**Concrete Examples of Toxic Pollution**

**Rare Earth Elements**

The strong catalytic, metallurgical, electrical, nuclear, magnetic, and luminescent properties of rare earth elements (REE) are critical to a broad spectrum of advanced and emerging low-carbon emission technologies[[1]](#endnote-1)[[2]](#endnote-2). Neodymium, praseodymium, dysprosium, and terbium are essential to produce permanent magnets[[3]](#endnote-3) for wind turbines, and high-capacity batteries for electric vehicles.[[4]](#endnote-4) Each electrical vehicle motor contains at least1kg of REEs[[5]](#endnote-5) An average permanent magnet for wind turbines - especially for offshore wind power generation - contains just over 1 ton of neodymium and 176kg of dysprosium.[[6]](#endnote-6) One study estimated that between 11 to 26 folds increase in REE supply is required to meet the global wind power targets.[[7]](#endnote-7)

Energy efficient consumer items promoted for green retro fittings also rely on REE for their performance. Yttrium, europium, and terbium are used in the manufacturing of compact fluorescent bulbs. LEDs (light-emitting diodes) rely on yttrium and europium, albeit significantly less of them to produce the same amount of light. These low-energy light sources reduce power use by 80% compared with traditional incandescent light bulbs. Likewise, a dash of yttrium and terbium is required to create bright colours in an energy-efficient screen.[[8]](#endnote-8)

**Toxic Hazards of Mining and Extraction of Rare Earth Elements**

Large-scale rare-earth mining clears massive land area for open-pit mines, causing large areas of deforestation and/or loss of native bushland[[9]](#endnote-9). In-situ leaching, involves drilling holes[[10]](#endnote-10) into the ground and pumping in chemicals to flush out slurry creates erosion and a legacy of discarded hazardous materials. Mining and processing one tonne of rare earths generates 2,000 tonnes[[11]](#endnote-11) of toxic waste.

RE minerals are bonded with long-live radionuclides of thorium (Th-232) and uranium (U-238), a range of toxic heavy metals and arsenic.[[12]](#endnote-12) The severity of the toxicity of the contaminants varies between different REE-mineral ores. At the mine site, pollution risk is associated with the waste rocks, ore stockpiles and wastes from the concentration plant, if the ore is enriched on site before being transported to the processing.

To extract and separate the rare earth into individual oxides, “hydrometallurgical (corrosive media treatment) and pyrometallurgical (high heat treatment) processes”[[13]](#endnote-13) are applied. Huge amounts of water, highly concentrated acid or alkali, and reagents are added at very high temperature at different stages at the processing plant. Toxic elements - typically long-lived radioactive Th- plant 232 and U-238, heavy metals (including residues of different rare earth minerals) and chemical compounds are left in the waste streams. Vast amounts of toxic fumes, toxic waste and contaminated wastewater are generated from the plant. The corrosive acids left in the wastes can leach toxic elements into the leachate.[[14]](#endnote-14) Mobility of these contaminants depends on the climatic, geological and geohydrological environment of where the waste is stored and the reliability of the waste management method.[[15]](#endnote-15)

**Health Effects Associated with Rare Earth Mining and Processing Hazards**

**Radiological Hazards**

Th-232 and U-238 with half-life of 14.5 and 4 billion years respectively, are sources of both external and ionizing radiation[[16]](#endnote-16). Ionizing radiation generates energy high enough to break chemical bonds to cause living tissue damages and cell mutations[[17]](#endnote-17). The 2020/21 UNSCEAR report[[18]](#endnote-18) further confirmed that even at low doses of ionizing radiation there is a risk of cancer and other chronic health conditions developing, and the risk increases linearly with the accumulated dose over one’s lifetime. There is no safe dose of ionizing radiation[[19]](#endnote-19). Ionizing radiation is a known reproductive hazard. It has been linked to birth defects and other reproductive problems.[[20]](#endnote-20) Low dose received simply delayed the development of cancer for years and even decades.[[21]](#endnote-21) Children exposed to Th-232 or U-238 will have higher risks of developing cancer since all radiation doses are cumulative and children have more years of life remaining than adults.[[22]](#endnote-22)

**Non-radiological Health Hazards**

While environmental and public health hazards of common toxic heavy metals have been well researched and largely understood[[23]](#endnote-23)[[24]](#endnote-24), studies on the toxicity of the various REE are still limited. Serious ecological and human health impacts of REE are as follows[[25]](#endnote-25):

