2017 HOUSE ENERGY AND NATURAL RESOURCES

HCR 3025

2017 HOUSE STANDING COMMITTEE MINUTES

Energy and Natural Resources Committee
Coteau –A Room, State Capitol

HCR 3025
3/2/2017
28640

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature	Kathleen Davis

Explanation or reason for introduction of bill/resolution:

To consider studying whether ND could act as an intermediary to provide fissile material from retiring intercontinental ballistic missiles as startup material for thorium energy production or research for new alternatives for energy production and to act as an intermediary to assist private parties to obtain permits for thorium from the federal government.

Minutes:

Attachment #1-#2

Chairman Porter:

Rep. Tom Kading: presented Attachment #1 and #2 regarding clean and sustainable energy development in ND. What can ND do to realize the maximum benefit from ICBM's.

15:16

Rep. Anderson: Are there any countries using this now? Does the lignite council support this?

Rep. Kading: No countries have a fully developed product. There was a couple reactors developed in the 50s-70s that were feasible and worked. India is developing these plants at this time. Regarding the lignite council, I guess we'll see but I don't know.

Chairman Porter: other questions? You're asking for a legislative council study. I look at this and think more of an Empower Commission where the industry experts across ND are doing exactly this. Did you give any consider to Empower Commission and how they would look at this with the experts that were there rather than us?

Rep. Kading: The Empower Commission isn't looking at this right now. If they wanted to that'd be great but aren't right now. It's worth having that conversation with them. I think the bigger question is the regulation for the federal government; how ND can bridge that gap, be an intermediary, bring a little stability to the permitting process or obtaining of materials.

Chairman Porter: other questions? Further testimony in support of HCR 3025? Opposition? Seeing none, the hearing was closed.

2017 HOUSE STANDING COMMITTEE MINUTES

Energy and Natural Resources Committee
Coteau –A Room, State Capitol

HCR 3025
3/2/2017
28652

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature	Kathleen Davis

Explanation or reason for introduction of bill/resolution:

To consider studying whether ND could act as an intermediary to provide fissile material from retiring intercontinental ballistic missiles as startup material for thorium energy production or research for new alternatives for energy production and to act as an intermediary to assist private parties to obtain permits for thorium from the federal government.

Minutes:

Chairman Porter: opened the hearing on HCR 3025.

Rep. Anderson: I so move a Do Pass on HCR 3025 and to be placed on the Consent Calendar.

Rep. Ruby: second

Chairman Porter: any discussion?

Rep. Seibel: does it have to be unanimous to go to the consent calendar? Ohhhhhh k. I guess I'll have to vote yes then.

Chairman Porter: no you don't have to. It can go to the 11th order after the vote.

Rep. Heinert: I have to agree with Rep. Seibel on this. Anybody in the western side of the state is going to have a tough time saying yes to this when they're living off coal and oil. Pretty hard to say change that philosophy right now.

Rep. Mitskog: I appreciate your input regarding the Empower Commission. They seem like a likely group to discuss this. They have a diversified approach to energy in our state. Do you know if there's been any discussion at that level?

Chairman Porter: we had a resolution or bill last session from Sen. Larsen about thorium. It was not passed. Two sessions ago, ok, and it was not passed. At the time that was more to get into a development of a plant rather than a study. So that one was not passed. This is a long shot at what it's asking for the federal government to give us weapons grade uranium.

Rep. Marschall: listening to his testimony, is kind of a repeat of a PBS Nova program that was aired about 2 weeks ago. Everything in this study he's requesting was in this show. There are companies out there do exactly doing what he's, thorium reactor, how it worked, who's researching it, the entire process. This study has already been complied with if you watched the Nova program a couple weeks ago. In a way I think this study is mute, unnecessary.

Chairman Porter: The clerk will call the roll on HCR 3025.
Yes 1 No 11 Absent 2 Motion failed.

Rep. Seibel: I moved for a Do Not Pass on HCR 3025

Rep. Heinert: second

Chairman Porter: the clerk will call the roll on a Do Not Pass.
Yes 10 No 2 Absent 2 Motion carried. Rep. Marschall is carrier.

