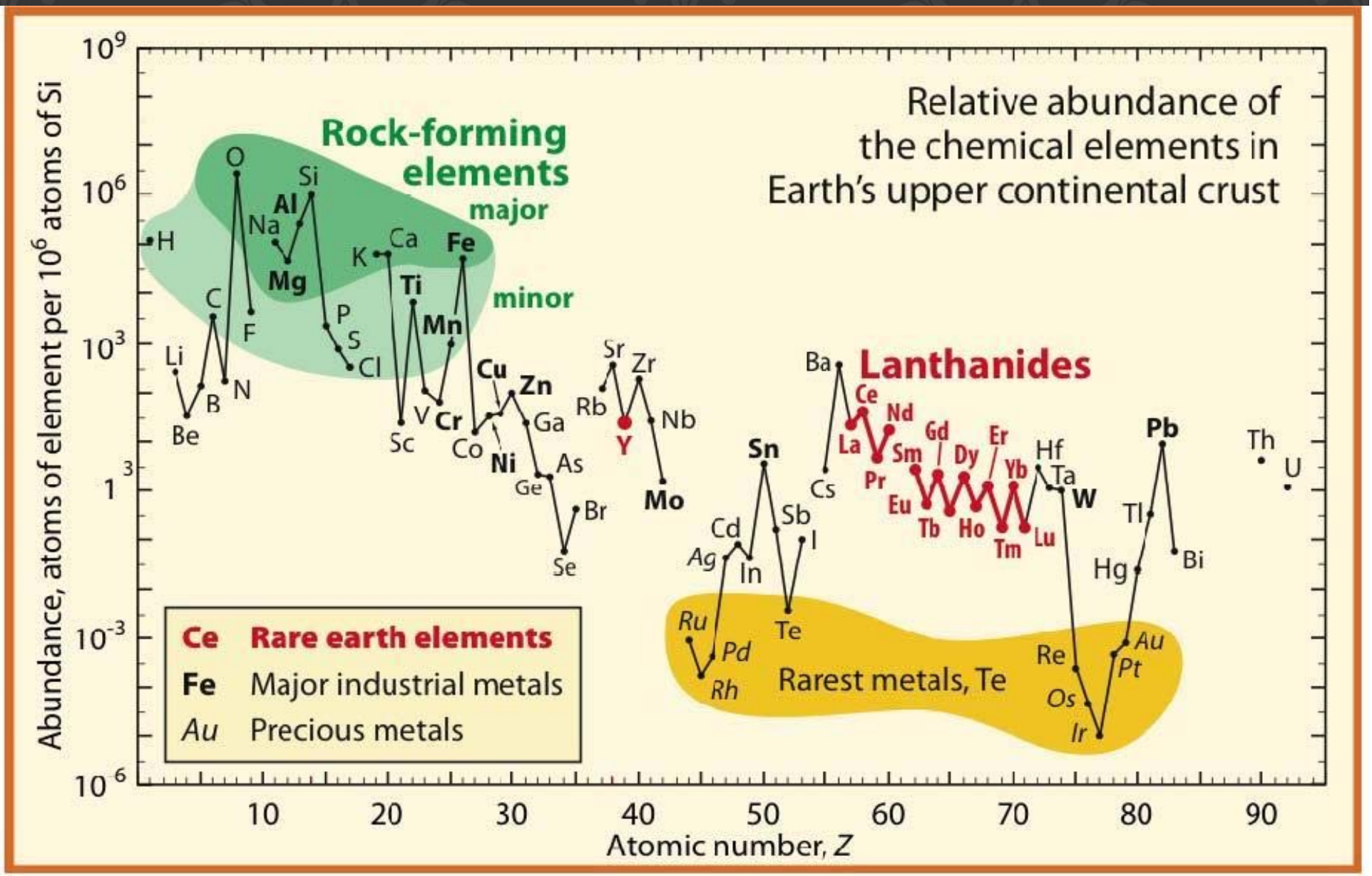
Energy = Money = Politics

We are just bit player in this sorted drama over money and resources… and we don't win.



