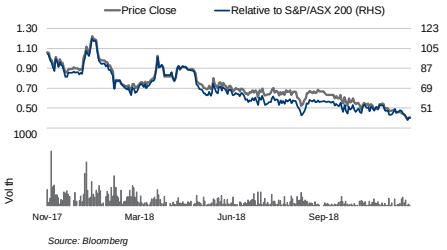
# Novonix

## Charging up their growth potential

## HOLD

| | |
|---|---|
| Current price: | A$0.41 |
| Target price: | A$0.67 |
| Previous target: | A$ |
| Up/downside: | 65.5% |
| Reuters: | NVX.AU |
| Bloomberg: | NVX AU |
| Market cap: | US$36.59m |
| | A$49.87m |
| Average daily turnover: | US$0.01m |
| | A$0.02m |
| Current shares o/s | 123.0m |
| Free float: | 30.5% |




Source: Bloomberg

| Price performance | 1M | 3M | 12M |
|---|---|---|---|
| Absolute (%) | -17.4 | -40.9 | -63.2 |
| Relative (%) | -17.9 | -31.5 | -59 |

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Analyst(s) own shares in the following stock(s) mentioned in this report:

– N/A

- NVX is building a battery anode business targeting the EV market.
- NVX has an existing battery testing business that services EV manufacturers and battery OEMs, e.g. Tesla, Panasonic and CATL.
- NVX owns a graphite deposit in Central Queensland with 1.9mt of contained graphite.
- Our sum of the parts estimate values NVX at 67 cps. We initiate coverage with a Hold rating.

### The EV market is growing and is reaching a tipping point

Sales of electric vehicles have grown from just over 100,000 vehicles pa in 2012 to more than 1m vehicles pa in 2017. All major car brands are offering electric passenger vehicles and some are developing electric trucks and buses as well. Bloomberg New Energy Finance is forecasting the market to grow to annual vehicle sales of 11m in 2025 and 30m by 2030.

### Synthetic graphite for extended life

NVX will manufacture synthetic graphite and then process it into battery grade anode powder through its interest in the PUREgraphite Joint Venture (PGJV). Synthetic graphite anode powder typically achieves a price premium relative to natural graphite anode powder and margins are high for synthetic graphite now. There are opportunities for NVX to establish a presence before anode supply builds to compete away future margins. A large portion of our value estimate (59 cps) is attributable to PGJV.

### A battery testing business that opens doors

NVX's battery testing business services some of the key players in the EV and LiB market such as Tesla, Panasonic, CATL, Samsung amongst others. The connections established with large industry players give NVX an edge for when the time comes to commercialise its anode product with large customers.

### A deposit with options

Mt Dromedary offers a good source of natural large flake graphite. PGJV is structured around synthetic graphite however NVX has the option to develop the reserve if there are synergies. Alternatively the deposit could be sold to free up capital to invest in more production capacity in PGJV.

### Investment view

Our estimate of the potential value of the anode business and the graphite reserves implies NVX is significantly undervalued compared to current market prices. However, investors should note that free cash flows may be many years away and the timing and size of any potential cashflows will greatly depend on large growth of the EV market. Additionally we look to see whether the PGJV can commence anode sales and whether management will exercise its option to increase its stake in PGJV to have more confidence in the primary driver of NVX's growth. The option expires in February 2019. We place NVX on a HOLD rating with a target price of 67 cps.

| Financial Summary | Jun-17A | Jun-18A | Jun-19F | Jun-20F |
|---|---|---|---|---|
| Revenue (A$m) | 0.19 | 2.40 | 3.50 | 15.88 |
| Operating EBITDA (A$m) | -5.11 | -7.85 | -6.10 | -0.00 |
| Net Profit (A$m) | -3.58 | -6.51 | -5.29 | -1.05 |
| Normalised EPS (A$) | (0.041) | (0.062) | (0.039) | (0.007) |
| Normalised EPS Growth | | 51.6% | (36.4%) | (82.2%) |
| FD Normalised P/E (x) | | NA | NA | NA |
| DPS (A$) | - | - | - | - |
| Dividend Yield | 0% | 0% | 0% | 0% |
| EV/EBITDA (x) | NA | NA | NA | NA |
| P/FCFE (x) | | NA | NA | NA |
| Net Gearing | (11.6%) | 4.2% | 9.8% | 14.0% |
| P/BV (x) | 1.71 | 1.58 | 1.64 | 1.78 |
| ROE | | (24.8%) | (15.6%) | (2.9%) |
| % Change In Normalised EPS Estimates | | | | |
| Normalised EPS/consensus EPS (x) | | | | |

SOURCES: MORGANS, NOVONIX

## Figure 1: Financial summary

| Valuation as at Nov-2018 | Rating: | HOLD (initiate) |
|---|---|---|
| DCF - NVX share of PureGraphite JV ($m AUD) | | $ 72.8 |
| DCF - BTS & Corporate ($m AUD) | | $ (21.2) |
| Multiple of reserves - Mt Dromedary ($m AUD) | | $ 30.9 |
| **DCF Total ($m AUD)** | | **$ 82.5** |
| Shares issued (m) | | 123.0 |
| **Value per share** | | **$ 0.67** |

| Projected returns | |
|---|---|
| 12m Target Price | $ 0.67 |
| Share Price | $ 0.41 |
| Upside/(downside) | 65.5% |
| Yield | 0.0% |
| 12m potential TSR | 65.5% |

DCF Inputs

| | |
|---|---|
| **RE** | **15%** |

| Mt Dromedary reserves | Tonnes (m) | Grade (%) | Contained Graphite (mt) |
|---|---|---|---|
| Measured | 1.0 | 12.9% | 0.1 |
| Indicated | 8.5 | 13.9% | 1.2 |
| Inferred | 4.8 | 12.4% | 0.6 |
| **Total** | **14.4** | **13.3%** | **1.9** |
| Estimated EV / t | | | 16.1 |
| **Mt Dromedary Value ($m AUD)** | | | **30.9** |

| **Profit and loss ($m)** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Revenue | 0.2 | 2.4 | 3.5 | 15.9 | 17.1 | 18.4 | 142.4 | 256.6 | 246.8 | 247.9 | 249.0 | 250.2 |
| Cost of sales | (0.1) | (1.2) | (1.9) | (7.1) | (7.4) | (7.6) | (82.8) | (160.8) | (164.9) | (169.7) | (174.6) | (179.7) |
| Gross profit | 0.1 | 1.2 | 1.6 | 8.8 | 9.7 | 10.8 | 59.6 | 95.8 | 81.9 | 78.2 | 74.4 | 70.4 |
| Operating costs | (5.2) | (9.1) | (7.7) | (8.8) | (9.0) | (9.1) | (20.7) | (32.0) | (32.0) | (32.7) | (33.4) | (34.1) |
| EBITDA | (5.1) | (7.8) | (6.1) | (0.0) | 0.8 | 1.6 | 38.9 | 63.8 | 49.9 | 45.6 | 41.1 | 36.4 |
| D&A | (0.0) | (1.4) | (1.3) | (1.5) | (2.5) | (7.0) | (8.9) | (9.2) | (9.7) | (10.1) | (10.6) | (11.1) |
| EBIT | (5.1) | (9.3) | (7.4) | (1.5) | (1.7) | (5.4) | 30.1 | 54.5 | 40.2 | 35.4 | 30.5 | 25.3 |
| Net Interest Expense | - | (0.0) | (0.0) | (0.0) | (0.6) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Profit Before Tax | (5.1) | (9.3) | (7.5) | (1.6) | (2.4) | (5.4) | 30.0 | 54.5 | 40.2 | 35.4 | 30.4 | 25.3 |
| Tax | 1.5 | 2.8 | 2.2 | 0.5 | 0.5 | 0.0 | (9.6) | (15.7) | (11.9) | (10.6) | (9.3) | (8.0) |
| Net Profit After Tax | (3.6) | (6.5) | (5.3) | (1.0) | (1.9) | (5.4) | 20.5 | 38.8 | 28.3 | 24.7 | 21.1 | 17.3 |
| FX gains / (losses) | - | - | (0.5) | 0.0 | (4.2) | (0.3) | (0.0) | 0.0 | 0.0 | 0.4 | 0.5 | 0.5 |
| **Total comprehensive income** | **(3.6)** | **(6.5)** | **(5.8)** | **(1.0)** | **(6.1)** | **(5.7)** | **20.5** | **38.8** | **28.3** | **25.1** | **21.5** | **17.8** |

