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INVESTMENT MANAGEMENT

The Vital Role of Emerging Markets in the Whole Economy Approach: Inside the EV Supply Chain

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Key takeaways

- Emerging Markets are a key driver of both global GDP and greenhouse gas emissions. Excluding them leaves major environmental impacts unaccounted for.
- As Scope 3 data is often unreliable, Osmosis' Emerging Market strategy considers direct supplier emissions, water usage, and waste generation data.
- Focusing just on the largest Developed Market entities ignores heavy impacts from EM suppliers handling high-intensity processes.
- Expanding to the Emerging Markets enables Osmosis to drive change where environmental burdens are greatest.

Osmosis' Whole Economy Approach

Osmosis' whole-economy approach seeks to promote environmental best practices by rewarding sector leaders and penalising laggards across the full spectrum of the market. Rather than excluding emissions-intensive sectors, many of which are essential to the just transition as well as socioeconomic stability, this approach aims to support a smooth transition to a sustainable economy.

Bringing Emerging Markets Into Scope for a Truly Economy-Wide Climate Solution

The country constituents of the MSCI Emerging Market Index represent almost half of global GDP and over half of global emissions. To advance a truly economy-wide solution, Osmosis is bringing emerging market (EM) countries into scope to consider both their economic activities and emissions. EM economies are now responsible for a large share of global manufacturing, and with it a disproportionate burden of emissions and environmental degradation. Developed markets (DM), increasingly "export" their carbon footprint by importing emission-intensive goods from jurisdictions with weaker climate standards, while shifting domestic production towards lower-carbon goods and services (Nielsen et al., 2020). By broadening our universe to include these EM companies, we seek to encourage positive, innovative environmental practices across each region and sector.

Limitations of Scope 3 and the Case for Supplier-Level Environmental Analysis

While Scope 3 emissions are commonly used by investors to account for supply chain emissions, they fail to comprehensively reflect the full environmental impacts of supply chain companies and can also lead to double counting. Unlike Scope 1 and 2 emissions, which can be directly calculated from fuel and electricity use, Scope 3 data relies on multiple external sources and is notoriously difficult to measure, which often renders the data incomplete. According to Boston Consulting Group, fewer than 10% of companies report Scope 3 emissions with accuracy.

Moreover, Scope 3 emissions insufficiently account for absolute water and waste based metrics, meaning that significant environmental impacts across the supply chain remain unaccounted for. As a result, considering the Scope 1 and 2 emissions of supplier companies, as well as their separate waste generation and water withdrawal values, offers a more reliable measure of environmental impact, particularly in sectors with complex global supply chains.

Osmosis observes a consistent trend across sectors: companies in DM largely outsource manufacturing operations to their counterparts in EM. In the technology, hardware, and equipment sector, for instance, DM firms typically focus on product design, such as semiconductors and chips, while EM companies undertake the resource-intensive manufacturing processes. A similar dynamic appears in the food producers sector, where DM companies are primarily engaged in secondary food processing, whereas EM firms are more heavily involved in agricultural production. While this pattern is evident across various sectors, we have chosen to illustrate the use of EM suppliers by DM entities through a short case study which of Tesla and the electric vehicle (EV) supply chain.

Case study: Tesla

Tesla, arguably one of the most well-known EV companies in the world, is headquartered in the United States but has a vast international supply chain. In its 2023 Annual Report Tesla states that its "products contain thousands of parts purchased globally from hundreds of suppliers."

Tesla's supply chain is particularly reliant on EM suppliers, often from China and the broader APAC region. Using Factset data, Osmosis identified that almost half of Tesla's ~220 key suppliers or partners are Chinese entities, shown in Figure 1 below. Whilst five of these entities are in the MSCI World index, 15 are in the MSCI Emerging Market index.

