

THE HUMAN & ENVIRONMENTAL COSTS OF “CLEAN ENERGY”

The Environmentalist Left touts wind, solar, and electric vehicles (EVs) as the only options for America's energy future. What they don't discuss are the horrible human and environmental costs to build these complicated devices.



June 2017

EXECUTIVE SUMMARY

Environmentalists say the only solution to America's energy needs is so-called "[clean](#)" energy. They paint "clean," or renewable, energy as coming from wholesome sources that rely "primarily on sun and wind."

Few advocates of "clean" energy, though, discuss how solar panels and wind turbines are made. There's a reason for their omission. Although environmentalists will not address this process, America Rising Squared's research reveals that "clean" energy technology comes at great human and environmental costs.

Technology in solar panels, wind turbines, electric vehicles (EVs), and EV batteries rely on rare earth metals that are hard to find and even harder to extract. Some of these rare metals come from countries with strong labor and environmental protections, like Canada and Germany, but many others come from countries without these protections.

China, for example, is a prime source for the graphite that goes into the lithium batteries that power electric cars. Graphite is produced under "[lax environmental controls](#)" in northeast China, with particles filling the air in nearby villages that pollute the water and make it difficult to breathe.

The Democratic Republic of the Congo (DR Congo) is a top country for the cobalt that goes into EVs. Workers in DR Congo, including children, "[labor in harsh and dangerous conditions](#)." Deaths are a regular occurrence in the underground mines, and the trade is so odious it recently caught the attention of [Amnesty International](#).

In addition to gross human rights violations, the tragic irony of rare earth production essential to "clean" energy is that it pollutes the environment in the strongest of ways. Rare earth minerals in Baotou – the largest industrial city in the Inner Mongolia region of China – are produced in a "truly alien environment, [dystopian and horrifying](#)." Baotou produces metals like [cerium](#) and [neodymium](#), materials that "clean" energy advocates proudly note go into wind turbine magnets.


Environmentalists seem to pay no attention to the horrifying conditions that make solar panels, wind turbines, and EVs, possible. Instead, they tell followers what they want to hear: that wind and solar are "clean," green solutions to America's energy challenges. The inconvenient truth is that these "clean" sources of energy are produced under the worst of labor and environmental rights violations. Read more to find out just what is under the hood of so-called "clean" energy.

WHAT GOES INTO “CLEAN ENERGY”







RARE EARTHS

Rare Earths Include Cerium, Dysprosium, Erbium, Europium, Gadolinium, Holmium, Lanthanum, Lutetium, Neodymium, Praseodymium, Samarium, Terbium, Thulium, Ytterbium, Yttrium, Ferrocenium, Monazite, Bastnasite, Mischmetal. (“Mineral Commodity Summaries: Rare Earths,” [U.S. Geological Survey](#), 1/16)






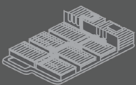
Wind Turbines

-  NEODYMIUM
-  PRASEODYMIUM
-  DYSPROSIUM








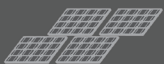
EV Magnets

-  NEODYMIUM
-  PRASEODYMIUM
-  DYSPROSIUM






EV Batteries

-  PRASEODYMIUM
-  LANTHANUM
-  CERIUM
-  LITHIUM
-  COBALT



Solar Panels

-  INDIUM
-  GALLIUM
-  TELLURIUM

RARE EARTH APPLICATIONS

(U.S. Interior Dept., 1/24/13; Energy.gov, 12/10)

WIND TURBINES

According To The Department Of Energy (DOE), “Neodymium, Praseodymium And Dysprosium Are Used In Magnets” For Wind Turbines. (“U.S. Department Of Energy Critical Materials Strategy,” [Energy.gov](#), 12/10)

- Although DOE Issued Its Report In 2010, A 2015 Release From U.S. Rare Earths, Inc. Said “Neodymium, Dysprosium And Praseodymium” Are Still Essential For Turbines. “The Licensor created the MSX Technology specifically for the recovery of Neodymium, Dysprosium and Praseodymium on a mandate from the U.S. government to seek alternative sources of these critical materials, that are currently produced and processed almost exclusively by the Chinese. These rare earth elements are required for the manufacturing of automobile electronic motors, wind turbines, computer hard drives, electronic displays, and fluorescent bulbs. They are often referred to as ‘technology metals.’” (Press Release, “U.S. Rare Earths Has Entered Into Two Agreements With Oak Ridge National Laboratory,” [U.S. Rare Earths, Inc.](#), 8/3/15)



According To The Daily Mail, A Magnet For A “Top Capacity Wind Turbine Would Use 4,400lb Of Neodymium-Based Permanent Magnet Material.”

Neodymium is commonly used as part of a Neodymium-Iron-Boron alloy (Nd₂Fe₁₄B) which, thanks to its tetragonal crystal structure, is used to make the most powerful magnets in the world. Electric motors and generators rely on the basic principles of electromagnetism, and the stronger the magnets they use, the more efficient they can be. It’s been used in small quantities in common technologies for quite a long time – hi-fi speakers, hard drives and lasers, for example. But only with the rise of alternative energy solutions has neodymium really come to prominence, for use in hybrid cars and wind turbines. A direct-drive permanent-magnet generator for a top capacity wind turbine would use 4,400lb of neodymium-based permanent magnet material.” (Smon Parry, “In China, The True Cost Of Britain’s Clean, Green Wind Power Experiment: Pollution On A Disastrous Scale,” [Daily Mail](#), 1/26/11)

- **Neodymium And Dysprosium Also Factor Into Siemens’ Wind Turbines.** “Down in one of Siemens’ huge engineering sheds below Stiesdal’s office, I was shown one of the company’s new gearless turbines. ... This ring is packed with 648 22cm-long neodymium magnets laced with another rare-earth element, dysprosium, which makes them much less liable to become demagnetised.” (Justin Rowlett, “Rare Earths: Neither Rare, Nor Earths,” [BBC News](#), 3/23/14)

In April 2015, Energy Department Scientists Created A New Alloy That Would Replace Dysprosium In Wind Turbines With Cerium.

“Karl A. Gschneidner and fellow scientists at the U.S. Department of Energy’s Ames Laboratory have created a new magnetic alloy that is an alternative to traditional rare-earth permanent magnets. The new alloy—a potential replacement for high-performance permanent magnets found in automobile engines and wind turbines--eliminates the use of one of the scarcest and costliest rare earth elements, dysprosium, and instead uses cerium, the most abundant rare earth.” (Press Release, “Ames Laboratory Scientists Create Cheaper Magnetic Material For Cars, Wind Turbines,” [U.S. Department Of Energy’s Ames Laboratory](#), 4/23/15)

One Substitute For Rare Earth Elements In Wind Turbines Calls For A “Mixed Iron-Cobalt Oleate Complex.” “The researchers used a mixed iron-cobalt oleate complex in a one-step synthetic approach to produce magnetic core-shell nanoparticles. The resulting materials showed strong magnetic properties and energy-storing capabilities. Their approach could signal an efficient new strategy toward replacing rare earths in permanent magnets and keeping costs stable, the researchers say.” (“Ensuring The Future Affordability Of Wind Turbines, Computers And Electric Cars,” [American Chemical Society](#), 6/1/16)

SOLAR CELLS

According To The Department Of Energy, “Indium, Gallium And Tellurium” Are Used For Solar Cells. (“U.S. Department Of Energy Critical Materials Strategy,” [Energy.gov](#), 12/10)

ELECTRIC VEHICLES (EVS) & EV BATTERIES

According To The Department Of Energy, “Neodymium, Praseodymium And Dysprosium Are Used In Magnets For Electric Vehicles.” (“U.S. Department Of Energy Critical Materials Strategy,” [Energy.gov](#), 12/10)



According To The Department Of Energy, “Lanthanum, Cerium, Praseodymium, Neodymium, Cobalt And Lithium Are Used In Electric Vehicle Batteries.” (“U.S. Department Of Energy Critical Materials Strategy,” [Energy.gov](#), 12/10)

Graphite Is An Ingredient In Lithium Batteries That Power Electric Cars. “Zhang and Yu live near a factory that produces graphite, a glittery substance that, while best known for filling pencils, has become an indispensable resource in the new millennium. It is an ingredient in lithium-ion batteries. Smaller and more powerful than their predecessors, lithium batteries power smartphones and laptop computers and appear destined to become even more essential as companies make much larger ones to power electric cars.” (*Peter Whoriskey, “In Your Phone, In Their Air,” The Washington Post, 10/2/16*)