| **Net Profit After Tax** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net Profit ($m) | (3.6) | (6.5) | (5.3) | (1.0) | (1.9) | (5.4) | 20.5 | 38.8 | 28.3 | 24.7 | 21.1 | 17.3 |
| - cents per share | (4.1) | (5.3) | (3.6) | (0.7) | (0.6) | (1.7) | 6.3 | 11.6 | 8.2 | 7.0 | 5.8 | 4.6 |
| - growth | | -30% | 32% | 81% | 9% | -177% | -467% | 84% | -29% | -15% | -17% | -20% |

| **Dividends** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dividends ($m) | - | - | - | - | - | - | - | 13.3 | 11.9 | 12.3 | 13.7 | 12.0 |
| Dividend per share (cents) | - | - | - | - | - | - | - | 4.0 | 3.5 | 3.5 | 3.8 | 3.2 |
| - growth | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | (0.1) | N/A | 0.1 | N/A |
| - payout of NPAT | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 34% | 42% | 50% | 65% | 69% |

| **Cashflows ($m)** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EBITDA | (5.1) | (7.8) | (6.1) | (0.0) | 0.8 | 1.6 | 38.9 | 63.8 | 49.9 | 45.6 | 41.1 | 36.4 |
| plus non-cash expenses | 3.6 | 6.3 | 5.3 | 5.4 | 5.5 | 5.7 | 5.8 | 6.0 | 6.1 | 6.3 | 6.5 | 6.7 |
| Gross operating cashflow | (1.5) | (1.5) | (0.8) | 5.4 | 6.3 | 7.3 | 44.7 | 69.7 | 56.0 | 51.9 | 47.6 | 43.1 |
| Tax paid | 1.5 | 2.8 | 2.2 | 0.5 | 0.5 | 0.0 | (9.6) | (15.7) | (11.9) | (10.6) | (9.3) | (8.0) |
| **Operating cashflow** | **(0.0)** | **1.3** | **1.3** | **5.9** | **6.8** | **7.3** | **35.2** | **54.0** | **44.1** | **41.2** | **38.2** | **35.1** |
| Capex | (13.1) | (2.4) | (8.1) | (1.8) | (16.5) | (58.4) | (4.9) | (4.9) | (4.9) | (4.9) | (5.0) | (5.0) |
| Net interest paid | - | (0.0) | (0.0) | (0.0) | (0.6) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| **Investing cashflow** | **(13.1)** | **(2.4)** | **(8.2)** | **(1.9)** | **(17.1)** | **(58.4)** | **(5.0)** | **(5.0)** | **(5.0)** | **(5.0)** | **(5.0)** | **(5.0)** |
| Equity issuance/(returns) | - | - | 10.4 | - | 97.5 | - | - | - | - | - | - | 0.0 |
| Share based compensation | (3.6) | (6.3) | (5.3) | (5.4) | (5.5) | (5.7) | (5.8) | (6.0) | (6.1) | (6.3) | (6.5) | (6.7) |
| Debt drawdown/(repaid) | (0.0) | (0.0) | 5.9 | (0.0) | (5.6) | (0.0) | (0.0) | (0.0) | (0.1) | (0.1) | (0.1) | (0.1) |
| Dividends paid | - | - | - | - | - | - | - | (13.3) | (11.9) | (12.3) | (13.7) | (12.0) |
| Other financing cash flows | - | - | - | - | - | - | - | - | - | - | - | - |
| **Financing cashflow** | **(3.6)** | **(6.3)** | **11.0** | **(5.4)** | **86.5** | **(5.7)** | **(5.9)** | **(19.3)** | **(18.1)** | **(18.7)** | **(20.3)** | **(18.7)** |
| **Net cashflow** | **(16.7)** | **(7.5)** | **4.2** | **(1.4)** | **76.1** | **(56.9)** | **24.4** | **29.8** | **21.1** | **17.6** | **13.0** | **11.4** |

| **Balance sheet ($m)** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cash | 2.4 | 0.4 | 4.5 | 3.1 | 74.6 | 17.5 | 41.8 | 71.6 | 92.8 | 110.7 | 124.1 | 136.0 |
| Receivables | 0.4 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Inventory | 0.3 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Investments in JVs / Fixed Assets | 25.9 | 27.3 | 34.2 | 34.5 | 48.5 | 99.9 | 95.9 | 91.6 | 86.8 | 81.6 | 76.0 | 69.9 |
| Tax assets | - | - | - | - | - | - | - | - | - | - | - | - |
| Goodwill | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| **Total Assets** | **34.0** | **34.2** | **45.2** | **44.1** | **129.6** | **123.8** | **144.2** | **169.7** | **186.1** | **198.8** | **206.6** | **212.4** |
| Payables | 3.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Debt | - | 1.7 | 8.1 | 8.0 | 2.0 | 1.9 | 1.9 | 1.8 | 1.8 | 1.7 | 1.7 | 1.6 |
| Other | 9.2 | - | - | - | - | - | - | - | - | - | - | - |
| **Total Liabilities** | **13.1** | **2.6** | **9.0** | **8.9** | **2.9** | **2.8** | **2.8** | **2.7** | **2.7** | **2.6** | **2.6** | **2.5** |
| **Net Assets** | **20.8** | **31.6** | **36.2** | **35.2** | **126.7** | **121.0** | **141.4** | **167.0** | **183.4** | **196.2** | **204.0** | **209.9** |
| **Average Shares on issue (m)** | **87.9** | **123.0** | **146.4** | **154.5** | **308.2** | **316.6** | **325.3** | **334.2** | **343.3** | **352.8** | **362.5** | **372.5** |

| **Key multiples** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EV/EBITDA (x) | N/A | N/A | N/A | - 82,583.9 | 173.5 | 121.8 | 4.6 | 2.4 | 2.8 | 2.8 | 2.9 | 3.2 |
| Price-to-earnings (x) | N/A | N/A | N/A | N/A | N/A | N/A | 10.7 | 5.8 | 8.1 | 9.6 | 11.5 | 14.4 |
| Dividend yield | - | - | - | - | - | - | - | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |

| **Gearing** | **FY17A** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net Debt ($m) | -2.4 | 1.3 | 3.6 | 4.9 | -72.6 | -15.5 | -39.9 | -69.8 | -91.0 | -109.0 | -122.4 | -134.3 |
| Net Debt / ND+E (%) | -11.6% | 4.2% | 9.8% | 14.0% | -57.3% | -12.8% | -28.2% | -41.8% | -49.6% | -55.5% | -60.0% | -64.0% |
| Net Debt / EBITDA (x) | 47.2% | -17.0% | -58.4% | -374635.0% | -9397.8% | -960.2% | -102.5% | -109.5% | -182.2% | -239.2% | -298.2% | -369.1% |
| Operating CF-to-interest (x) | N/A | 198.2 | 27.2 | 126.6 | 10.5 | 167.1 | 836.8 | 1331.4 | 1133.1 | 1100.6 | 1063.6 | 1023.3 |

| **Growth Ratios** | **FY18A** | **FY19E** | **FY20E** | **FY21E** | **FY22E** | **FY23E** | **FY24E** | **FY25E** | **FY26E** | **FY27E** | **FY28E** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Revenue | 1134% | 46% | 353% | 8% | 8% | 674% | 80% | -4% | 0% | 0% | 0% |
| Gross Profit | 889% | 29% | 453% | 11% | 10% | 454% | 61% | -14% | -5% | -5% | -5% |
| EBITDA | -73% | 15% | -14% | -2% | -2% | -126% | -55% | 0% | -2% | -2% | -2% |
| EBIT | -82% | 20% | 79% | -14% | -212% | 658% | 81% | -26% | -12% | -14% | -17% |
| NPAT | -82% | 19% | 80% | -82% | -185% | 477% | 89% | -27% | -13% | -15% | -18% |
| Operating Cash Flow | 227145% | 6% | 345% | 14% | 8% | 384% | 54% | -18% | -7% | -7% | -8% |

SOURCES: MORGANS RESEARCH, NOVONIX

# Charging up their growth potential

## Business structure

### Corporate structure

NVX has three divisions: Battery Testing, Battery Materials and Graphite Exploration and Mining.

