

WITNESS INFORMATION FORM

Please complete the Witness Information Form before testifying:

Date: 12/5/22

Name: Connie Kline

Are you representing: Yourself Organization

Organization (If Applicable): _____

Position/Title: _____

Address: _____

City: Willoughby Hills State: OH Zip: 44094

Best Contact Telephone: 440-946-9012 Email: _____

Do you wish to be added to the committee notice email distribution list? Yes No

Business before the committee

Legislation (Bill/Resolution Number): HB 434 Anthem Act

Specific Issue: "Advanced" Reactors

Are you testifying as a: Proponent Opponent Interested Party

Will you have a written statement, visual aids, or other material to distribute? Yes No

(If yes, please send an electronic version of the documents, if possible, to the Chair's office prior to committee. You may also submit hard copies to the Chair's staff prior to committee.)

Will your testimony be written, spoken, or both? probably just written

Please provide a brief statement on your position:

HB 434 would create a Nuclear Development Authority with virtually unrestricted powers to use public moneys and acquire private property to both promote and assume regulatory powers from the NRC, DOE, DOD etc. to construct and operate advanced reactors benefiting private corporations without cost, liability, specificity or provision for community/public involvement.

Please be advised that this form and any materials (written or otherwise) submitted or presented to this committee are records that may be requested by the public and may be published online.

Chairman McColley and Committee members, thank you for the opportunity to present the following testimony.

- If nuclear power is so desirable, why aren't investors rushing to buy stock instead of taxpayers having to shoulder the financial burdens and radioactive risks??
- "Today's problems come from yesterday's 'solutions.'" MIT scientist Peter Senge's The Fifth Discipline

HB 434 SUMMARY

- On 3/23/22, the Ohio House passed HB 434 (1), another "advanced" nuclear reactor bill which:
- "(seeks) to create "a Nuclear Development Authority (NDA)" with sweeping, alarming, nearly unrestricted powers
 - "...for which public moneys may be spent and private property acquired" (2)
 - "(will) enter into...approve agreements with...and assume any regulatory powers delegated from the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Energy (DOE),...the U.S. Department of Defense (DOD),...or any branch of the U.S. military or similar federal agencies, departments, or programs governing the construction and operation...of nuclear reactors and the handling of radioactive materials...(3)
 - "To make this state all of the following:
 1. **A leader in the development and construction of new-type advanced-nuclear-research reactors:** This is undefined but is presumably molten salt/thorium reactors as referenced in this and previous bills and repeatedly in House proponent testimony. (See also Notes 20-22)
 2. **A national and global leader in the commercial production of (radioactive) isotopes:** This is undefined but could involve the highly dangerous process of "breeding" highly radioactive fuel/elements as indicated in House sponsor and proponent testimony. (See also Notes 20-22, 25)
 3. **A leader in the research and development of high-level-nuclear waste reduction ..."** This is also undefined but is undoubtedly the failed, extremely hazardous "reprocessing" of highly radioactive fuel/elements, potentially from all over the U.S. or the world as indicated repeatedly in House sponsor and proponent testimony using the word "reprocessing" and various euphemisms such as "burning" "consuming" used, irradiated reactor fuel. (4) (See also Notes 26-30)

IGNORED ISSUES

Sponsor and proponent testimonies have claimed that the purpose of HB 434 is to merely develop a 10 MW experimental research reactor, but a 10 MW reactor is NOT specified anywhere in the bill. Sponsor/proponent testimonies clearly state that the goal is to commercialize much larger reactors for power/electricity production and potentially fuel breeding and reprocessing.

HB 434 fails to address: public health and safety measures; siting requirements; emergency/evacuation planning; taxpayer costs and liability caps for research, construction, operation and post-reactor clean up, decommissioning, nuclear waste disposal; security and nuclear weapons proliferation safeguards etc.

AMENDMENT WORSENS LACK OF PUBLIC INVOLVEMENT, TRANSPARENCY, ACCOUNTABILITY

Even before a last minute, one sentence amendment moved the NDA from the Ohio Department of Administrative Services (DAS) to the Ohio Department of Development/JobsOhio Corporation (Dev), (5) HB 434, like its predecessors (6), had no provisions for community or public stakeholder involvement despite unlimited upfront taxpayer money and billions of dollars in potential liability under worst case scenarios.