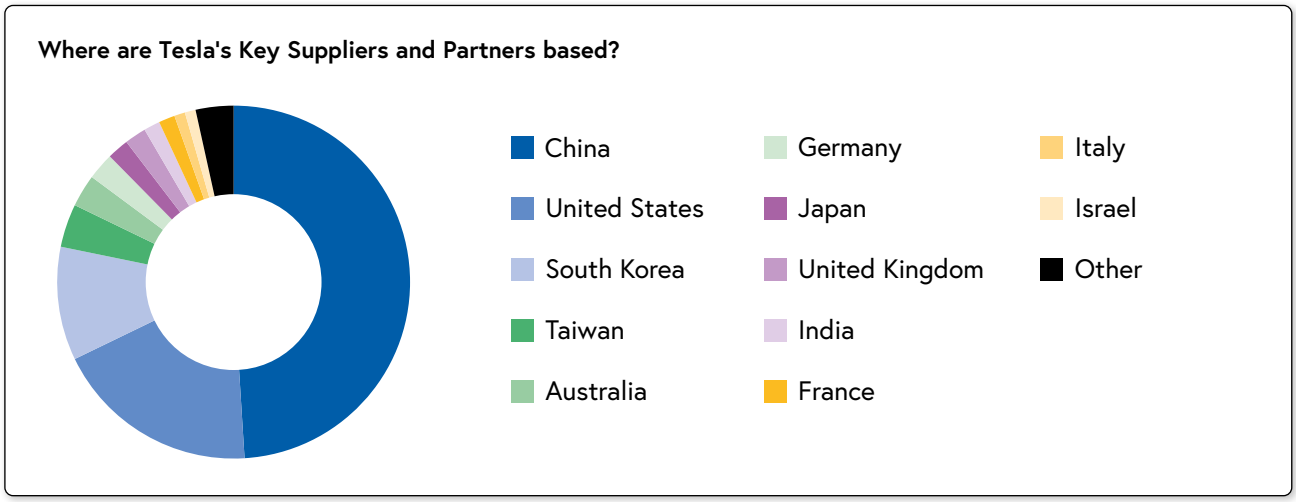

Figure 1: Factset Data, 2024

When analysing Tesla's global supply chain, it is clear that the firm uses materials from suppliers across all stages of EV production. This begins with the sourcing of key battery materials, followed by battery cell manufacturing. Tesla also relies on third-party suppliers for semiconductor fabrication and the production of mechanical parts before final assembly. These processes are often some of the most resource-intensive activities in the supply chain.

Refinement

Tesla relies heavily on outsourcing the refinement of key battery materials to specialised chemical materials manufacturers, particularly in China. While mining of raw materials like lithium often occurs in countries such as Australia and Chile (together responsible for around 70% of global lithium extraction), the chemical transformation of these materials into battery-grade compounds is dominated by China. China currently refines approximately 60% of the world's lithium and is responsible for 90% of global production capacity for battery chemical materials, making it indispensable to the EV supply chain.

With nearly 40% of the 61 suppliers providing refined materials for Tesla's EV batteries being Chinese entities, they source key battery materials and components from several major Chinese suppliers in the MSCI EM index. Ganfeng Lithium (Ganfeng), the world's largest producer of lithium metals and China's top lithium compounds manufacturer, primarily supplies Tesla with lithium hydroxide, a vital product in EV batteries. Similarly, Zhejiang Huayou Cobalt (Huayou) provides Tesla with ternary precursors essential for lithium ion batteries. Both of these materials are essential for achieving higher energy density in batteries, which in turn contributes to longer ranges for EVs.

When examining the most recent sustainability reports of both Ganfeng Lithium and Zhejiang Huayou Cobalt, similarities emerge, particularly in the environmental impact of their mineral-to-chemical refining stages. In terms of waste generation, both companies attribute large amounts of their solid waste to activities that remove impurities and by-products. As for carbon emissions, the refining processes at both firms are highly energy-intensive, requiring sustained high-temperature chemical reactions which in turn generate significant greenhouse gas emissions. For Ganfeng, refining is also the primary driver of high water usage,

due to processes like leaching, crystallization, and washing. Huayou also highlights that its use of hydrometallurgy, which relies on aqueous solutions to extract metals, contributes significantly to water use.