### Battery Testing

BT makes battery testing equipment and consults with battery OEMs and EV manufacturers such as Tesla, Panasonic, CATL and Samsung amongst many others. The business was acquired in June 2017 and is based in Halifax, Nova Scotia. The founders of the acquired business, Dr Chris Burns and Dr David Stevens, stayed on following the acquisition and now work for NVX as the COO and CTO respectively.

In addition to the sales it generates, BT offers strategic value for NVX by virtue of the connections NVX has established with key businesses in the EV supply chain. The battery testing business should also help NVX understand the qualities targeted by battery manufacturers for the anode product it will develop in the Battery Materials division.

In FY18 we estimate the gross margin of the business was $1.4m or approximately 60%. We have used similar assumptions to forecast the gross profit of this business that NVX has used. We have assumed that revenue will grow by 30% pa and COGS will grow by 10% pa until FY23 with long term growth reverting to 1.1%. We also include the corporate overheads (executive pay, admin, etc.) against this business segment.

**Figure 2: Gross margin actuals and forecast - Battery Testing**

| Financial Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|
| Revenue | 0.2 | 2.4 | 4.0 | 6.7 | 11.2 | 18.7 | 21.3 | 21.6 |
| COGS | -0.1 | -1.0 | -1.8 | -3.1 | -5.2 | -8.8 | -10.0 | -10.1 |
| Gross Margin | 0.1 | 1.4 | 2.2 | 3.6 | 6.0 | 10.0 | 11.3 | 11.5 |
| Gross Margin (%) | 64% | 60% | 55% | 54% | 54% | 53% | 53% | 53% |

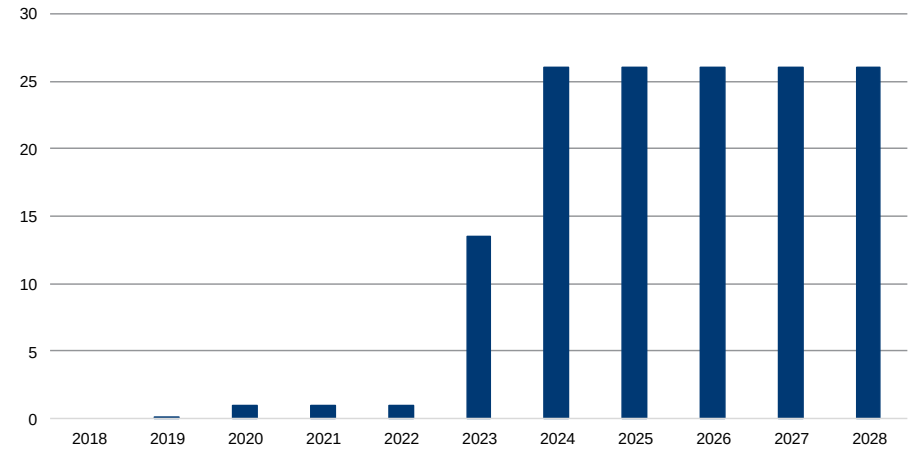
SOURCES: MORGANS, NOVONIX

### Battery Materials

The Battery Materials segment holds NVX's share of the PUREgraphite Joint Venture (PGJV). PGJV owns the IP for the process of manufacturing anode powder and artificial graphite from petroleum coke using a proprietary process. The JV was formed in March 2017 and NVX holds a 50% interest with the remainder held by Coulometrics. The business is located in Chattanooga, Tennessee which offers access to petroleum coke, cheap electricity (~ USD 50 / MWh) and affordable skilled labour. NVX has an option to acquire another 25% of the JV for another $5m USD which expires in February 2019.

PGJV will also be one of the few manufacturers in the LiB supply chain that is based in the US which offers a further advantage as EVs become further integrated into the economy and the military. PGJV aims to develop manufacturing capacity of 1ktpa before the end of FY19 and by 2023 PGJV aims to further expand its capacity by 25ktpa. PGJV may target further large scale expansion to 75ktpa but we have not included this in our modelling. We rely instead on a 2-stage growth assumption in the terminal value which is further detailed in the Valuation section in this report.

**Figure 3: PGJV anode production forecast by financial year (ktpa)**




SOURCE: MORGANS

As PGJV's intellectual property is protected as a trade secret rather than patented, NVX has been unwilling to disclose much detail about the anode manufacturing process. We have used the electric arc furnace anode manufacturing industry as a guide. Anodes made for steel smelting also use synthetic graphite made from petroleum coke. There are a number of listed companies whose main or sole business is to manufacture anodes. Figure 4 and Figure 5 show the show some of the cost rates gleaned from reviewing the recent financial statements of HEG Limited (HEG) and Graphite of India Limited (GIL). Additionally Figure 6 shows the forecast for needle coke prices which is the variety of petroleum coke used to manufacture EAF anodes.

**Figure 4: Refractory consumables – cost rate**

| Company | Year | Cost (USD / t) | Assumed Value (USD / t) |
|---|---|---|---|
| GIL | 2018 | 271 | 542 |
| GIL | 2017 | 241 | 542 |
| HEG | 2017 | 207 | 542 |
| HEG | 2018 | 182 | 542 |

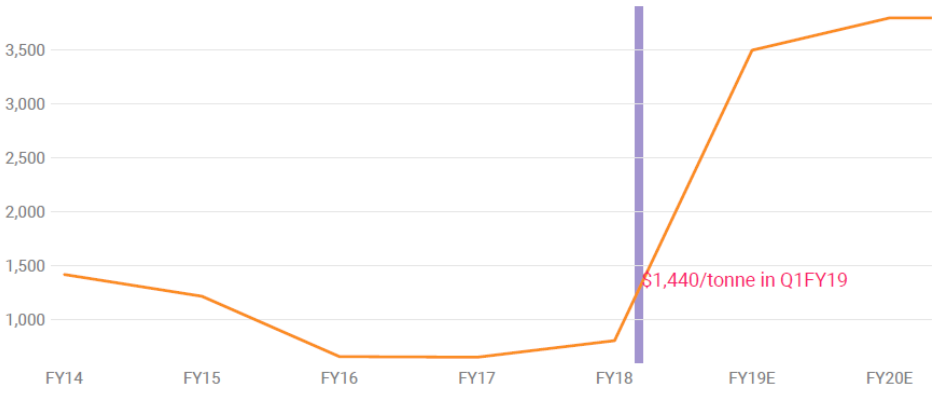
SOURCES: MORGANS, COMPANY REPORTS

**Figure 5: Repairs and maintenance – cost rate**

| Company | Year | Cost (USD / t) | Assumed Value (USD / t) |
|---|---|---|---|
| HEG | 2018 | 105.4 | 150 |
| HEG | 2017 | 74.3 | 150 |
| GIL | 2018 | 62.0 | 150 |
| GIL | 2017 | 61.6 | 150 |

SOURCES: MORGANS, COMPANY REPORTS

**Figure 6: Needle coke prices**




SOURCE: BLOOMBERG QUINT

NVX has stressed there are key differences between those businesses and PGJV such as: different grades of petroleum coke used as a feedstock, increased milling costs for PGJV to spheroidise the graphite particles, and coating costs. We have made adjustments where necessary to account for those differences.