Thorium Concentrations




Relative abundance of the chemical elements in Earth's upper continental crust
Rock-forming elements
major
minor
Lanthanides
Rarest metals, Te
Ce Rare earth elements
Fe Major industrial metals
Au Precious metals
Abundance, atoms of element per 10^6 atoms of Si
Atomic number, Z
H Li Be B C N O F Na Mg Al Si P S Cl K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Rb Sr Y Zr Nb Mo Ru Rh Pd Ag Cd In Sn Sb Te I Cs Ba La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Th U

The Periodic Table of the Elements

Lanthanide Series

Rare Earths and associated elements, Lutetium, Yttrium, Thorium and Scandium

hydrogen 1 H 1.0079																	helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium Mg 24.305											aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078		scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.693	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80
rubidium 37 Rb 85.468	strontium 38 Sr 87.62		yttrium 39 Y 88.906	zirconium Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29
cesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
francium 87 Fr [223]	radium 88 Ra [226]	89-102 **	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununnilium 110 Uun [271]	unununium 111 Uuu [272]	ununbium 112 Uub [277]		ununquadrium 114 Uuq [289]				

* Lanthanide series

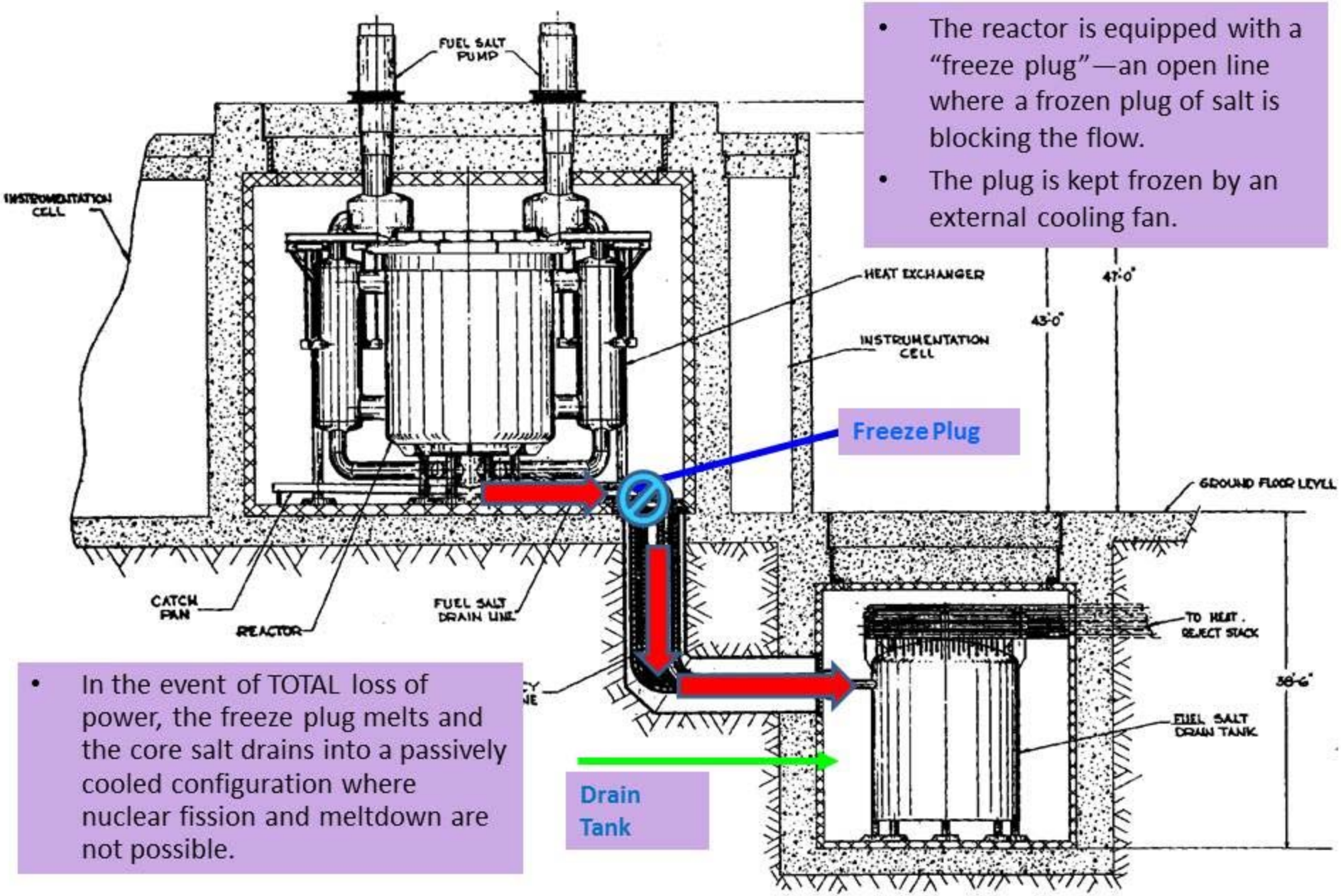
** Actinide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