The DAS is a government agency, but **JobsOhio, a controversial, much criticized private corporation** created under the DEV in 2011 "is **NOT** a state or public department, agency, or body, and thus is exempt from many requirements imposed on public entities...(including) Open Meetings Law, Sunshine Laws, Public Records Laws...Directors and employees of JobsOhio are **NOT**...public servants, employees or officials of the state...and generally are **NOT** subject to official ethics laws...and certain Criminal Code provisions..." according to a 3/16/22 Ohio Legislative Services Commission JobsOhio Fact Sheet. (7)

INHERENT CONFLICTS OF INTEREST WITHIN THE NDA

Despite a detailed, complicated process to form a Nominating Council to choose members of the NDA "To foster...partnerships...among...the state's...private companies...(and) public...sectors..." (8), there are no restrictions regarding the NDA's relationship with private companies that have vested, financial interests in these reactors. Nothing precludes private companies from being members of the Nominating Council or the NDA, itself, and under JobsOhio virtually no public information, transparency, or accountability would be available.

The NDA could assume inherently conflicting nuclear promotional and safe regulatory powers from the NRC, DOE, DOD etc. which are not permitted federally. (9)

HR 518 which began this reactor push in Ohio in 2017 was adopted verbatim from a petition on the website of **eGeneration**, a private corporation promoting molten salt reactors. All subsequent bills contain language attributable to eGeneration. (10)

Four of the seven people presenting HB 434 House proponent testimony on 12/8/21 and five of six presenting 11/29/22 Senate proponent testimony have direct ties to eGeneration or **Elysium Industries** or **Exyodys Energy**, private corporations indirectly tied to eGeneration, which seek to develop and commercialize Fast Chloride Molten Salt Reactors. (11)

EXORBITANT TAXPAYER COSTS

Sponsor and proponent testimonies have mentioned federal funding, but HB 434 does specify a funding source, referring only to **"public moneys"** without specified spending limits. This clearly implies Ohio taxpayers. Private companies like Elysium have applied for and received DOE "advanced" reactor money.

<https://www.energy.gov/ne/articles/elysium-industries-usa-awardee-tier-ii>.

While DOE money is also taxpayer funded, federal taxpayers are a much larger pool than Ohio taxpayers. There shouldn't have to be any additional Ohio taxpayer money. All investment should really be private. But Elysium, eGeneration and any other "advanced" reactor company, including super rich Bill Gates' 345 MW Sodium reactor, all rely on taxpayer funding because investors/venture capitalists are unwilling to bankroll such dangerous, expensive, uncertain ventures. eGeneration had an unsuccessful Go Fund Me account which is now inactive.

"Advanced" reactors are proving extremely costly when compared to far safer, non-nuclear energy sources. The cost for the 465 MW NuScale reactor is projected to be \$90 to \$120/Mwh. (12)

NO LESSONS LEARNED FROM THE HB 6 SCANDAL

HB 6 testimony and independent polling revealed widespread disapproval of nuclear bailouts and subsidies and strong support and preference for solar, wind, and energy efficiency. The conservative Buckeye Institute and the Ohio Chapter of Americans for Prosperity testified against HB 6, as "corporate welfare...(and) a glorified slush fund." (13)

Instead of encouraging and promoting investment in safe, far less costly, non-nuclear alternatives, the PUCO, the Ohio Power Siting Board (OPSB), Ohio governors, and the Ohio legislature have systematically decimated Ohio's renewable energy and efficiency standards and stymied investment in wind and solar, presumably to force dependence on nuclear power.

Ohio was 13th in the U.S. for wind power until a 2014 Ohio law (HB 483) created the most restrictive wind turbine set backs in the country and impeded renewables and efficiency. (14) HB 6 completely eliminated the 2008 renewable and energy efficiency standards which, to date, have not been even partially restored.