Our key assumptions for FY19 are:

- Petroleum Coke price – $3,500 USD / t
- Electricity consumption – 20 MWh / t
- Electricity price – $50 USD / MWh
- Refractory consumables - $542 USD / t (2 x highest comparison rate)
- Repairs and maintenance – 5% of capex or $150 USD / t
- Battery anode - $11 / kg
- NVX will exercise its option to increase its share of PGJV to 75%

**Figure 7: Financial forecast for NVX share of PGJV (USDm)**

| Financial Year | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| Revenue | 0.0 | 8.3 | 8.2 | 7.8 | 98.8 |
| EBITDA | -0.4 | 3.8 | 3.6 | 3.2 | 35.1 |
| PBT | -1.1 | 3.0 | 2.7 | 2.2 | 32.7 |
| Tax | 0.3 | -0.8 | -0.7 | -0.6 | -8.8 |
| NPAT | -0.8 | 2.2 | 2.0 | 1.6 | 23.9 |

SOURCE: MORGANS

## Exploration and evaluation

NVX is in the process of applying for a mining licence for its Mt Dromedary tenure. Mt Dromedary is a graphite and copper deposit in Central Queensland located approximately 180km southwest of Rockhampton. A JORC report was released by NVX in 2016 and the assessed tonnages are shown in Figure 8 below.

**Figure 8: Summary of NVX's graphite resources**

| Domain | Type | Tonnage (Mt) | TGC % | Total Contained Graphite (Mt) |
|---|---|---|---|---|
| High Grade (>10% TGC) | Weathered | 1.3 | 17.5% | 0.2 |
| | Primary | 7.2 | 18.6% | 1.3 |
| Medium Grade (4 to 10% TGC) | Weathered | 0.9 | 5.7% | 0.1 |
| | Primary | 5.0 | 6.0% | 0.3 |
| **Total** | | **14.4** | **13.3%** | **1.9** |

SOURCE: NVX

We have not attempted to model a DCF of the development of the Mt Dromedary deposit. We have compiled a list of other companies that hold reserves of natural graphite in Figure 9 and have estimated a ratio of Enterprise Value / tonne of contained graphite to establish a reasonable multiple to value NVX's deposit.

NVX plans to spend $4m to further explore the deposit to better define its economic prospects. Given that PGJV's anode product will use synthetic graphite it may not make sense for NVX to develop Mt Dromedary into production. It is possible that NVX may sell Mt Dromedary and use the freed capital to fund investments in synthetic anode production.

**Figure 9: Comparable graphite miners / explorers**

| Company | Total Resources (Mt) | TGC % | Total Contained Graphite (Mt) | EV | EV / t |
|---|---|---|---|---|---|
| Hexagon Resources | 21.3 | 4.5% | 1.0 | 34.6 | 36.0 |
| Magnis Energy Technologies | 174.0 | 5.4% | 9.4 | 184.0 | 19.6 |
| Talga Resources | 48.1 | 17.1% | 8.2 | 73.8 | 9.0 |
| Syrah Resources | 81.4 | 16.2% | 13.2 | 408.7 | 31.0 |
| Walkabout Resources | 5.0 | 16.1% | 0.8 | 22.7 | 28.2 |
| Bass Metals | 9.2 | 4.1% | 0.4 | 39.9 | 104.7 |
| Battery Minerals | 152.6 | 8.5% | 13.0 | 15.6 | 1.2 |
| Graphex Mining | 53.5 | 5.6% | 3.0 | 18.5 | 6.2 |
| Volt Resources | 461.0 | 4.9% | 22.6 | 30.3 | 1.3 |
| Triton Minerals | 46.1 | 6.6% | 3.0 | 38.4 | 12.6 |
| **Mean (ex Bass Metals)** | | | | | **16.1** |

SOURCES: MORGANS, ASX, COMPANY REPORTS

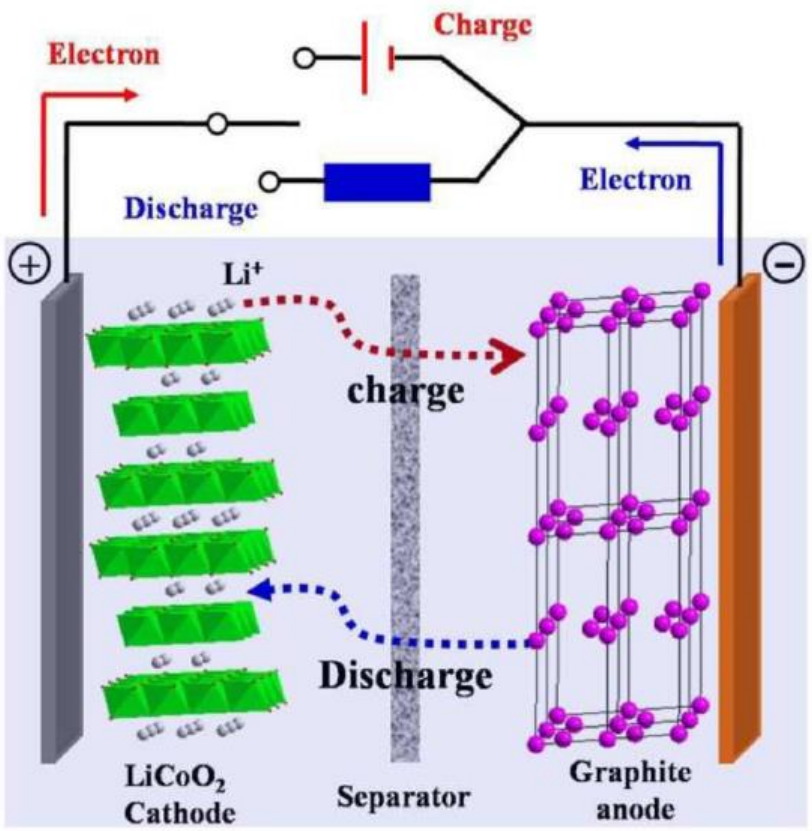
## Technology overview

### Lithium Batteries

Lithium batteries are a key component of the majority of electric vehicles (EVs) that are currently on the market or forecast to be produced for the foreseeable future. Lithium batteries offer an economic form of energy storage that is also compact enough to fit onto the chassis of a passenger vehicle. As passenger EVs have developed, manufacturers are also expanding their product line into electric trucks and buses as well.

Lithium batteries store energy by the movement of lithium ions (Li+). During the charging cycle lithium ions are intercalated, or stored, in the anode. Graphite is a material formed from stacks of two dimensional carbon crystals. Graphite anodes store the lithium ions between the crystalline carbon layers. As the battery discharges the lithium ions move out from between the carbon sheets and back into the cathode.