Date: 3-2-17

Roll Call Vote #: 1

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. 3025

House Energy & Natural Resources **Committee**

☐ **Subcommittee**

Amendment LC# or Description:

Recommendation
☐ Adopt Amendment
☒ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☒ Place on Consent Calendar

Other Actions ☐ Reconsider ☐

Motion Made By Rep Anderson **Seconded By** Rep Ruby

Representatives	Yes	No	Representatives	Yes	No
Chairman Porter		✓	Rep. Lefor	AB	
Vice Chairman Damschen		✓	Rep. Marschall		✓
Rep. Anderson	✓		Rep. Roers Jones		✓
Rep. Bosch		✓	Rep. Ruby		✓
Rep. Devlin		✓	Rep. Seibel		✓
Rep. Heinert		✓			
Rep. Keiser	AB		Rep. Mitskog		✓
			Rep. Mock		✓

Total (Yes) 1 No 11

Absent 2

Floor Assignment

If the vote is on an amendment, briefly indicate intent:

Date: 3-2-17

Roll Call Vote #: 2

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. 3025

House **Energy & Natural Resources** **Committee**

☐ **Subcommittee**

Amendment LC# or Description:

Recommendation
☐ Adopt Amendment
☐ Do Pass ☒ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions ☐ Reconsider ☐

Motion Made By Rep Seibel **Seconded By** Rep Heinert

Representatives	Yes	No	Representatives	Yes	No
Chairman Porter	✓		Rep. Lefor	AB	
Vice Chairman Damschen	✓		Rep. Marschall	✓	
Rep. Anderson		✓	Rep. Roers Jones	✓	
Rep. Bosch	✓		Rep. Ruby	✓	
Rep. Devlin	✓		Rep. Seibel	✓	
Rep. Heinert	✓				
Rep. Keiser	AB		Rep. Mitskog	✓	
			Rep. Mock		✓

Total (Yes) 10 No 2

Absent 2

Floor Assignment Rep Marschall

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

HCR 3025: Energy and Natural Resources Committee (Rep. Porter, Chairman) recommends **DO NOT PASS** (10 YEAS, 2 NAYS, 2 ABSENT AND NOT VOTING). HCR 3025 was placed on the Eleventh order on the calendar.

2017 TESTIMONY

HCR 3025

1
3-2-17
HCR 3025

Representative Tom Kading
District 45
/2/15
House Standing Committee on Energy and Natural Resources - Coteau A Room

Chairman Porter and members of the committee, for the record I am Representative Tom Kading from District 45 in north Fargo. I bring to you today House resolution 3025 which is in regards to clean and sustainable energy development in North Dakota.

Did you know that there is more energy potential in the fly ash waste from at a coal plant than the coal that was burned?

This past year I have gotten to know a number of individuals in the growing industry of clean nuclear energy. Most current nuclear reactors used in energy production are considered light water reactors. These methodologies were pushed heavily during the cold war due to the fact that nuclear weapons can be derived from their operations. In the 50s and 60s a number of different reactor types were proposed. The light water reactor type was the primary type which the was promoted due to the weapon potential. Another type of reactor which was explored was called a molten salt reactor. This was a much safer method but did not have the weapon potential. I will get into a little more detail as to why a molten salt reactor is safer for energy production. This molten salt reactor is where I think North Dakota has a special role to play in clean and sustainable thorium energy production.

First, I am a strong believer that the private sector is more than capable in driving innovation in the energy field than government. Enabling the private sector is what we should strive to accomplish. The problem the clean nuclear industry faces is primarily the federal government. Under current law the Nuclear Regulatory Commission - also known as the NRC - must approve a proposed facility prior to one being built. Though approval by the NRC is a good thing for safety, the amount of time it takes this agency to approve a project is borderline ridiculous. It takes at least 5-7 years to obtain a permit. When I surveyed those in the industry, they said there is no real average, rather it is really kind of random at the discretion of the NRC and this is a huge hindrance to the development of such clean energy.

Under federal law, there are alternatives to regulation by the NRC. The branches of the military have always had the authority to regulate nuclear facilities on their property. Of course we're familiar with the Navy and their nuclear submarines, but the Army built, operated, and regulated eight reactors back in the 1960s. Considering the presence that the Air Force has here in North Dakota, an alternative may be for the Air Force to work with the Army Reactor Office rather than the NRC. The Army Reactor Office would have to be staffed up and educated on the new thorium reactor technology, but that will have to happen in any scenario. I think that the Army will be much more highly motivated to successfully regulate thorium reactors than the NRC will, because the military will directly benefit from safe, independent, reliable energy generation on their facilities.

We don't have any nuclear reactors in North Dakota but we have something much more potentially dangerous.

- We have approximately 150 Minuteman 3 missiles surrounding Minot Air Force Base here in the state. Minuteman 3 missiles are ICBMs that are tipped with a nuclear warhead, which is uranium or plutonium jacketed with high-explosives.
- There has been a lot of talk in the current administration and in Russia to reduce the number of nuclear arms in both countries, and eliminating land based ICBMs. This is particularly attractive because these are the weapons that cause the other side to target your homeland. Nuclear missiles by and large aren't pointed at our cities. They're pointed at North Dakota, Montana, and Wyoming because that's where our ICBMs are located. If a nuclear war ever did occur North Dakota would be pummeled over and over again by the Russians in an attempt to destroy our ICBMs
- Current proposals include reducing ICBMs to 300, 150, or reduction all together.

