GREEN POWERHOUSE

T&E blueprint for battery regulations in Europe

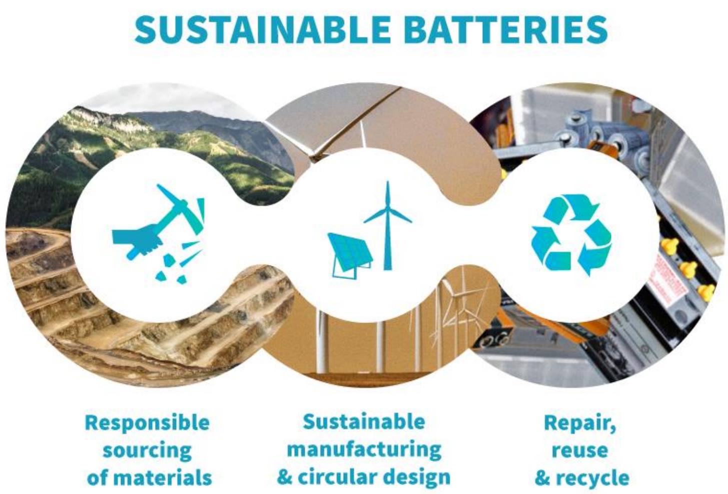
November 2019

Summary

Decarbonising road transport requires a shift away from petroleum-powered combustion engine vehicles towards zero emission mobility. Thanks to significant improvements in quality as well as steep cost reductions, a surge in the sales of lithium-ion battery powered electric vehicles is expected in the coming years. One million plug-in cars will need to be sold in 2020 to meet the EU's car CO2 standards, and achieving the bloc's 2030 goals would require sales of up to 40%.

The shift to electric cars offers multiple benefits including lower energy imports, reduced air and noise pollution and increased resource efficiency - unlike oil, lithium, nickel and cobalt can be recycled and do not need to be burned to power vehicles. Thanks to recent investments by CATL, Northvolt, Tesla, LG, Umicore and others the EU is now also much better placed to play a leading role in the global battery race.

The current policy framework for batteries predates the electric car revolution and is completely outdated as a result. The EU Commission's ongoing review of policy options for batteries provides a unique opportunity to introduce smart regulations underpinning the rapid development of a green, ethical and world-leading battery supply chain in Europe. The key areas to be addressed to ensure battery sustainability include the manufacturing of batteries, the sourcing of key minerals as well as the rules governing battery reuse and recycling.



When it comes to the impact of battery production – which accounts for up to 40% of electric vehicles' lifecycle emissions – it is cell manufacturing, including cathodes and precursor materials needed to produce them, that has the largest environmental impact since it requires much energy to manufacture. The upcoming rules on environmental performance of batteries should ensure battery makers use zero emission energy and best-in-class production processes. The regulation should require measuring and reporting the carbon footprint of battery value chains, phasing out the use of hazardous materials in cell manufacturing and circular design.

Batteries – whether in cars or at the end of their life as second life storage applications – offer a readily available distributed energy resource and can store electricity cheaply, facilitating the integration more renewables across Europe. Almost all of the key metals such as cobalt, nickel and lithium can and should be recovered for producing new batteries, which will reduce the need to mine more virgin material. The upcoming review of the EU Battery Directive must remove barriers to innovative battery reuse applications and set ambitious recycling targets requiring recycling rates of at least 90% (and higher where possible) for each of the key battery materials.

The vast majority of materials used in batteries today are extracted outside Europe. Cobalt, one of the minerals with the worst reputation, is largely mined in the Democratic Republic of Congo. Those buying and using such metals – battery (material) producers and carmakers – have a responsibility to ensure it is sourced sustainably and to observe international labour conventions. The EU has the chance to ensure responsible corporate behaviour across the supply chain by imposing standards for batteries, or battery materials placed on the EU market. Battery metals should not be singled out, and all companies that rely on extraction of fuels and metals globally including oil should apply strict due diligence in their supply chains. To ensure this, the OECD Due Diligence guidelines on responsible business conduct and supply chains should be made mandatory on all companies operating in Europe. EU trade and development policy should help European companies source materials sustainably via smart investment aid and help improve safety, health and working conditions in the artisanal mining sector.