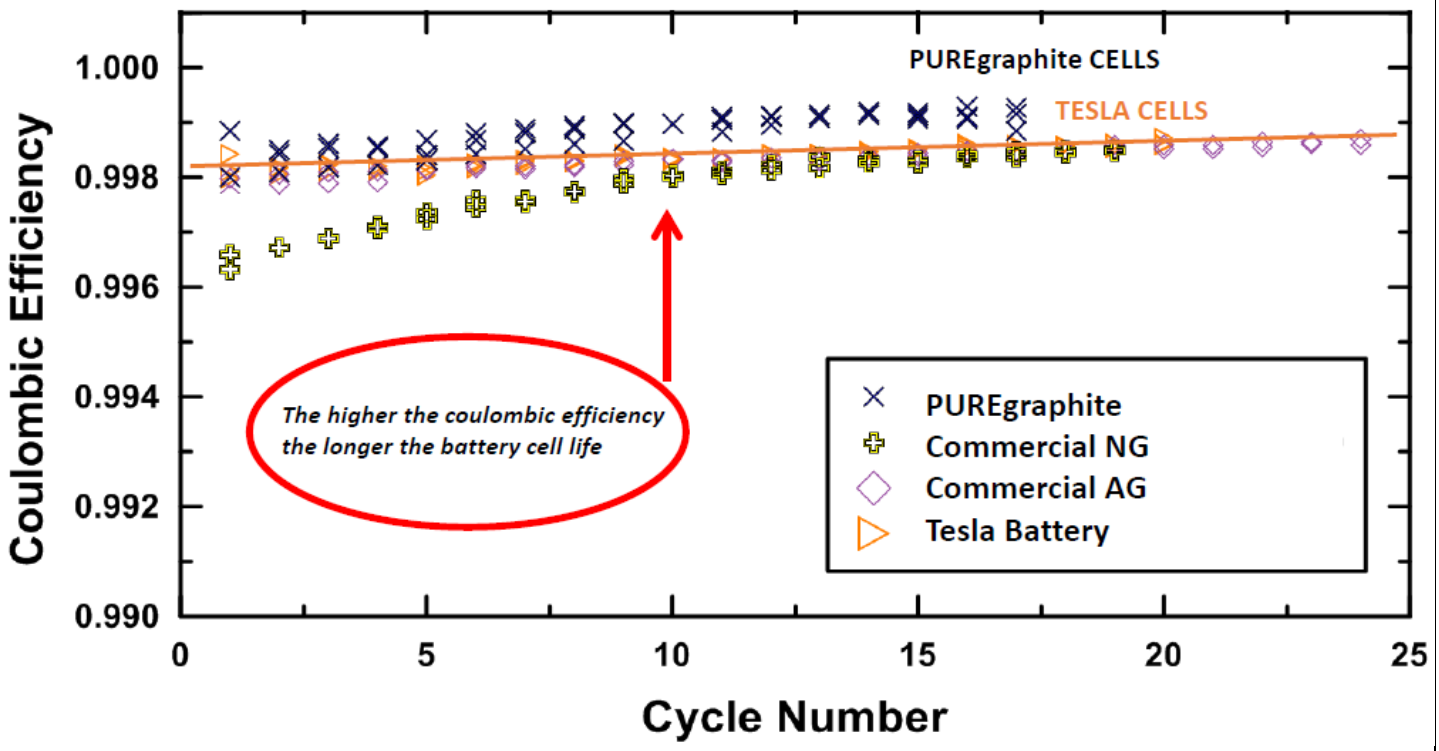
**Figure 10: Illustration of the charge / discharge process in a lithium ion battery**




SOURCE: ENERGIES JOURNAL (COST PROJECTION OF STATE OF THE ART LITHIUM-ION BATTERIES FOR ELECTRIC VEHICLES UP TO 2030)

The life of lithium batteries is key to the economics of the vehicle as according to Bloomberg New Energy Finance, battery packs are estimated to make up approximately 42% of the cost of an EV in 2018. Given the high proportion of the cost it is unlikely to be economically feasible to replace a battery pack on an aged vehicle. Tesla warrants their current batteries for up to 8 years with unlimited kilometres. A good indicator of the life of a battery is its coulombic efficiency which measures how much charge is recoverable from a battery as a proportion of the charge put into it. Lithium batteries will typically increase in coulombic efficiency in their first few charge cycles up to a certain limit particular to that battery.

**Figure 11: Coulombic efficiency of competing battery materials**

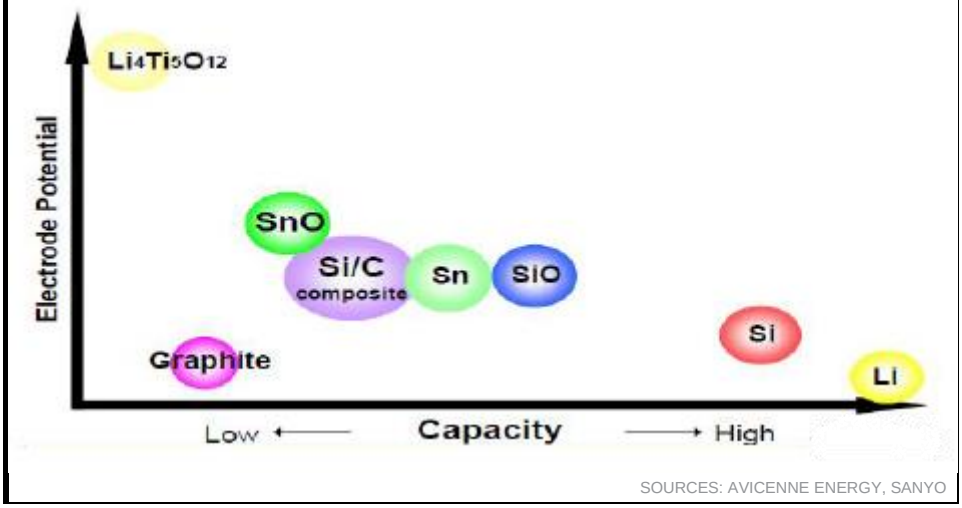



SOURCE: NVX

### Anodes for Lithium Batteries

Lithium battery technology has developed with graphite as the default anode material. There are a range of alternative materials but as graphite is widely available and relatively cheap compared to alternatives it is likely to be the most common anode material for the foreseeable future. It is possible to increase the storage capacity of graphite by including silicon but this causes issues with battery integrity as the silicon will swell in size as charge is stored. NVX, along with some of its competitors, is investing in R&D into this technology but nothing has been commercialised yet.

**Figure 12: Storage capacity and electric potential of various anode materials**




SOURCES: AVICENNE ENERGY, SANYO

### Artificial graphite manufacturing

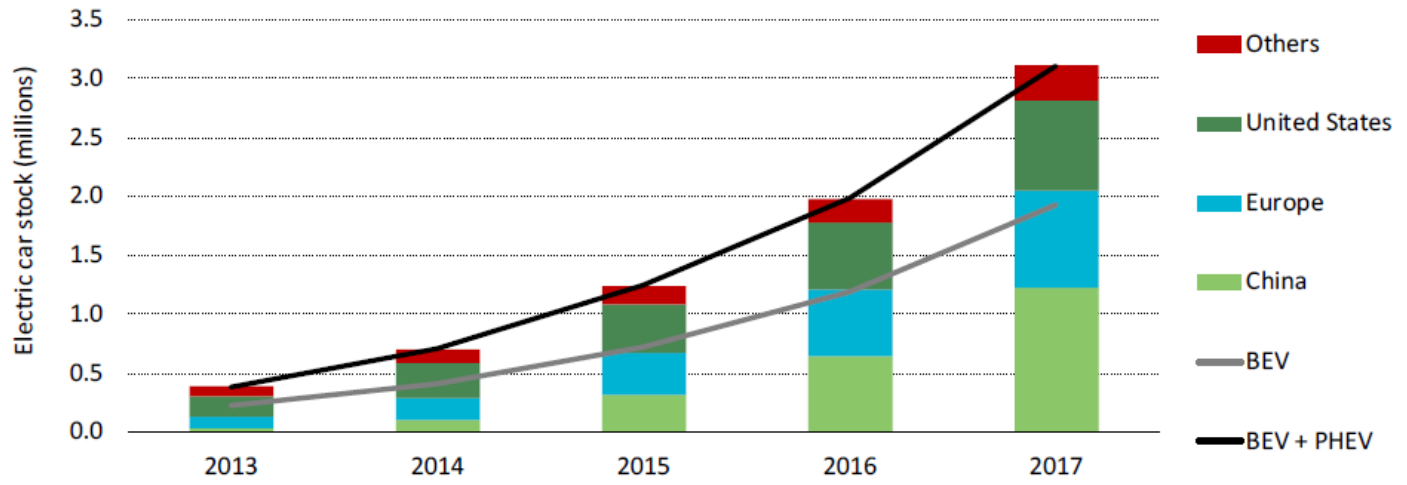
Graphite can be manufactured using petroleum coke, a by-product of petroleum refining. Petroleum coke is mostly carbon (typically > 95%) and will vary in quality from refinery to refinery. Petroleum coke has been used for decades to manufacture graphite anodes used in electric arc furnaces (EAF) to smelt steel. NVX has been keen to clarify that while their manufacturing process is similar to that used to manufacture EAF anodes, both the feedstock and the manufacturing techniques may be slightly different.