So what this study aims to accomplish is explore what North Dakota can do to realize the maximum benefit from the reduction in ICBMs, so that we could become the logical place for clean energy reactors to be built and operated while they are permanently destroying material that was once part of man's most fearful weapon. These and other possibilities would be fleshed out in the study.

I noted earlier that more energy is stored in the fly ash waste from a coal plant than the coal burned to make the waste. To understand this, I'll give you a brief background in how nuclear fission works:

- Traditional Light Water Reactors use Uranium 235 to make heat which in part makes energy from a steam turbine.
- U235 makes up 0.711% of natural Uranium which can be mined.
- A nuclear power plant general uses refined Uranium which is has about 2-4% U235.
- This means 99.2% of mined Uranium goes to waste and is stored as a waste material
- The element in the disposed fly ash is Thorium.

Thorium is not fissile by itself and therefore cannot be used as a weapon. Thorium is considered fertile. This means it can be converted to a fissile element which can be used to produce heat. There are obviously some complicated procedures involved that I am not going to get into, but it is a process which can be carried out. Once fissile, nearly 100% of the Thorium can be used up in the electricity production and leaves very little radioactive waste.

- Thorium is approximately 4 times more abundant than Uranium and much more efficient.
- Thorium can be commonly found in North Dakota
- A Uranium based reactor has radioactive waste that last about 10,000 years, whereas a Thorium based reactor has radioactive waste that lasts about 300 years.

The best way to use thorium is in a design called the Liquid Fluoride Thorium Reactor or LFTR.

  - LFTRs operate safely at low pressures and have no possibility for meltdown or release of pressure. They are made of chemically stable materials that do not react with air and water. They shut down.
  - Traditional Light Water Reactors are high pressure.

- Low pressure means the reactor doesn't explode due to pressure. High pressure is probably the most common failure in a reactor's radioactive containment system.

- LFTRs shut down automatically if cooling is lost and their stable, self-controlling nature was demonstrated back in the 1960s. The key to all this is that they are a fluid based fuel rather than a solid based fuel. This means if the fuel begins to overheat, the fluid fuel would melt a salt plug and harmlessly drain into storage tanks. No human or computer action is required for this and is therefore very reliable and safe.
- LFTRs can be small scale. This could significantly help alleviate the problem of transmission loss from moving power over a long distance.

One might ask why hasn't this been widely adopted in the US yet, and the answer is regulation makes it very difficult. Since the '60s all of the major nuclear reactor construction companies have moved out of the business due to federal difficulties. The last 2 US builders in the industry have moved out of the business since the Fukushima events. These two companies were GE and Westinhouse. There are many small companies looking to get into the business but it is difficult given the federal government. One notable company is called FLIBE Energy. They have developed a design for a LFTR. Another company ran by the Bill and Melinda Gates Foundation called TerraPower is developing another atomic concept.

Bill Gates' organization is quoted as saying, and I quote, "It was believed that business interests could develop a scalable, sustainable, environmentally friendly, and cost-competitive energy source that would allow all nations to quicken their pace of economic development and reduce poverty."

Gates is also noted for saying China is the best place to pursue next-generation nuclear power. I personally don't want this to happen, I want to see the US, Canada, and North Dakota being the place for next-generation nuclear power. We have a great deal to offer thorium technology developers and I think we can work along side Wyoming and Saskatchewan on any such project.

Inexpensive energy drives innovation and economic growth. One blossoming industry in the state is the drone industry. The drone industry primarily operates on electric power. Inexpensive, reliable, safe, and CO_2 clean energy will help push the industry.