Union Of Concerned Scientists (UCS): In 2015: “Manufacturing Emissions” Were 15 To 68 Percent Higher For EVs Than “An Equivalent Gasoline Vehicle.” “Manufacturing a mid-sized EV with an 84-mile range results in about 15 percent more emissions than manufacturing an equivalent gasoline vehicle. For larger, longer-range EVs that travel more than 250 miles per charge, the manufacturing emissions can be as much as 68 percent higher.” (“*Cleaner Cars from Cradle to Grave (2015),” Union Of Concerned Scientists, 2015*)

- **Lithium-Ion Batteries Are “Particularly Material- And Energy-Intensive To Produce.”** “Both types of vehicle begin in much the same way. Raw materials are extracted, refined, transported, and manufactured into various components that are assembled into the car itself. Because electric cars store power in large lithium-ion batteries, which are particularly material- and energy-intensive to produce, their global warming emissions at this early stage usually exceed those of conventional vehicles.” (“*Cleaner Cars from Cradle to Grave (2015),” Union Of Concerned Scientists, 2015*)

In November 2016, A Report By The Management Consulting Firm Arthur D. Little Concluded That A Battery Electric Vehicle (BEV) Would Generate Approximately Three Times As Much Human Toxicity Over The Course Of Its Lifespan Compared To An Internal Combustion Engine Vehicle (ICEV). “Across all of the other secondary environmental impacts ADL measured – except for FFDP [Fossil Fuel Depletion Potential] – the BEV performed similarly or worse than the ICEV. BEVs generated more than twice as much freshwater toxicity potential and BEVs were responsible for nearly twice as much mineral depletion, owing to the use of heavy metals in the manufacturing process for BEVs (see Appendix D for greater detail). Nonetheless, neither BEV manufacturing nor ICEV manufacturing poses a threat to the global supply of mineral resources. All other secondary environmental measures pale in comparison with the potential impact BEVs have on human health. Because human toxicity potential is distributed differently across a vehicle’s lifetime, the decision to drive a BEV instead of an ICEV essentially shifts the damage to human life caused by car ownership, from a relatively small impact more localized to the vehicle in the case of an ICEV, to a relatively large impact localized to the mineral mine tailings in the case of a BEV. For the American driver, the decision becomes a trade-off between generating small amounts of pollution in one’s local community (or driving region) versus generating comparatively large amounts of pollution in regions where mining and manufacturing occur.” (*John W. Brennan And Timothy W. Barder, “Battery Electric Vehicles Vs. Internal Combustion Engine Vehicles”, Arthur D. Little, 11/29/16*)



HYBRID CARS

Each Toyota Prius Contains Over Thirty Pounds Of Rare Earth Metals, Mostly In The Motor And The Rechargeable Battery. “There are over thirty pounds of rare earth metals inside of each Toyota Prius that comes off a production line, with most of that mass split between rare earth components essential to motors and the rechargeable battery.” (*Keith Veronese, “Rare: The High-Stakes Race To Satisfy Our Need For The Scarcest Metals On Earth,” 2015, p.42*)

Lanthanum Used In The Batteries Accounts For Between Ten And Fifteen Pounds Of The Thirty Pounds Of Rare Earth Metals In Each Toyota Prius. “Of this thirty, ten to fifteen pounds is lanthanum with the lanthanum used as the metal component of nickel metal hydride (NiMH) batteries.” (*Keith Veronese, “Rare: The High-Stakes Race To Satisfy Our Need For The Scarcest Metals On Earth,” 2015, p.42*)

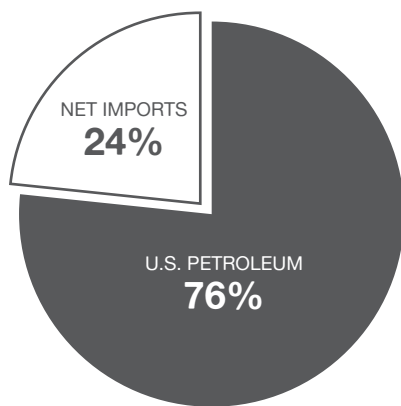
As The First Generation Of Hybrids Reach The End Of Their Lifetime, People Will Need To Replace Their Battery Or Buy A New Car, Which Will Increase Rare Earth Metal Consumption. “As the first generation of hybrid automobiles reaches the end of its lifetime, owners will be forced to replace their battery or move on to a different car, with both alternatives bringing an uptick in rare earth metal consumption.” (*Keith Veronese, “Rare: The High-Stakes Race To Satisfy Our Need For The Scarcest Metals On Earth,” 2015, p.42*)

WHERE DO RARE EARTH METALS & MINERALS COME FROM?



THE U.S. PRODUCES MOST OF ITS OWN OIL,
BUT DEPENDS ON THE WORLD FOR RARE EARTH

U.S. DOMESTIC PETROLEUM PRODUCTION AND NET IMPORTS OF PETROLEUM AS SHARES OF PETROLEUM CONSUMPTION, 2015



Note: Petroleum includes crude oil, petroleum products, and biofuels.

Source: U.S. Energy Information Administration, Monthly Energy Review. Table 3.3a, October 2016

RARE EARTH RESERVES

As Of 2016, The World Had 120,000,000 Metric Tons In Rare Earths Reserves. (*"Mineral Commodity Summaries: Rare Earths," U.S. Geological Survey, 1/17*)

According To The World Coal Association, There Are About 892 Billion Tons Of Proven Coal Reserves In The World. "There are an estimated 892 billion tonnes of proven coal reserves worldwide." (*"Where Is Coal Found," World Coal Association, Accessed 4/10/17*)

According To The Organization Of Petroleum Exporting Countries (OPEC), The World Has About 202 Trillion Standard Cubic Meters Of Proven Natural Gas Reserves. (*"Natural Gas Data," Organization Of The Petroleum Exporting Countries, Accessed 4/10/17*)

According To A 2016 British Petroleum Statistical Review, The World Has About 1,700 Billion Barrels Of Proven Oil Reserves. (*"BP Statistical Review Of World Energy June 2016," BP 6/16*)

**85% of rare-earth metals
come from China**



**85% of U.S. petroleum comes
from the U.S. and Canada**



CHINA'S RARE EARTH, OR AMERICA'S ENERGY?

(Justin Rowlett, "Rare Earths: Neither Rare, Nor Earths," BBC News, 3/23/14; U.S. Energy Information Administration, Monthly Energy Review, Table 3.3a, October 2016)

RARE EARTH METALS COME MOSTLY FROM CHINA

Ninety Percent Of The World's Supply Of Rare Industrial Metals Originates In Just Two Countries. "At the moment, 90 percent of the world's current supply of rare industrial metals originates from two countries." (*Keith Veronese, "Rare: The High-Stakes Race To Satisfy Our Need For The Scarcest Metals On Earth," 2015, p.35*)

BBC: "More Than 85% Of The World's Supply Of Rare-Earth Metals Come From China." "The problem is getting hold of the rare earths that make this possible. More than 85% of the world's supply of rare-earth metals comes from China. And practically 100% of the "heavy" rare earths - at the farther end of the periodic table - come from China, including Stiesdal's dysprosium. China has some very rich deposits of rare earths in Inner Mongolia. And, until recently, China has not been very squeamish about the consequences of rare-earth extraction." (*Justin Rowlett, "Rare Earths: Neither Rare, Nor Earths," [BBC News](#), 3/23/14*)

Between 2012 And 2015, China Accounted For More Than 70 Percent Of U.S. Imports Of Rare-Earth Compounds And Metals. "Import Sources (2012–15): Rare-earth compounds and metals: China, 72%; Estonia, 7%; France, 5%; Japan, 5%; and other, 12%." (*"Mineral Commodity Summaries: Rare Earths," [U.S. Geological Survey](#), 1/17*)

China's Rare Earth Industry Association Has Forecasted That Consumption Of Rare-Earth Oxides In China Will Increase From 98,000 Tons In 2015 To 149,000 In 2020. "According to China's Rare Earth Industry Association, consumption of rare-earth oxides in China was forecast to increase from 98,000 tons in 2015 to 149,000 tons in 2020." (*"Mineral Commodity Summaries: Rare Earths," [U.S. Geological Survey](#), 1/16*)