Furthermore, the environmental intensities of both companies are markedly higher than Tesla's across all three key performance indicators. In terms of water withdrawal, both Ganfeng and Huayou report intensities that are both roughly 60 times greater than Tesla's. For carbon emissions, Ganfeng's emissions intensity is more than 65 times higher, while in terms of waste generation, Huayou's intensity exceeds Tesla's by over 50 times. These impacts are not properly considered by looking solely at Tesla's direct reporting.

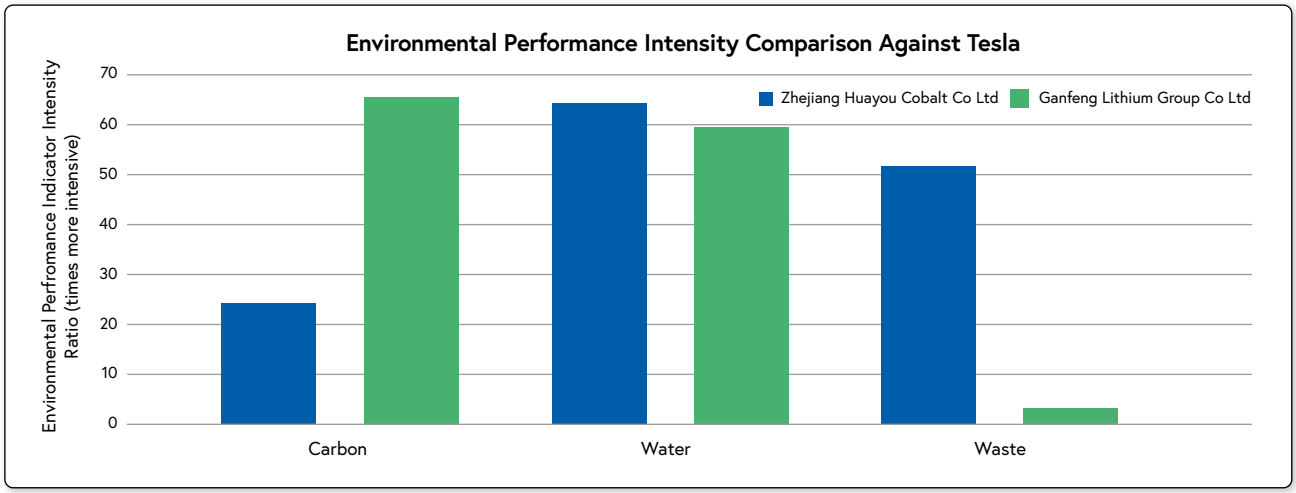

Figure 2: Osmosis IM, May 2025

Batteries

As batteries are central to powering EVs, their efficiency and longevity are critical. One of the most significant players in Tesla's supply chain is Contemporary Amperex Technology Co. Limited (CATL), the world's largest EV battery producer, involved in lithium mining and electric vehicle battery manufacturing. CATL and Tesla work together to develop fast charging battery technology and the former is a key supplier of batteries to Tesla's Shanghai Gigafactory.

The Shanghai Gigafactory is of particular note as it is one of the only wholly owned foreign automakers in China, as previously foreign firms were only allowed to have such facilities through joint ventures. The facility has the capacity to produce over 950,000 vehicles annually and functions as a key distribution hub for the growing Asian EV customer base. It also plays a strategic role, given Tesla's reliance on suppliers across China and the broader Asia-Pacific region. Several of these suppliers, also listed in the MSCI Emerging Markets Index, maintain direct supply relationships with the facility.

South Korea also plays a crucial role in Tesla's battery supply strategy, through its partnerships with LG Chem and LG Energy Solution. LG Chem, initially brought on to supply batteries for the Shanghai Gigafactory, has since expanded its role to support production in Berlin. Meanwhile, LG Energy Solution, a dedicated battery manufacturer subsidiary of LG Chem and also an MSCI Emerging Market constituent, entered a six-year agreement with Tesla in 2024. This partnership is focused on supplying battery components and jointly advancing Tesla's 4680 battery technology, which promises faster charging, improvements in vehicle range and overall efficiency.

