

December 2018



Pre-IPO Opportunity

Tirupati Graphite PLC



Flake graphite producer on an expansion charge

The only new graphite production coming on stream in 2019

Tirupati Graphite PLC*

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Stock Data

LSE Pre-IPO Opportunity

Company Profile

Sector: Mining
Commodity: Flake Graphite
Stage: Production
Ticker: -
Exchange: Planned LSE-listing
Risky target valuation: £159m / 165p/sh

Activities

Graphite exploration and production. TG is developing the Vatomina and Sahamamy projects, wholly-owned flake graphite projects in Madagascar.

Production is already underway at Sahamamy but TG is planning major expansions at both projects in Madagascar. The projects are shaping up to be some of the lowest cost flake graphite projects globally. The company is backed by Tirupati Carbons, an Indian-based company with two decades of successful flake graphite operations.

Directors and Management

Shishir Poddar	Managing Director
Hermant Poddar	Non-Executive Director
Christian Dennis	Non-Executive Director
Rajesh Kedia	Non-Executive Director

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*Optiva Securities acts as an advisor to TG

Tirupati Graphite

Fully-integrated graphite producer on the expansion path

Tirupati Graphite PLC (TG), a fully-fledged graphite producer is now fully integrated into the graphite value chain as a result of the recent acquisition of TSG, a downstream graphite company established by TG's parent company. TG's Madagascar projects are high purity flake graphite deposits with sector-leading capital intensity and operating costs. TG is pursuing a phased expansion strategy with the goal of producing 81,000tpa graphite from Madagascar and 20,000tpa of value-add graphite products from its downstream business. TG plans to complete an IPO on the LSE during 2019.

Vatomina. Construction is underway at Vatomina with the first 6,000tpa plant due for commissioning in mid-2019. On the back of a recent drill programme with TG's own rig, a maiden JORC resource and updated CPR are due for completion shortly. Early earthworks are underway and TG expects construction to be completed by April 2019. On site infrastructure has been ungraded significantly as Vatomina transitions into a producing asset.

Sahamamy. Since acquiring the Sahamamy project in early 2018, TG has already increased production from the existing plant from 20tpm to 50tpm demonstrating the company's processing expertise. However, this inherited plant is old and inefficient and TG has commenced construction of a new 3,000tpa plant at an adjacent site. Earthworks and foundations are underway and the ball mill has been installed. TG has recently updated the CPR and released an updated JORC resource. TG is familiar with Sahamamy's graphite product, having been buying 100% of the production for the last three years.

Phased Development. TG plans to minimise upfront capex and equity dilution by pursuing a phased expansion approach. At Sahamamy, the initial 3,000tpa plant will be followed by a 18,000tpa expansion. At Vatomina, the initial 6,000tpa plant will be followed by 3x 18,000tpa modular expansions to bring total production capacity to 81,000tpa in Madagascar making TG one of the largest producers of quality flake graphite.

TSG. TG has now acquired a 100% interest "Tirupati Speciality Graphite" which was established by TCCPL India to develop downstream value-added flake graphite processes. We view this as a pivotal development exposing the company to the entire flake graphite value chain. The raw graphite will be sourced from TG's Madagascar operations and TG plans to ramp up to 20,000tpa of value-add high-margin products including expandable, spherical and micronized graphite. These are high value per tonne products for use in key growth markets. A 1,200tpa pilot plant in India is already in operation.

TGMRC. The Tirupati Graphene and Mintech Research Centre will be a fully integrated technology and research centre to support TG's downstream graphite business with a focus on advanced graphite applications, composites and graphene. TG also expects the division to generate revenue in its own right through technology development and consulting.

Graphite fundamentals remain strong. Supply and demand fundamentals look likely to support further price growth, especially for large and jumbo flakes. Tightening Chinese environmental policy, strong forecast growth in EV adoption and batteries coupled with a shortage of quality projects will feed through to strong demand growth, in our view. **TG will represent the only new graphite production coming on stream in 2019.**

Indicative valuation. Our risky sum of the parts "all-in" valuation drives our current target valuation of £159m or 168p/sh on a fully-diluted basis and using highly conservative inputs, punitive risk multiples and equity funding assumptions. For comparison purposes only, on an unrisks basis our sum of the parts increases to £307m. We see considerable scope for value accretion as the company transitions into a producer and a leading producer of downstream graphite products. Nevertheless, TG has significant work ahead with several key funding and development milestones required to successfully execute its strategy and meet our initial target valuation.