To add insult to injury, Ohio has recently passed laws like SB 52 allowing counties to kill solar and wind projects (primarily based on aesthetics), even those approved by the OPSB. (15) Yet cities and counties are statutorily forbidden from banning coal mining, natural gas/oil drilling/fracking, or nuclear projects. (16)

It would be far safer and more prudent for Ohio to encourage research and development of the many promising alternatives to lithium batteries for energy storage. (17)

MEDICAL ISOTOPE FALSEHOODS

To justify these reactors and make them more palatable to the public, proponents tout medical isotope production claiming there is none in the United States. This is simply not true. Congress passed The American Medical Isotope Production Act of 2012

<https://www.ncbi.nlm.nih.gov/books/NBK396175/>

and there are at least three commercial medical isotope producing facilities in the U.S. (18)

SERIOUS, EXPENSIVE PROBLEMS OHIO COULD FACE IF HB 434 BECOMES LAW

Thorium, molten salt, or sodium cooled reactors, and "reprocessing" or "breeding" intensely radioactive isotopes aren't new. They are a regurgitation of past, cataclysmic failures that produced high-level, long-lived, radioactive waste and continue to pose serious health, environmental, and nuclear weapons proliferation threats.

A) Thorium, Molten Salt, Sodium Cooled, and Breeder Reactors - Contamination, Waste, Proliferation Problems

● **Actinides** are 15 radioactive elements that include uranium, thorium, and plutonium. They spontaneously ignite in the presence of air and react with boiling water or dilute acid to release potentially explosive hydrogen gas. (19) See also HB 434 [Sec. 4164.05 (3)(c) and (f), p. 5, lines 119 and 122]

● Contrary to industry promotion and proponent testimony, unlike uranium, thorium is not a nuclear reactor fuel. It cannot power reactors because it does not contain enough fissionable material to cause a chain reaction. Uranium-235 or plutonium-239 are necessary to start the reaction until enough thorium is converted to uranium-233 to sustain the chain reaction. (20)

● Uranium-233 and plutonium-239 are nuclear bomb explosive materials and nuclear weapons proliferation threats. (21)

● Thorium/molten salt reactors produce high-level radioactive waste that remains dangerous and must be isolated for hundreds, thousands, or millions of years. For example, U-233 has a half-life of 160,000 years making its hazardous life (a factor of 10-20) millions of years. (22)

● Molten salt is highly corrosive and damaging. "Sodium reacts vigorously with water and steam and is extremely reactive, oxidizing rapidly when exposed to air. The basic chemical reaction with water...produces a caustic sodium hydroxide solution and... (potentially explosive) hydrogen gas."

U.S. Department of Energy, Tank Closure and Waste Management, Final Environmental Impact Statement, (DOE/EIS-0391, December 15, 2012, P. F-207).

<https://www.hanford.gov/page.cfm/FinalTCWMEIS> (23)

● "The stabilization and disposal of the irradiated nuclear fuel at the very small Experimental Molten Salt Reactor that operated at the **Oak Ridge National Laboratory** in Tennessee for four years from 1965-1969 has become the most challenging cleanup problem that Oak Ridge has faced, and the site has still not been remediated (as of 2019)." (24)

● **Fermi 1** in Michigan was a Liquid Metal Fast Breeder Reactor that used liquid sodium as its coolant. It had a **partial core melt down** on October 5, 1966 and was shut down in 1972. Years later, on May 20, 2006. **Fermi 1 caught on fire due to sodium leaking** from piping. (25)

B) Reprocessing - Contamination, Waste, Proliferation Problems

● Reprocessing involves chemical treatments to separate uranium and plutonium from highly radioactive irradiated reactor fuel. This uranium and plutonium can be used to fuel reactors and make nuclear bombs using as little as 20 pounds of plutonium which is the reason why the U.S. abandoned reprocessing in the 1970s and signed the Nuclear Non-Proliferation Treaty which was extended indefinitely in 1995. (26)

● Reprocessing is extremely **expensive**. (27)

● Reprocessing does **NOT** reduce the volume of radioactive waste. Depending on the techniques used, the volume of highly radioactive waste can actually be increased which exacerbates the need for waste storage and disposal. (28)

● New York is the only state to create a nuclear development authority which built the only U.S. nuclear waste **reprocessing plant at West Valley, NY**. The facility was a disaster and only operated for six years from 1966-1972 before permanently closing due to fires, high worker exposure, and radioactive releases. Clean up has cost the state of New York and the federal government \$3 billion for partial remediation and is expected to take decades and billions of dollars more for cleanup to prevent contamination of the Great Lakes. (29)