In The U.S., 60 Percent Of Rare Earths Are Used For Producing Catalysts. “The estimated distribution of rare earths by end use was as follows, in decreasing order: catalysts, 60%; metallurgical applications and alloys, 10%; ceramics and glass, 10%; glass polishing, 10%; and other, 10%.” (*“Mineral Commodity Summaries: Rare Earths,” U.S. Geological Survey, 1/16*)

RARE METALS ARE SCARCE, AND DEMAND WILL INCREASE

Yale Environment 360 Reported That Rare Earth Metals Are Scarce. “With the global push to reduce greenhouse gas emissions, it’s ironic that several energy- or resource-saving technologies aren’t being used to the fullest simply because we don’t have enough raw materials to make them. ... The problem was that China, which controlled 97 percent of global rare earth production, had clamped down on trade. A solution was brokered and the price shock faded, but the threat of future supply problems for rare earths and other so-called ‘critical elements’ still looms.” (*Nicola Jones, “A Scarcity Of Rare Metals Is Hindering Green Technologies,” Yale Environment 360, 11/18/13*)

“Limited” Recycling Is Another Problem. “Because recycling is limited, [San Jose State University professor Dustin] Mulvaney said, those recoverable [rare] metals could go to waste.” (*Christina Nunez, “How Green Are Those Solar Panels, Really?” National Geographic, 11/11/14*)

- **Only About One Percent Of Potentially Critical Rare Earth Metals Are Recycled.** “End-of-life recycling rates vary from about 1% for potentially critical metals like the rare earth elements to 55% or so for aluminium and 70% or more for iron.” (*Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” Nature, 3/16/17*)

In A 2017 Report Published In The Journal *Nature*, Researchers Concluded Supplying Raw Materials To A Growing Society Was “A Persistent Underlying Global Challenge.” “The current oversupply of raw materials in world markets masks a persistent underlying global challenge, namely, how to supply raw materials to an expanding global population that is expected to reach 8.5 billion by 2030—the target date for the United Nations sustainable development goals.” (*Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” Nature, 3/16/17*)

The Researchers Said The “Transition To A Low-Carbon Society” Outlined In The Paris Climate Agreement “Will Require Vast Amounts Of Metals And Minerals.” “First, on 12 December 2015, a historic international agreement on climate change was formally adopted in Paris. This adds momentum to a transition to a low-carbon society, a change that will require vast amounts of metals and minerals.” (*Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” Nature, 3/16/17*)

- **“Mineral Resourcing And Climate Change Are Inextricably Linked, Not Only Because Mining Requires A Large Amount Of Energy, But Also Because The World Cannot Tackle Climate Change Without An Adequate Supply Of Raw Materials To Manufacture Clean Technologies.”** (*Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” Nature, 3/16/17*)



Nature: Over The Next Two To Three Decades “An Unprepared Minerals Industry Will Struggle To Meet Demand For Several Metals (For Example, Copper) For Which Substitutes Are Not Readily Available.” “Recent evaluations of shorter-term supply risk and criticality suggest that, over the next 2–3 decades (when the availability of metals for recycling is expected to remain low) an unprepared minerals industry will struggle to meet demand for several metals (for example, copper) for which substitutes are not readily available.” (Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” [Nature](#), 3/16/17)

- **“Given The Rapid Pace Of Technological And Demographic Change, Broader Discussion Of Current And Future Mineral Supply Is Needed To Avoid Disruptive Volatility In Prices And Supply.”** (Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” [Nature](#), 3/16/17)

Some Specialty Metals Are “Dependent On The Mining Of Their Host Mineral.” “In addition, speciality metals such as germanium are by-products of mining other minerals, in this case zinc sulfide, which contains trace amounts of germanium, and are thus dependent on the mining of their host mineral.” (Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” [Nature](#), 3/16/17)

“The Development Of Renewable Energy Sources And Other High-Technology Applications Will Require New Infrastructure That Will Consume A Different Mix Of Minerals From Current Applications, Including Not Only ‘Critical’ Metals Such As The Rare Earths, But Also Vast Amounts Of Common Commodities Such As Copper, Steel And Cement.” (Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” [Nature](#), 3/16/17)

RARE EARTH AS POLITICAL LEVERAGE

“Beijing Uses Access To Their Rare Metals As A Way To Attract Foreign Investment That Will Subsequently Bring International Technology To China.” “Beijing uses access to their rare metals as a way to attract foreign investment that will subsequently bring international technology to China. The central government wants to upgrade its businesses. In a sense, Beijing is modeling its industrial growth after Japan’s Hitachi Corporation – once a mining services company, now it’s one of the world’s largest technology companies.” (David S. Abraham, *The Elements of Power: Gadgets, Guns, and the Struggle for a Sustainable Future in the Rare Metal Age*, 2015, p. 197)

In A 2017 Report Published In The Journal Nature, Researchers Anticipated The Need For “Greater Environmental Diplomacy To Assure Access To Mineral Deposits Which Are Irregularly Distributed And Often Occur In Areas Of Conflict.” “We anticipate a need for greater environmental diplomacy to assure access to mineral deposits which are irregularly distributed and often occur in areas of conflict.” (Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” [Nature](#), 3/16/17)

- **“The Future Availability Of Metals And Other Mineral Products Will Depend Both On Economic And Market Factors (Metal Prices, Anticipated Supply And Demand) And On Social And Environmental Pressures.”** (Saleem H. Ali, Damien Giurco, Nicholas Arndt, et al, “Mineral Supply For Sustainable Development Requires Resource Governance,” [Nature](#), 3/16/17)



⁶⁰**Nd** NEODYMIUM

CHINA HAS A MONOPOLY ON NEODYMIUM

Neodymium Is Used In Magnets For Wind Turbines And Electric Motors For Hybrid Cars. “Neodymium is used, as in the case of dysprosium, in magnets in wind turbines and electric motors for hybrid cars.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.93, 2013)

“China Has A Monopoly In Neodymium Production And Has The Largest Reserves.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.93, 2013)

⁵⁹**Pr** PRASEODYMIUM

CHINA, RUSSIA, AND BRAZIL PRODUCE THE MOST PRASEODYMIUM

“Praseodymium Is Mainly Used In Glass Manufacture And Magnets.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.93, 2013)

The Largest Producers Of Praseodymium Are China, Russia And Brazil. The largest reserves are in China, USA, and Commonwealth of Independent States and largest producers are China, Russia and Brazil. (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.93, 2013)

⁶⁶**Dy** DYSPROSIUM

DYSPROSIUM PRODUCTION IS CONCENTRATED IN CHINA

Dysprosium Is Used In Wind Energy Generation. “The main use of dysprosium is in neodymium-iron-boron magnets for applications such as hard disc drives, automobiles and motors, as well as in wind energy generation.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.91, 2013)

“Dysprosium Production Is Almost Entirely Concentrated In China.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.91, 2013)

The Demand For Dysprosium Is Likely To Grow Rapidly In The Coming Years Due To Competition Over Rare Earth Magnets. “The demand for dysprosium is likely to grow rapidly during the coming years due to competition over rare earth magnets.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.91, 2013)

- **“Demand Could Increase By 2,600% Over The Next 25 Years.”** (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.91, 2013)

57 La LANTHANUM

CHINA, RUSSIA, AND BRAZIL PRODUCE THE MOST LANTHANUM

“Lanthanum Is Usually Employed As A Battery Constituent, Especially In NiMH-Based Batteries.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.92, 2013)

If Growth In Hybrids Continues And NiMH Batteries Remain The Preferred Battery Choice, Then There Could Be A Possible Shortage In Lanthanum. “There can be a possible shortage in lanthanum if growth in hybrids is strong and NiMH remains the preferred battery of choice.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.93, 2013)

The Largest Producers Of Lanthanum In The World Are China, Russia And Brazil. “The largest reserves of lanthanum are in China, USA, and Commonwealth of Independent States and largest producers are China, Russia and Brazil.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.92-93, 2013)

58 Ce CERIUM

CHINA IS THE TOP CERIUM PRODUCER

The Top Cerium Producer In The World Is China, Followed By Russia And Malaysia. “Top 3 producers: 1) China 2) Russia 3) Malaysia” (“Periodic Table: Cerium,” [Royal Society Of Chemistry](#), Accessed 3/14/17)

“Cerium Is Used In NiMH Batteries Of Electric Vehicles.” (Alina Pathan, Nordisk Ministerråd and Nordisk Råd, “Tracking Environmental Impacts In Global Product Chains: Rare Earth Metals And Other Critical Metals Used In The Cleantech Industry,” pg.91, 2013)