Tirupati Graphite – now fully integrated

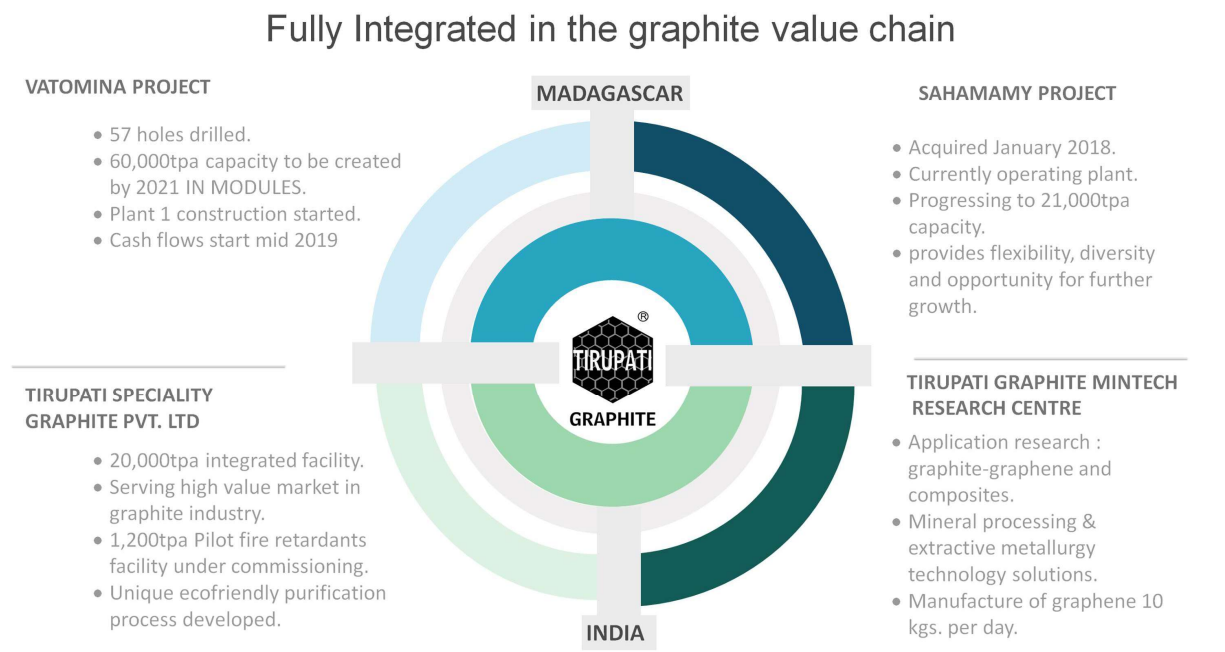
A high-purity graphite producer on the cusp of a major expansion

- Tirupati Graphite plc (“TG”) is a London-incorporated company, and the holder of 100% of Tirupati Resources Mauritius (“TRM”), a private company holding the Vatomina and Sahamamy flake graphite projects in Madagascar. TG has also recently acquired a major downstream graphite business in India. **TG’s Madagascar projects will represent the only new graphite production coming on stream globally in 2019 according to Fast Markets.**
- **TG is about to commence ramp up in Madagascar.** TG already produces graphite from its Sahamamy operation at around 600tpa. A new plant is being built to replace the old inefficient plant and TG plans to increase capacity in two stages with a new 3,000tpa plant, followed by an 18,000tpa expansion. At Vatomina, construction is underway for a 6,000tpa plant which TG expects to commission by mid-2019. The company then plans to add three more 18,000tpa modules for total capacity of 60,000tpa. In combination with Sahamamy, TG expects to ramp up to total production of 81,000tpa in Madagascar by 2021. **New Downstream acquisitions**
- TG now has complete exposure to the graphite value addition chain as a result of the recent 100% acquisition of TSG which aims to produce 20,000tpa of value-add graphite products and TGMRC which aims to undertake research and development activities and graphene production.

Heading towards an IPO on the LSE in 2019

- TG is planning to list on the main board of the LSE in a March 2019. The exact timing has not been set as yet, although we believe this will once the new plants at Sahamamy and Vatomina are operational, meaning that TG will already be a 9,000tpa producer.

Figure 1 - TG is now a fully integrated graphite business



Source: TG

Valuation Update

Valuation summary

We have updated our valuation to reflect development progress at Vatomina and Sahamamy (Rostaing) and the acquisition of Tirupati's downstream graphite businesses in India. As TG goes through the preparation stages for a planned IPO on the London Stock Exchange the company has provided considerably more detail on its development and expansion plans.