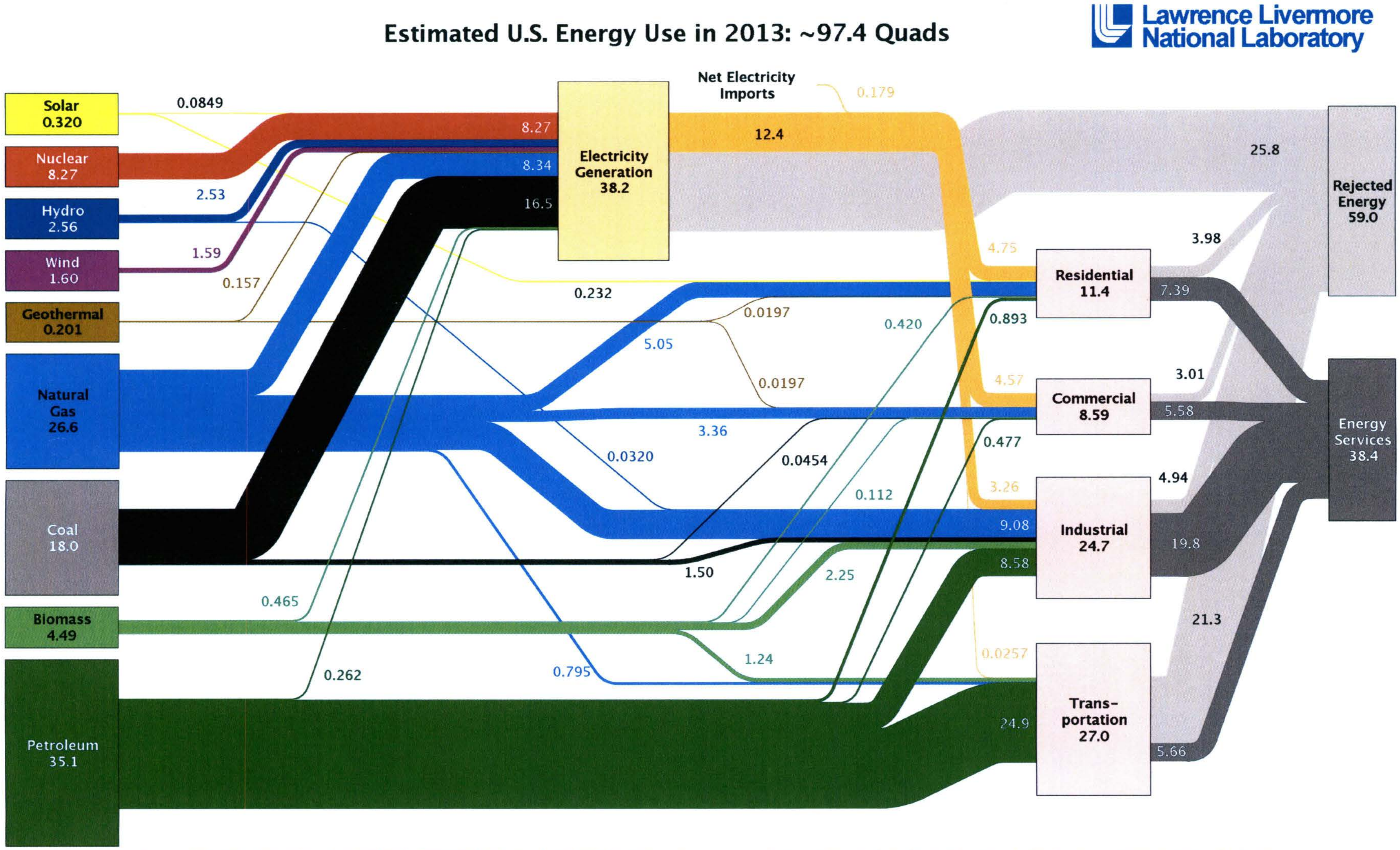
As a side point, Excess heat from small atomic units can be additionally used for:

- Direct use in shale oil extraction (local site/mobile)
- Hydrogen production
- Desalination
- Coal to liquid fuel (Fischer-Tropsch)

In conclusion, this study can help North Dakota prepare for the clean nuclear future using special materials that are already here in the state. This study can lead us to a clean, efficient, reliable, and safe energy source. By taking the initiative at the state level we can get around the inertia and indifference of the federal government. By getting the federal government out of the way in the permitting process and helping private companies obtain the materials they need, North Dakota can help make this idea possible. I urge you to vote yes.

Thank you and I will try to answer any questions.

