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A New Paradigm: Sustainable Mobility

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Abstract:
The purpose of this individual report is to understand one of the main risks associated with clean energy mobility solutions and how it can impact revenue of electric vehicle sales. The potential restrictions on lithium extraction, a silvery-white metal essential for rechargeable batteries, can reversal the upward supply of electrified powered motors and undermine the demand considering the increase in cost ownership. These limitations dependent on supranational regulatory decisions and scarcity of natural resources which will affect the market for electric powered vehicles which will influence Daimler's revenue.

Keywords:
- Lithium
- Electric
- Sustainable
- Mobility

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The booming demand for **non-fuel vehicles** has rearranged the mineral industry. The pressure on lithium extraction has soared since mid-2015 because of the intensified **demand** for **electric vehicles (EV).** Until the end of 2018, the demand for lithium exceeded the supply, driving the prices of EV uphill, stressing the automobile players over the supply of raw materials. The race to lithium triggered the opening of new extraction sites, which ultimately prompted the involvement of institutional organizations apprehensive about the negative externalities of over-exploration of natural resources. The environmental impact of finding all means required to produce batteries become an issue in its own right.

Lithium is extracted from **lithium minerals**, because it is not usually found in its element form due to its high reactivity. The largest reserves of lithium minerals are located in the Pacific Coast of South America (especially in Chile and Bolivia), Argentina, Australia and China. Other relevant deposits are found in Portugal, Brazil and United States. However, some of these reserves are not economically extractable, thus, the resources potentially extractable represent 2.55×10^7 ton.

The amount necessary to fully operate an electric lithium battery depends on each car characteristics: size, engine power, battery autonomy period, etc. However, the median amount for battery is **2.4kg**. Considering this median requirement, if all the word reserves that are economic extractable would be used, the total produced vehicles would reach 4.1 billion, but if instead, the production of batteries used the total potential extractable resources, the total amount of EV produced would reach 10.6 billion vehicles.

Back in 2015, policies such as the Nationally Determined Contributions made for the Paris Agreement were important to prompt the energy transition, stating that the climate change mitigation will be developed with the usage of EV in parallel with the decarbonisation of fuelled power systems. Additionally, the Chinese government encouraged the acquisition of clean energy vehicles over fossil fuelled in its Low Carbon Emission Plans. These government

incentives were a crucial factor to help the market into equilibrium, as the global outcome of lithium prices are mostly determined by the outcome of largest EV market, the Chinese market. Moreover, in 2017, the Clean Energy Ministerial (CEM) a working force partnership of the world's key economies set a global objective for all 13 members of CEM of a **30%** market share for EV in the total sales of all vehicles by 2030. These 13 members, which include China, India and several EU countries, account for 75% of global emission of greenhouse gas and 90% of global clean energy investments. CEM priorities include innovative priorities to accelerate the deployment of **clean solution**, mobilizing public and private investments towards realistic clean goals. In detail, its campaign EV 30@30 was designed to speed up the placement of EV in circulation, up to a volume of sales of **44 million** worldwide in 2030.These policies prompted the run to lithium stressing the mineral extractions which were not prepared to the extraordinary demand. Since 2015, up until the end of 2018, period in which supply met demand, the prices for lithium rocketed.

The global sales of all types of EV in 2018, **doubled** compared to the homologous period of 2017, from 1.148.700 to 2.018.247 units. The production of vehicles by Daimler followed the global trend for clean energy mobility. As such, the sales of Mercedes-Benz branch reached more than **28.436** vehicles in 2018 a relevant expansion considering the less than 1.000 cars sold in 2010, representing, as of 2018,a market share of 1%. Nonetheless, considering Daimler interest position in other subsidiaries and joint ventures associated with clean energy mobility, the units sold would amount to **41.580**, adding up the sales from BAIC Group, Geely Automobile and the Smart brand, an influence share on the market of **5,65%** in terms of units sold. Considering the EV sold in 2018 and the median value of 2.4 kg of lithium**,** the required lithium amount as of 2018, was 4.844 ton.