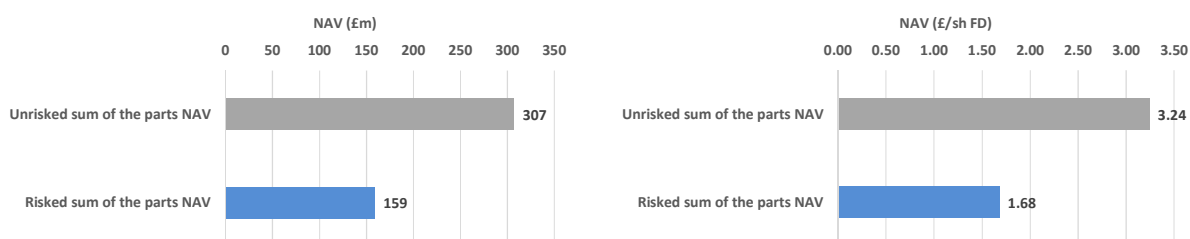
Now one development scenario.

We previously modelled a base-case and expansion case which was predicated a differing build-out of capacity at Vatomina, the base-case solely being based on a Phase 1 expansion at Vatomina to 22,800tpa and the expansion case being based on modular expansion with an additional 3x 18,000tpa units. However, given the much higher level of disclosure regarding expansion and subsequent to our site visit to Madagascar, we now have much increased confidence in the execution of the company's phased expansion to 81,000tpa graphite. As such, our sum of the parts valuation now considers a single staged development scenario as the rationale and impetus for low capital intensity expansions is clear.

Target valuation summary

We ascribe an indicative risked target valuation of £159m or 168p/sh per share based on a risked sum of the parts valuation. This assumes that TG meets development and funding milestones, ramps up graphite production in Madagascar and develops the Indian downstream successfully. On an unrisked basis, our NAV is £307m (£3.24 fully diluted). **We have been more conservative than company estimates as we incorporate a delayed production ramp-up** but we stress that TG must meet critical milestones in order to move towards this valuation. **We also use extremely punitive risk/valuation multiples but expect this risk discount to unload considerably** on the back of development progress and production ramp up.

Figure 2 - TG NAV valuation summary (GBP £m)



Source: Optiva estimates

Valuation basis

We assume 95m shares in issue post-IPO and post funding of Phase 1 which is based on current shares in issue of 57.8m (as of Oct 2018), plus 10m shares (TSG acquisition) plus 1.2m shares (share remuneration). In addition to this, we fully dilute for equity funding through to post IPO. We assume a further £2m pre-IPO round at 30p/sh and £9m IPO fundraise at IPO at 35p/sh, assuming that the remaining £9m of the total £20m funding requirement is sourced via debt-related mechanisms. **Note that our view of equity dilution is extremely punitive** with shares placed at 30p and 35p representing only a 5p-10p increase over the last round of share issuance in September 2018 at 20p/sh.

Although we see very strong rationale for placement at much higher prices given development progress and downstream acquisition, we retain a conservative outlook to set our base valuation. Equity dilution is clearly a major variable in our valuation but we present some sensitivity analysis around this assumption. The exact number of shares in issue will not be known until after the IPO has been completed.

Figure 3 - Indicative sum of the parts NAV

UNRISKED sum of the parts NAV	Valuation method	Discount rate	EBITDA Multiple	NPV (GBP £m)	Post-pre-IPO	£/sh *
Vatomina	DCF	10%	-	140.9		1.49
Sahamamy	DCF	10%	-	45.2		0.48
Tirupati Speciality Graphite (TSG)	DCF/EBITDA multiple blend	10%	3.5	69		0.72
TGMRC	DCF/EBITDA multiple blend	10%	3.0	42		0.44
Cash from capital raise				11.0		0.12
Unrisked NAV				307.3		3.24

RISKED sum of the parts NAV	NAV multiple	Risked NPV (GBP £m)	Post-IPO	£/sh *
Vatomina	0.5x	70.4		0.74
Sahamamy	0.5x	22.6		0.24
Tirupati Speciality Graphite (TSG)	0.5x	34		0.36
TGMRC	0.5x	20.8		0.22
Cash from capital raise		11.0		0.12
Risked NAV		159.1		1.68

*assumes 95m shares in issue post-IPO

Source: Optiva estimates

Unrisked base valuation

We have valued the assets of Tirupati Graphite Plc using a variety of approaches. For the graphite mining assets in Madagascar we use an NPV-based approach based on the DCF models of the company's graphite projects. For TG's downstream graphite businesses in India we use a blend of NPVs and EBITDA multiples. We have modelled Vatomina ramping up to 60,000tpa of graphite through a stage 4 expansion and we model Sahamamy ramping up to 21,000tpa, bringing total group production from Madagascar to 81,000tpa although we assume that this level is not reached until 2024, a year later than TG estimates. Our NPV^{10%} is £140m for Vatomina and £45.2m for Sahamamy.