A review of these companies' sustainability reports reveals that their environmental impacts closely mirror those of firms focused on battery materials refinement. For CATL, the primary sources of carbon emissions stem from its high energy consumption in the systems used for electrode production and cell assembly. Waste generation is mainly driven by scrap metals and production materials as high precision requirements result in large by-products, while water usage is predominantly linked to equipment cleaning and purification processes, and leads to CATL having an intensity based footprint almost 1800 times higher than that of Tesla.

Semiconductors

Tesla's supplier network for semiconductors plays a critical role in enabling its advanced self-driving and power management capabilities. While Tesla manufactures some of its own chips, it relies heavily on a network of key semiconductor partners to support its Full Self-Driving (FSD) initiatives and battery systems. Notably, NVIDIA, a major U.S.-based chip designer, collaborates with Tesla on autonomous vehicle technology by supplying AI-focused chips that process sensor data to power autopilot and self-driving functions.

Although NVIDIA designs the chips, it outsources manufacturing to companies like Taiwan Semiconductor Manufacturing Company (TSMC) and SK Hynix in South Korea, both of which are identified by Bloomberg as key suppliers, and both contribute significantly to the environmental footprint due to their manufacturing operations. The environmental footprint of semiconductor manufacturing is exceptionally large. In addition to the significant carbon emissions driven by high energy consumption, certain production processes, like etching, release greenhouse gases with extremely high global warming potential (GWP). Moreover, the manufacturing process requires vast amounts of ultra-pure water for chip cleaning leading to large water usage, which itself is also highly energy-intensive to produce.

Mechanical Part Manufacturing

Whilst Tesla does have its own mechanical part manufacturing capabilities, it also includes partnerships with major global players like Samsung Electronics and Huayu Automotive Systems for these processes. Samsung Electronics, based in South Korea, is one of the world's largest appliance and consumer electronics companies, and contributes mechanical parts to Tesla's operations. Beyond manufacturing, it was announced in late July 2025 that Samsung Electronics won an 8-year, $16.5bn contract to produce Tesla's next generation of custom artificial intelligence chips for Tesla's new manufacturing facility in Texas, part of the $40bn investment Samsung has made in the plant. In addition, Samsung has partnered with Tesla on its SmartThings Energy platform, allowing users to monitor energy production and consumption. Tesla and Samsung Electronics are also exploring further collaboration in green technologies, including vehicle automation and energy management systems.

Meanwhile, Huayu Automotive Systems, also a key supplier to Tesla's Shanghai Gigafactory, provides a wide range of mechanical and interior components, such as doors, seats, and battery boxes. The company has made substantial investments in mainland China and Hong Kong, establishing dedicated facilities to serve Tesla's production needs.

Entities involved in mechanical part manufacturing typically have substantial environmental footprints. A major contributor to waste is the large volume of scrap metal generated, particularly from aluminium, steel, and iron, during cutting, casting, and machining processes. Greenhouse gas emissions are also significant, as key operations such as welding are highly energy-intensive, relying heavily on electricity and fossil fuels. Additionally, water usage is considerable, driven by the use of cooling water, as well as by surface treatment processes like rinsing.

Uncovering hidden supply chain impact

For Tesla, outsourcing critical processes such as material refinement, semiconductor manufacturing, and mechanical component production enables cost reduction and access to high-quality materials. While Tesla discloses data on its direct emissions, water withdrawal, and waste generation, many of the most environmentally intensive stages of production, particularly refinement and semiconductor fabrication, are carried out by third-party suppliers in regions with less stringent environmental regulations. Accounting for only Tesla's direct environmental impact does not accurately reflect the activities of its many suppliers.

As the world transitions towards a low-carbon economy, it is increasingly important to adopt a more comprehensive approach to environmental responsibility by including the upstream impacts of outsourced activities. As a focus on the direct environmental impacts of DM entities alone fails to account for the footprint of overseas suppliers, Osmosis' expansion into the EM allows us to begin to account for the companies that shoulder the largest burden of emissions and environmental degradation across the entire economy. By broadening our universe to include these EM companies, we seek to encourage positive, innovative environmental practices across each region and sector. Expanding the whole-economy solution to a global economy solution takes these environmental impacts into account.

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