Rare Earth Elements

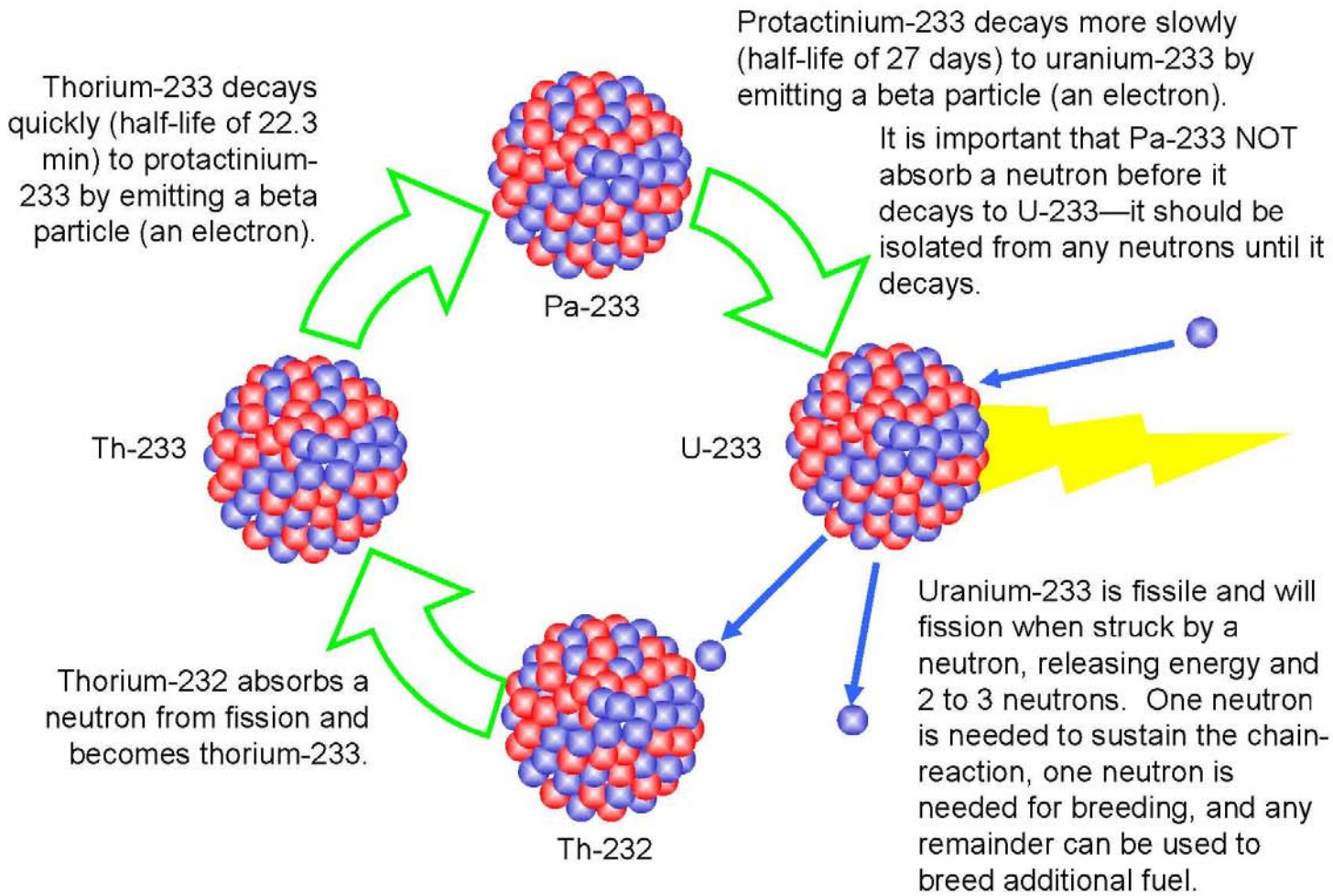
LFTR is Walk Away Safe

- The reactor is equipped with a "freeze plug"—an open line where a frozen plug of salt is blocking the flow.
- The plug is kept frozen by an external cooling fan.