We model TG's Indian businesses in two separate parts; the Tirupati Speciality Graphite ("TSG") business and the Tirupati Graphene & Mintech Research Centre ("TGMRC"). As these are not pure mining businesses, we derive our valuation from a blend of NPV (DCF model based) and forward EBITDA multiples. We have been more conservative in our valuation approach for the downstream side of TG's business. In conjunction with NPVs, we use relatively low EBITDA multiples of 3.5x and 3x respectively for TSG and TGMRC, well below long-run sector averages (5-7x), but reflecting the major task ahead of developing the downstream flake graphite business. We see TSG as the main driver of value in the Indian Segment. We value TSG at £69m and TGMRC at £42m.

Ongoing corporate costs and working capital are captured by our DCF model, but we further adjust our valuation for cash received from equity raising at the pre-IPO and IPO round, seeing as we incorporate the diluted number of shares in our valuation. Our model assumes a pre-IPO raise of £2m at 30p and an IPO equity raise of £9m at 35p per share. **All in, our unrisked sum of the parts NAV is £307m (£3.24/sh) which is the read through valuation for a fully-fledged and operational business.**

Risked valuation

In terms of a current valuation target **we apply a heavy discount to our sum of the parts valuation** to reflect the significant milestones ahead; namely development, execution and funding risks. We employ a risk-weighted approach using a range of NAV multiples which we have lowered to reflect the fact that our valuation is now based on the total staged ramp up to 81,000tpa in Madagascar (previously we had a base-case and expansion scenario) which incurs greater risk and uncertainty due to the scale of development, expansion and funding required. We anticipate that risk discount on the valuation will reduce if TG successfully hits major milestones. All in, our risked NAV valuation is £159m or 168p per share on a fully diluted basis, post IPO fund raise. This implies that TG has the potential to re-rate along the value curve as development progresses. **Our modelling indicates a robust business with an exit valuation many multiples of the current valuation**, albeit with considerable development and optimisation work ahead.

Valuation and modelling assumptions

We have based our DCF models on inputs derived from the company's detailed development plan. Our production, operating cost and capital cost assumptions are derived directly from the company's estimates. Although the company's aims are achievable, they are also ambitious in our view and consequently we have been more cautious on the timelines. Most of our conservatism manifests itself in a much slower production ramp up than the company's plans we present elsewhere in the note. **We believe that TG has good potential to beat our slower ramp-up timeline, which will have a considerable upward impact on valuation.** Note that TG's plan would see full capacity ramp up by 2021, where as we see full capacity by calendar year 2023-2024, a two year delay. Again, this is highly conservative but we will review this as development progresses.

**Note that we use financial years (April to March year-end) in our model to match TG's financial reporting year -end. For example, 2021 refers to the financial year 2020-2021 ending in March 2021.*

Vatomina assumptions

- Modular expansion in four stages; Stage 1 at 6,000tpa and then three additional stages of 18,000tpa for total ramped up capacity of 60,000tpa graphite.
- With the plant due to be commissioned in April 2019 we assume that Stage 1 is fully commissioned in the 2019-2020 year, along with 25% of production from Stage 2. We progressively add the 18,000tpa expansions to reach full capacity by the year ending March 2024. This is approximately 12-months later than TG's current development plan.
- Total capex of £13m spread over 4 years as each additional processing stage is added. We incorporate sustaining capital at 10% of mining and processing operating costs.
- Mine life 20 years. This implies total ore mined in the order of 22.5Mt assuming full capacity to 60,000tpa graphite, which is in excess of the upper end of the JORC CPR Exploration target. However, significant drilling has been undertaken since the previous CPR and TG expects to report a major upwards revision to the resource in Q4 2018. TG still sees potential for a c.50Mt resource. If we model mining based on the current Exploration Target (13Mt), our NPV^{10%} is £105m, down from £140m for a 20-year LOM.
- Opex at \$220/t processed including all mining, processing, admin, G&A and royalties.
- Madagascar corporate tax rate at 20%
- 10% discount rate.
- Graphite basket sales price of £754/t (\$980/t) based on TG's grade, yield and indicative product pricing for jumbo, large and small flake products. We model a 35%/35%/30% split for jumbo, large and small flakes respectively.