* *High concentrations of rare earth elements reduce plant growth and nutritional quality, impaired biochemical function in plants, and induce neurotoxicity, acute and chronic health effects, and genotoxicity in aquatic animals. The uptake, partitioning, and bioaccumulation of rare earth elements may also occur along the trophic levels in aquatic ecosystems.*
* *Human health risks include (1) severe damage to nephrological systems and nephrogenic systemic fibrosis induced by gadolinium-based contrast agents used in medical applications, (2) induced sterility and anti-testicular effects in males, (3) dysfunctional neurological disorder and reduced intelligent quotient, (3) fibrotic tissue injury, (4) pneumoconiosis, and (5) oxidative stress and cytotoxicity.*

A recent study[[26]](#endnote-26) found that early pregnancy exposure to lower levels of REE mixture was associated with an increased risk of gestational diabetes mellitus (GDM). Specifically, neodymium, praseodymium, and lanthanum showed the strongest effects in the mixture.

**Pushing Hazards and Toxic Legacy to Marginalized Communities**

RE is ‘neither rare nor earth’. RE deposits are found in relative abundance on the earth’s crust[[27]](#endnote-27) and in the sea floor[[28]](#endnote-28). Its rarity is linked to the exceptionally low concentration of the individual rare earth element (REE) in the ore body, costly and hazardous extraction, refining, pollution control/management and disposal of massive quantities of toxic and radioactive wastes.[[29]](#endnote-29) Ecological modernization of the West and Japan has pushed the hazards to frontier sacrificial/conflict zone affecting marginalized communities in Inner Mongolia in China[[30]](#endnote-30) and increasingly, developing countries like Malaysia, Myanmar, Brazil, Vietnam and India – ie to the path of least resistance. Pollution control, environmental safeguards, occupational health and safety (OH&S) measures are often lacking in these countries, compromising their rights to good health, clean water, sustainable livelihoods and clean air. Delayed health and ecological effects have led to radioactive toxic legacy sites being created, leaving intergenerational toxic and radiological hazards and burdens[[31]](#endnote-31) to those who have not benefitted from the exploitation[[32]](#endnote-32) while reducing local climate resilience and adaptive capabilities.[[33]](#endnote-33)[[34]](#endnote-34)

**The Toxic Hazards of Australia’s Lynas Rare Earth Ltd.**

Australia’s Lynas Rare Earth Ltd. (Lynas) is the first major RE producer outside of China. It mines RE at its Western Australian Mt Weld mine, enriched the mineral and transports lanthanide concentrate over 7000 km to the Port of Kuantan in Malaysia to its secondary beneficiation plant where RE oxides have been produced since 2013. The plant was constructed in secrecy[[35]](#endnote-35) and has sparked over a decade of protests in Malaysia.[[36]](#endnote-36)[[37]](#endnote-37)[[38]](#endnote-38) Lynas has conveniently taken advantage of the delayed health effects, and weak and incapable environmental law enforcement in Malaysia, denying that its wastes are hazardous and radioactive[[39]](#endnote-39)[[40]](#endnote-40).

Since 2014, AidWatch has worked closely with several Malaysian CSOs to seek redress for the injustice and toxic radioactive pollution caused by Lynas. Some of the problems associated with Lynas are:

* In 2011, IAEA reviewed the pre-licence stage of Lynas’ operations and made 11 recommendations[[41]](#endnote-41). A follow up review visit took place in 2014 and a further 8 suggestions were made[[42]](#endnote-42). Much of IAEA’s suggestions were ignored, beyond cherry picking the diplomatically worded findings since the IAEA only has coercive influence on its member states. Lynas has never carried out a safety case analysis for its radioactive waste storage facility or for the proposed permanent waste dump next to it in the peat swamp, or carried out critical monitoring activities as per IAEA.
* Millions of tons of contaminated wastes piled up high next to the plant exposed to the weather and the annual monsoon deluges – see drone images attached.
* The limited public consultation, where environmental impact assessment reports were not easily access by the public or CSO scrutiny, beyond viewing them[[43]](#endnote-43).
* A 12-year tax break awarded to Lynas so it does not pay any corporate tax.[[44]](#endnote-44)
* Lynas’ ‘zero-harm’ claims and denial of radioactive hazards resulted in lax environmental and public health safeguards
* A review by the Malaysian Government in 2018[[45]](#endnote-45) revealed serious groundwater contamination from samples obtained from Lynas’ own monitoring stations from a Health Impact Study (HIS),