Introduction

Some call rechargeable lithium-ion batteries the “new gold” as the decarbonisation of cars, trucks and power grids depends on this fast improving technology. Batteries are poised to become one of the 21st century’s key technologies and the market for batteries is expected to be worth tens of billions by the middle of the 2020s. The Commission rightly launched the EU Battery Alliance that successfully supports the creation of a battery value chain to Europe. At least 16 gigafactories are planned or announced so far in Europe providing at least 131 GWh capacity by 2023.

Unlike combustion engines that burn oil, batteries do not burn lithium or other minerals like cobalt and nickel, which can be fully recovered and used again. From a life cycle perspective battery-powered vehicles are already better than engined cars. However, they still have an environmental impact, notably in parts of their manufacturing and metals extraction. These impacts can and should be minimised in order to achieve the EU’s climate and other environmental objectives. The upcoming EU regulations on battery manufacturing, design and end of life are very timely to ensure the ramping up factories produce sustainable and safe batteries. This paper outlines T&E vision and recommendations on how those policies need to be designed to maximise both industrial and climate benefits.

1. Sustainable battery manufacturing

In contrast to cars with a combustion engine (diesel, petrol and natural gas) that emit large amounts of both CO_2 and air pollutants during their lifetime, electric vehicles driven on a battery (or a fuel cell) emit zero emissions of any kind from their exhaust. However - just as for conventional cars - upstream emissions in electric vehicles are associated with their production phase, notably lithium-ion batteries (LIB). Little robust, primary up-to-date data is available on the 20-odd materials and complex and fast evolving processes used in LIB cell, module and pack manufacturing. The recent report by Circular Energy Storage commissioned by T&E and published alongside this policy brief, highlights the current climate impact range of LIB batteries to be between 39 kg CO_2e/kWh and 196 kg CO_2e/kWh, equivalent to between 11,800 - 89,400kms driven by a diesel car. The reasons for this wide spread are:

1. lack of current primary data, with much modelling based on studies dating back as far as 1999 (the older the study, the higher the climate impact as electricity is less decarbonised). While the earlier

pilots have a higher per kWh energy input, the new gigafactories demonstrate a significantly lower energy use due to economies of scale and process efficiency gains;

2. lack of a consistent calculation approach, often ignoring the reuse and recycling potential completely. At the moment industrial LIB recycling is mainly limited to portable batteries, as the volumes of EV batteries from end-of-life vehicles is still very small. This makes it difficult to accurately estimate the real world impact of different recycling processes. There are also different approaches for how to consider battery end-of-life in a vehicle LCA study.[1]

This highlights the urgent first step for the EU battery regulations to put in place and maintain a robust and up-to-date database of emission factors for different battery materials and processes which are at the cell level and are *factory*, *process* and *location* specific. Such effort is already being pursued in the US by the Argonne Laboratory via GREET.

Battery manufacturing is a complex electrochemical process that, in a very simplified form for a common Nickel-Manganese-Cobalt (NMC) LIB chemistry includes:

- Refining extracted ores into battery grade materials, e.g. lithium hydroxide or cobalt sulfate
- Producing precursors and, following a reaction with lithium, cathode active material. Anode active material using graphite and/or silica is produced separately
- Anode and cathode active materials are coated on copper and aluminum foils to produce electrodes, dried and stacked
- Production of liquid electrolytes
- All the above components are assembled into cells
- Cells turned into modules and battery management systems (BMS) or electronic controls added
- Finally, packs are assembled, often by carmakers at this stage as sized and calibrated for individual EV models.

These key steps for an example Nickel-Manganese-Cobalt (NMC) chemistry are shown in figure 1 below.