Sahamamy assumptions

- Modular expansion in two stages; Stage 1 to increase to 3,000tpa from the current 600tpa capacity by the installation of a new processing plant and Stage 2, the installation of a 18,000tpa plant to increase total capacity to 21,000tpa over two years. We assume this total capacity is reached by the end of the financial year 2022, about 12-months slower than company plans.
- TG expects the new Stage 1 3,000tpa plant at Sahamamy to be completed and commissioned by the end of the year. We model on 75% production for first year of production.
- Total capex of £5m of which only £550,000 required for Stage 1 and the remainder capex for the 18,000tpa expansion.
- Mine life 16 years. This implies total ore mined in the order of 5.6Mt assuming full capacity to 21,000tpa graphite. We base this on current indicated resources (2.8Mt) and assume a highly conservative 25% conversion of inferred resources which amount to 10.7Mt, adding 2.7Mt to mining inventory. Note that TG has a 15Mt Exploration Target as per the latest CPR and although we use 16

years LOM for valuation purposes, the nature of the resource potential means that a much longer LOM is likely achievable.

- Same discount rate, graphite pricing and opex factors as per Vatomina.

Tirupati Speciality Graphite assumptions

- We assume that TG constructs an integrated downstream processing facility for the manufacture of 20,000tpa value-added graphite flakes.
- We assume modular development with two 10,000tpa stages and we assume final capacity is reached by 2022 (calendar year 2021-2022)
- Products. TG plans on producing the following value-add products; purified flake graphite, expandable fire retardants, micronized & colloid products and spherical graphite.
- We assume different prices for each product, with the overall basket price set at £2,300/t (US\$3,000/t with a range of \$2,500/t to \$3,500/t). We assume total operating costs averaging £1,425/t (\$1,850/t). Capex £12.5m spread over 2019-2021.
- We include the Patalganga pilot plant in our modelling of TSG, ramping up to 2,800tpa.

TGMRC assumptions

- We assume revenue and services ramp up from the financial year-ending 2020. As per company guidance, we have assumed sales revenue generation from starting at 30% capacity level with gradual increase to reach at 90% capacity. Revenue is derived from a mix of services including research and development and graphene development activities as per company guidance. Total revenue ramps up to £16m in our model.
- We assume total capex of £11m.

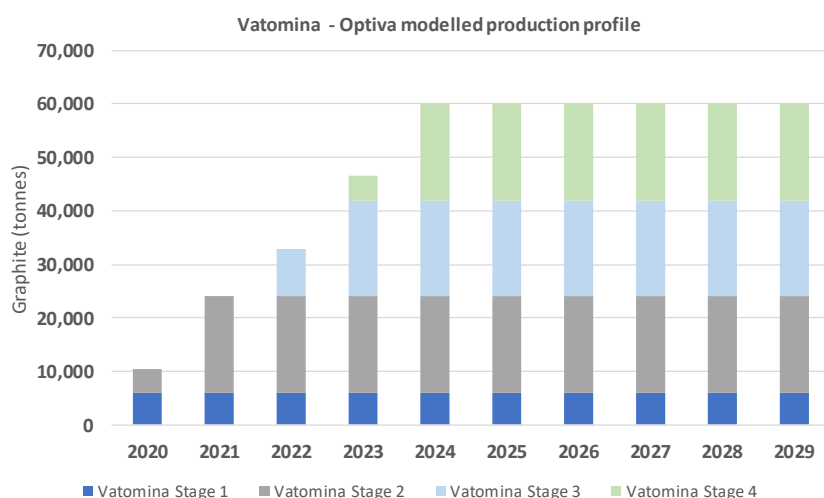
Valuation outputs

Vatomina

We model the first full year of production from Vatomina in the year ending March 2020 with first production commencing from mid-calendar year 2019. We assume only 10,500t of production for year 1 and progressively ramp up production to full 60,000tpa capacity by financial year 2024 (calendar year 2023-2024)

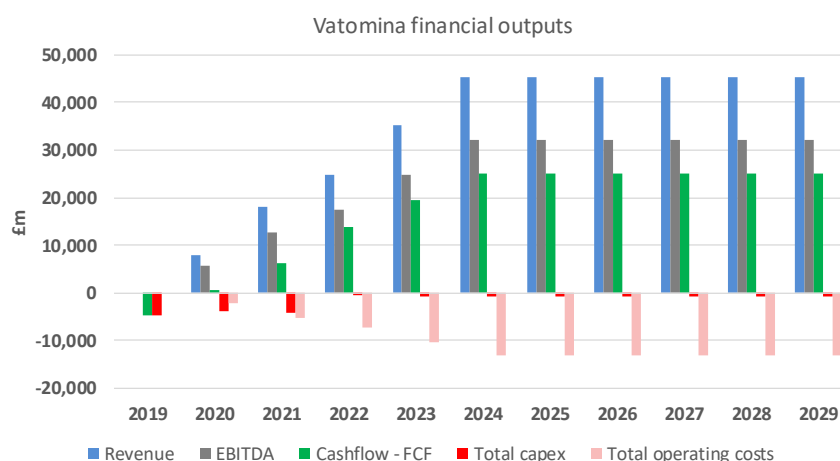
Our DCF indicates steady-state annual revenue of £45m, annual average EBITDA of £32m, and steady-state net free cash flow of £24m. This implies average gross margin of 71% and EBITDA margin of 29%. The potential margins remain impressive, with a margin of c. £530/t at the EBITDA level and £417/t at the FCF level post tax and capital expenditure.