“…The nickel concentration on March 15, 2016 at the GW13 monitoring station was at 96,100 μg/L, which is 1,281 times more than the Dutch Intervention Value (DIV) of 75 μg/L.”.[[46]](#endnote-46)

Other toxic heavy metals that have exceeded the DIV are lead, mercury, arsenic and chromium. However, the Government did not follow up from the HIS findings even though there are fifty families nearby relying on groundwater for their daily uses and tests for radionuclides contamination were not carried out.

* The permanent waste dump construction contract has been awarded without any public tendering process to a company linked with the King (Agong who is the sultan of the state of Pahang where Lynas’ plant is located) with no experience of dealing with radioactive waste. [[47]](#endnote-47) Other problems linked to the proposed ‘permanent’ disposal facility (PDF) can be found in the attached Aid/Watch submission and the Justification document on its EIA.
* The Malaysian Government has largely been captured by Lynas and is under tremendous geopolitical pressure to accept the environmentally unjust deal instead of acting in the interest of its public and environmental health to prevent another toxic radioactive legacy.
* Lynas and Malaysia have lowered the classification of the radioactive waste against scientific facts, IAEA guidelines and established international standards for this type of waste – refer to attached “A critique of criteria for siting of disposal facility for waste containing naturally occurring radioactive material (NORM)”.

Other details on the local impacts can be found in the attached document entitled “MPI Case Study: The Making of Lynas Toxic Legacy in Malaysia”.

Further information on CSO’s critique/opposition to Lynas can be accessed through:

* <https://aidwatch.org.au/stop-lynas/>
* <https://foe-malaysia.org/article_tags/lynas/>
* <https://ntn.org.au/contamination-likley-at-rare-earth-plant/>
* <https://www.greenpeace.org/malaysia/publication/1083/a-radioactive-ruse-report-on-lynas-malaysia/>
* <https://aliran.com/civil-society-voices/lynas-must-prioritise-peoples-safety-and-environment-ngos>
* <https://www.slideshare.net/palmdoc/mma-statement-on-lynas>
* <http://savemalaysia-stoplynas.blogspot.com/>

**Rare Earth Concerns in Other Countries**

China -The Bayan Obo mining district of Inner Mongolia - which supplies 45% of the world’s REEs – has become an iconic site of toxic pollution from China’s rare earth industry. There, pollution and waste have created an acidic toxic lake that cannot support life[[48]](#endnote-48), poisoned farmlands and river systems, and caused severe health impacts to people and livestock. The waste contains large quantities of heavy metals, chemicals, and radioactive wastes.[[49]](#endnote-49) The pollution is so serious that the Yellow River 10 kms away was contaminated through its tributaries. Fatal cases of cancer are on the rise and ruined crops have been reported. Some places have become known as cancer villages, where the entire village population had to be relocated.[[50]](#endnote-50)

Brazil: <https://e360.yale.edu/features/boom_in_mining_rare_earths_poses_mounting_toxic_risks>

Myanmar:<https://www.globalwitness.org/en/campaigns/natural-resource-governance/myanmars-poisoned-mountains/> and <https://news.mongabay.com/2022/08/toxic-rare-earth-mines-fuel-deforestation-rights-abuses-in-myanmar-report-says/>

**Good Practices and Lessons Learned**

While REE are critical and strategic for transition technologies crucial in tackling climate change, it is important that their ecological and social footprints do not replicate the negative impacts of fossil fuel and minerals extractive industries. We must advocate for and ensure that energy and technological transitions are just, clean and safe, especially for communities who have not contributed to climate change.

The Public Health Association of Australia (PHAA) has proposed 22 actions to be taken to ensure that rare earth mining and processing are aligned with the **UN Sustainable Development Goal 7 – Affordable and clean energy; Goal 9 – Industry, innovation and infrastructure; Goal 12 – Responsible consumption and production; and Goal 17 – Partnerships for the Goals** <https://www.phaa.net.au/documents/item/2829> p.3 and 4 and the attached policy statement.

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