CHILE CONTAINS HALF OF THE WORLD'S MOST ECONOMICALLY EXTRACTABLE LITHIUM

As Of 2016, The World Had 14 Million Metric Tons In Workable Lithium Reserves. (*"Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 1/17*)

The Market For Lithium Is Expected To Triple By 2025. "The market, while still relatively small — worth about \$1bn a year — is expected to triple in size by 2025, according to analysts at Goldman Sachs." (Cecilia Jamasmie, Chinese-Korean Group To Build \$2 Billion Lithium Batteries Plant In Chile," [Mining](#), 12/6/16)

"Lithium Supply Security Has Become A Top Priority For Technology Companies In The United States And Asia." (*"Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 1/17*)

The Largest Potential Growth Area For Lithium In 2015 Was Rechargeable Batteries. "Rechargeable batteries were the largest potential growth area for lithium compounds." (*"Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 1/16*)

- **Of All Rechargeable Batteries, Demand Is Greatest For Lithium Batteries.** "Demand for rechargeable lithium batteries exceeds that of other rechargeable batteries." (*"Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 1/16*)
- **Lithium Batteries Are Used In Electric And Hybrid Electric Vehicles.** "Automobile companies were developing lithium batteries for electric and hybrid electric vehicles." (*"Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 1/16*)

Lithium Batteries Have Become An Irreplaceable Component Of Rechargeable Batteries Used In High-Tech Devices. "Lithium, frequently referred to as "white petroleum," drives much of the modern world, as it has become an irreplaceable component of rechargeable batteries used in high tech devices." (Cecilia Jamasmie, Chinese-Korean Group To Build \$2 Billion Lithium Batteries Plant In Chile," [Mining](#), 12/6/16)

Chinese And Korean Investors Are Advancing Towards Opening A \$2 Billion Mega-Lithium Batteries Plant In Chile. "Chinese and Korean investors are said to be in advanced talks with the Chilean government to open up a \$2 billion mega-lithium batteries plant in the country's north, known for its vast salt flats under which experts say there is enough of the commodity to supply the world for decades." (Cecilia Jamasmie, Chinese-Korean Group To Build \$2 Billion Lithium Batteries Plant In Chile," [Mining](#), 12/6/16)

Chile Contains Half Of The World's Most Economically Extractable Lithium. "That should be great news for Chile, as the country contains half of the world's most 'economically extractable' reserves of the metal, according to the US Geographical Survey (USGS)." (Cecilia Jamasmie, Chinese-Korean Group To Build \$2 Billion Lithium Batteries Plant In Chile," [Mining](#), 12/6/16)

Between 2012 And 2015, The U.S. Imported 57 Percent Of Its Lithium From Chile And 40 Percent From Argentina.

"Import Sources (2012–15): Chile, 57%; Argentina, 40%; China, 2%; and other, 1%." (*"Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 1/17*)



DEMOCRATIC REPUBLIC OF THE CONGO (DR CONGO) DOMINATES WORLD COBALT PRODUCTION

As Of 2016, The World Had 7,000,000 Metric Tons In Cobalt Reserves. (*"Mineral Commodity Summaries: Cobalt," U.S. Geological Survey, 1/17*)

- As Of 2016, One Million Tons Of Cobalt Resources Had Been Identified In The United States. "Identified cobalt resources of the United States are estimated to be about 1 million tons. Most of these resources are in Minnesota, but other important occurrences are in Alaska, California, Idaho, Michigan, Missouri, Montana, Oregon, and Pennsylvania. With the exception of resources in Idaho and Missouri, any future cobalt production from these deposits would be as a byproduct of another metal." (*"Mineral Commodity Summaries: Cobalt," U.S. Geological Survey, 1/17*)





- **As Of 2016, 25 Million Tons Of Terrestrial Cobalt Resources Had Been Identified Worldwide.** “Identified world terrestrial cobalt resources are about 25 million tons.” (*“Mineral Commodity Summaries: Cobalt,”* [U.S. Geological Survey](#), 1/17)

DR Congo Is The World’s Leading Source Of Mined Cobalt, With More Than Half Of World Cobalt Mine Production. “Congo (Kinshasa) continued to be the world’s leading source of mined cobalt, supplying more than one-half of world cobalt mine production.” (*“Mineral Commodity Summaries: Cobalt,”* [U.S. Geological Survey](#), 1/16)

- **DR Congo’s Copper Belt In Southern Katanga Accounts For Almost Half Of The World’s Cobalt Reserves.** “Over 50 percent of the world’s cobalt is currently produced in DR Congo, with the copper belt in the southern Katanga region accounting for almost half of the world’s reserves at 3.4 million metric tons.” (Stefan Sabo-Walsh, *“The Hidden Risks of Batteries: Child Labor, Modern Slavery, And Weakened Land And Water Rights,”* [Greentech Media](#), 3/29/17)

DR CONGO’S ARTISANAL MINES RELY ON CHILD LABOR, AND THE COUNTRY IS HOME TO “MODERN SLAVERY”

Twenty Percent Of Cobalt Exports From Congo Come From Artisanal Mines, And A Majority Of These Mines Are “Unregulated And Operate Illegally.” “Although much of this is produced at large-scale industrial mines, the Congolese government reports that around 20 percent of cobalt exports from the country originate in artisanal mines, a majority of which are unregulated and operate illegally.” (Stefan Sabo-Walsh, *“The Hidden Risks of Batteries: Child Labor, Modern Slavery, And Weakened Land And Water Rights,”* [Greentech Media](#), 3/29/17)

- **It Is Estimated That 40,000 Children Work In Artisanal Mines In The Southern Part Of DR Congo, Including In Cobalt Mines.** “Shockingly, 40,000 children are estimated to be employed in artisanal mines in southern DR Congo, including in cobalt extraction.” (Stefan Sabo-Walsh, *“The Hidden Risks of Batteries: Child Labor, Modern Slavery, And Weakened Land And Water Rights,”* [Greentech Media](#), 3/29/17)
- **DR Congo Is Rated “‘Extreme Risk’ In Regard To Child Labor, Modern Slavery, Trafficking And Occupational Health And Safety.”** “According to the research, the country is rated ‘extreme risk’ for child labor, modern slavery, trafficking and occupational health and safety.” (Stefan Sabo-Walsh, *“The Hidden Risks of Batteries: Child Labor, Modern Slavery, And Weakened Land And Water Rights,”* [Greentech Media](#), 3/29/17)

DR CONGO’S “BRUTAL WARFARE” MAKES IT THE “WORLD’S NEW PROBLEM ADDICTION”

An April 2017 Axios Report From “World-Class Energy Expert” Steve Levine Called Cobalt “The World’s New Problem Addiction.” “For those worried about lithium becoming the world’s new problem addiction, you are watching the wrong element. Your eyes instead should be peeled toward cobalt, a super-expensive metal and a primary component of all commercial advanced batteries. Cobalt’s expense is one matter; the other is where it largely comes from — Congo, the venue of some of the world’s most brutal warfare.” (Ben Geman, *“Generate,”* [Axios](#), 4/12/17)



- **Levine Noted The Importance Of Cobalt For Tesla Vehicles And The Electric Chevy Volt.** “Cobalt is in the cathode of your iPhone (lithium cobalt-oxide, invented by the famous John Goodenough at the University of Texas); your Tesla, if you happen to own one (lithium cobalt aluminum); and your Chevy Volt (nickel manganese cobalt). It is indispensable, mainly because it allows for a stable, energy-dense electrode.” (Ben Geman, “Generate,” [Axios](#), 4/12/17)

ELECTRIC VEHICLES USE MORE THAN 40% OF GLOBAL COBALT PRODUCTION

The Electric Vehicle Battery Industry Uses 42% Of Global Cobalt Production. “Cobalt supply is even more elusive than lithium supply, and the industry currently uses 42 percent of global cobalt production with the remaining 58 percent going to diverse industrial and military applications.” (“Electric Car Showdown: China And Tesla Scramble For Supply,” [Yahoo Finance](#), 2/9/17)

THE GLOBAL COBALT SUPPLY IS ELUSIVE

The Global Cobalt Supply Is Even More Elusive Than The Global Lithium Supply. “Cobalt supply is even more elusive than lithium supply, and the industry currently uses 42 percent of global cobalt production with the remaining 58 percent going to diverse industrial and military applications.” (“Electric Car Showdown: China And Tesla Scramble For Supply,” [Yahoo Finance](#), 2/9/17)