Figure - Vatomina production profile* (graphite tpa) - modular expansion – Optiva estimates



*First 10- years of LOM only and Financial year (march year-end) basis Source: Optiva estimates

Figure 4 - Vatomina financial outputs – first 10 years of LOM, Optiva projections



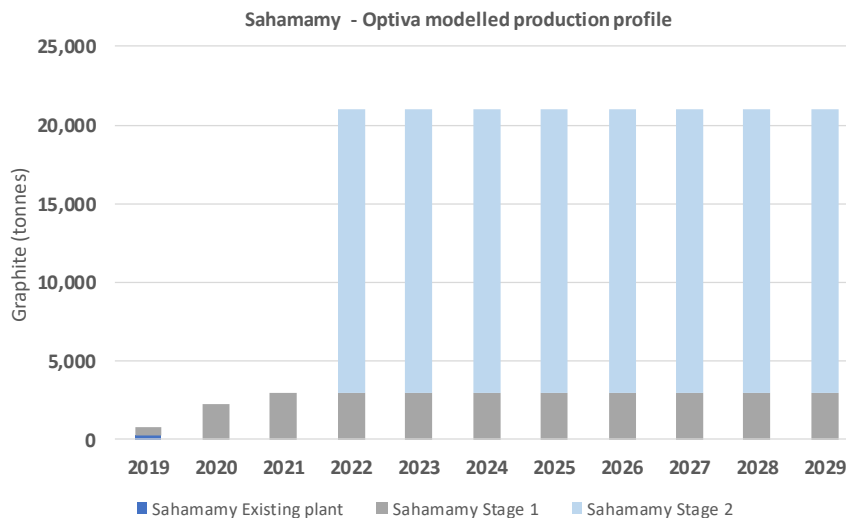
Source: Optiva estimates

Sahamamy

We model production from Sahamamy ramping up from the current 600tpa (old plant) to 3,000tpa with the new plant. We assume production from stage 1 commences in the current financial year (ending March 2020) but assume a slow ramp up to full 3,000tpa a year later. We model the stage 2 18,000tpa expansion in 2022 bringing the project to full capacity of 21,000tpa.

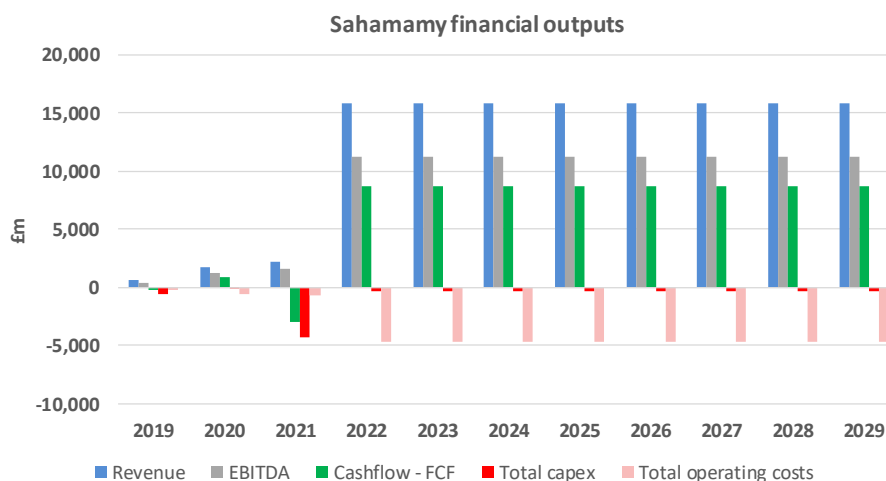
Our DCF indicates steady-state annual revenue of £15m, annual average EBITDA of £11m, and steady-state net free cash flow of £8.7m. Operating margins per tonne are the same as at Vatomina as we use the same operating cost and revenue assumptions.