● Reprocessing has been a disaster world-wide including Sellafield, England (formerly Windscale); Rokkasho, Japan; La Hague, France; Kysym, Russia. (30)

END NOTES/REFERENCES

(1) HB 434 As Amended and Voted Out of the Ohio House on 3/23/22

PDF Text

https://search-prod.lis.state.oh.us/solarapi/v1/general_assembly_134/bills/hb434/PH/02/hb434_02_PH?format=pdf

General Information

<https://ohiohouse.gov/legislation/134/hb434><https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA134-HB-434>

(2) Public money and eminent domain - Ibid. (Sec. 4164.04, p. 4, lines 80-81)

(3) Authorizing OH to enter into, approve agreements with, assume regulatory power from federal agencies/departments
Ibid.

[Sec. 3748.03(b), p. 2, lines 32-35]

[Sec. 3748.03 (2)(B), p. 2, lines 43-44]

[Sec. 4164.05 (3)(F), p. 6, lines 133-136]

[Sec. 4164.11(E), p.11, lines 273-276]

(Sec. 4164.20, p. 14, lines 366-370)

(4) Make OH a leader in "advanced" reactors, radioactive isotopes, radioactive waste reprocessing Ibid.

[Sec. 4164.10 (B)(1-3), p. 10, lines 251-257]

[Sec. 4164.05 (3)(c) and (f), p. 5, lines 119 and 122]

[Sec. 4164.15 (L), p.13, line 349]

(Sec. 4164.16, p. 13, lines 352-353)

"Molten Salt (See Notes 20-23) and Actinide chemistry" (See Note 19)

(5) Amendment language moving the NDA from the DAS to the DEV/JobsOhio Ibid.

(Sec. 4164.04, p. 3, lines 75-76)

(Sec. 4164.12, p. 11, lines 297-298)

OH Legislative Service Commission Summary Analysis of HB 434, p. 4 "Creation" shows NDA's original placement in Department of Administrative Services, a government agency <https://www.legislature.ohio.gov/download?key=17598&format=pdf>

(6) Previous OH bills to create an NDA for "advanced" reactors

● HB 771 - 132nd General Assembly, 56 pages.

Summary & Links

<https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA132-HB-771>

PDF Text

https://search-prod.lis.state.oh.us/solarapi/v1/general_assembly_132/bills/hb771/IN/00/hb771_00_IN?format=pdf

● HB 104 - 133rd General Assembly, 34 pages, placed NDA in Department of Commerce, a government agency

Summary & Links

<https://www.legislature.ohio.gov/legislation/legislation-documents?id=GA133-HB-104>

PDF Text

https://search-prod.lis.state.oh.us/solarapi/v1/general_assembly_133/bills/hb104/IN/00?format=pdf

● SUB. HB 104 - 133rd General Assembly, substitute 10 page version passed the House but not the Senate, also placed NDA in Department of Commerce, a government agency

PDF Text of Sub. HB 104

https://search-prod.lis.state.oh.us/solarapi/v1/general_assembly_133/bills/hb104/PH/02?format=pdf

OH Legislative Service Commission Brief Comparison of the 2 versions of HB 104

<https://www.legislature.ohio.gov/download?key=13435&format=pdf>

(7) OH Legislative Commission 3/16/22 JobsOhio Fact Sheet

<https://www.lsc.ohio.gov/documents/reference/current/membersonlybriefs/134%20JobsOhio%20FAQs.pdf>

(8) Public/private partnerships - Ibid [Sec. 4164.11(C), p. 10, lines 265-269]

(9) Federal separation of nuclear regulation, promotion, weapons

"By 1974, Congress abolished the Atomic Energy Commission [(AEC) established in 1954 which had come under such strong attack (because it) had responsibility for (both) the development and production of nuclear weapons and the safe regulation of civilian uses of nuclear materials. Supporters and critics of nuclear power agreed that the (conflicting) promotional and regulatory duties of the AEC should be assigned to different agencies. The Energy Reorganization Act of 1974 assign(ed) one agency, now the DOE, responsibility for nuclear promotion and development and production of nuclear weapons. The 1974 Act created the NRC to ensure the safe civilian use of radioactive materials while protecting people and the environment."