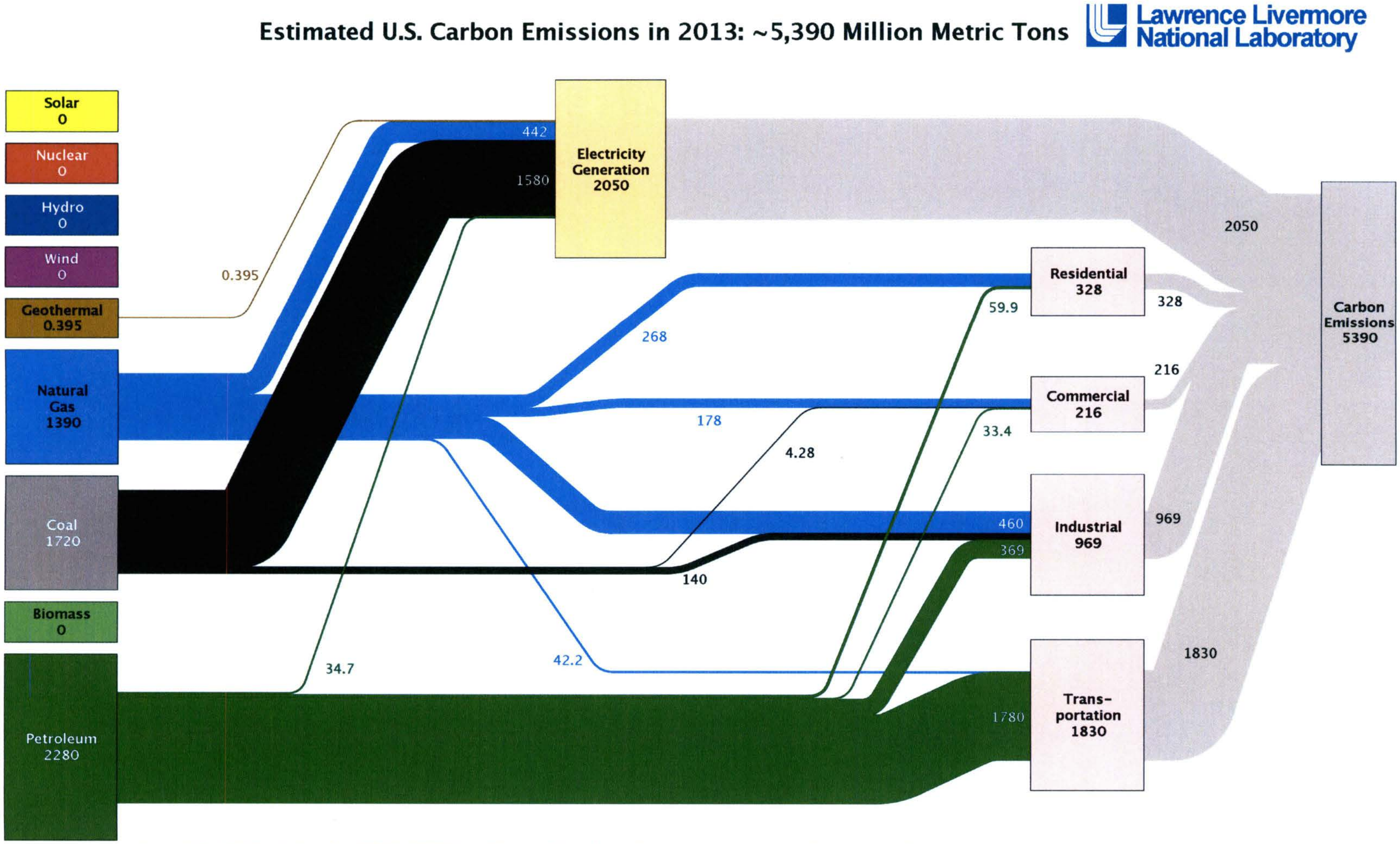
Waste



Source: LLNL 2014. Data is based on DOE/EIA-0035(2014-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

KADING HCR 3025 3-2-17 2

CO2

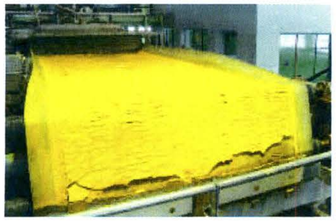


Source: LLNL 2014. Data is based on DOE/EIA-0035(2014-03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Carbon emissions are attributed to their physical source, and are not allocated to end use for electricity consumption in the residential, commercial, industrial and transportation sectors. Petroleum consumption in the electric power sector includes the non-renewable portion of municipal solid waste. Combustion of biologically derived fuels is assumed to have zero net carbon emissions - the lifecycle emissions associated with producing biofuels are included in commercial and industrial emissions. Totals may not equal sum of components due to independent rounding errors. LLNL-MI-410527

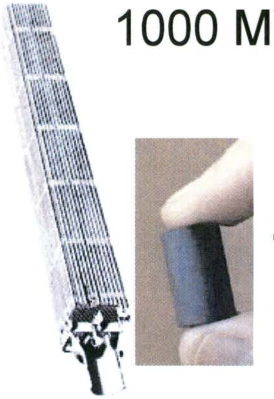
Uranium Fuel Cycle vs. Thorium

1000 MW of electricity for one year

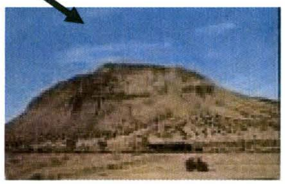
800,000 tons Ore



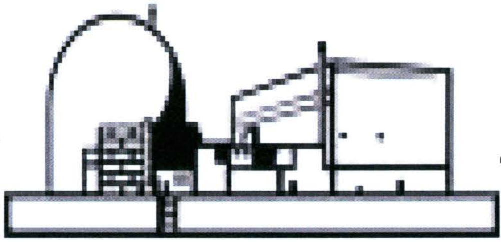
250 tons
Natural uranium



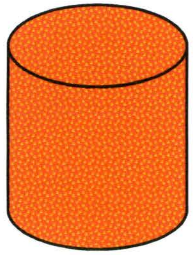
35 tons
Enriched Uranium
(Costly Process)



