

Wind turbines or weapons? Competing Uses of Energy Transition Minerals

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Overview

Energy transition objectives are threatened by competing uses for energy transition minerals (ETM). This is especially evident in the ongoing military offensives in Gaza, Lebanon, and Ukraine, where, in the form of weapons, large volumes of ETM are used to end life and destroy infrastructure. Weapons manufacturers' consumption of ETM is likely to grow with [increases in defense expenditures](#) and armed conflicts, which will [strain the essential civilian economy](#), including renewable energy development.

Case Study: MK-84s & JDAMS v. Wind Turbines

Many of the same ETM that are used to produce wind turbines are also used to make missiles. MK-84s and Joint Direct Attack Munitions (JDAMs) are two types of missiles produced by US defense contractors and purchased by the Israeli Defense Forces (IDF). These weapons, each weighing 2,000 pounds and impacting areas up to 365 meters (equivalent to 58 soccer fields), have been extensively used in civilian areas of Gaza, including Israeli-designated safe zones. Their deployment goes beyond targeted operations, causing indiscriminate destruction that disproportionately impacts women and children. By September 2024, at least [67%](#) of Gaza's cropland had been destroyed and 42,000m² of solar panels. A [UN report](#) stated that IDF actions demonstrate "an apparent indifference to the death of civilians and the impact of the means and methods of warfare selected."

As of September 2024, over 500,000 JDAM kits have been produced (19,000 sold to IDF as of [8/2024](#)), diverting ETM from renewable energy technology supply chains. To put this ETM misallocation in perspective, here we provide rough estimates of the ETM costs of producing 500,000 JDAM kits, based on best available data:

- **Aluminum:** The equivalent amount of aluminum could produce 8,127 4.2MW wind turbines, an energy generation capacity equivalent to 2.5 average nuclear reactors.
- **Lithium:** The guidance section of each missile contains approximately 1.85kg of Li/Si/Fes₂ batteries, adding up to the equivalent amount needed to produce more than 70,000 average EV car batteries.
- **Neodymium-Iron-Boron Magnets:** Each JDAM contains an estimated 0.34kg of NdFeB Magnets, enough to produce 1,360 4.2MW wind turbines.

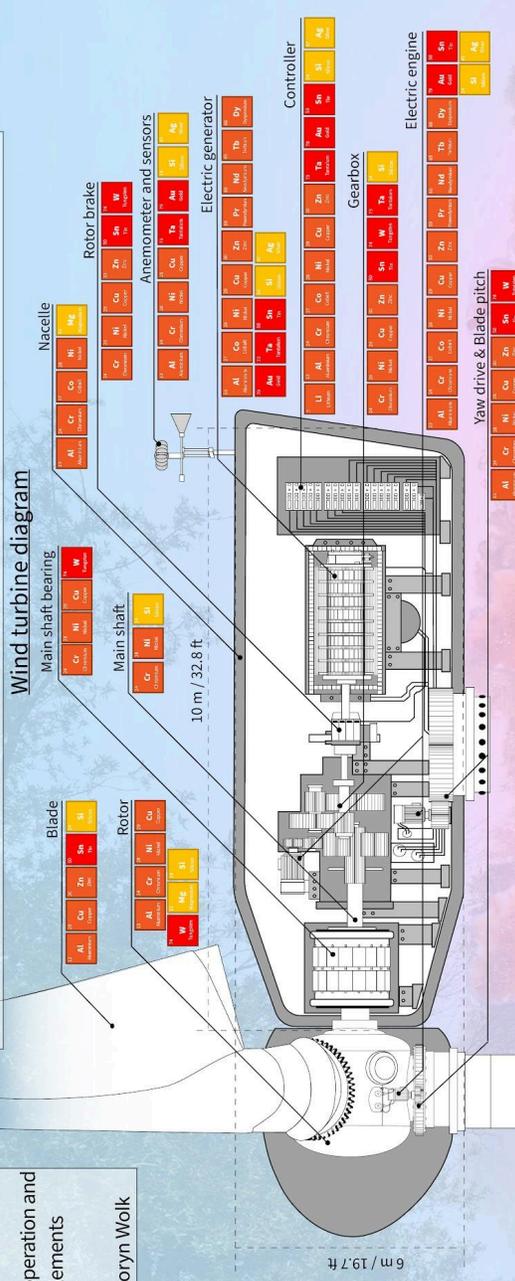
Significance: Multigenerational Consequences of ETM Misallocation

The misappropriation of ETMs by war profiteering interests creates a legacy of violence that impacts future generations. Missiles with complex electronics dropped from planes increase the spatial and temporal scale of repercussions of warfare by covering impacted areas in heavy metal dusts and nanoparticulate that re-proliferate in post-conflict clean-up efforts, subjecting local populations to [long-term exposure](#). The intergenerational health effects from metal exposure due to munitions detonation include increased birth defects, preterm births, and cancers. The health [impacts of munition fragments](#) in bodies, varying in metals compositions, remain under-explored, as studies typically focus on environmental effects or a single metal in isolation. For example, [environmental studies on munition-grade tungsten](#) material have shown that tungsten solubilizes over time, potentially migrating into groundwater, lowering soil pH, and enhancing the mobility of other metallic contaminants.