<https://www.nrc.gov/about-nrc/history.html>

(10) eGeneration Petition and HR 518

eGeneration's Petition - <https://egeneration.org/petition/>

HR 518 - as adopted by the House in the 132nd General Assembly

https://search-prod.lis.state.oh.us/solarapi/v1/general_assembly_132/resolutions/hr518/AH/02/hr518_02_AH?format=pdf

(11) Private corporate vested interests

Four of the seven people presenting HB 434 House proponent testimony on December 8, 2021 - David Amerine, William Thesling, Jon Morrow, Eugenio Villaseca - have direct ties to eGeneration. A fifth, Edward Pheil, co-founder of Elysium Industries, which seeks to develop and commercialize the Elysium Fast Chloride Molten Salt Reactor, coordinates with eGeneration.

<https://thoriumenergyalliance.com/resource/elysium-industries-mcsfr-molten-chloride-salt-fast-reactor-ed-pheil/>

In Senate 11/29/22 proponent testimony, five of the six people testifying - Thesling, Amerine, Morrow, Pheil (now representing a new corporation Exodys Energy, instead of Elysium Industries, which seeks to develop fast chloride molten salt reactors) and Donald Larson of the Molten Salt Reactor Assn. all have private corporate vested interests.

(12) "Advanced" reactors costs/warnings

"Energy ranked by cost"

<https://solarpower.guide/solar-energy-insights/energy-ranked-by-cost>

"Nuscale costs soar"

<https://www.utilitydive.com/news/nuscale-nuclear-reactor-smr-uamps-rising-steel-prices-interest-rates/636619/>

<https://sightlineu3o8.com/2022/11/rising-steel-prices-interest-rates-could-push-nuscale-utah-project-cost-to-100-mwh-but-support-remains/>

"Small nuclear reactors, huge costs"

<https://prometheus.org/2021/10/11/small-nuclear-reactors-huge-costs/>

"Nuclear power is so uneconomical even Bill Gates can't make it work without taxpayer funding."

<https://archive.thinkprogress.org/nuclear-power-is-so-uneconomical-even-bill-gates-cant-make-it-work-without-taxpayer-funding-faea0cdb60de/>

"Advanced reactors could lead to new threats"

<https://nationalinterest.org/feature/dangerous-decisions-about-advanced-nuclear-reactors-could-lead-new-threats-183934>

"Natrium reactor may depend on bombs"

<https://www.msn.com/en-us/news/world/fate-of-natrium-nuclear-plant-may-depend-on-turning-bombs-into-fuel/ar-AA127nek>

(13) Ohioans support wind/solar renewables, energy efficiency, and oppose nuclear power

"Conservatives oppose bailouts and nuclear power, support renewables "

<https://www.cleveland.com/business/2019/02/conservative-ohio-voters-want-most-of-ohios-electricity-to-come-from-renewable-sources.html>

"Conservatives consider nuclear bailouts as corporate welfare"

<https://energynews.us/2019/05/06/midwest/conservatives-criticize-firstenergy-nuclear-bailout-bill-as-corporate-welfare/>

August 2020 Polling on HB 6

<https://static1.squarespace.com/static/568c2a10c647ad1e5182756c/t/5f3ff12bc06aa76ba05900bd/1598026029663/HB6+Repeal+Polling+Memo.pdf>

<https://static1.squarespace.com/static/568c2a10c647ad1e5182756c/t/5f3ff259cf516a64b6131a95/1598026330138/HB6+Repeal+Polling+Presentation+deck+%281%29.pdf>

(14) HB 483 negatively impacted OH wind development

"Ohio energy policies spurred growth, now driving business away Pew report says" 1/13/15

https://www.cleveland.com/open/2015/01/ohio_renewable_energy_policies.html

"Drops in Ohio clean energy investment could hurt jobs, growth" 1/22/15

<https://energynews.us/2015/01/22/midwest/drops-in-ohio-clean-energy-investment-could-hurt-jobs-growth/>

"Lawsuit: Ohio wind setbacks were adopted in violation of state constitution" 11/15/18

<https://energynews.us/2018/11/15/lawsuit-ohio-wind-setbacks-were-adopted-in-violation-of-state-constitution/>