215 tons
depleted uranium
-disposal plans uncertain

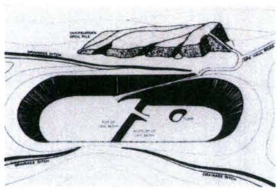


Uranium-235 content is "burned" out of the fuel; some plutonium is formed and burned



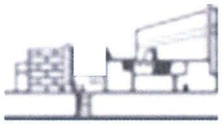
35 tons Spent Fuel
Yucca Mountain
(~10,000 years)

- 33.4 t uranium-238
- 0.3 t uranium-235
- 0.3 t plutonium
- 1.0 t fission products

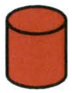


200 tons Ore

1 ton
Natural Thorium



Thorium introduced into blanket of fluoride reactor; completely converted to uranium-233 and "burned"



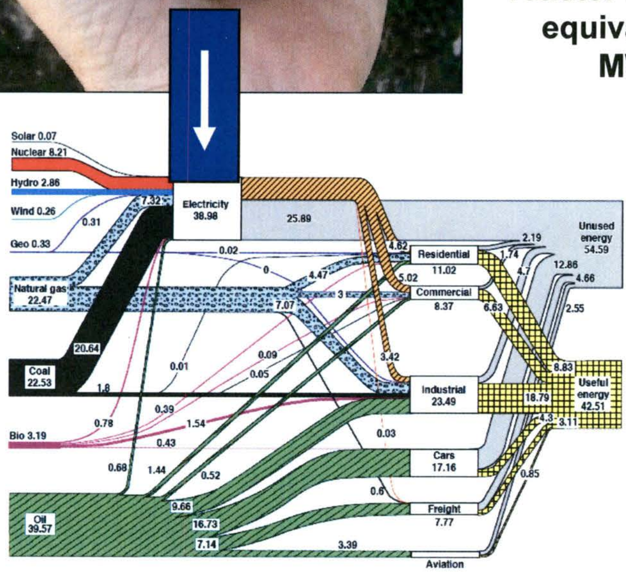
1 Ton
Fission products; no uranium, plutonium, or other actinides

Within 10 years, 83% of fission products are stable and can be partitioned and sold.

The remaining 17% fission products go to geologic isolation for ~300 years.

3

Can Thorium Be That New Line?



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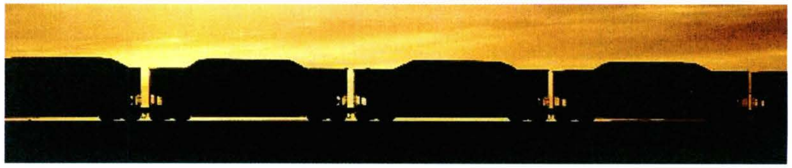
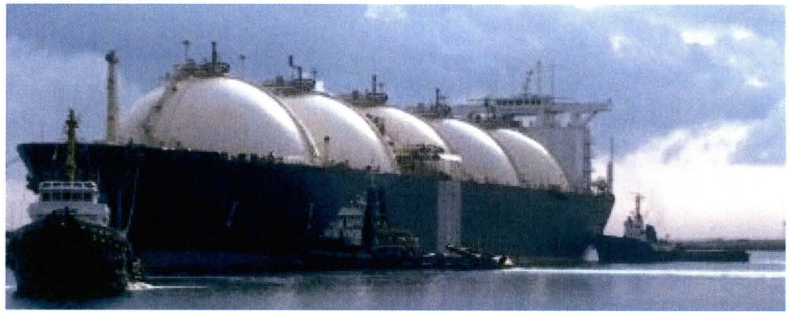
6 kg of thorium metal in a liquid-fluoride reactor has the energy equivalent (66,000 MW*hr) of:

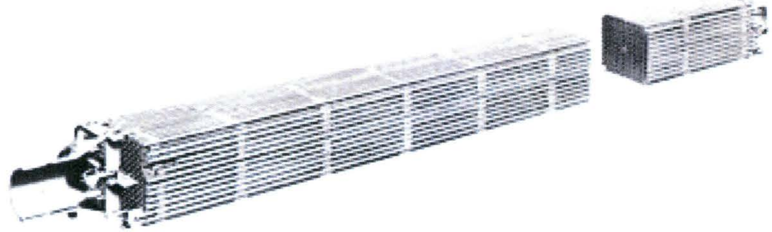


230 train cars (25,000 MT) of bituminous coal or,

600 train cars (66,000 MT) of brown coal,



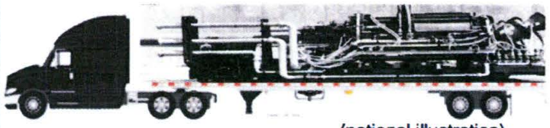
or, 440 million cubic feet of natural gas (15% of a 125,000 cubic meter LNG tanker),



or, 300 kg of enriched (3%) uranium in a pressurized water reactor.