97% Of Cobalt Is Produced As An “Afterthought—Mined And Brought To Market As A By-Product Of Nickel Or Copper.” “Companies like Tesla (TSLA) and Panasonic (PC) need reliable sources of the metal, and the supply chain is anything but, because 97 percent of it is just an afterthought—mined and brought to market as a by-product of nickel or copper.” (“Electric Car Showdown: China And Tesla Scramble For Supply,” [Yahoo Finance](#), 2/9/17)

The Cobalt Supply Has Tightened Due To Drops In The Price Of Nickel And Copper, Which Makes It Uneconomical To Mine Them. “And as the price of nickel and copper continue to plunge, it makes mining them uneconomical, further tightening the cobalt supply picture.” (“Electric Car Showdown: China And Tesla Scramble For Supply,” [Yahoo Finance](#), 2/9/17)



THE U.S. GETS THE LARGEST SHARE OF ITS INDIUM FROM CHINA

According To A U.S. Geological Survey Conducted From 2008 To 2011, The U.S. Gets Around 29 Percent Of Its Indium From China. (“Mineral Commodity Summaries 2013,” [U.S. Department Of The Interior](#), 1/24/13)

- **The U.S. Gets 23 Percent Of Its Indium From Canada, 14 Percent From Japan, 11 Percent From Belgium, And 23 Percent From Other Countries.** (“Mineral Commodity Summaries 2013,” [U.S. Department Of The Interior](#), 1/24/13)



GALLIUM

THE U.S. GETS THE LARGEST SHARE OF GALLIUM FROM CHINA

According To The U.S. Geological Survey, An Estimate Of Gallium Reserves Is Not Possible. “Gallium occurs in very small concentrations in ores of other metals. Most gallium is produced as a byproduct of processing bauxite, and the remainder is produced from zinc-processing residues. Only a portion of the gallium present in bauxite and zinc ores is recoverable, and the factors controlling the recovery are proprietary. Therefore, an estimate of reserves is not possible.” (*“Mineral Commodity Summaries: Gallium,”* [U.S. Geological Survey, 1/17](#))

In 2016, World Low-Grade Primary Gallium Production Was Estimated At 375 Tons, 20% Lower Than The Previous Year. “In 2016, world low-grade primary gallium production was estimated to be 375 tons—a decrease of 20% from 470 tons in 2015.” (*“Mineral Commodity Summaries: Gallium,”* [U.S. Geological Survey, 1/17](#))

Over Half Of All Gallium Consumed Is Used For Producing Integrated Circuits. “About 57% of the gallium consumed was used in ICs.” (*“Mineral Commodity Summaries: Gallium,”* [U.S. Geological Survey, 1/16](#))

- **The Remaining Gallium Is Almost Entirely Used For Producing Optoelectronic Devices.** “Optoelectronic devices, which include laser diodes, LEDs, photodetectors, and solar cells, accounted for nearly all of the remaining gallium consumption.” (*“Mineral Commodity Summaries: Gallium,”* [U.S. Geological Survey, 1/16](#))

From 2012 To 2015, The U.S. Got 34 Percent Of Its Gallium From China According To The U.S. Geological Survey. “Import Sources (2012–15): China, 34%; Germany, 28%; United Kingdom, 20%; Ukraine, 13%; and other, 5%.” (*“Mineral Commodity Summaries: Gallium,”* [U.S. Geological Survey, 1/17](#))

TELLURIUM

THE U.S. GETS THE LARGEST SHARE OF ITS TELLURIUM FROM CANADA

As Of 2016, The World Had 25,000 Metric Tons In Tellurium Reserves. (*“Mineral Commodity Summaries: Tellurium,”* [U.S. Geological Survey, 1/17](#))

“World Production Of Tellurium In 2016 Was Estimated To Be About 400 Tons.” (*“Mineral Commodity Summaries: Tellurium,”* [U.S. Geological Survey, 1/17](#))

- **More Than 90% Of Tellurium Has Been Produced From Electrolytic Copper Refining.** “More than 90% of tellurium has been produced from anode slimes collected from electrolytic copper refining, and the remainder was derived from skimmings at lead refineries and from flue dusts and gases generated during the smelting of bismuth, copper, and lead-zinc ores.” (*“Mineral Commodity Summaries: Tellurium,”* [U.S. Geological Survey, 1/17](#))



The Major Use For Tellurium In The United States In 2015 Was The Production Of Cadmium-Telluride (CdTe) Solar Cells. “Tellurium was used in the production of cadmium-telluride (CdTe) solar cells, which was the major end use for tellurium in the United States.” (*Mineral Commodity Summaries: Tellurium*,” [U.S. Geological Survey](#), 1/16)

Cadmium-Telluride Solar Cells Have Improved In Efficiency As Compared To Silicon-Based Solar Cells. “CdTe solar cells continue to improve with respect to efficiency when compared with silicon-based solar cells.” (*Mineral Commodity Summaries: Tellurium*,” [U.S. Geological Survey](#), 1/16)

Although Tellurium Can Be Replaced In Most Of Its Uses, There Are Usually Losses In Efficiency Or Product Characteristics. “Several materials can replace tellurium in most of its uses, but usually with losses in efficiency or product characteristics.” (*Mineral Commodity Summaries: Tellurium*,” [U.S. Geological Survey](#), 1/16)

From 2012 To 2015, The U.S. Imported 59 Percent Of Its Tellurium From Canada And 24 Percent From China According To The U.S. Geological Survey. (*Mineral Commodity Summaries: Tellurium*,” [U.S. Geological Survey](#), 1/17)

ANOTHER IMPORTANT INGREDIENT FOR RENEWABLES:

GRAPHITE

CHINA PRODUCES TWO-THIRDS OF THE WORLD'S GRAPHITE

As Of 2016, The World Had 250,000,000 Metric Tons In Graphite Reserves. (*Mineral Commodity Summaries: Graphite*,” [U.S. Geological Survey](#), 1/17)

Natural Graphite Was Not Produced In The United States In 2016. “Although natural graphite was not produced in the United States in 2016, approximately 98 U.S. firms, primarily in the Northeastern and Great Lakes regions, consumed 24,200 tons valued at \$25.6 million.” (*Mineral Commodity Summaries: Graphite*,” [U.S. Geological Survey](#), 1/17)

In 2016, China Produced Two-Thirds Of The World's Graphite. “During 2016, China produced 66% of the world's graphite and consumed 35%.” (*Mineral Commodity Summaries: Graphite*,” [U.S. Geological Survey](#), 1/17)

“The Major Uses Of Natural Graphite In 2016 Were Brake Linings, Foundry Operations, Lubricants, Refractory Applications, And Steelmaking.” (*Mineral Commodity Summaries: Graphite*,” [U.S. Geological Survey](#), 1/17)

WHAT GOES INTO “CLEAN ENERGY”: HUMAN RIGHTS ABUSES



A young boy sleeps on bags of cobalt after a long day's work on December 13, 2005 in Ruashi mine about 20 kilometers outside Lubumbashi, Congo, DRC. (Photo by Per-Anders Pettersson/Getty Images)

THE WASHINGTON POST'S EXPOSÉ OF COBALT MINING IN AFRICA REVEALS WIDESPREAD ABUSES

The Worldwide Surge In Cobalt Demand Is “Mostly” Driven By EVs. “Worldwide, cobalt demand from the battery sector has tripled in the past five years and is projected to at least double again by 2020, according to Benchmark Mineral Intelligence. This increase has mostly been driven by electric vehicles.” (Todd C. Frankel, “The Cobalt Pipeline,” [The Washington Post](#), 9/30/16)

- **The Typical Electric Car Requires 10 To 20 Pounds Of Cobalt.** (Todd C. Frankel, “The Cobalt Pipeline,” [The Washington Post](#), 9/30/16)

“The World’s Soaring Demand For Cobalt Is At Times Met By Workers, Including Children, Who Labor In Harsh And Dangerous Conditions.” “The world’s soaring demand for cobalt is at times met by workers, including children, who labor in harsh and dangerous conditions. An estimated 100,000 cobalt miners in Congo use hand tools to dig hundreds of feet underground with little oversight and few safety measures, according to workers, government officials and evidence found by The Washington Post during visits to remote mines.” (Todd C. Frankel, “The Cobalt Pipeline,” [The Washington Post](#), 9/30/16)

- **Cobalt Goes Into EV Batteries, But Recent Scientific Developments Call For Cobalt In Solar Cells.** “Researchers at the University of Basel have successfully replaced the rare element iodine in copper-based dye-sensitized solar cells by the more abundant element cobalt, taking a step forward in the development of environmentally friendly energy production. The journal Chemical Communications has published the results of these so-called Cu-Co cells.” (“*Cobalt Replacements Make Solar Cells More Sustainable*,” Phys.org, 8/2/13)