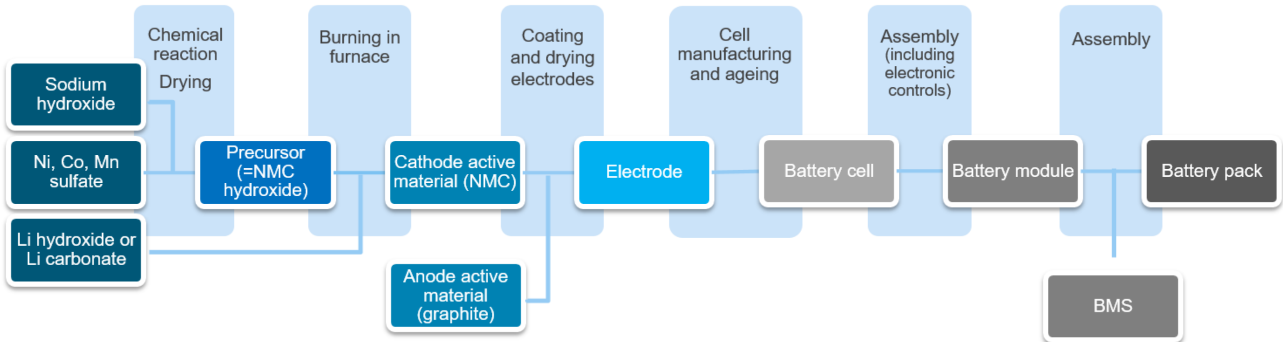


Figure 1: Example manufacturing process for an NMC lithium-ion battery (source: T&E)

The most energy and carbon intensive part of LIB is the production chain of battery cells, responsible for as much as 75% of energy consumption, which makes this step impossible for any future policy to ignore. Figure 2 below shows an example break-out of different steps for (currently on the market but getting fast

[1] Some studies only consider collection, dismantling and separation within the LCA analysis boundary and assign the environmental impact to the recycled materials to be included in the future product using these recycled (secondary) materials (so called 'Recycled Content' approach). These studies therefore assign an additional impact for end-of-life disposal, i.e. recycling is associated with additional processing emissions. Other LCA studies apply a recycling credit, because the future use of recycled material will offset use of primary material (also known as the 'Avoided Burden' or 'End of Life' approach).
N. Hill et al., (2019), Circular Economy Perspectives for the Management of Batteries used in Electric Vehicles. Available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC117790/jrc117790_jrc_circular_econ_for_ev_batteries_ricardo2019_final_report_pubsy_online.pdf

outdated) NMC111 cell chemistry. The detailed data on latest chemistries such as NMC811 (8 parts nickel, one part manganese and one part cobalt) is not readily available but is expected to have lower carbon footprint. The below nonetheless gives an overview of the battery emissions 'hot spots' that should be part of future EU regulation, starting with transport of refined battery metals and minerals to be used as precursors.

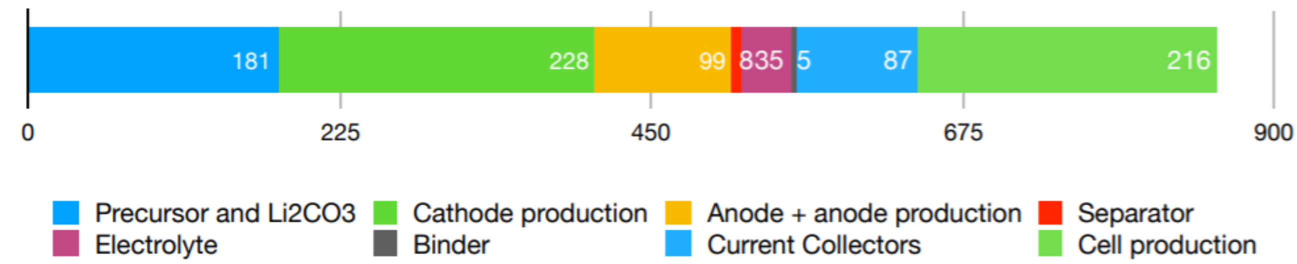


Figure 2: Energy used in MJ per kWh of NMC111 battery cell (without casing)

To reduce the carbon and environmental footprint of battery production, the upcoming EU sustainable performance requirements should target the above battery emissions "hot spots". Notably:

- The preparation of precursors such as NMC hydroxide (used in nickel-manganese-cobalt chemistry found on most modern cars and trucks) and active materials (mixing lithium carbonate, or "Li2CO3" in the figure above) requires complex chemical reactions as well as lengthy heating in furnaces at high temperatures. Deploying waste heat recovery processes and technologies will significantly reduce emissions from this phase. Crucially, the impact of precursors and active materials is very chemistry-dependent. E.g. preparing cobalt sulfate consumes roughly twice as much energy as nickel sulfate, and nine times as much as manganese sulfate – so making LIB rich in nickel (coming to market as NMC811) or earlier LMO chemistries are expected to have lower carbon footprint.
- Producing electrodes and assembling cells stands out as a particularly energy intensive process which, depending on chemistry, generates up to half of the cell's energy footprint, or third of all battery. Huge improvements can come from better cathode coating techniques that would make the cathode powder mixing and coating processes more efficient. T&E understands that a number of (not yet public) pilots are being ramped up/supported by EU funds in this field already, which will help EU battery manufacturers significantly improve their environmental footprint.
- Given complex global supply chains, transportation emissions are a significant proportion of battery production as materials are shipped between mines in Africa, processing in China and final assembly in Europe or the US. Up to 10% of overall carbon emissions can be attributed to transportation according to literature and are very specific to the material or process in question. The current industrial trend for vertically integrated and local supply chains will drastically reduce those movements and therefore transport emissions. E.g. Northvolt, the flagship EU battery factory located in Sweden, gets some of its refined materials close by in Scandinavia (e.g. nickel is refined in Finland), while preparing active cathode material, manufacturing cells, assembling packs, and even integrating recycling facilities on site.
- Ultimately, the battery production is as clean as the energy used in the various processes requiring both a lot of electricity and heat (e.g. for electrode drying). The location of battery cell manufacturing therefore has crucial and direct impact on its carbon footprint. Siting future gigafactories in countries with low carbon energy mix such as Sweden, France or Spain, faster phase-out of coal and increased deployment of renewable energy sources across Europe will have the biggest potential to make battery manufacturing (and electric vehicles use phase) sustainable. The design of the future EU regulations should seek to incentivise the future battery production facilities to be located near low carbon energy sources and for such considerations to be integrated into the initial project planning.

To speed up sustainable battery production in Europe, T&E recommends the EU environmental performance requirements (previously Ecodesign) to include the following:

Lower carbon footprint:

- Mandatory requirements on all battery manufacturers whose products are found on the EU market to **measure and report each battery's** carbon and energy footprint. This should include the following emission hotspots: producing precursors, cathode and anode materials, cells, modules, BMS and pack manufacturing, alongside associated transport emissions. The data should be specific to manufacturing process, factory and location, notably on the energy sources used. The Commission, or a separate designated authority, should be tasked to compile the industry-provided data into a single regularly updated EU database and put in place procedures to independently verify the data accuracy.
- Where companies do not provide such specific data, default values[2] to be used as emission factors should be established on the conservative end of the spectrum - as a minimum the energy and carbon emissions data of the country where electrodes, electrolytes and cells were produced should be used. Companies are allowed to use lower emission factors only where they can reliably prove that their individual processes or energy sources are better.
- The information should be provided both on CO2 (n kgCO2 per kWh battery) and on energy use (kWh per kWh battery) to enable choosing lower carbon batteries by vehicle or electronic equipment manufacturers, and over the battery's lifetime to take count of expected lifetime/durability.
- In a second step once the accurate data has been collected and data verification process established, a mandatory CO2 threshold should be considered as recommended by the Ecodesign preparatory study. This will ensure that all future batteries follow manufacturing best practice, reduce their environmental footprint and use clean energy in their production.
- EU research & innovation funding should target where improvement of different battery manufacturing steps is most needed and has the biggest potential, notably better coating techniques, industrial waste heat recovery processes and environmentally friendly and efficient recycling.

Sustainable battery design:

- Use of hazardous materials in the various battery manufacturing processes should be phased-out and tightly controlled to spur innovation into better methods, materials and a toxic-free battery value chain in line with the expected EU "zero pollution ambition" in air, water and chemicals.
- Batteries should be designed to be durable and with a long cycle life (times of full charge-discharge) of minimum 10 years, incorporating easy repairs and reuse. Batteries placed on the market should have a warranty of at least 10 years.
- The design of battery cells and packs should incorporate circularity from the outset to ease the disassembly, repair, reuse and recycling, as well as wider reversed logistics. The future regulation should require every battery manufacturer placing their products on the EU market to design batteries in a way that aids circularity, while avoiding overly-prescriptive performance provisions given the fast pace of technological innovation. Crucially, battery systems should be designed in a way that would allow all qualified and independent battery dealers - such as repurposing workshops and authorised recyclers - to easily retrieve information on how to safely disassemble, dismantle and treat different battery cells, modules & packs (via labels, QR codes, etc).

Access to battery data:

[2] Whereby manufacturers are allowed prove where their performance is better, including independent verification.

