LITHIUM

- Lithium (Li) is the lightest metal on Earth and is used in batteries to power various electrical and electronic goods including mobile phones and electric cars.
- As demand for lithium rises, the mining impacts are increasingly affecting communities where this harmful extraction takes place, jeopardising their access to water.
- Current levels of lithium collection in the EU are very low. In the case of batteries, this amounts to an estimated 5 % of the lithium-ion batteries put on the European market. Most of the current lithium is either dumped in landfill or incinerated, contributing to Europe's dependency on lithium supply.
- Unless the EU introduces mandatory collection and recycling targets for metals such as lithium, the current wasteful practices will continue, contributing to far-reaching negative environmental and social impacts.

DEMAND FOR LITHIUM IS RISING

Lithium converts chemical energy into electrical energy very efficiently.[1] Analysts project that rechargeable lithium-ion (Li-ion)[2] batteries have the highest potential for future energy storage systems.[3] Lithium is therefore in high demand, especially to power personal electronic goods like mobile phones, energy storage systems and (hybrid) electric vehicles.[4]

Accessible, high-quality lithium is largely concentrated in a few Andean countries, primarily Bolivia and Chile (although Bolivia is not yet exporting its lithium resources on an industrial scale).

Figure 1: Identified lithium resources worldwide, 2012 [5]

COUNTRY	MILLION TONNES
Bolivia	9
Chile	7.5
China	5.4
United States	4
Argentina	2.6
Australia	1.8
Brazil	1
Congo (Kinshasa)	1
Serbia	1
Canada	0.36

Certain analysts believe that demand for lithium is likely to rise dramatically, due to the manufacturing and marketing of new electronic devices such as mobile phones and laptops.[6] Demand has already risen sharply: lithium use in rechargeable batteries increased from 0% of the market share in 1991 to 80% in 2007. The European Commission has stated that the tonnage of lithium used in portable batteries could increase ten-fold between 2010 and 2020.[7]

Another key factor will be the use of lithium in large electric vehicle batteries. Large, lightweight lithium-ion batteries for new electric vehicles[8] are set to be launched by over a dozen automobile manufacturers, including Mercedes Benz, BMW, Audi and Volkswagen by the end of 2013.[9] Toyota, Mitsubishi and others[10] have expressed concerns that consumer demand may overtake supply by 2020. In January 2010, Toyota's subsidiary company Toyota Tsusho and Australian lithium mining company Orocobre Ltd announced a joint venture to develop the Olaroz Argentine Lithium-Potash lithium mining project, to secure access to lithium deposits.[11]

As acknowledged by the European Commission:
"[The] deployment of 'green' vehicles reduces the use of fossil fuels but increases the demand for electricity and certain raw materials, some of which are subject to supply restrictions and concentrated in a few geographical areas (e.g. rare earth elements for electronic components and fuel cells, lithium for batteries)."[12]

LITHIUM MINING IMPACTS

Lithium is found in the brine of salt flats. Holes are drilled into the salt flats and the brine is pumped to the surface, leaving it to evaporate in ponds. This allows lithium carbonate to be extracted through a chemical process.

The extraction of lithium has significant environmental and social impacts, especially due to water pollution and depletion. In addition, toxic chemicals are needed to process lithium. The release of such chemicals through leaching, spills or air emissions can harm communities, ecosystems and food production. Moreover, lithium extraction inevitably harms the soil and also causes air contamination.[13]

The salt flats where lithium is found are located in arid territories. In these places, access to water is key for the local communities and their livelihoods, as well as the local flora and fauna. In Chile's Atacama salt flats, mining consumes, contaminates and diverts scarce water resources away from local communities.[14] The extraction of lithium has caused water-related conflicts with different communities, such as the community of Toconao in the north of Chile[15]. In Argentina's Salar de Hombre Muerto, local communities claim that lithium operations have contaminated streams used for humans, livestock and crop irrigation.[16]

There has been widespread speculation about whether Bolivia could become a lithium superpower, possibly overtaking Chile, by unlocking its massive resources, which may exceed 100m tonnes in its salt flats.[17]

Lithium exploration and investment is also taking place outside the Andean region. The American Nova mining corporation, for example, is moving ahead with the purchase of licensing agreements for lithium mining properties in Mongolia, in response to the current boom in sales of electronic goods.[18]

Bolivia has, so far, resisted large-scale industrial mining of lithium, although it has plans to build a pilot project as a precursor to the possible development of a lithium mining industry in the future.[19] However, the lithium-rich Salar de Uyuni is near to the San Cristóbal Mine, which, since it opened in 2007, has caused an "environmental and social disaster that affects all of Southwest Potosí" including through the use of 50,000 litres of water per day.[20]

EU LITHIUM COLLECTION RATES ARE LOW, POLICIES FOCUS ON OLDER BATTERY TECHNOLOGIES

Overall, the EU produces around 24 kg of electrical and electronic waste per citizen per year, which includes lithium used in high-tech industries.[21] With respect to batteries, the EU has regulations concerning their collection, recycling, treatment, and disposal,[22] which required battery collection rates of at least 25% by the end of September 2012 and will require 45% by the end of September 2016. This legislation does not specifically address lithium battery collection.