## Market analysis

### Electric Vehicles

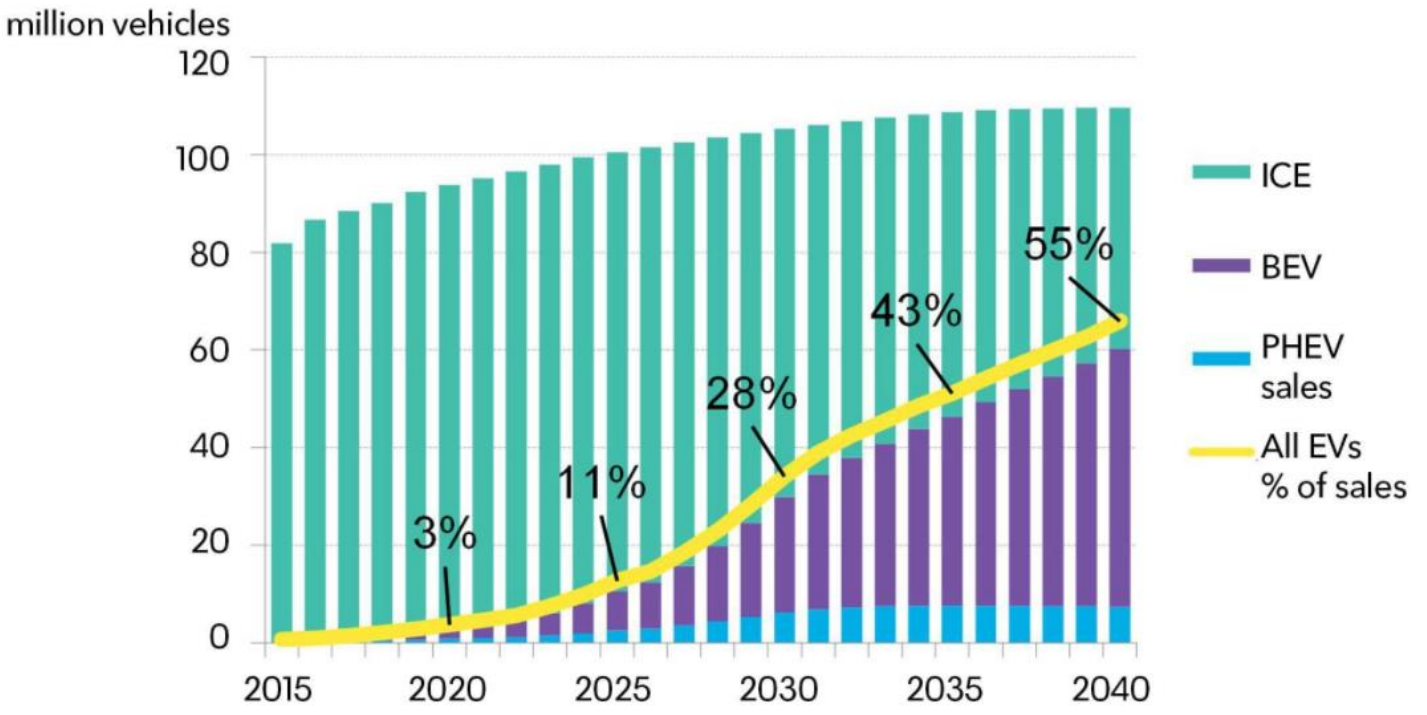
Sales of electric vehicles have grown from just over 100,000 vehicles pa in 2012 to more than 1m vehicles p.a. in 2017. All major car brands are offering electric passenger vehicles and some are developing electric trucks and buses as well. Bloomberg New Energy Finance is forecasting the market to grow to annual vehicle sales of 11m in 2025 and 30m by 2030.

**Figure 13: Passenger electric car stock in major regions and the top-ten Electric Vehicle Initiative countries**




SOURCE:IEA – GLOBAL EV OUTLOOK 2018

**Figure 14: Forecast annual global light duty vehicles**

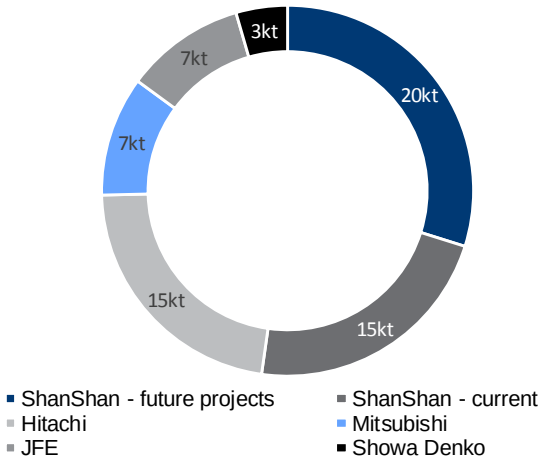



SOURCE: BLOOMBERG NEW ENERGY FINANCE

### Battery anode

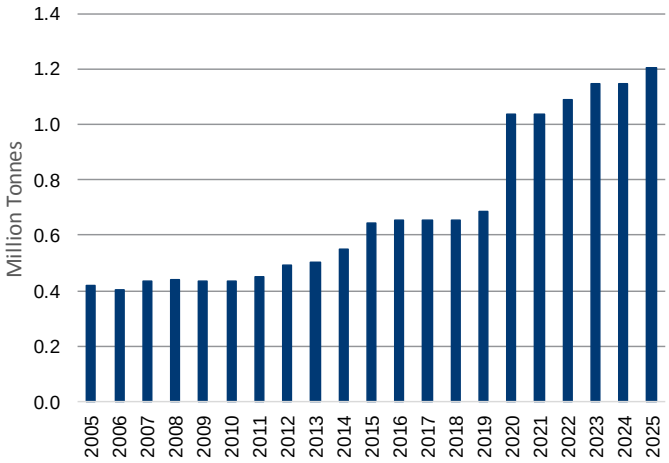
Premium grade lithium ion batteries (i.e. suitable for electric vehicles) require refined raw materials of a high purity and quality to manufacture them. The negative electrode, or anode of a lithium battery (LiB) is made from almost pure graphite. The graphite can be produced from natural sources, i.e. mined or it can be manufactured. Supply of both types of graphite is increasing as new mines are brought online and companies invest in new synthetic graphite manufacturing capacity.

**Figure 15: Artificial graphite production capacity**




SOURCE: AVICENNE ENERGY 2017

**Figure 16: Graphite - historical and forecast production**




SOURCE: BLOOMBERG

Demand for EV grade battery materials is set to expand rapidly in the next decade. The IEA has identified 21 GWh of currently installed battery manufacturing capacity and forecast capacity increases of almost 7.5 times the current identified production in the next 10 years.

