DOES LITHIUM REALLY MATTER FOR THE ELECTRIFICATION OF THE TRANSPORTATION SECTOR?

Dr Emmanuel HACHE, IFP Energies nouvelles, +33 1 47 52 67 49, emmanuel.hache@ifpen.fr,
Dr Gondia Sokhna SECK, IFP Energies nouvelles, gondia-sokhna.seck@ifpen.fr,
Marine SIMOEN, IFP Energies nouvelles, marine.simoen@ifpen.fr

Overview

To ensure the compliance with stringent climate goals and to improve energy security, different countries are willing to step up their efforts to accelerate the development and deployment of electrification of transport, and in general, of alternative fuels and propulsion methods. The most optimistic scenarios show that the electric vehicle could account for one-third of the market in 2025, half in 2040 and up to 1.7 billion electric vehicles by 2050, representing a market share of 70%. According to Bloomberg (2017), electric vehicles could account for 35% of sales in 2040 and this percentage could rise to 70% for two-wheelers. Even OPEC has revised upwards its scenarios by 500% between 2015 and 2016 in order to integrate this figure in the Oil price scenario of the Organization. As the price of batteries is constantly decreasing and many manufacturers of electric vehicles (Tesla Motors, General Motors, etc.) announce the price of electric vehicles to decrease at around $ 30,000 in the coming years, a massive diffusion of electric vehicles could be ovserved in the years to come. In that context, the deployement of renewables into the world's energy mix could lead to new, unexpected interdependencies such as dependencies to critical materials and more especialy to Lithium. Historically lithium is used in the glass and ceramic industries, lubricant and aluminum production. With the development of Li-ion technologies, Lithium also found a strong new market in the battery sector for small electronics (phone or laptop in particular) but also for electric vehicle. The main reserves are located in South America (Chile, Bolivia, Argentina) while the main users of lithium products are the United States or Asian countries (Japan, South Korea or China). Today the lithium market size is a very small market compared to non-ferrous metal markets, poorly organized and not transparent regarding its price formation. If the spot market has developed in China in recent years, most of the contracts are always over the counter (OTC). From an industrial organization point of view, the concentration of reserves in a small number of countries and the oligopolistic structure of the industrial players (Albermale, FMC, SQM and Tianqi Lithium represent around 78% of the market share for primary lithium) make market development very uncertain. In that context the purpose of this article is to assess if accessible lithium resources are sufficient for expanded demand due to lithium battery electric vehicles worldwide.

Methods

We rely on our linear programming World energy-transport model based on the ETSAP-TIAM model (Times Integrated Assessment Model. ETSAP-TIAM) which is the global multiregional incarnation of the TIMES (The Integrated MARKAL-EFOM System) model generator to compute a partial equilibrium. The latter is a technoly rich bottom-up cost optimization belonging to the MARKAL family model. It is used to conduct a systematic examination of potential futures of the transport sector under various scenarios : 1.5°C, 2°C, 3C°. The ETSAP-TIAM covers 16 regions – Africa, Australia-New Zealand, Canada, Central and South America, China, European Union+, Central Asia Caucasus, Other Eastern Europe, Russian Federation, India, Japan, Mexico, Middle-East, Other Developing Asia, South Korea, United States with a time horizon up to 2050. We model and estimate energy and market dynamics, costs or demand for alternative sector consuming lithium under different recycling scenarios over a multi-period time horizon.

Results & conclusion

Our conclusions can be drawn at several levels. The scenarios developed in this article tend to show that a marked penetration of the electric vehicle worldwide should not lead to a shortage of lithium, even in the scenario converging towards 2 ° C by 2050. Thus, the dynamics of lithium supply tends to reduce the tensions that could exist on the market. The first phase of global penetration of electric vehicles has already resulted in a 3-fold increase in lithium resources between 2000 and 2017 and a 4-fold increase in reserves between 2000 and 2017. It is understood that these scenarios do not allow to conclude on the volatility of lithium prices by 2050, these prices being able to be affected by events that would occur on the equilibrium of the market that it is on the supply (delay for production, geopolitical problems on a major producer, etc.) or demand (acceleration of growth in consumption, etc.). But the

consequences of lithium price increase could not affect the electric vehicle dynamic. Thus Lithium represents only 2% of the total cost of a battery and an increase of 300% of lithium prices will only trigger a 4% increase of battery prices. However, long-term equilibrium commodity markets teach us that the lack of objective criticality of resources does not avoid different forms of vulnerabilities, that should be find in economic, industrial, geopolitical or environmental fields. The main risk concerning the lithium market are based on the evolution of the structure of its market and more especially the concentration of the main players in the market. Price volatility could weaken newcomers on the market and lead to new consolidations (mergers and acquisitions) between the players and a market power in the lithium market. National production strategies are an extremely important risk parameter for the lithium market in the coming years. In some cases, concession companies are subject to mining quotas (Chile) as well as limited-term lease contracts. In other cases, exploitation is not possible at present (Bolivia). The evolution of the investment climate and the evolution of the national strategies of the countries in the lithium triangle are key parameters to understand the future of lithium regarding electrification dynamic. Our global model allows us implementing and analyzing as well in a larger scale the impact of other strategic materials (nonferrous such as cobalt, nickel, copper and rare-earth metals such as neodymium, terbium, lanthanum…) either in transport or in power sector with the growing penetration rate of Renewables Energy Technologies (RETs). It is very useful as a good decision-making tool for a better foresight within investments according to future market stresses for a better sectoral screening.

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