LILIUM (LILM US)



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14 March 2023

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Price (\$)	0.83
Shares in issue (m)	373
Mkt Cap (\$m)	330
Net debt (\$m)	0
EV (\$m)	329
BVPS (c)	159.4

Share price performance

1m	-25.8%
3m	-33.0%
12m	-77.5%
12 m high/low	5.5/0.8
Ave daily vol (30D)	1,515,057

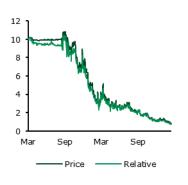
Shareholders

Tencent Holdings	23.5%
Zennstrom Niklas	11.0%
Atomico Guernsey	11.0%
Lgt Global Invest	6.5%
Baillie Gifford & Co	4.7%
Meiner Matthias	4.6%
Born Sebastian	4.6%
B Riley Financial In	4.3%
Invesco Ltd	2.4%
683 Capital	0.8%
Total for top 10	73.3%
Free float	38.2%
Source: Bloomberg	13 Mar 23

Next news Q3s Q1

Business description

eVTOL developer and regional air mobility operator



BATTERY BUILDS BARRIERS

Our recent investor visits to Lilium and cell production partner Customcells demonstrated the benefits of Lilium's cell technology choice and production partner selection. The combination delivers a unique solution giving sufficient range for Lilium to compete in the regional aviation market and also giving cell-by-cell traceability for aviation regulators. The company remains on track, targeting start of production of a type conforming aircraft in the current year, a manned aircraft in late 2024 and ideally type certification in 2025.

Cell technology creates competitive advantage

Lilium's battery cell technology is important to delivering a competitive product. It enables the 175km operating range targeted at launch that puts Lilium ahead of the competition for its passenger capacity. This means that Lilium is competing at the short end of the regional aviation market rather than the air taxi space.

Traceability creates barrier to entry for an aerospace cell

Traceability provides a barrier to entry to those using "black box" cell solutions where individual cell level data is not available, let alone electrode layer level data. Our visit made it clear that Lilium has a highly differentiated power solution and a production partner that can provide the level of traceability required by aviation regulators.

Lilium receiving cells

Customcells is now on average delivering "double digit" cells every week to Lilium with a capacity to deliver thousands of cells annually. Customcells recently completed a funding round and will be able to grow capacity to meet Lilium's needs. Customcells' planned capacity growth would meet Lilium's initial planned production volume and anticipated ramp up.

Customcells is key to delivering Ionblox cell technology

Customcells has industrialized the proprietary formation process for the high silicon content cells developed by Lilium's technology partner Ionblox and has also begun the industrialization of the prelithiation process that maximises cell performance. This adds to the overall cell capacity. As a result, Lilium has now produced a cell with sufficient power for take-off and landing yet without much loss of energy for range. It also allows for much faster charging without increased degradation.

€m, Dec	2020pf	2021a	2022e	2023e	2024e	2025e
Sales	0	0	0	0	0	280
EBITDA	-292	-284	-265	-280	-307	-297
PBT	-342	-299	-282	-307	-345	-369
EPS	-1.2	-1.4	-1.0	-1.1	-0.2	-0.2
CFPS	-1.0	-1.9	-0.9	-0.8	-0.1	-0.3
DPS	0.0	0.0	0.0	0.0	0.0	0.0
Net Debt (Cash)	-509	-320	-198	32	-1,720	-1,210
Debt/EBITDA	1.7	1.1	0.7	-0.1	5.6	4.1
P/E	-0.7	-0.6	-0.8	-0.8	-4.4	-4.1
EV/EBITDA	0.6	0.0	-0.5	-1.3	4.5	3.0
EV/sales	na	na	na	na	na	-0.6
FCF yield	-125.7%	-233.9%	-103.8%	-98.6%	-16.3%	-33.9%
Div yield	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

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THE LILIUM CELL DE-RISKED

Customcells is the cell production partner for the Lilium Jet and has established a production facility at Tübingen in Germany with a prototype cell line capable of delivering thousands of cells per annum which will allow for the production of Lilium's first type conforming jets. Customcells has the capability of expanding production to meet Lilium's initial production volume at the existing site and has identified locations for further production expansion anticipating Lilium's ramp up to full capacity.