Children In DR Congo Work In Underground Mines. “No one knows exactly how many children work in Congo’s mining industry. UNICEF in 2012 estimated that 40,000 boys and girls do so in the country’s south. ... Children work not just in underground mines, in violation of Congo’s mining code, but also on the fringes of the cobalt trade.” (Todd C. Frankel, “*The Cobalt Pipeline*,” The Washington Post, 9/30/16)

Deaths Are A Regular Occurrence For Miners. “Deaths happen with regularity, too, diggers said.” (Todd C. Frankel, “*The Cobalt Pipeline*,” The Washington Post, 9/30/16)

- **Miners Also Have Higher Urinary Concentrations Of Cobalt, Lead, Cadmium, And Uranium.** “One of their studies found residents who live near mines or smelters in southern Congo had urinary concentrations of cobalt that were 43 times as high as that of a control group, lead levels five times as high, and cadmium and uranium levels four times as high. The levels were even higher in children.” (Todd C. Frankel, “*The Cobalt Pipeline*,” The Washington Post, 9/30/16)
- **One Miner Said “We Are Suffering.”** “‘We are suffering,’ said one digger, Nathan Muyamba, 29. ‘And our suffering is for what?’ ... Other diggers wait until dark to invade land owned by private mining companies, leading to deadly clashes with security guards and police. ... Pay is based on what they find. No minerals, no money. And the money is meager — the equivalent of \$2 to \$3 on a good day, Nsenga said.” (Todd C. Frankel, “*The Cobalt Pipeline*,” The Washington Post, 9/30/16)

AMNESTY INTERNATIONAL CONDEMNED THE CONGOLESE COBALT TRADE IN A 2016 REPORT

Amnesty International Traced Cobalt In Electric Vehicle (EV) Batteries To DR Congo. “L&F Material Co. (L&F), a South Korean firm, which accounted for 13.16 per cent of Huayou Cobalt’s sales, worth 192,001,500 yuan (US\$31 million), in 2013. ... In a newspaper interview in October 2014, [L&F’s] CEO Lee Bong-won said it supplied battery materials to Samsung SDI, LG Chem Ltd. (LG Chem) and electric vehicle battery manufacturers based in Japan, North America and Europe.” (“*This Is What We Die For*”: Human Rights Abuses In The Democratic Republic Of The Congo Power The Global Trade In Cobalt,” Amnesty International, 1/19/16)

In The Congolese Cobalt Mines, “Accidents Are Common.” “Artisanal miners work in mines which they dig themselves. Hand-dug mines can extend for tens of metres underground, often without any support to hold them up, and are poorly ventilated. There is no official data available on the number of fatalities that occur, but miners said accidents are common, as unsupported tunnels collapse frequently. Between September 2014 and December 2015 alone, the DRC’s UN-run radio station, Radio Okapi, carried reports of fatal accidents involving more than 80 artisanal miners in the former province of Katanga. However, the true figure is likely to be far higher as many accidents go unrecorded and bodies are left buried underground.” (“*This Is What We Die For*”: Human Rights Abuses In The Democratic Republic Of The Congo Power The Global Trade In Cobalt,” Amnesty International, 1/19/16)



- **Children Do “Physically Demanding” Work.** “UNICEF estimated in 2014 that approximately 40,000 boys and girls work in all the mines across southern DRC, many of them involved in cobalt mining. The children interviewed by researchers described the physically demanding nature of the work they did. They said that they worked for up to 12 hours a day in the mines, carrying heavy loads, to earn between one and two dollars a day. Even those children who went to school worked 10 – 12 hours during the weekend and school holidays, and in the time before and after school.” (*“This Is What We Die For”: Human Rights Abuses In The Democratic Republic Of The Congo Power The Global Trade In Cobalt,* [Amnesty International](#), 1/19/16)

THE POST ALSO LOOKED AT GRAPHITE MINES IN NORTHEASTERN CHINA

Miners Produce Graphite, An Ingredient In Lithium Batteries That Power Electric Cars. “Zhang and Yu live near a factory that produces graphite, a glittery substance that, while best known for filling pencils, has become an indispensable resource in the new millennium. It is an ingredient in lithium-ion batteries. Smaller and more powerful than their predecessors, lithium batteries power smartphones and laptop computers and appear destined to become even more essential as companies make much larger ones to power electric cars.” (*Peter Whoriskey, “In Your Phone, In Their Air,”* [The Washington Post](#), 10/2/16)

- **The Rise Of EVs “Promises A Huge Surge In The Lithium-Ion Battery Business.”** “Now the rise of the electric-car industry promises a huge surge in the lithium-ion battery business. Making batteries big enough to power cars will cause a daunting leap in demand. A laptop requires just a handful of the familiar, thin, cylindrical lithium-ion batteries known as ‘18650s.’ A smartphone requires even less. But a typical electric car requires thousands of times the battery power. Today, the best known ‘gigafactory’ for electric-car batteries is the one being built by Tesla in the Nevada desert — a plant the company says will produce 500,000 electric-car batteries annually. But it’s just one of many. About a dozen other battery gigafactories are being planned around the world.” (*Peter Whoriskey, “In Your Phone, In Their Air,”* [The Washington Post](#), 10/2/16)

Graphite Is Produced Under “Lax Environmental Controls” In China. “The companies making those products promote the bright futuristic possibilities of the ‘clean’ technology. But virtually all such batteries use graphite, and its cheap production in China, often under lax environmental controls, produces old-fashioned industrial pollution.” (*Peter Whoriskey, “In Your Phone, In Their Air,”* [The Washington Post](#), 10/2/16)

- **Graphite Fills The Air And Pollutes The Water In Villages Surrounding Graphite Plants.** “By daylight, the particles are visible as a lustrous gray dust that settles on everything. It stunts the crops it blankets, begrimes laundry hung outside to dry and leaves grit on food. The village’s well water has become undrinkable, too. ... But it’s not just the air. The graphite plant discharges pollutants into local waters, Zhang and Yu said — a nightly event that they can detect by smell: The discharges leave a chemical odor that irritates their noses and throats. Those emissions have not only made their water undrinkable, they said, but also kept the local river from freezing in winter.” (*Peter Whoriskey, “In Your Phone, In Their Air,”* [The Washington Post](#), 10/2/16)

“The Resulting Fine-Particle Pollution Can Cause An Array Of Breathing Difficulties.” “Graphite powder can quickly become airborne dust, drifting for miles. Without systems of tarps and fans to keep it under control, the resulting fine-particle pollution can cause an array of breathing difficulties, such as aggravating lung disease or reducing lung function, and has been linked to heart attacks in people with heart disease, according to the U.S. Environmental Protection Agency.” (*Peter Whoriskey, “In Your Phone, In Their Air,”* [The Washington Post](#), 10/2/16)

IV. WHAT GOES INTO “CLEAN ENERGY”: ENVIRONMENTAL ABUSES



Rare earth discharge liquid which discharged by Bao Steel, outflows from a pipeline into ‘rare earth lake’ formed by the cumulative emission in the nearby of Xinguang village on November 26, 2010 in Baotou, Inner Mongolia of China. (Photo by VCG/VCG via Getty Images)

A CHINESE MINE IS AN EXAMPLE OF THE ENVIRONMENTAL HORRORS BEHIND RARE EARTH MINING

China’s Baotou Is Home To The World’s Largest Rare Earth Mine. “When the Inner Mongolia University of Science and Technology flew me to Baotou for a rare earth conference in 2014, I thought the university would extend an invitation to visit Bayan Obo mine, or its tailings pond just outside the city. After all, inviting some of the leading rare earth researchers to the home of the world’s largest rare earth mine without showing it to them would be like assembling chocolatiers in Hershey, Pennsylvania, and not visiting the chocolate factory. Instead of a mine visit, conference organizers arranged a trip to ride dune buggies in the desert and to see a Genghis Khan Mausoleum. The organizers said the government wouldn’t allow foreign visitors to the mine.” (David S. Abraham, *The Elements of Power: Gadgets, Guns, and the Struggle for a Sustainable Future in the Rare Metal Age*, 2015, p. 196)

- **During A 2014 Rare Earth Conference In Baotou, The Chinese Government Wouldn’t Allow Foreign Visitors To See The Baotou Mine.** (David S. Abraham, *The Elements of Power: Gadgets, Guns, and the Struggle for a Sustainable Future in the Rare Metal Age*, 2015, p. 196)