- Battery management systems should be designed to provide standardised access to key battery parameters and usage data to enable innovative and smart battery services. As a minimum this "battery passport" should include:
    1. static information: battery production date & location, carbon footprint based on the reporting above, chemistry, content of critical raw materials, instructions on how to repair/disassemble/dismantle, etc.
    2. dynamic information connected to its use: state of health (remaining capacity & fade and voltage drop), as well as information on charging history and use.
- Integrating an additional smart control algorithm to control the charge and discharge cycle of EV batteries should be considered. This is needed to estimate when electric car batteries are best suited to provide auxiliary grid services and thus maximise battery longevity, which will become especially important once EVs start providing Vehicle-to-Grid services.

2. Reuse and recycling

Over its lifetime an average diesel car burns over 10,000 liters of fuel[3] - the toxic fumes from this process are at the heart of the current air quality and climate crises in Europe. A battery electric vehicle on the other hand uses up to 10kg of cobalt to drive (not burn!) the vehicle in zero emission mode for at least 10-15 years,[4] and often more if the battery is used in second life applications. Already much more resource efficient than fuels, future batteries that maximise longevity and are recycled effectively will have a minimum impact compared to cars run on diesel, petrol or gas.

A report by the Element Energy commissioned by T&E earlier this year analyses the different end-of-life pathways that a lithium-ion battery can take, as summarised below. When the battery performance is no longer good enough for a car or a truck (less range, worse acceleration, etc.), it should be reused in less demanding applications, notably stationary energy storage or forklifts, or as a buffer in high power charging stations to reduce peaks. Such second life batteries will provide extra storage flexibility on the grid and allow for higher penetration of renewables across Europe. It is therefore important to incentivise longer lifetime and remove the barriers in the current Battery Directive for second life applications.

[3] E.g. a segment C diesel car at 6 L/100 km emits 12,000 liters over a 200,000 km lifetime, or 18,000 liters over a 300,000 km lifetime.
[4] According to Auke Hoekstra, "Current batteries are estimated to last at least 1,500 to 3,000 cycles before they lose 20% of capacity". Conservatively assuming 1,500 cycles (assumption used in European Commission's Ecodesign preparatory study), 300 km range and 20,000 km per year, the battery would last about 15 years in its first EV application. Based on:
Auke Hoekstra, (2019), The Underestimated Potential of Battery Electric Vehicles to Reduce Emissions. Available at:https://www.sciencedirect.com/science/article/pii/S2542435119302715
Preparatory Study on Ecodesign and Energy Labelling of rechargeable electrochemical batteries with internal storage under FWC ENER/C3/2015-619- Lot 1, Task 6 Report

Figure 3: Overview of battery end-of-life pathway

The ultimate goal is to fully recover all the valuable materials in a battery at the end of its lives - notably lithium, nickel and cobalt - so that from e.g. the 10kg of cobalt mentioned earlier at least 9kg is available to make new battery cells instead of mining virgin materials. While few people today question the benefit of recycling as it helps to secure critical materials in Europe, the market for LIB recycling today is in China where EU batteries are often sent. An important finding of Element Energy's study is that Europe has inadequate recycling capacity or expertise: even on a moderate EV uptake scenario, the current recycling capacity, estimated at 33,000 tonnes/year, will not be enough when current electric cars come to the end of life from 2030 onwards. Equally important is the fact that there is almost no lithium battery recycling at a commercial scale in Europe today with most companies providing low value collection or shredding only.

Recycling also has environmental impacts, e.g. high-energy intensity (pyrometallurgy processes) or use of solvents, water and some toxic chemicals (hydrometallurgy). While the most sustainable process might be direct recovery, it is still in its infancy and there are concerns over the quality of directly recovered components. Recycling content and associated emissions should therefore be accurately accounted for and integrated into battery lifecycle emissions reporting. At the same time, EU innovation support and incentives should be targeted to improve and scale up the current practices, by

- making them flexible & technology-agnostic;
- investing in environmentally friendly and efficient processes (moving towards hydro and using more vertical integration of metal recovery and cell production to reduce emissions and demand for chemicals); and,
- investing in new digital and automation technologies to optimize cost-effectiveness of disassembly and dismantling.