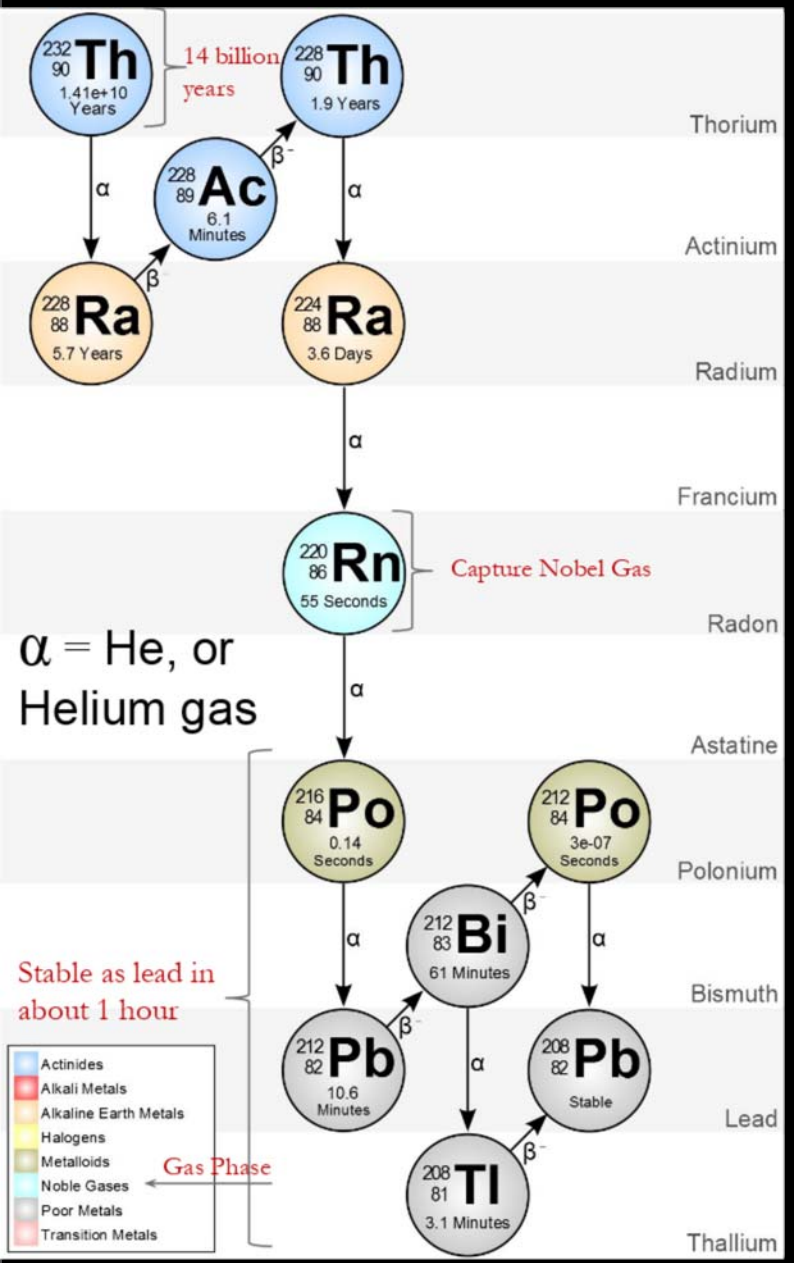


- In the event of TOTAL loss of power, the freeze plug melts and the core salt drains into a passively cooled configuration where nuclear fission and meltdown are not possible.

Thorium-Uranium Breeding Cycle



Thorium | Can it be Stored Safely ?



Thorium's natural decay chain makes safe storage possible:

- Thorium is stable for +14 billion years
- Thorium is not water soluble
- Thorium is primarily an alpha emitter
- Thorium transmutes into Radon, a Noble Gas [Rn]
- Thorium decays into lead [Pb]

Radon can be captured -- eliminating the possibility of radio-active release