Lithium battery energy density chart

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The energy density for different types of batteries are also illustrated. Figure 1. Snapshot and energy density for different types of batteries. Currently, the most common Li-ion batteries in telecom applications are LFP, NMC and NCA. Some of their characteristics are summarized in the following table.

Figure 3 displays eight critical parameters determining the lifetime behavior of lithium-ion battery cells: (i) energy density, (ii) power density, and (iii) energy throughput per percentage point, as well as the metadata on the aging test including (iv) cycle temperature, (v) cycle duration, (vi) cell chemistry, (vii) cell format, and (viii ...

Battery demand is growing exponentially, driven by a domino effect of adoption that cascades from country to country and from sector to sector. This battery domino effect is set to enable the rapid phaseout of half of global fossil fuel demand and be instrumental in abating transport and power emissions. This is the conclusion of RMI"s recently published report X-Change: Batteries. In this article, we highlight six of the key messages from the report.

Battery sales are growing exponentially up classic S-curves that characterize the growth of disruptive new technologies. For thirty years, sales have been doubling every two to three years, enjoying a 33 percent average growth rate. In the past decade, as electric cars have taken off, it has been closer to 40 percent.

Source: Ziegler and Trancik (2021), Placke et al. (2017) for 1991-2014; BNEF Long-Term Electric Vehicle Outlook (2023) for 2015-2022 and the latest outlook for 2023 (*) from the BNEF Lithium-Ion Battery Price Survey (2023).

Source: Ziegler and Trancik (2021) before 2018 (end of data), BNEF Long-Term Electric Vehicle Outlook (2023) since 2018, BNEF Lithium-Ion Battery Price Survey (2023) for 2015-2023, RMI analysis.

As battery costs fall and energy density improves, one application after another opens up. We call this the battery domino effect: the act of one market going battery-electric brings the scale and technological improvements to tip the next. Battery technology first tipped in consumer electronics, then two- and three-wheelers and cars. Now trucks and battery storage are set to follow. By 2030, batteries will likely be taking market share in shipping and aviation too.

Source: BNEF, RMI analysis; Electronics share of addressable market percentage indicative, transport percentage based on 2022 EV sales share, stationary storage defined as sales volume today divided by peak sales in long term (2050). Trains, ships, and airplane total addressable market sizes illustrative.

How fast will batteries continue to grow and improve? The answer is a lot faster than today"s consensus view.

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When it comes to the growth of small modular technologies, there are two rules of thumb: the first is that superior technologies undergoing rapid cost decline tend to grow exponentially; the second is that most analysts miss the first. Batteries have been no exception to this rule, having been consistently underestimated by modelers.

Over the past years, many battery forecasts have effectively projected linear growth. As Exhibit 4 illustrates, actual sales keep outrunning such forecasts and as a result analysts keep revising their projections upward. The caution of such linear thinking may, on the surface, seem reasonable, but in reality, it is simply wrong.

If we look forward to the next seven years, we see the drivers of change strengthening. Notably, we see costs continuing to fall, policy support continuing to rise, and competition between economic blocs continuing to drive a race to the top. And while there are barriers to battery adoption on the horizon, humanity"s wit, will, and capital are scaling proportionally faster. Thus, we do not see a scenario of slow adoption as credible; instead, we model two futures: fast or faster. Reality is likely to lie somewhere between the two.

RMI forecasts that in 2030, top-tier density will be between 600 and 800 Wh/kg, costs will fall to $32-$54 per kWh, and battery sales will rise to between 5.5-8 TWh per year. To get a sense of this speed of change, the lower-bound (or the "fast" scenario) is running in line with BNEF"s Net Zero scenario. The faster S-curve scenario exceeds it.

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