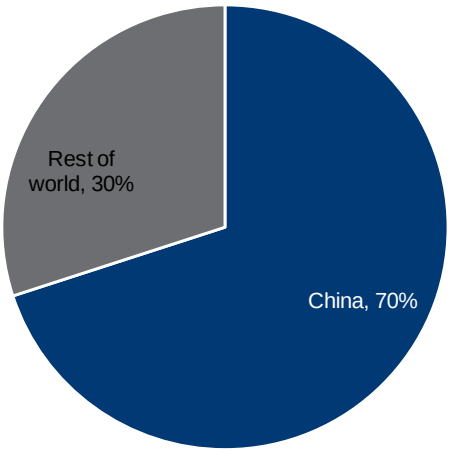
**Figure 17: Sample of main operational and announced Li-ion battery factories**

| Country | Manufacturer | Production Capacity (GWh / yr) | Year of commissioning |
|---|---|---|---|
| **Operational** | | | |
| China | BYD | 8 | 2016 |
| United States | LG Chem | 2.6 | 2013 |
| Japan | Panasonic | 3.5 | 2017 |
| China | CATL | 7 | 2016 |
| **Announced** | | | |
| Germany | TerraE | 34 | 2028 |
| United States | Tesla | 35 | 2018 |
| India | Reliance | 25 | 2022 |
| China | CATL | 24 | 2020 |
| Sweden | Northvolt | 32 | 2023 |
| Hungary | SK Innovation | 7.5 | 2020 |

SOURCE: IEA

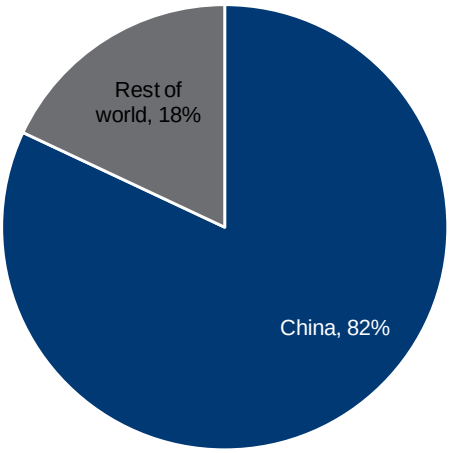
The majority of the world's production of refined battery grade anode materials is located in China. As the marketplace shifts away from internal combustion engines, the EV supply chain will become a significant strategic security consideration. NVX is well positioned to differentiate itself from the current market participants given its North American location.

**Figure 18: Natural graphite production in 2016**




SOURCES: AVICENNE ENERGY

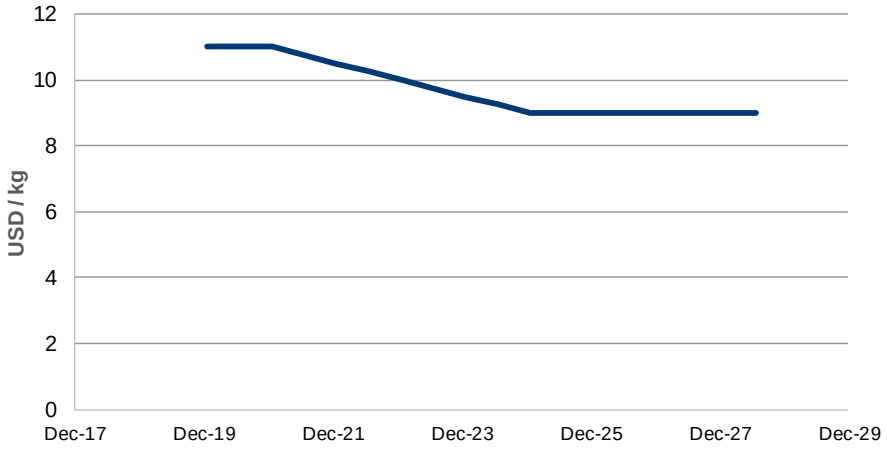
**Figure 19: Artificial graphite production in 2016**




SOURCE: AVICENNE ENERGY

Avicenne Energy estimates that the current price for battery graphite ranges from US$6/kg to US$12/kg depending on the grade of the material. Batteries that use anode powder developed from synthetic graphite has shown superior longevity than those developed from natural graphite. Battery manufacturers also typically value consistency of their input materials which would be easier to control with synthetic graphite. We have developed our pricing assumptions based on Avicenne Energy's forecast numbers as presented in Ohio, March 2018.

**Figure 20: Battery Anode Price Assumptions**




SOURCE: MORGANS

## Management

**Managing Director – Philip St Baker**

- As Managing Director of ERM Power grew turnover from $10 million to over $2 billion in six years and created the fastest growing energy retail business in Australia which is now rapidly expanding in the USA.
- In 2014 Philip received the Ernst & Young Queensland Entrepreneur of the Year Award for Listed Companies and was a nominee for the Australian Entrepreneur of the Year.
- Philip is also an owner representative for the St Baker Energy Innovation Fund and is a member of the Queensland Advisory Board for the Starlight Foundation.

**CEO PUREgraphite JV – Dr Edward Buiel**

- Founded Coulometrics in 2008 and co-founded PUREgraphite in 2017.
- Coulometrics is a leading US-based battery cell and materials development and testing company and a commercial electrode coating business and is the co-venturer with NVX in PGJV.
- Dr Buiel gained his PhD in 1998 from Dalhousie University (DAL) under Dr Jeff Dahn studying the development of carbon anode materials for lithium ion batteries.

**CEO Novonix – Dr Chris Burns**

- Co-founded NOVONIX in Canada in 2013.
- Former Senior Battery Research Engineer with TESLA.
- Chris gained his PhD from Dalhousie University (DAL) where he played a key role in the invention of High Precision Coulometry (HPC technology) invented at DAL (accredited to Dr Jeff Dahn).

**CTO Novonix – Dr David Stevens**

- Co-founded NOVONIX in Canada in 2013.
- Former Research Associate at Dalhousie University with the Jeff Dahn Research Group that now works exclusively for TESLA.
- NOVONIX spun out of DAL and today manufactures the highest accuracy battery test equipment in the world used by leading battery makers, manufacturers and researchers including Apple, Microsoft, TESLA, 3M, GM, Bosch, Dyson, XALT Energy, Panasonic, ATL, CATL and more.
- Has extensive R&D experience with lithium ion batteries, carbon materials and high precision battery cell measurement techniques.

## Valuation and risks

### Valuation

We have valued NVX as a sum of the parts valuation. Different segments of the business have been valued using different methods:

- Battery Testing services – DCF using FCFE
- PGJV – DCF using FCFE
- Mt Dromedary – multiples of reserves

**Figure 21: Components of NVX value**

| | Value (AUD m) | Value / share |
|---|---|---|
| PGJV | 72.8 | 0.59 |
| BTS | -21.2 | (0.17) |
| Mt Dromedary | 30.9 | 0.25 |
| **Total** | **82.5** | **0.67** |

SOURCE: MORGANS

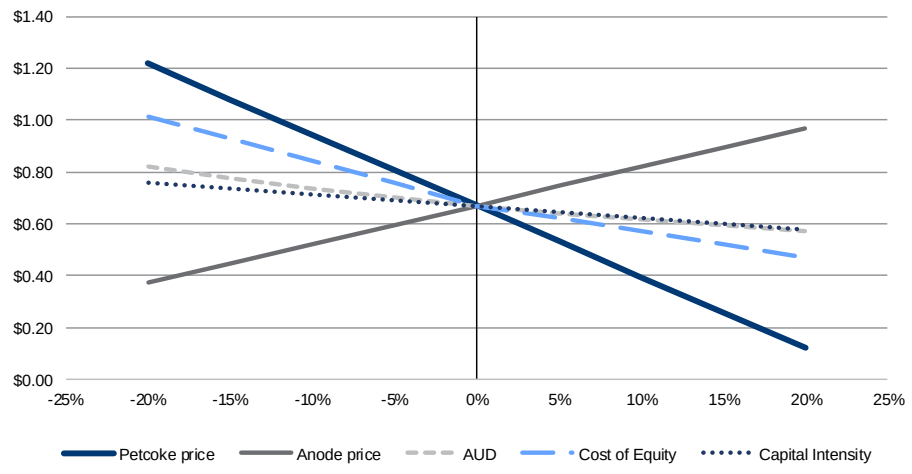
We have made several key assumptions in calculating the DCFs:

- A cost of equity of 15%
- Inflation at 2.5%
- A 2-stage growth assumption in the terminal value:
  - High growth period of 15% for 10 years
  - Followed by long term nominal growth of 3.5% (1% real growth)
- A long term AUD:USD rate of 0.73
- A long term CAD:USD rate of 0.78

These are on top of the key FY19 PGJV assumptions:

- Petroleum Coke price – $3,500 USD / t
- Electricity consumption – 20 MWh / t
- Electricity price – $50 USD / MWh
- Refractory consumables - $542 USD / t (2 x highest comparison rate)
- Repairs and maintenance – 5% of capex or $150 USD / t
- Battery anode - $11 / kg
- NVX will exercise its option to increase its share of PGJV to 75%

**Figure 22: Share price sensitivities**




SOURCE: MORGANS

As NVX is yet to enter full scale production we have estimated sensitivities to our assumptions to understand the variance that will be possible between our forecasts and what NVX may achieve. Figure 22 shows the movement in the share price if one of the identified variables is adjusted while keeping the others the same. This modelling shows that the key sensitivities are the cost of petroleum coke feedstock and the achievable price of the anode. The cost of equity is also a significant downside sensitivity. The tables in Figure 23 and Figure 24 detail the price changes shown in Figure 22.

**Figure 23: Commodity price sensitivities**

| | | ANODE PRICE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -20% | -15% | -10% | -5% | 0% | 5% | 10% | 15% | 20% |
| COKE PRICE | -20% | 0.92 | 0.99 | 1.07 | 1.14 | 1.22 | 1.29 | 1.37 | 1.44 | 1.52 |
| | -15% | 0.78 | 0.86 | 0.93 | 1.01 | 1.08 | 1.16 | 1.23 | 1.31 | 1.38 |
| | -10% | 0.65 | 0.72 | 0.80 | 0.87 | 0.94 | 1.02 | 1.09 | 1.17 | 1.24 |
| | -5% | 0.51 | 0.58 | 0.66 | 0.73 | 0.81 | 0.88 | 0.96 | 1.03 | 1.11 |
| | 0% | 0.37 | 0.45 | 0.52 | 0.60 | **0.67** | 0.74 | 0.82 | 0.89 | 0.97 |
| | 5% | 0.24 | 0.31 | 0.38 | 0.46 | 0.53 | 0.61 | 0.68 | 0.76 | 0.83 |
| | 10% | 0.10 | 0.17 | 0.25 | 0.32 | 0.40 | 0.47 | 0.55 | 0.62 | 0.69 |
| | 15% | 0.08 | 0.08 | 0.11 | 0.18 | 0.26 | 0.33 | 0.41 | 0.48 | 0.56 |
| | 20% | 0.08 | 0.08 | 0.08 | 0.08 | 0.12 | 0.20 | 0.27 | 0.35 | 0.42 |

SOURCE: MORGANS

**Figure 24: Foreign exchange and cost of equity sensitivities**

| | | FX (USD:AUD) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0.58 | 0.63 | 0.68 | 0.73 | 0.78 | 0.83 | 0.88 |
| COST OF EQUITY | 12% | 1.26 | 1.16 | 1.08 | 1.02 | 0.96 | 0.90 | 0.86 |
| | 13% | 1.08 | 1.00 | 0.93 | 0.88 | 0.82 | 0.78 | 0.74 |
| | 14% | 0.94 | 0.87 | 0.81 | 0.76 | 0.72 | 0.68 | 0.65 |
| | 15% | 0.82 | 0.76 | 0.71 | **0.67** | 0.63 | 0.60 | 0.57 |
| | 16% | 0.73 | 0.68 | 0.63 | 0.59 | 0.56 | 0.53 | 0.51 |
| | 17% | 0.64 | 0.60 | 0.56 | 0.53 | 0.50 | 0.47 | 0.45 |
| | 18% | 0.58 | 0.54 | 0.50 | 0.47 | 0.45 | 0.43 | 0.41 |

SOURCE: MORGANS

Additionally we have valued the Mt Dromedary deposit by estimating the EV contribution from the graphite resources (we've ignored any potential value in any copper that might be found) by calculating the average EV / t of contained graphite of comparable listed peers and then multiplying that value by the amount of contained graphite in Mt Dromedary.

This is a very simplistic way to assess the value of the deposit. We believe it's appropriate to produce a conservative outcome because natural graphite does not appear to be a core part of NVX's strategy of building capacity in artificial graphite manufacturing and the sample we've selected shows a bias towards a lower number. A number of the peers included show a remarkably low EV / t which might indicate problems with their projects that Mt Dromedary may not have but we've included them anyway for conservatism. We've also excluded Bass Metals from the calculation as it's a clear outlier on the upside. This may be due to the market attributing value to their lithium exploration activities.

**Figure 25: Summary of NVX's graphite resources**

| Domain | Type | Tonnage (Mt) | TGC % | Total Contained Graphite (Mt) |
|---|---|---|---|---|
| High Grade (>10% TGC) | Weathered | 1.3 | 17.5% | 0.2 |
| | Primary | 7.2 | 18.6% | 1.3 |
| Medium Grade (4 to 10% TGC) | Weathered | 0.9 | 5.7% | 0.1 |
| | Primary | 5.0 | 6.0% | 0.3 |
| **Total** | | **14.4** | **13.3%** | **1.9** |

SOURCE: NVX

**Figure 26: Comparable graphite miners / explorers**

| Company | Total Resources (Mt) | TGC % | Total Contained Graphite (Mt) | EV | EV / t |
|---|---|---|---|---|---|
| Hexagon Resources | 21.3 | 4.5% | 1.0 | 34.6 | 36.0 |
| Magnis Energy Technologies | 174.0 | 5.4% | 9.4 | 184.0 | 19.6 |
| Talga Resources | 48.1 | 17.1% | 8.2 | 73.8 | 9.0 |
| Syrah Resources | 81.4 | 16.2% | 13.2 | 408.7 | 31.0 |
| Walkabout Resources | 5.0 | 16.1% | 0.8 | 22.7 | 28.2 |
| Bass Metals | 9.2 | 4.1% | 0.4 | 39.9 | 104.7 |
| Battery Minerals | 152.6 | 8.5% | 13.0 | 15.6 | 1.2 |
| Graphex Mining | 53.5 | 5.6% | 3.0 | 18.5 | 6.2 |
| Volt Resources | 461.0 | 4.9% | 22.6 | 30.3 | 1.3 |
| Triton Minerals | 46.1 | 6.6% | 3.0 | 38.4 | 12.6 |
| **Mean (ex Bass Metals)** | | | | | **16.1** |

SOURCES: MORGANS, ASX, COMPANY REPORTS

## Risks

As it's a very early stage company an investment in NVX carries clear risks:

- High leverage to the growth rate of the EV market & charging infrastructure.
- A need to secure sales and customers of its anode product.
- Maintaining the secrecy of its artificial graphite process.
- Viability of a long term supply of petroleum coke.
- New entrants reducing margins.
- New technology displacing lithium batteries.
- Foreign exchange movements
- Changes to tax regimes

### Queensland

| | |
|---|---|
| Brisbane | +61 7 3334 4888 |
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| Brisbane: Edward St | +61 7 3121 5677 |
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| Partners | |
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| Kedron | +61 7 3350 9000 |
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| Richmond | +61 3 9916 4000 |
| South Yarra | +61 3 8762 1400 |
| Southbank | +61 3 9037 9444 |
| Traralgon | +61 3 5176 6055 |
| Warrnambool | +61 3 5559 1500 |

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### Northern Territory

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| Norwood | +61 8 8461 2800 |
| Unley | +61 8 8155 4300 |




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