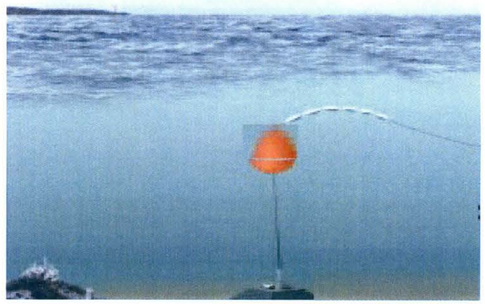
And what is the best way to extract its potential?

Unique Applications

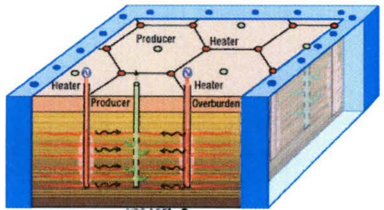


(notional illustration)

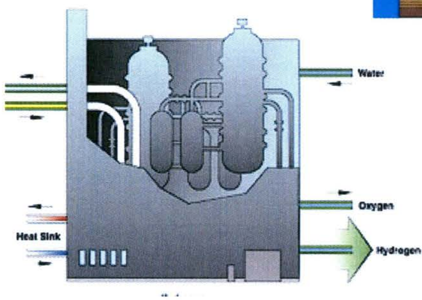
- **Mobility:**
  - Site relocations(lower financial risk)
  - Military or disaster relief
  - Near consumer, lower grid losses
  - Ships (including littoral naval vessels for an all nuclear US Navy)

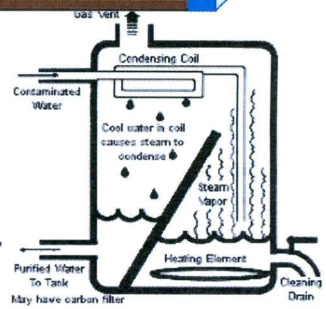


- **Submerged units:**
  - Hidden (aesthetic view)
  - Threat resistant
  - Good heat rejection
  - Unaffected by storm or earthquake



- **High Temperatures:**
  - Direct use in shale oil extraction (local site/mobile)
  - Hydrogen production
  - Desalination
  - Coal to liquid fuel (Fischer-Tropsch)