In Baotou, Processing Plants Produce Rare Earth Minerals And Dispose Of The Waste In Toxic Lakes. “Arguably, what makes [neodymium], and cerium, scarce enough to be profitable are the hugely hazardous and toxic process needed to extract them from ore and to refine them into usable products. ... a vast amount of poisonous waste as a byproduct.” (Tim Maughan, “*The Dystopian Lake Filled By The World’s Tech Lust*,” [BBC](#), 4/2/15)

- **In 2009, China Produced 95 Percent Of The World’s Supply Of Rare Earth Minerals. Baotou’s Mines Contain 70 Percent Of The World’s Reserves.** “You may not have heard of Baotou, but the mines and factories here help to keep our modern lives ticking. It is one of the world’s biggest suppliers of ‘rare earth’ minerals. These elements can be found in everything from magnets in wind turbines and electric car motors, to the electronic guts of smartphones and flatscreen TVs. In 2009 China produced 95% of the world’s supply of these elements, and it’s estimated that the Bayan Obo mines just north of Baotou contain 70% of the world’s reserves.” (Tim Maughan, “*The Dystopian Lake Filled By The World’s Tech Lust*,” [BBC](#), 4/2/15)

Baotou, China Is “A Truly Alien Environment, Dystopian And Horrifying.” “Welcome to Baotou, the largest industrial city in Inner Mongolia. ... It is one of the world’s biggest suppliers of ‘rare earth’ minerals. ... [The Baotou toxic lake is] a truly alien environment, dystopian and horrifying.” (Tim Maughan, “*The Dystopian Lake Filled By The World’s Tech Lust*,” [BBC](#), 4/2/15)

- **“Black, Barely-Liquid, Toxic Sludge” Fills A Lake.** “From where I’m standing, the city-sized Baogang Steel and Rare Earth complex dominates the horizon, its endless cooling towers and chimneys reaching up into grey, washed-out sky. Between it and me, stretching into the distance, lies an artificial lake filled with a black, barely-liquid, toxic sludge. Dozens of pipes line the shore, churning out a torrent of thick, black, chemical waste from the refineries that surround the lake. The smell of sulphur and the roar of the pipes invades my senses. It feels like hell on Earth.” (Tim Maughan, “*The Dystopian Lake Filled By The World’s Tech Lust*,” [BBC](#), 4/2/15)

One Of Baotou’s Specialties Is Cerium, “One Of The Most Abundant Rare Earth Minerals.” “One of our first visits in the city is to a processing plant that specialises mainly in producing cerium, one of the most abundant rare earth minerals.” (Tim Maughan, “*The Dystopian Lake Filled By The World’s Tech Lust*,” [BBC](#), 4/2/15)

- **In 2015, The U.S. Government’s Ames Laboratory Touted The Fact Its New Alloy For Wind Turbine Magnets Uses Cerium.** “The new alloy—a potential replacement for high-performance permanent magnets found in automobile engines and wind turbines--eliminates the use of one of the scarcest and costliest rare earth elements, dysprosium, and instead uses cerium, the most abundant rare earth.” (Press Release, “*Ames Laboratory Scientists Create Cheaper Magnetic Material For Cars, Wind Turbines*,” [Ames Laboratory](#), 4/23/15)

Another One Of Baotou’s Specialties Is Neodymium, “A Vital Component In ... Wind Farm Turbines” And EV Motors. “One of Baotou’s other main exports is neodymium, another rare earth with a variety of applications. ... At the other end of the scale they are a vital component in large equipment that requires powerful magnetic fields, such as wind farm turbines and the motors that power the new generation of electric cars.” (Tim Maughan, “*The Dystopian Lake Filled By The World’s Tech Lust*,” [BBC](#), 4/2/15)

- **A “Top Capacity Wind Turbine Would Use 4,400lb Of Neodymium-Based Permanent Magnet Material.”** “But only with the rise of alternative energy solutions has neodymium really come to prominence, for use in hybrid cars and wind turbines. A direct-drive permanent-magnet generator for a top capacity wind turbine would use 4,400lb of neodymium-based permanent magnet material.” (Simon Parry and Ed Douglas, “*In China, The True Cost Of Britain’s Clean, Green Wind Power Experiment: Pollution On A Disastrous Scale*,” [Daily Mail](#), 1/26/11)



WATCH: BBC's Maughan Published A YouTube Video Of The Toxic Tailings Lake. (Tim Maughan, "Baotou Toxic Lake," [YouTube](#), 8/8/14)

THE GUARDIAN AND DAILY MAIL ALSO VISITED BAOTOU

The Guardian: "An Endless Expanse Of Viscous Grey Sludge." "A short walk from the 43-year-old former farmer's dilapidated brick home in Xinguang Number One Village, is the world's largest rare earths mine tailings pond – an endless expanse of viscous grey sludge built in the 1950s under Mao Zedong." (Jonathan Kaiman, "Rare Earth Mining In China: The Bleak Social And Environmental Costs," [The Guardian](#), 3/20/14)

- **"Processing One Ton Of Rare Earths Produces 2,000 Tons Of Toxic Waste."** "Processing rare earths is a dirty business. Their ore is often laced with radioactive materials such as thorium, and separating the wheat from the chaff requires huge amounts of carcinogenic toxins – sulphates, ammonia and hydrochloric acid. Processing one ton of rare earths produces 2,000 tons of toxic waste; Baotou's rare earths enterprises produce 10m tons of wastewater per year." (Jonathan Kaiman, "Rare Earth Mining In China: The Bleak Social And Environmental Costs," [The Guardian](#), 3/20/14)

The Guardian: Villages Surrounding The Baotou Lake "Are Decimated." "In 2009, Baotou Steel began relocating farmers from villages around the tailings pond to resettlement sites on the city's outskirts; it has set up a waste managing warehouse staffed by 400 employees. Yet the pond is still a reminder of how far China's cleanup effort has to go. Surrounding villages are decimated. Stray dogs amble through dessicated corn and wheat fields, the rusted frames of dismantled greenhouses arching above tangles of discarded plastic bags." (Jonathan Kaiman, "Rare Earth Mining In China: The Bleak Social And Environmental Costs," [The Guardian](#), 3/20/14)

- **Toxic Contents Seep "Into Groundwater."** "The pond, owned by the Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Company, or Baotou Steel, lacks a proper lining and for the past 20 years its toxic contents have been seeping into groundwater, according to villagers and state media reports. It is trickling towards the nearby Yellow River, a major drinking water source for much of northern China, at a rate of 20 to 30 metres a year, a local expert told the influential Chinese magazine Caixin." (Jonathan Kaiman, "Rare Earth Mining In China: The Bleak Social And Environmental Costs," [The Guardian](#), 3/20/14)

Daily Mail: The Toxic Tailings Lake Is A "Vast, Hissing Cauldron Of Chemicals." "This vast, hissing cauldron of chemicals is the dumping ground for seven million tons a year of mined rare earth after it has been doused in acid and chemicals and processed through red-hot furnaces to extract its components." (Simon Parry and Ed Douglas, "In China, The True Cost Of Britain's Clean, Green Wind Power Experiment: Pollution On A Disastrous Scale," [Daily Mail](#), 1/26/11)

Daily Mail: "People Too Began To Suffer." "People too began to suffer. Dalahai villagers say their teeth began to fall out, their hair turned white at unusually young ages, and they suffered from severe skin and respiratory diseases. Children were born with soft bones and cancer rates rocketed." (Simon Parry and Ed Douglas, "In China, The True Cost Of Britain's Clean, Green Wind Power Experiment: Pollution On A Disastrous Scale," [Daily Mail](#), 1/26/11)