The Battery Directive should be reviewed without delay to ensure timely investments and ramp up. We do not want to end up with battery recycling in 2030 where we are with the battery supply chain today: whereby the lack of timely investments by carmakers has led to some short-term supply concerns. Europe should see battery recycling as an asset, not a burden, and an opportunity to create local industries and jobs.

The EU Battery regulation (not directive) should:

- Create a separate category for lithium-ion batteries (and post-Li in the future), setting robust collection requirements and targets to ensure batteries are not lost or illegally shipped at the end of their life. To streamline implementation, the directive should be turned into a regulation.
- Set ambitious recovery targets of at least 90% - and higher where feasible - for critical battery materials such as cobalt, lithium, nickel, etc. Additional requirements should apply on recycling quality to ensure part of it is battery grade (no downcycling).
- Barriers to battery reuse and 2nd life should be removed. Definitions of waste and raw material shall be clarified. Lines of responsibility and warranty shall also be clarified to allow business models and innovative businesses to develop. While no mandatory targets should be set on reuse only; car OEMs and other battery owners should be free to decide whether to use them for 2nd and 3rd life applications.
- To ensure circularity of battery material streams and traceability, a digital tracking and identification system should be set up for all batteries on a cell level that are produced, used and recycled in Europe. This is already done in China and allows for a transparent system to monitor battery manufacturing location, its lifetime performance and users; in particular, it allows industry and authorities to trace when and how batteries are recycled to ensure it is done by authorised waste management facilities.
- There should be a single market for seamless LIB transportation for reuse, repair, dismantling and recycling across the EU, and the current transportation rules simplified to allow economies of scale to develop.
- This should be supported by research and development funding into recycling process improvement, e.g. similar to the US Battery Recycling Centre *Recell* launched recently.

To ensure energy or chemicals intensive recycling processes are scaled-up sustainably, attention also needs to be paid to process efficiency and decarbonisation. Clean electricity should be incentivised via mandatory measuring and reporting batteries carbon footprint, whereas efficient industrial synergies such as vertical integration of metals recovery and manufacturing should be supported.

3. Responsible sourcing of raw materials globally

The growing demand of batteries for mobile and grid applications has put into spotlight the key metals used in lithium-ion technology, such as cobalt, lithium and nickel. The attention has especially turned to the implications of the electric vehicle boom on cobalt, i.e. the working conditions in the mines of the Democratic Republic of Congo, where around two thirds of global cobalt production is today. The transition to a zero emission economy in Europe should not increase problems elsewhere. On the contrary, if done responsibly increased demand for minerals mined in countries such as the DRC could help support much-needed development in these countries. However, this requires materials such as cobalt must be sourced in socially and environmentally responsible ways.

It is important to acknowledge that mining challenges in places like Congo are much older and deeper that the recent push for emobility, and that the extraction and refining practices in oil and gas industry are no better. Instead of bashing electric cars, we should use their rise as a leverage to put pressure on downstream companies to clean up their supply chains, and on governments to put solid governance structure in place to solve problems in both large scale and artisanal mining in a comprehensive and pan-industry manner. Singling out one product will not do it, as the problem will simply move elsewhere.

Various certification schemes have sought to improve sourcing of materials such as copper, tin, gold and cobalt for a while, with the (voluntary) OECD Due Diligence Guidance for responsible supply chains, supported by the Responsible Business Conduct guidelines, which are acknowledged as the best practice in this field. T&E has recently undertaken a detailed comparative analysis of the six largest global supply chain certification schemes applicable to the industrial cobalt production in the DRC. This analysis shows that while most schemes are comprehensive in their design and sustainability criteria, they lack rigorous and independent enforcement. Crucially, traceability on where cobalt is extracted and transparent information on mining conditions on the ground remain the weakest spots of most schemes.

This underscores that there is no need for *new* standards or certification schemes – the focus should rather be on better enforcing what is already there, notably

- making the OECD guidelines mandatory for midstream and downstream battery companies operating in or exporting to Europe to ensure responsible business conduct and mandatory due diligence of entire supply chain including extraction;
- improving traceability and enforcement via independent third-party auditing and/or verification and use of new digital tools;
- Ensuring timely consultation of affected local communities where metals are mined and providing “access to remedy” for those;
- Given that the OECD guidelines do not cover the environmental impacts of materials extraction, additional international standards on this - such as ISO14001 and ISO45001 - should be required for any upstream and midstream company to comply with if their materials are used in batteries on EU market.