Customcells is more than a simple cell manufacturer and has been key in developing the cell manufacturing processes. Customcells delivers three key advantages to Lilium: silicon anode production, prelithiation and production traceability.

SILICON ANODE PRODUCTION

The Lilium Jet offers more range for its passenger capacity than any other eVTOL in the market allowing it to target the regional aviation market. It can do this because of a cell based on silicon anode technology from Lilium's cell technology partner Ionblox (formerly Zenlabs). Lilium has the exclusive use of this technology for applications in regional eVTOL market.

The inclusion of silicon in the graphite anode of a lithium-ion cell can result in greater energy and power density. For Lilium this allows for a battery with sufficient power for take-off and landing yet without much loss of energy for range. It also allows for much faster charging without increased degradation.

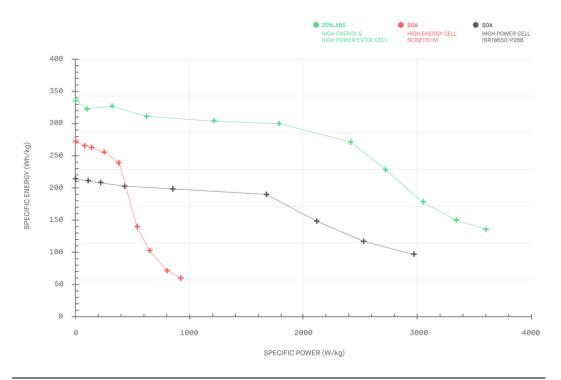
However, swelling issue is critical in production during the formation process which is the initial charge and discharge operations of the cell. Swelling is potentially at its greatest during formation. Customcells have industrialized the proprietary formation process for the high silicon content cells developed by Lilium's technology partner Ionblox.

PRELITHIATION

When a cell is used for the first time the lithium forms an interface which results in a high loss of active lithium in the first few cycles. The loss is greater for newer anode materials including silicon anodes which have higher active lithium loss (ALL). Prelithiation looks at pre-setting additional lithium to compensate for this initial loss, therefore significantly increasing the available energy. Customcells has begun the industrialization of the prelithiation process for the Ionblox cell technology. The Customcells process is a roll-to-roll solution allowing for mass production.

The resulting cell can maintain high specific power of 2500 W/kg even at a low State of Charge (SOC).

Ragone Plot of the Ionblox cell versus state of the art (SOA) cells



Source: Lilium

The advantage of the Lilium cell is then its combination of both superior specific energy and specific power capabilities. This is what allows the high power for take-off and landing to be delivered while maintaining the higher range of the Lilium Jet.

PRODUCTION TRACEABILITY

Traceability and aerospace are a massive advantage and a barrier to entry. Customcells is pioneering the application of data in cell manufacturing, monitoring, and traceability. This will allow them to deliver cell level data giving aviation regulators the full traceability they require. In fact, Customcells will go beyond this and will be able to deliver data down to the electrode level.

As part of this key data process, Lilium mandates EDI (Electronic Data Interface) functionality between itself and its suppliers, including Customcells, through standard contract terms. This builds on processes developed by automotive and aerospace OEMs and introduced by Lilium. This allows traceability to be run right back through the supply chain building a complete data set for each cell and giving regulators access at the component level that is the norm in aerospace.

Most rival cell manufacturers present customers and regulators with a "black box" cell solution where data on individual cells may be unavailable. This gives Lilium a competitive advantage resulting from its strong partnership base in the cell space and its protection from exclusivity clauses in its supply contracts.

TOWARDS A TYPE CERTIFICATION

A traceable high-performance battery is one of the building blocks for Lilium to hit its targets and a key element in the journey towards a type certification (TC). Getting that certification from Lilium's primary airworthiness regulator, EASA, is of course essential for commercialisation. This work continues with c. 80% of certification plans now delivered to the European regulator EASA.

Two key insights were helpful in giving a picture of relations with EASA. Firstly, both EASA and FAA have mandates to support the development of aviation. While this is broad, it is clear to both regulators that aviation must decarbonise if it is to develop. As a result, we see a general willingness of both regulators to facilitate sustainable aviation subject to the overriding need for safety. Secondly, we think it is clear that EASA is fully engaged on this project. In 2022 alone, Lilium had over 70 scheduled meetings with EASA.