(15) OH has destroyed wind/solar renewable energy

"Governor Mike Dewine signs (SB 52) giving (county) commissioners 'kill switch' on wind, solar projects" 7/13/21

<https://www.wtol.com/article/news/politics/state-politics/ohio-gov-mike-dewine-signs-bill-wind-solar-projects/512-643ddb27-ce1e-410d-9a52-8774b768f2a9>

Legal Summary/Analysis of SB 52

<https://www.jdsupra.com/legalnews/ohio-legislature-adopts-new-wind-and-2878693/>

"Volatile place new (solar and wind) laws thwart Ohio renewables" 8/5/21

<https://www.eenews.net/articles/volatile-place-new-laws-thwart-ohio-renewables/>

"Kingwood solar operation opposed by Greene County Commission" 10/21/21

<https://www.daytondailynews.com/local/giant-kingwood-solar-operation-opposed-by-greene-county-commission/HXYWTBZHSBC57BAUDY73J5VN3A/>

"Local residents oppose painter creek solar project" 12/13/21

<https://www.dailyadvocate.com/2021/12/13/local-residents-oppose-painter-creek-solar-project-at-darke-co-parks-commissioners-meeting-apex-open-house/>

"Parks district terminates solar company easement agreements" 2/14/22

<https://www.dailyadvocate.com/2022/02/14/parks-district-terminates-easement-agreements-with-apex>

Northern Ohio county officials will hold a public hearing in April on whether to effectively ban utility-scale wind projects" 3/18/22

<https://www.bucyrustelegraphforum.com/story/news/2022/03/17/crawford-commissioners-take-first-step-toward-restricting-wind-farm-development/7080680001/?>

"Ohio regulators reject Republic Wind's request for a rehearing to consider a planned \$92 million wind project in northern Ohio" 3/17/22

<https://www.toledoblade.com/local/environment/2022/03/17/republic-wind-strikes-out-on-rehearing-request-ohio-supreme-court-is-next-option/stories/20220317138>

After finally eliminating the Ohio Power Siting Board's "poison pill" disallowing night time operation of Lake Erie's proposed Ice Breaker wind project for eight months of the year, the General Assembly effectively killed the project altogether, although the Department of Energy has, fortunately, extended its grant for a year. Ice Breaker costs millions in comparison to the billions that "advanced" reactors could cost Ohioans.

"Ohio axes 'poison pill' for Lake Erie project" 9/20/20

<https://governorswindenergycoalition.org/ohio-axes-poison-pill-for-lake-erie-project/>

"Icebreaker wind project proposed for Lake Erie needs to find more financing soon" 10/19/21

<https://www.cleveland.com/news/2021/10/icebreaker-wind-project-proposed-for-lake-erie-needs-to-find-more-financing-soon.html>

- 7- 12/6/22 Connie Kline HB 434 Opponent Testimony Senate Energy and Public Utilities Committee

"Republicans in Ohio House reject support for proposed Lake Erie Ice Breaker Wind Project" 12/11/21

<https://www.cleveland.com/news/2021/12/republicans-in-the-ohio-house-of-representatives-reject-chance-to-support-proposed-icebreaker-wind-project-for-lake-erie.html>

"Federal grant extended for off-shore wind project" 1/18/22

<https://www.cleveland.com/news/2022/01/icebreaker-federal-grant-extended-giving-advocates-for-cleveland-offshore-wind-project-more-time-to-arrange-financing.html>

"OH Supreme Court allows Ice Breaker construction to proceed" after 13 years 8/10/22

<https://www.msn.com/en-us/news/us/in-6-1-decision-ohio-supreme-court-approves-icebreaker-wind-project-in-lake-erie/ar-AA10wfsR>

<https://www.msn.com/en-us/news/us/ohio-supreme-court-allows-construction-of-offshore-wind-farm-in-lake-erie-to-proceed/ar-AA10widz>

(16) Local governments cannot ban oil/gas drilling/fracking

HB 201 enacted 9/30/21 (to) "Prevent local governments from limiting use of natural gas"

<https://www.legislature.ohio.gov/legislation/legislation-votes?id=GA134-HB-201>

Ohio Secretary of State Husted's August 2015 ruling that counties can't ban oil and gas well drilling/fracking