Figure - Sahamamy production profile* (graphite tpa) - modular expansion – Optiva estimates



*First 10- years of LOM only and Financial year (march year-end) basis Source: Optiva estimates

Figure 5 - Sahamamy financial outputs – first 10 years of LOM, Optiva projections

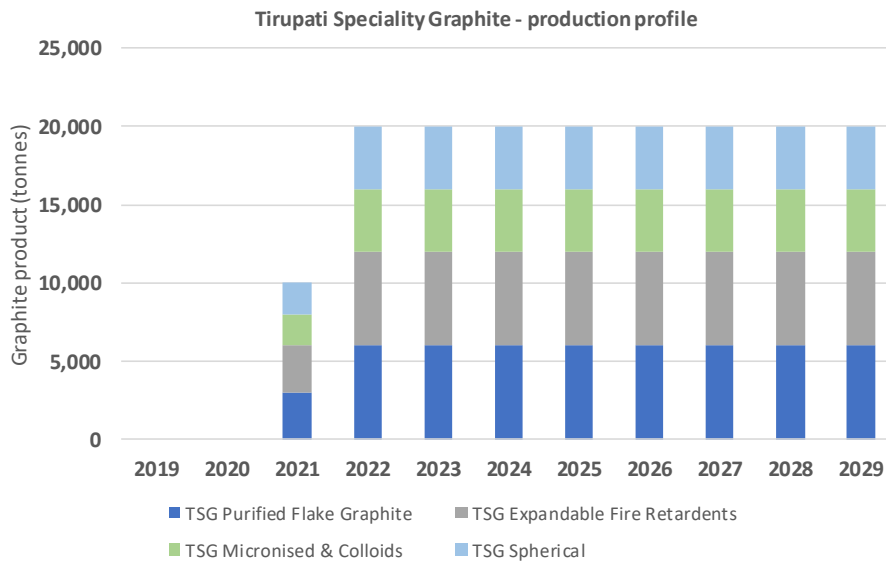


Source: Optiva estimates

Tirupati Speciality Graphite

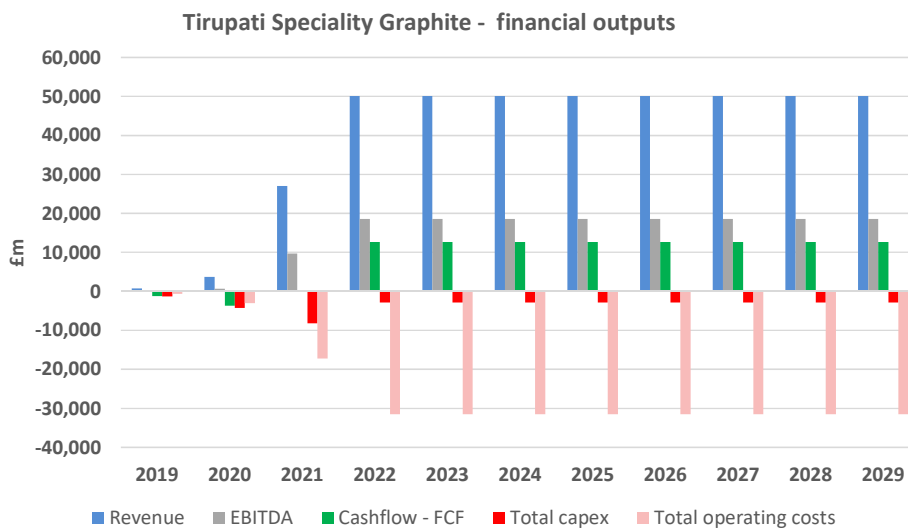
We model the TSG downstream business commencing production in 2021 with a two phase expansion, each phase being 10,000tpa of value-add graphite products. We model the relative split and sales prices as per company estimates.

Figure - TSG production profile* (graphite value-add products tpa) – Optiva estimates



*First 10- years of LOM only and Financial year (march year-end) basis, excludes pilot plant Source: Optiva estimates