The previous OECD guidelines on responsible supply chains have already been integrated into national or supranational legislation on conflict minerals (tin, tantalum, tungsten & gold), such as the US Dodd Frank Act or the EU Conflicts Minerals Regulation, but do not currently apply to cobalt, nickel or lithium systematically.

A single, reliable and enforceable mechanism on which to base supply chain due diligence and choice of suppliers across all the materials will also benefit the EU battery industry, who often get lost in the myriad voluntary schemes applicable to individual metals. Companies should not be pulling out of e.g. Congo completely or blankly refusing to buy from small scale miners; instead downstream companies should work with and require their suppliers to improve mining conditions and refining practices. Instead the EU trade and development policy should help European companies source materials sustainably via smart investment aid and help improve safety, health and working conditions in the artisanal mining sector.

T&E therefore calls on the EU to:

- Make the 5-step due diligence requirements of the OECD Guidelines on responsible business conduct and responsible supply chains binding on the upstream, midstream and downstream companies that use globally extracted materials such as fuels, metals and minerals in Europe. This would include metals such as cobalt, nickel and lithium in batteries found on the EU market. This should first and foremost apply to large scale industrial mines as well as medium-size mining sites. Third party verification should be used to ensure robust compliance.
- EU should put in place guidelines and an enabling framework to help companies use new technologies, notably blockchain-like digital ledgers, to aid supply chain traceability and due diligence. However, this should not replace downstream companies’ responsibility to verify the accuracy of mines data, to regularly audit (at least annually) and to effectively mitigate the supply chain risks.
- Companies participating in voluntary supply chain certification schemes should not be assumed to comply automatically, and should still be required to rigorously apply the binding OECD Due Diligence requirements.
- Mining companies, traders and smelters should be obliged to comply with the international standard ISO14001 on environmental impact and ISO45001 on occupational health if their materials are used in batteries on EU market.

Due to its informal nature, it is more difficult to always apply due diligence in line with the above recommendations to the artisanal mining sector. But banning such informal supply of cobalt or other materials is not an answer since millions of people depend on this revenue, and the child labour problem will simply shift elsewhere. Instead, the EU should use its trade and development policy to improve conditions of artisanal miners in places like Congo by formalising the sector, establishing cooperatives, creating authorized zones for artisanal mining, as well as improving health and safety conditions. Ongoing initiatives such as the Kasulo model or the one by the German Corporation for International Cooperation (GIZ) and Trafigura show this is feasible and can bring tangible positive results to the communities. What is needed is to scale such pilots into an industry-wide practice and ensure the costs of such initiatives do not disproportionately fall on artisanal miners' shoulders.

The EU should:

- Target its new EU-Africa Partnership and the EU development policy at formalising small scale artisanal mining sector and provide support to turn current pilots into pan-industry practice - e.g. include clauses in all trade agreements on compliance with the OECD guidelines for the import of raw materials, fund large-scale formalisation activities that span across mines and many years, etc.
- As part of its investment aid, the EU should support countries like Congo that export a lot of critical metals to develop domestic refining capacity so that they can export the processed higher value material to Europe directly. This will not only aid development and jobs, but will also shorten supply chains and thus slash transport emissions associated with battery production.

Ultimately, as car and battery manufacturers require larger supplies of metals such as cobalt and nickel, their capacity to influence how it is mined, refined and sourced grows significantly. Just as car makers are in full control of their diesel supply chains today - which are tightly integrated - OEMs can similarly place requirements on battery materials they buy in the future. Global markets and economies of scale mean traders and smelters will eventually apply the single standard to sell to all of its clients instead of producing different batches for different companies. And with responsible/conscious consumerism on the rise, responsible sourcing will become electric vehicles' license to operate – and will only help the EU industry to differentiate itself and market its batteries as best.

Short conclusion

Emobility revolution is just around the corner, and Europe is rightly prioritising battery value chain development in its industrial strategy. As dozens of battery makers are setting up shop in Europe now is time to put in place ambitious yet smart regulations to ensure European companies compete globally on producing most sustainable batteries. This means responsible sourcing of metals and minerals, clean manufacturing process, durable use and recovery of valuable materials at the end of battery life. Crucially, 'green' should not be an add on - but becomes the standard for electric vehicles, appliances and other applications using batteries to be sold and used in Europe and globally.

Further information

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