<https://www.governing.com/archive/ohio-counties-cant-vote-to-ban-fracking-husted-rules.html>

(17) Alternatives for lithium battery energy storage

<https://www.youtube.com/watch?v=-vobMI5ldOsh><https://climatebiz.com/lithium-battery-alternatives/>

<https://www.thomasnet.com/insights/7-lithium-battery-alternatives/>

<https://energystoragereport.info/12-alternatives-to-lithium-ion-battery-storage/>

<https://www.world-energy.org/article/24888.html>

<https://news.utexas.edu/2021/12/06/sodium-based-material-yields-stable-alternative-to-lithium-ion-batteries/><https://emojicut.com/q-and-a/what-will-replace-lithium-batteries-in-the-future>

<https://www.dw.com/en/the-batteries-of-the-future-sodium-instead-of-lithium/a-54707542>

<https://www.forbes.com/sites/annapowers/2020/01/31/your-next-battery-could-be-made-from-salt-scientists-make-greener-advances/?sh=32b3bc3e43a5>

(18) U.S. medical isotope production facilities

A. Shine Technologies in Janesville, WI

www.shinefusion.com

<https://www.shinefusion.com/medical-isotopes/>

Diagnostic uses of medical isotopes. SPECT (single-photon emission computerized tomography) and PET (positron emission tomography). Shine decays Molybdenum-99 to technetium-99, as does

B. Niowave in Lansing, MI

<https://www.niowaveinc.com/index.php/medical-radioisotopes/>

Produces radioisotopes molybdenum-99 and xenon-133 for nuclear medicine imaging.

C. NorthStar in Beloit, WI

<https://www.northstarnm.com/our-products/>

Uses non-uranium based processes to produce the vitally important medical radioisotope, molybdenum-99 (Mo-99) here in the United States.

(19) Properties of actinides

<https://www.thoughtco.com/actinides-606643>

<https://www.toppr.com/guides/chemistry/the-d-and-f-block-elements/actinoids/>

(20-22) Thorium, molten salt, sodium cooled, breeder reactor problems

"Why molten salt reactors are problematic" Dr. MV Ramana, Ph.D physicist nuclear engineering, energy policy

<https://theconversation.com/nuclear-power-why-molten-salt-reactors-are-problematic-and-canada-investing-in-them-is-a-waste-167019>

"It's time to give up on breeder reactors"

https://www.academia.edu/28562158/Its_time_to_give_up_on_breeder_reactors

"'Advanced' Isn't Always Better" Dr. Ed Lyman, Ph.D, nuclear physicist

<https://www.ucsus.org/sites/default/files/2021-03/advanced-isnt-always-better-full.pdf>

"Thorium: the wonder fuel that wasn't " Robert Alvarez DOE Senior Policy Advisor, Adjunct Professor Johns Hopkins University, aide to U.S. Senators James Abourezk and John Glenn

<https://thebulletin.org/2014/05/thorium-the-wonder-fuel-that-wasnt/>

"Thinking About Thorium" Dr. Gordon Edwards, Ph.D, nuclear consultant, physicist, mathematician

http://www.ccnr.org/think_about_thorium.pdf

"The Hype About Thorium Reactors " Dr. Gordon Edwards, Ph.D

http://www.ccnr.org/thorium_hype_2021.pdf

"Thorium Fuel: No Panacea for Nuclear Power " Dr. Arjun Makhijani, Ph.D., nuclear and electrical engineer

<https://ieer.org/wp/wp-content/uploads/2012/04/thorium2009factsheet.pdf>

"Ten Myths About Thorium as a Nuclear Energy Solution"

http://static1.1.sqspcdn.com/static/f/356082/28076399/1549591884627/BN_ThoriumFactSheet.pdf?token=%2BhC94COVbA55iTMPPUULCtGjMJU%3D

"New' Nuclear Reactors? Same Old Story" Dr. Amory Lovins, Ph.D. physicist

<https://theecologist.org/2016/apr/12/new-nuclear-reactors-same-old-story>

"Thorium - history and dangers"

<https://thoriumnuclear.wordpress.com/2015/04/02/thorium-history-and-dangers/>

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