Legend:

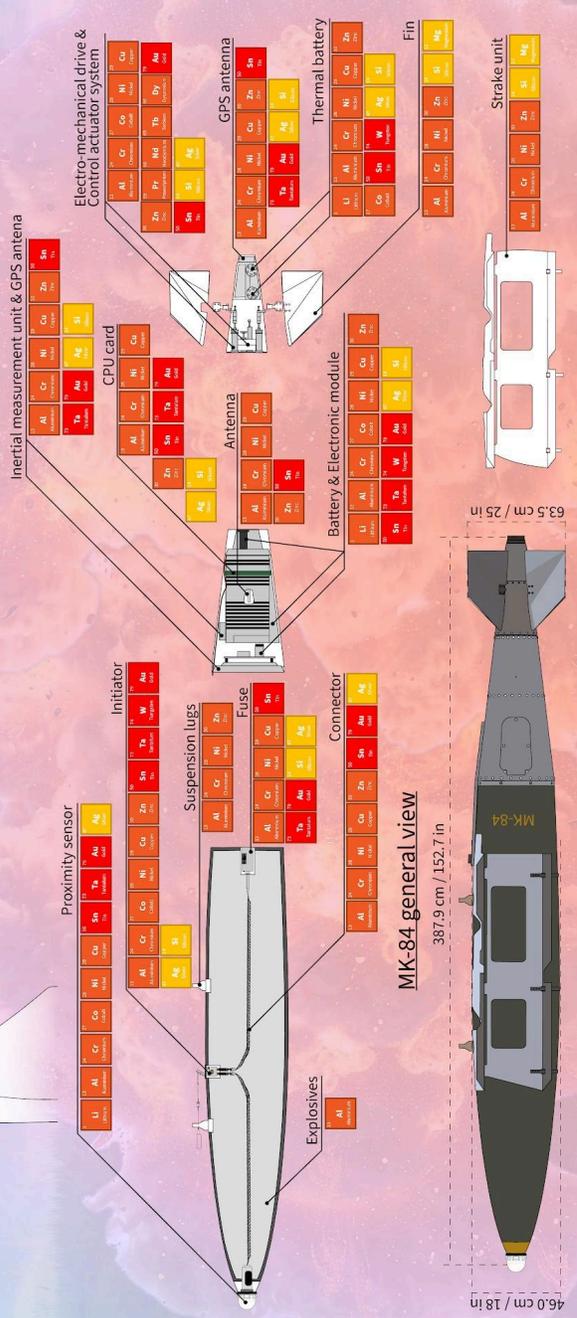
- International Energy Agency (IEA)
 - Critical elements
 - Organization for Economic Co-operation and Development (OECD) Conflict elements
 - Other elements
- Authors: Romain Richaud and Coryn Wolk

Competing Use of Elements in Wind Turbines and MK-84 Guided Bombs



27 Bombs Mk-84

MK-84 and JDAM diagram



Height ratio:
1 Wind turbine = 27 Bombs Mk-84

Redefining ‘Conflict Minerals’: Beyond Bag & Tag

Current conflict mineral legislation in the [US](#), [EU](#), and [OECD](#) is focused on the point of mineral extraction. This narrow definition of ‘conflict mineral’ only pertains to those extracted under conditions of armed conflict and human rights abuses, such as 3GT (Tin, Tungsten, Tantalum, & Gold). There is no current policy framework to prevent the use of minerals to fund and enable armed conflict beyond the site of extraction. This is a significant oversight that enables the continued misappropriation of ETM by war profiteering interests. This narrow definition channels policy interventions—such as the “[Bag & Tag](#)” method which consists of placing the extracted minerals in a bag, sealing it at the extraction site and recording it to guarantee traceability—only to the sites of extraction. This method aims to track materials at their source to prevent conflict minerals from entering the global market, and thereby avoid potential liabilities for downstream firms for fueling armed conflict. This approach displaces the responsibility to decouple minerals and armed conflict from major multinational weapons manufacturers to local communities, many in remote artisanal and small-scale mining contexts. Furthermore, these tags can easily be tampered with or counterfeited, providing false assurances of compliance for downstream firms while failing to address the structural drivers of exploitation and violence throughout mining supply chains: most especially in the misappropriation of minerals by firms that enable [war crimes](#) and crimes against humanity due to extensive civilian targeting and destruction. The disconnect between transparency measures in upstream activities and zero accountability for violence and conflict in downstream applications must be addressed.

The Influence of Supply Funding on Demand Allocation

The US, as the world’s largest military supplier, strategically employs the Department of Defense (DoD) to channel millions of dollars into constructing a domestic supply chain for ETMs. The DoD markets these investments as “[Mine to Magnet](#)” initiatives. But as the examples of JDAMs and MK-84 indicates, batteries and magnets are used in a range of applications besides those critical to the energy transition. Without proper oversight, it is likely that the resources of battery and magnet supply chains are predominantly allocated under the pretext that national security needs take [precedence over civilian and renewable energy applications](#). This approach is reinforced by changes in the use of the Defense Production Act (DPA), which was originally enacted to support materiel preparedness for U.S. military defense and now plays a pivotal role in facilitating federal funding and contracts for “critical mineral” production and manufacturing for energy and defense applications in the U.S., Canada, and through recent expansion, the UK and Australia. The extensive flow of funds through the DoD under the broad authorities of the DPA limits public oversight through heavy redaction and limited disclosures on the basis of security concerns. This makes it challenging for the public and lawmakers to discern whether funding ETM supply chains for defense contractors supercedes civilian renewable energy needs or even to assess whether such resource allocation aligns with reasonable needs of national defense, as opposed to war profiteering.

An Expanded Supply Chain Approach to ETM Regulation and Management

To address the challenges of the energy transition without exacerbating planetary crises, ETM supply chain regulation and management must incorporate measures to eliminate the use of minerals to fund and enable armed conflict at all stages. This is inseparable from the importance of pursuing broad-based environmental remediation and circular economy strategies to [expand ETM supply while reducing reliance on new geological deposits](#). The diversion of ETM to weapons applications detracts from climate-critical projects and severely undermines climate goals.