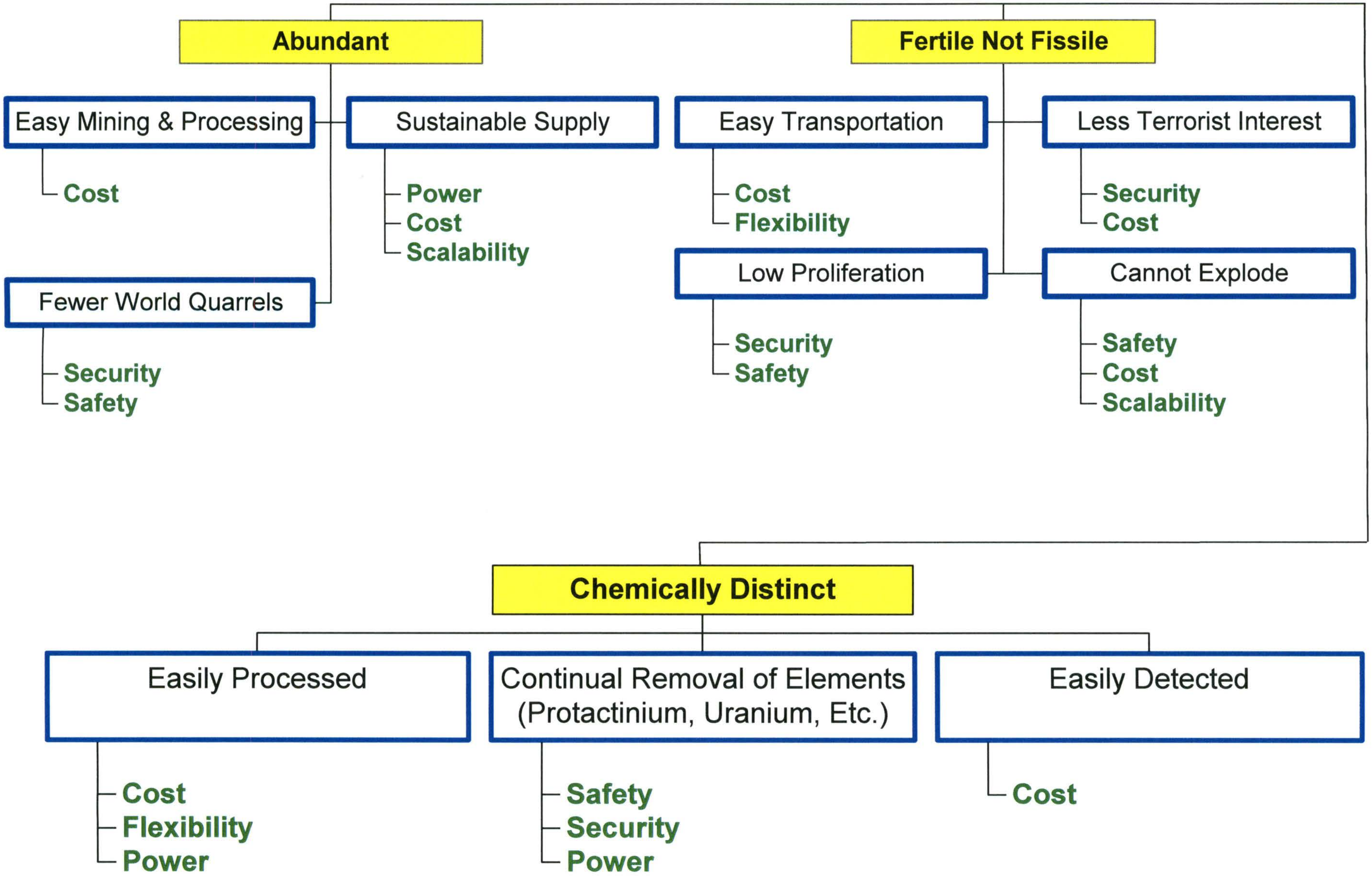


Relative Comparison:
Uranium vs Thorium Based Nuclear Power

	Uranium LWR (light water reactor, high pressure low temp)	*Thorium LFTR (liquid fluoride thorium reactor, low pressure high temp)*
Plant Safety	Good (high pressure)	Very Good (low pressure, passive containment)
Burn Existing Nuclear Waste	Limited	Yes
Radioactive Waste Volume (relative)	1	1/30th
Waste Storage Requirements	10,000+ yrs.	~300 yrs.
Produce Weapon Suitable Fuel	Yes	No
High Value By-Products	Limited	Extensive
Fuel Burning Efficiency	<1%	>95%
Fuel Mining Waste Vol. (relative)	1000	1
Fuel Reserves (relative)	1	>1000
Fuel Type - Fuel Fabrication/Qualification	Solid Expensive/Long	Liquid Cheap/Short
Plant Cost (relative)	1 (high pressure)	<1 (low pressure)
Plant Thermal Efficiency	~35% (low temp)	~50% (high temp)
Cooling Requirements	Water	Water or Air
Development Status	Commercial Now	Demonstrated 1950-1970

Source: http://www.energyfromthorium.com/ppt/thoriumEnergyGeneration.ppt

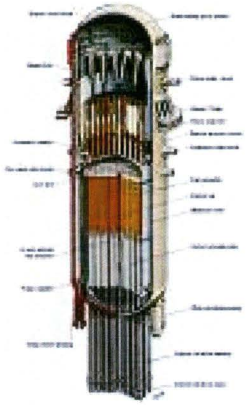
Thorium Advantages

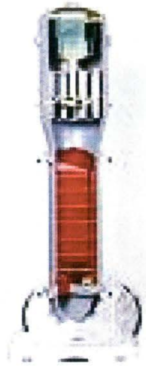


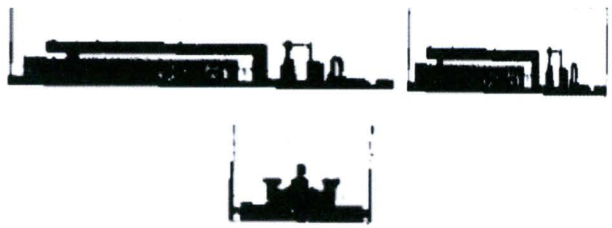
Thorium Reactor could cost 30-50% Less

(Cost Effective & Grid Interfacing)

- No pressure vessel required
- Liquid fuel requires no expensive fuel fabrication and qualification
- Smaller power conversion system
  - Uses higher pressure (2050 psi)
- No steam generators required
- Factory built-modular construction
  - Scalable: 100 KW to multi GW
- Smaller containment building needed
  - Steam vs. fluids
- Simpler operation
  - No operational control rods
  - No re-fueling shut down
  - Significantly lower maintenance
  - Significantly smaller staff
- Significantly lower capital costs
- Lower regulatory burden
- No grid interfacing costs:
  - Inherent load-following
  - No power line additions/alterations
  - Minimum line losses
  - Plant sized by location/needs







Plant Size Comparison: Steam (top) vs. CO2 (bottom) for a 1000 MWe plant