The exploration of brine operation (low quality lithium) over refined production of lithium, resulting in low-quality materials, lightened the heavy demand in Chinese market resulting in a

two-fold decrease of lithium price per tonne in 2018. In the long term, the addition of new mineral sites and improvement of the existing ones are fundamental to match forecasted demand over next decade, which is expected to be **5** times higher in this 10-year period, considering the demand by EVs, energy storage systems and other mobile digital devices. However, several obstacles have been faced by the mineral industry, considering the recent capital expenditures shrinkage, delay in mine openings and bearish market in lithium and other mineral equities are representative of the development challenges that lay ahead in the following years, reflecting the drawbacks of hast requirements of such substantial mineral volume. However, market expectation about these issues are still positive and the apprehension about over-supply of these inorganic matter are unfounded as the market for lithium is expected to arrive in a period of persistent supply deficit in early 2020s.

The forecast of Daimler Business Model in the near future has most part of its uncertainty rooted in its new revenue streams and how exogenous factors will affect profitability of its future cashflows. The electric branch will have a significant relevance in Daimler total units sales and average price per vehicle. The main report underlying assumptions assumed an **optimistic scenario** that by 2030, the total sales of EV would reach **30%** of total sales. However, this approach doesn't consider fluctuations in lithium prices that would ultimately influence sales prices and the demand-supply dynamics. In this optimistic scenario, the EV purchase cost would only be 15% higher than the traditional mobility automobiles.

The underlying assumptions to develop these scenarios consist of: same units sold in 2030 but a different proportion of EV; GDP growth for the next decade will be similar regardless of lithium prices and EV sold and Daimler's market share on Electric Vehicle Market is the same irrespective of lithium prices and market penetration of EV.

The **best-case scenario** would be one which extraction meets supply, no extreme regulatory legislation would be enforced, and customers would have a high level of satisfaction with EV

usage. This paramount will match the expectations of EV 30@30 by CEM of low carbon emission by 2030. That would result in around **40 million** cars sold on a yearly basis by 2030, representing around **30%** of all vehicles sold. The effects on units' sales, average price, revenue and other financial statement accounts is displayed in the table below:

	2018	2019E	2020E	2021E	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Mercedes-Benz EV														
Revenue	2.418	2.020	2.539	4.570	5.650	7.088	8.764	10.836	13.398	16.565	20.482	25.325	31.312	38.715
Industry Overview (in units)														
EV Cars Market	2.018.247	2.522.809	3.153.511	3.941.889	4.927.361	6.159.201	7.699.001	9.623.752	12.029.690	15.037.112	18.796.390	23.495.487	29.369.359	36.711.699
Total Vehicles Sold	95.055.937	96.957.056	98.896.197	100.874.121	102.891.604	104.949.436	107.048.424	109.189.393	111.373.181	113.600.644	115.872.657	118.190.110	120.553.913	122.964.991
EV/Total Vehicles		2,6%	3,2%	3,9%	4,8%	5,9%	7,2%	8,8%	10,8%	13,2%	16,2%	19,9%	24,4%	29,9%
Daimler Sales (in units)														
EV Unit Sales	41580	35.000	46.200	60.984	80.499	106.259	140.261	185.145	244.391	322.596	425.827	562.092	741.961	979.389
Total Sales	2.382.791	2.355.540	2.462.234	2.574.245	2.693.183	2.828.027	2.960.723	3.072.744	3.149.419	3.216.695	3.269.842	3.302.378	3.305.822	3.267.308
EV/ Total	1,7%	1,5%	1,9%	2,4%	3,0%	3,8%	4,7%	6,0%	7,8%	10,0%	13,0%	17,0%	22,4%	30,0%
Daimler Average Prices														
Electric Vehicles	58.144	57.715	56.889	56.271	55.661	55.056	54.459	53.868	53.283	52.705	52.133	51.567	51.007	50.453
Traditional Vehicle	44726,2645	45.662	45.678	45.625	45.521	44.859	44.560	44.305	44.104	43.965	43.943	43.974	44.082	44.306
EV/Traditional		26,4%	24,5%	23,3%	22,3%	22,7%	22,2%	21,6%	20,8%	19,9%	18,6%	17,3%	15,7%	13,9%
Daimler EV Market Share	2,06%	1,39%	1,42%	2,06%	2,06%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%
Global GDP Growth	3,92%	3,96%	3,50%	3,30%	3,16%	3,06%	3,00%	2,96%	2,92%	2,88%	2,84%	2,80%	2,76%	1,61%

