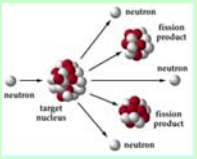
Nuclear Power

Sean Hanczor

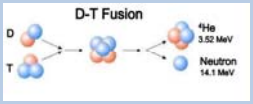
Nuclear Fission



Fission is the process of releasing energy stored in an atom by **splitting** heavy nuclei such as Uranium-235 and Plutonium 239

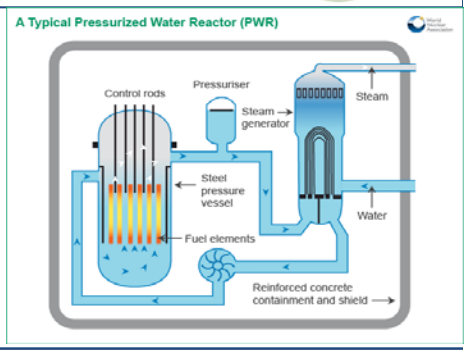
vs.

Nuclear Fusion

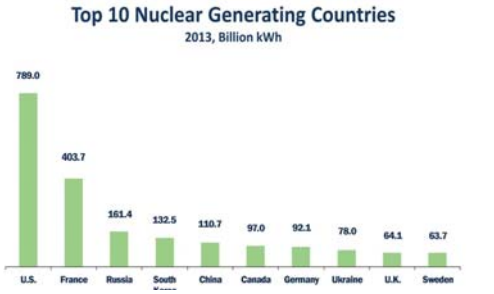


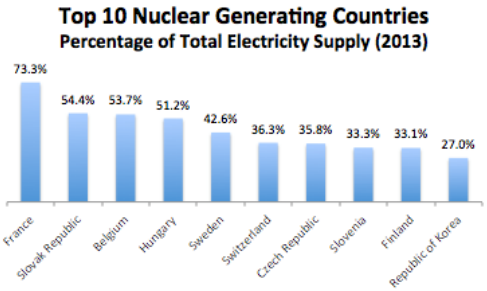
Fusion is the process of releasing energy stored in an atom by **combining** two lighter nuclei such as tritium and deuterium

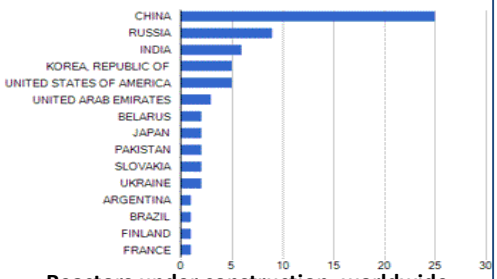
Fusion power offers the prospect of an inexhaustible energy source for future, but so far presents insurmountable scientific and engineering challenges.
With current technology, the most feasible reaction is between the nuclei of the two heavy isotopes of hydrogen – deuterium (D) and tritium (T). Each D-T fusion event releases 17.6 MeV compared with 200 MeV for a U-235 fission)



International Statistics

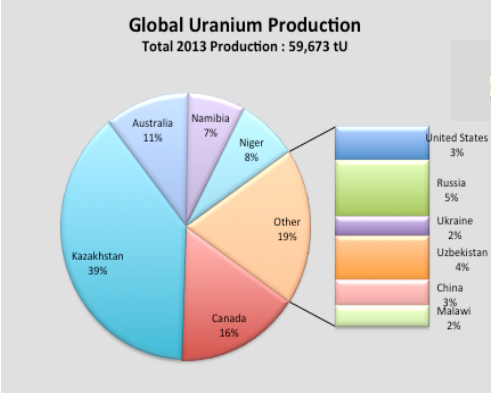






Reactors under construction, worldwide
as of 1-21-2015

Where do we get Uranium?



Benefits

Levelized cost of electricity production is increasingly competitive with coal, gas, and oil

Minimal CO_2 emissions, saving about 2 billion metric tons per year

Nuclear fission produces roughly a million times more energy per unit fuel weight than fossil fuel alternatives

Large power-generating capacity capable of meeting industrial and city needs

Problems

High construction costs

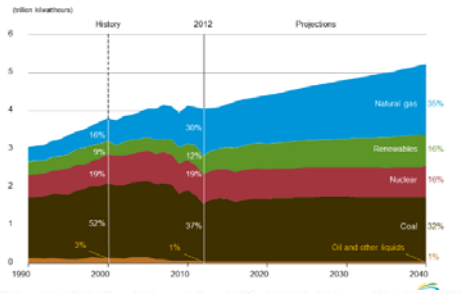
Finite natural resource of uranium

Total global combined generation of **high-level nuclear waste** averages 2,000 metric tons per year

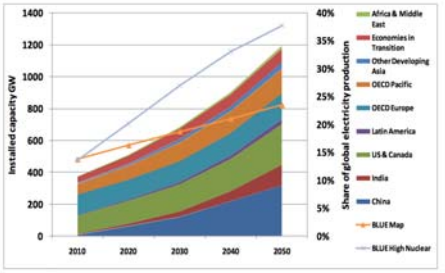
Spent nuclear fuel decays to safe radioactive levels, but this process takes tens of thousands of years

Waste has to be maintained, monitored, and guarded against threat of proliferation

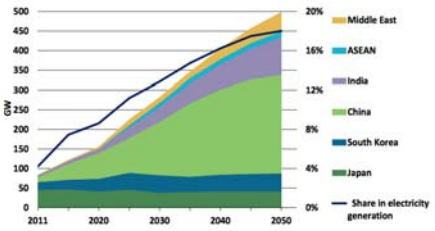
Projections



Growth of Nuclear Capacity and Electricity Generation to 2050



Nuclear power in Asia and Middle East in ETP 2°C scenario (2DS) (preliminary)



Reactor Type	Fuel	Coolant	Moderator	Number	GWe	Main Countries in Use
Pressurized Water Reactor (PWR)	enriched uranium-oxide	water	water	273	253	US, France, Japan, China, Russia
Boiling Water Reactor (BWR)	enriched uranium-oxide	water	water	81	76	US, Japan, Sweden
Pressurized Heavy Water Reactor (PHWR)	natural uranium-oxide	heavy water	heavy water	48	24	Canada
Gas-cooled Reactor (AGR & Magnox)	natural uranium (metal), enriched uranium-oxide	carbon dioxide	graphite	15	8	UK
Light Water Graphite Reactor (RBMK & EGP)	enriched uranium-oxide	water	graphite	11 + 4	10.2	Russia
Fast Neutron Reactor (FBR)	plutonium-oxide, uranium-oxide	liquid sodium	none	2	0.6	Russia

New News in Nuclear

- Electricity producers in New York, Ohio, and Illinois are asking for several hundreds of millions of dollars in financial support to keep costly nuclear power plants in business- a move that is likely to boost customer's power bills
- Canada and India strike uranium deal which will provide India with 7.1 million pounds of uranium over the next five years, a contract worth around $300 million

Nuclear Reference Sheet

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Nuclear Fission

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http://www.atomicarchive.com/Fission/Fission1.shtml

vs.

Nuclear Fusion

Image: Google Images

Pressurized Water Reactor
World Nuclear Association (2015)
http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Power-Reactors/Nuclear-Power-Reactors/

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Top 10 Nuclear Generating Countries

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Nuclear Percentage of Total Electricity Supply

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European Nuclear Society (2015)
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Global Uranium Production

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The Wall Street Journal (2015)