While none of this can guarantee a type certification, we feel that the Lilium Jet is getting a fair hearing and the company is fully delivering what the regulators need to make their decisions.

Certification Basis Which requirements will apply for the Lilium Jet? Means of Compliance Which means to demonstrate compliance? Certification Plans Collection of evidences to demonstrate compliance Compliance Demonstration Verification of compliance Compliance Demonstration Verification of compliance EASA 100% AGREED 1N PROCESS FAA CO-VALIDATION VIA EASA / FAA TREATY EASA 80% IN PROCESS FAA CO-VALIDATION VIA EASA / FAA TREATY FAA CO-VALIDATION VIA EASA / FAA TREATY FAA CO-VALIDATION VIA EASA / FAA TREATY

2025 Certification Program Process

Source: Lilium

HOW A SILICON ANODE BATTERY WORKS

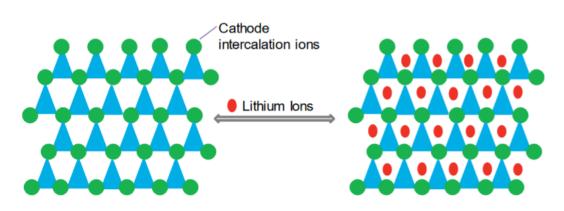
Battery anodes need to receive and store lithium ions in some form, this is how the energy in a battery is stored. In a traditional battery, lithium ions are stored (intercalated) between layers in the anode material. This is normally a stable process with a reasonably high cycling efficiency.

A silicon anode can result in much higher energy density. To achieve this the anode has to use alloying where lithium ions react with the silicon anode material to form an alloy. This allows more lithium ions to be stored which results in a higher energy density. However, the materials see large volume changes during charging and discharging, with silicon anodes expanding to four times their initial volume when fully lithiated. This creates significant damage to the anode structure leading to short cycle lives, with the performance improvements from the silicon lasting only a couple of hundred cycles.

The volume change problem is not trivial and as a result, silicon is being blended with graphite in order to create improvements. The volume expansion problem is so great that blending is currently restricted to c. 3-5% by weight. It is possible to increase this and the ideal is to have a high silicon (i.e., >20%) anode.

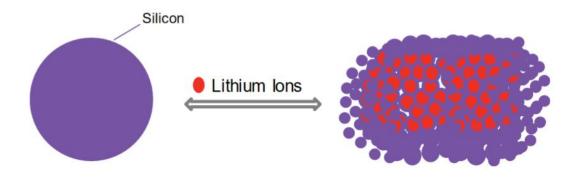
We have been told that the Ionblox anode contains over 30% silicon. To do this the volume expansion problem needs to be addressed.

Electrode intercalation reactions



Source: Bloomberg New Energy Finance

Lithium alloying with silicon showing volume expansion



Source: Bloomberg New Energy Finance

SOLVING THE VOLUME EXPANSION PROBLEM

- Contain the silicon with graphene or carbon nano structures
- Reduce the particle size of the silicon
- Physically contain the silicon but would need a new production process writing off existing processes

Ionblox has not disclosed its approach to containing swelling, but we know that through Customcells it is delivering working cells to Lilium.