The amount of Li-ion batteries collected in the EU in 2010 was estimated at 1,289 tonnes along with 297 tons of lithium primary batteries.[23] This is only about 5% of the Li-ion batteries put on the market, according to the Belgian recyclers, Umicore.[24] Germany, France, Belgium and the Netherlands have the best track records for battery collection, including primary and secondary lithium-ion batteries.[25] Yet even these countries have very low collection rates, as shown in Figure 2.

The EU's existing legislation aims to reduce mercury, cadmium, lead and other metals in the environment by minimising the use of these substances in batteries in the first place, and by treating and re-using old batteries.[26] However, it currently focuses on the relatively simple recycling of, for instance, alkaline and lead acid batteries.[27] It does not address the complex chemistries of newer battery technologies, including lithium batteries, which contain compounds of various metals.[28]

The potential scope for the recycling of lithium can be complicated since the material is toxic,[29] highly reactive[30] and flammable. It tends to be incinerated or ends up in landfill due to very low collection rates and flawed waste legislation.

Low collection rates, the low and volatile market price of lithium, and the high cost of recycling relative to primary production have contributed to the absence of lithium recycling.[31] Although lithium's commercially valuable powder form, lithium carbonate, can be recovered from primary lithium batteries, rechargeable lithium-ion batteries tend to be processed with a view to recovering just some of the numerous metals they contain, such as cobalt, nickel, aluminium and copper. Remaining elements, such as lithium, are usually discarded.[32]

However, recyclers are gradually reacting to predicted changes in demand. Belgian recyclers Umicore, for example, have expanded their capacity, as they expect the collection of Li-ion batteries from (hybrid) electric vehicles to be more significant both in terms of tonnage and because of their size and the fact that people are unlikely to hoard them.[33] These changes need to be underpinned and coordinated, through the introduction of appropriate legislation, increased investment in infrastructure, and the development and sharing of new technologies.

Lithium collectors use different sorting processes, some of which are currently subject to commercial confidentiality. French metal recycling company, SNAM, for example, is authorised to process up to 300 tonnes of lithium-ion batteries annually. After the batteries are sorted, they go through a process of pyrolysis to get rid of plastic and paper materials. Cobalt, aluminium, copper and iron are recycled but lithium is not currently recovered.[43] SARP Industries/Euro Dieuze, also in France, specialises in battery recycling, including the recovery of lithium using hydro-metallurgical processes. However, as a new activity undergoing research and development, the details of its activities are restricted by confidentiality agreements.[44]

Figure 2: European lithium battery collectors [34]

COUNTRY	COMPANY	CAPACITY (tonnes of batteries per year)
France	SARP/Euro Dieuze Recupyl SNAM	200[35] 110[36] 300[37]
Switzerland	Batrec Industrie AG	200[38]
Belgium	Umicore	7,000[39]
Germany	Stiftung Gemeinsames Rücknahmesystem Batterien	340[40]
Netherlands	Stibat	n/a[41]
United Kingdom	G&P Batteries	145[42]

WHAT NEEDS TO HAPPEN NEXT

The future of lithium collection and recycling in the EU is directly related to future demand for lithium, the price and availability of lithium imports, and EU policies specifically designed to reduce lithium consumption and imports.

Continuing demand for electronic devices such as mobile phones, combined with the development of electric vehicles powered by lithium-ion batteries means that demand for lithium, which is already high, will soar.

Strong investment in lithium collection and recycling infrastructure and technologies, combined with effective regulation, could result in much higher collection and recycling rates for lithium batteries. Financial incentives to encourage the production of more sustainable devices through responsible product design could facilitate their reduced demand.

Extensive social and environmental impact assessments should also underpin new legislation on the procurement, waste and reuse of natural resources, including metals such as lithium. Investment in public awareness-raising programmes about the environmental impacts of wasteful consumption of luxury items, including electronic goods, should also be prioritised.

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