The outcome of this positive scenario is a share price of **62,19€**, which reflects the recognition by market players belief on the explosion of electrified mobility, which would be eased by the continuous access to lithium mineral that would decrease the average price of EVs to 10% to 15% of the price of traditional vehicles

The **poorest scenario** would be one with extreme quotas on lithium extractions and low interest on EV due to high cost of ownership. The minimal expectation would be of total sales of **5-10%**, which would represent a sales interval if **7-14** million units. The effects on units' sales, average price, revenue and other financial statement accounts is displayed in the table below:

The outcome of this pessimistic scenario is a share price of **43,75€,** which reflects the recognition of market players' disbelief on electrification of large share of vehicles sold, which would imply that large investments in R&D were completed but the overall market conditions were unfavourable, and customers' acceptance of these products was below expectations, considering that due to level of prices of lithium, the price of EVs would be 30% more expensive than the fuelled motor vehicles.

	2018	2019E	2020E	2021E	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Mercedes-Benz EV														
Revenue	2.418	2.020	2.427	3.702	4.225	4.829	5.481	6.222	7.063	8.018	9.106	10.326	11.685	13.189
Industry Overview (in units)														
EV Cars Market	2.018.247	2.310.893	2.645.972	3.029.638	3.468.936	3.971.931	4.547.862	5.207.301	5.962.360	6.826.902	7.816.803	8.950.240	10.248.025	11.733.988
Total Vehicles Sold	95.055.937	96.957.056	98.896.197	100.874.121	102.891.604	104.949.436	107.048.424	109.189.393	111.373.181	113.600.644	115.872.657	118.190.110	120.553.913	122.964.991
EV/Total Vehicles		2,383%	2,676%	3,003%	3,371%	3,785%	4,248%	4,769%	5,353%	6,010%	6,746%	7,573%	8,501%	9,543%
Daimler Sales (in units)														
EV Unit Sales	41580	35.000	42.595	51.838	63.087	76.777	93.437	113.713	138.389	168.420	204.967	249.444	303.574	369.449
Total Sales	2.382.791	2.355.540	2.464.902	2.580.830	2.705.792	2.849.524	2.995.090	3.125.422	3.228.150	3.331.920	3.435.483	3.537.663	3.636.922	3.729.615
EV/ Total	1,745%	1,486%	1,728%	2,009%	2,332%	2,694%	3,120%	3,638%	4,287%	5,055%	5,966%	7,051%	8,347%	9,906%
Daimler Average Prices														
Electric Vehicles	58.144	59.360	59.381	59.313	59.115	58.168	57.657	57.161	56.676	56.188	55.733	55.194	54.550	53.775
Traditional Vehicle	44726	45.662	45.678	45.625	45.473	44.745	44.351	43.970	43.597	43.221	42.871	42.457	41.961	41.365
EV/Traditional		30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%	30,0%
Daimler EV Market Share	2,06%	1,51%	1,54%	2,06%	2,06%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%	2,09%
Global GDP Growth	3,92%	3,96%	3,50%	3,30%	3,16%	3,06%	3,00%	2,96%	2,92%	2,88%	2,84%	2,80%	2,76%	2,78%

Nonetheless, the expected probabilities on these events are divergent, since from the understanding of the automobile industry, the best-case scenario would probably occur around **75%-85%,** as a manifest of institutional efforts to reduced pollution through low carbon emission motors in EV. However, the low probability of the worst-case scenario, around **15%-25%** would be the result of environmental concerns about over extraction of lithium which would limit the potential EV sold.

It is definitely possible to build millions of electric vehicles with lithium-ion batteries, but it may not be possible to make billions of them. Nonetheless, the short/medium term future of electric cars powered with lithium batteries is safe, since producers expected electric mobility to boost in the years to come and the existent reserves are enough to meet demand in the medium-term perspective.