FINANCIAL MODEL

Profit and Loss Account

€m, Dec	2020pf	2021a	2022e	2023e	2024e	2025e
Turnover						
eVTOL	0	0	0	0	0	279
CO2	0	0	0	0	0	1
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	0	0	0	0	0	280
Operating profit						
eVTOL	-292	-289	-282	-307	-343	-371
CO2	0	0	0	0	0	1
Other	0	0	0	0	0	0
Other	0	0	0	0	0	0
Operating profit	-292	-289	-282	-307	-343	-370
P&L Account	2020pf	2021a	2022e	2023e	2024e	2025e
Turnover	0	0	0	0	0	280
Operating Profit	-292	-289	-282	-307	-343	-370
Investment income	0	-1	0	0	0	0
Net Interest	-50	-9	0	0	-1	2
Pre Tax Profit (UKSIP)	-342	-299	-282	-307	-345	-369
Goodwill amortisation	0	0	0	0	0	0
Exceptional Items	0	-111	0	0	0	0
Pre Tax Profit (FRS3)	-342	-410	-282	-307	-345	-369
Tax	0	-1	0	0	0	0
Post tax exceptionals	0	0	0	0	0	0
Minorities	0	0	0	0	0	0
Net Profit	-342	-411	-282	-307	-345	-369
Dividend	0	0	0	0	0	0
Retained	-342	-411	-282	-307	-345	-369
EBITDA	-292	-284	-265	-280	-307	-297
EPS (c) (UKSIP)	-1.22	-1.40	-1.01	-1.10	-0.19	-0.20
EPS (c) (FRS3)	-1.22	-1.91	-1.01	-1.10	-0.19	-0.20
FCFPS (c)	-1.04	-1.94	-0.86	-0.82	-0.14	-0.28
Dividend (c) Source: Company data, Lor	0.00	0.00	0.00	0.00	0.00	0.00

Source: Company data, Longspur Research estimates

KEY POINTS

- Company pre-revenue while it develops until 2025 when we assume first revenue begins
- C. $\ensuremath{\mathfrak{C}}$ 200m cost outflow rising ahead of launch in 2025

Balance Sheet

€m, Dec	2020pf	2021a	2022e	2023e	2024e	2025e
Fixed Asset Cost	29	42	109	174	235	470
Fixed Asset Depreciation	-6	-11	-28	-55	-91	-164
Net Fixed Assets	23	31	81	119	143	305
Goodwill	0	0	0	0	0	0
Other intangibles	1	1	1	1	1	1
Investments	0	15	15	15	15	15
Stock	0	0	0	0	0	92
Trade Debtors	0	0	0	0	0	46
Other Debtors	6	31	31	31	31	31
Trade Creditors	-8	-35	-62	-113	-170	-262
Other Creditors <1yr	-5	-15	-15	-15	-15	-15
Creditors >1yr	0	-3	-3	-3	-3	-3
Provisions	0	-3	-5	-8	-10	-12
Pension	0	0	0	0	0	0
Capital Employed	16	22	44	28	-7	199
Cash etc	620	353	231	1	1,752	1,349
Borrowing <1yr	101	23	23	23	23	23
Borrowing >1yr	10	10	10	10	9	116
Net Borrowing	-509	-320	-198	32	-1,720	-1,210
Share Capital	38	40	41	41	52	52
Share Premium	837	779	897	897	2,886	2,886
Retained Earnings	-459	-717	-999	-1,306	-1,651	-2,020
Other	110	240	302	364	427	491
Minority interest	0	0	0	0	0	0
Capital Employed	16	22	44	28	-7	199
Net Assets	526	343	241	-4	1,714	1,409
Total Equity	526	343	241	-4	1,714	1,409

Source: Company data, Longspur Research estimates

KEY POINTS

- Fixed assets grow with capex accelerating from 2024 with assumed network capex
- Cash is adequate but tight in 2023
- Equity raise assumed in 2024 to fund network capex

Cashflow

€m, Dec	2020pf	2021a	2022e	2023e	2024e	2025e
Operating profit	-292	-289	-282	-307	-343	-370
Depreciation	0	6	17	27	36	73
Provisions	0	2	2	2	2	2
Other	0	61	62	62	63	64
Working capital	0	4	27	51	57	-46
Operating cash flow	-292	-215	-174	-164	-185	-277
Tax paid	0	0	-1	0	0	0
Capex (less disposals)	0	-17	-67	-65	-61	-235
Investments	0	-185	0	0	0	0
Net interest	0	-2	0	0	-1	2
Net dividends	0	0	0	0	0	0
Residual cash flow	-292	-419	-241	-230	-248	-510
Equity issued	0	0	119	0	2,000	0
Change in net borrowing	0	189	122	230	-1,752	510
Adjustments	0	-36	0	0	0	0
Total financing	0	153	241	230	248	510

Source: Company data, Longspur Research estimates

KEY POINTS

- Operating cash outflow and capex dominate ahead of launch
- Capex for network from 2025 assumed in our forecasts but could be external
- Working capital impact with first revenue in 2025

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