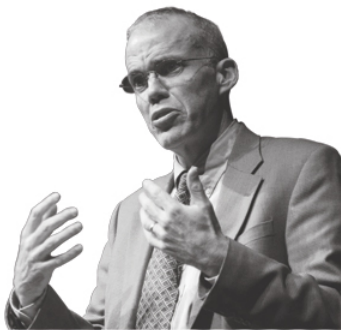
WIRED: “YOU HAVE TO MOVE A LOT OF EARTH TO GET JUST A LITTLE BIT” OF RARE EARTH

In Examining Tesla’s Environmental Impact, *Wired* Reported On The Massive Effort Needed To Extract Rare Earth Metals. “Rare metals only exist in tiny quantities and inconvenient places—so you have to move a lot of earth to get just a little bit. In the Jiangxi rare earth mine in China, Abraham writes, workers dig eight-foot holes and pour ammonium sulfate into them to dissolve the sandy clay. Then they haul out bags of muck and pass it through several acid baths; what’s left is baked in a kiln, leaving behind the rare earths required by everything from our phones to our Teslas. At this mine, those rare earths amounted to 0.2 percent of what gets pulled out of the ground. The other 99.8 percent—now contaminated with toxic chemicals—is dumped back into the environment. That damage is difficult to quantify, just like the impact of oil drilling.” (*Lizzie Wade, “Tesla’s Electric Cars Aren’t As Green As You Might Think,” [Wired](#), 3/31/16*)

- **Tesla Refuses To Identify The Sources Of “Graphite, Cobalt And Lithium” That Goes Into Its Batteries.** “In each case, Tesla denied that the products from those companies reached their batteries. So if not from those companies, where does Tesla get its graphite, cobalt and lithium? Tesla declined to identify sources. As evidence of its concern that suppliers operate cleanly, Tesla officials note that the core of its mission involves improving the environment and that it has taken steps to make sure that the inputs to its forthcoming battery ‘Gigafactory’ in Nevada will be clean.” (*Peter Whoriskey, “Tesla Aims To Sustain Purity Of Car Batteries, But Can Any Company Be Sure?” [The Washington Post](#), 12/30/16*)

ENVIRONMENTALISTS SUPPORT AGGRESSIVE EXPANSION OF WIND AND SOLAR IN THE U.S.

Bill McKibben Supports A Plan To Make The U.S. Energy Grid 100 Percent Wind And Solar By 2050. (Op-Ed, Bill McKibben, “A World At War,” [New Republic](#), 8/15/16)



“ TO MAKE THE STANFORD PLAN WORK, YOU WOULD NEED TO BUILD A HELL OF A LOT OF FACTORIES TO TURN OUT THOUSANDS OF ACRES OF SOLAR PANELS, AND WIND TURBINES THE LENGTH OF FOOTBALL FIELDS, AND MILLIONS AND MILLIONS OF ELECTRIC CARS AND BUSES.

(Bill McKibben Op-Ed, New Republic, 8/15/16)

- In 2008, McKibben Said A Proper Response After The 9/11 Attacks Would Have Been A \$1-Per-Gallon Gas Tax And The Installation Of Solar Panels On The Roofs Of American Homes. MCKIBBEN: “I mean- What did President Bush, what was his first impulse in the aftermath of 9/11? HOST: “After 9/11, go shopping.” MCKIBBEN: “First impulse was to bomb somebody but. second impulse was, ‘Go back to normal, return to shopping.’ That’s how he put it. HOST: “Yes, yes.” MCKIBBEN: “Which was very sad. You know, if we’d taken that moment- if he’d said instead, ‘You know, job number one is to put Osama Bin Laden in a box but job number two is to make sure we’re never in this situation again. We’re gonna put a dollar tax on gasoline tomorrow so that we can stop using so much, you know, of that Middle Eastern oil and we’re going to put solar panels on top of half of the houses in America before I leave office.’ We were all in a state of shock and sadness and we all would have saluted and said, ‘Yes, sir.’” (Calvin College, “Is More Better? Rethinking Consumption,” [YouTube](#), 4/7/12)
 - **WATCH:** Bill McKibben Also Said He Owns An Electric Vehicle. (Core News, “Bill McKibben Says He Drives An Electric Car,” [YouTube](#), 10/3/16)
- WATCH:** Tom Steyer Touted Wind And Solar – And His Goal For 50 Percent “Clean Energy” By 2030 – In A 2015 Ad For NextGen Climate. (NextGen Climate, “Even More,” [YouTube](#), 11/12/15)
- Under Steyer’s Leadership, Farallon Capital Held Stock In Coal Plants, Nuclear Plants, And Oil And Gas Companies In Texas, Oklahoma And Louisiana. “So-called powerhouse Democratic donor Tom Steyer, who has donated \$5 million to defeat Prop 23, which would suspend green power in California, runs an investment firm that holds stock in ‘dirty coal’ and nuclear plants, oil and gas companies in Texas, Oklahoma and Louisiana. Additionally, Steyer’s investment firm holds stock in the leading photovoltaic solar panel supplier in California, Yingli Green Energy Holding Company of China.” (Wayne Lusvardi, “Prop. 23 Foe Profits From “‘Dirty Coal,’” [Cal Watchdog](#), 10/28/10)
 - **WATCH:** Steyer Also Talked Up The Benefits Of Solar Energy With Nevada Reporter Jon Ralston. (Core News, “Tom Steyer On Solar Energy,” [YouTube](#), 10/4/16)

Earthjustice Touts Its Rooftop Solar Project In Hawaii, And Brags Of “Creating Pathways For Clean Power.” “As a result of a multi-year collaboration with Earthjustice, Hawai‘i’s main electric utility has adopted a groundbreaking plan that helps tens of thousands of rooftop solar set-ups in the state connect to the grid—establishing a cutting-edge model for the rest of the nation.” (“Clean Energy,” [Earthjustice](#), Accessed 10/17/16)

GREENPEACE “A 100 PERCENT RENEWABLE ENERGY FUTURE IS NECESSARY

(Greenpeace, Accessed 10/17/16)

Greenpeace Calls A “100 Percent Renewable Energy Future ... Necessary.” “A 100 percent renewable energy future is necessary not only for the climate, but also for local communities. Moving away from the current fossil fuel economy can make our communities healthier, reduce pollution, and create more and better jobs. It can take the burden off the backs of low-income communities and communities of color that have borne the worst impacts of the fossil fuel economy. A 100 percent renewable future can ensure that our energy economy is one that works for everyone, not just fossil fuel CEOs.”

(“100% Renewable Energy For All,” [Greenpeace](#), Accessed 10/17/16)

The League Of Conservation Voters Works To Promote Renewable Energy And Advocates For Extending The Production Tax Credit (PTC) For Wind. “At the end of 2015, the President signed a bill that would extend the Production Tax Credit for wind energy and the Investment Tax Credit for solar energy for years into the future. Combined, these measures have produced a legacy that cannot be undone. ... The extension of the PTC and ITC were crucial for the wind and solar industries, helping the United States cut carbon emissions before the EPA’s Clean Power Plan takes effect.” (“Promoting Clean Energy,” [League Of Conservation Voters](#), Accessed 3/9/17)



“HARNESSING THE POWER OF THE SUN AND WIND-- IS THE ONLY LONG-TERM AND THE MOST ECONOMICAL OPTION.

(National Wildlife Federation, Accessed 10/17/16)

The National Wildlife Federation Calls Wind And Solar “The Only Long-Term” Option. “Renewable energy--essentially harnessing the power of the sun and wind--is the only long-term and the most economical option to reduce the global warming pollution produced by our current dependence on fossil fuels. NWF works to remove the barriers so that America and the rest of the world will quickly expand wind, solar, geothermal and biomass energy to power a new clean energy economy for all Americans.” (*“Develop Wildlife Friendly Renewable Energy,”* [National Wildlife Federation](#), Accessed 10/17/16)



**WE ARE WORKING TO
GET MILLIONS MORE
ELECTRIC VEHICLES
ON THE ROAD**

(NRDC, Accessed 10/17/16)

The Natural Resources Defense Council (NRDC) Is Working To “Expand The Market For Wind And Solar Power.”

“NRDC works to dramatically scale up renewable power around the world. We help states and nations pass clean energy standards and implement other policies that expand the market for wind and solar power, and we help utilities effectively bring renewable power onto the electric grid.” (*“Clean Energy,”* [NRDC](#), Accessed 10/17/16)

- **NRDC Also Works “To Get Millions More Electric Vehicles On The Road.”** “NRDC works with automakers and government leaders not only to make cars go farther on a tank of gas but also to take them off gas entirely. We’ve helped drive the federal government to adopt major improvements in fuel-economy standards. And we are working to get millions more electric vehicles on the road and advocating ways to make them more affordable.” (*“Clean Vehicles and Fuels,”* [NRDC](#), Accessed 10/17/16)

The Sierra Club Touts Its Support For “100% Clean And Renewable Energy.” “Cleaner, cheaper, healthier energy is here. It’s time for leaders across the U.S. to commit to 100% clean and renewable energy for all.” (*“Ready For 100,”* [Sierra Club](#), Accessed 10/17/16)