Figure 6 - TSG financial outputs – first 10 years, Optiva projections



Source: Optiva estimates

Figure - TG – Group consolidated financial forecasts - Optiva estimates

YE		Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25
		2019	2020	2021	2022	2023	2024	2025
Production								
Vatomina	tonnes	0	10,500	24,000	33,000	46,500	60,000	60,000
Sahamamy	tonnes	800	2,250	3,000	21,000	21,000	21,000	21,000
Revenue								
Vatomina	£'000	0	7,915	18,092	24,877	35,054	45,231	45,231
Sahamamy	£'000	603	1,696	2,262	15,831	15,831	15,831	15,831
TSG	£'000	780	3,640	26,997	50,074	50,074	50,074	50,074
TGMRC	£'000	0	0	13,139	15,016	16,893	16,893	16,893
Total Revenue	£'000	1,383	13,252	60,490	105,798	117,851	128,028	128,028
Opex								
Vatomina	£'000	0	-2,310	-5,280	-7,260	-10,230	-13,200	-13,200
Sahamamy	£'000	-176	-495	-660	-4,620	-4,620	-4,620	-4,620
TSG	£'000	-640	-2,985	-17,245	-31,505	-31,505	-31,505	-31,505
TGMRC	£'000	0	-1,891	-5,349	-6,342	-6,765	-5,310	-5,310
Total operating costs	£'000	-816	-7,680	-28,533	-49,727	-53,120	-54,635	-54,635
EBITDA								
Vatomina	£'000	0	5,605	12,812	17,617	24,824	32,031	32,031
Sahamamy	£'000	427	1,201	1,602	11,211	11,211	11,211	11,211
TSG	£'000	140	655	9,752	18,569	18,569	18,569	18,569
TGMRC	£'000	0	563	7,790	8,674	10,128	11,583	11,583
Total EBITDA	£'000	567	8,025	31,956	56,071	64,731	73,393	73,393
PAT								
Vatomina	£'000	0	4,250	9,715	13,359	18,824	24,289	24,289
Sahamamy	£'000	324	910	1,214	8,496	8,496	8,496	8,496
TSG	£'000	112	524	6,382	12,016	12,016	12,016	12,016
TGMRC	£'000	0	432	5,587	6,201	7,272	8,436	8,436
Total PAT	£'000	436	6,117	22,898	40,071	46,607	53,236	53,236
Net income								
Vatomina	£'000	-4,708	682	6,320	13,782	19,420	25,059	25,059
Sahamamy	£'000	-213	940	-2,975	8,772	8,772	8,772	8,772
TSG	£'000	-1,193	-3,728	-68	12,713	12,713	12,713	12,713
TGMRC	£'000	-500	-4,073	-124	6,617	7,779	9,089	9,089
Total net income	£'000	-6,614	-6,180	3,154	41,884	48,684	55,632	55,632
Capex								
Vatomina	£'000	-4,708	-3,861	-4,063	-495	-698	-900	-900
Sahamamy	£'000	-559	-34	-4,273	-315	-315	-315	-315
TSG	£'000	-1,305	-4,253	-8,225	-2,852	-2,852	-2,852	-2,852
TGMRC	£'000	-500	-4,529	-6,517	-507	-531	-385	-385
Total capex	£'000	-7,072	-12,675	-23,078	-4,169	-4,395	-4,452	-4,452

Financial year (march year-end) basis Source: Optiva estimates

Sensitivity analysis

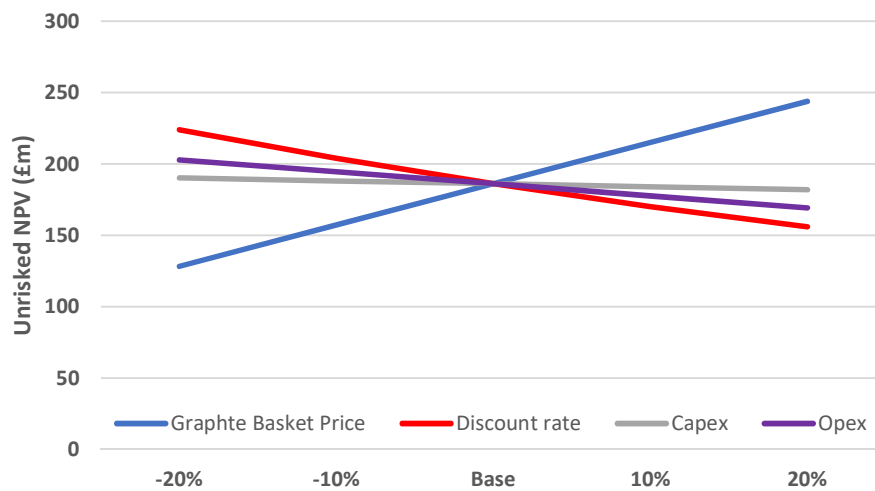
The sensitivity of the combined Vatomina and Sahamamy project NPV (unrisked) is outlined below. As expected, the Madagascar projects are most sensitive to changes in the graphite basket price.

Figure 7 Unrisked project NPV (Vatomina + Sahamamy) sensitivity - graphite basket price vs discount rate

Graphite basket price (\$/t)	Discount rate			
	5%	8%	10%	12%
700	171	126	104	86
800	217	161	133	111
900	264	196	162	136
980	301	224	186	156
1,000	311	231	192	161
1,100	357	266	221	186

Source: Optiva estimates

Figure 8 - Unrisked project NPV (Vatomina + Sahamamy) sensitivity to change in major parameters (£m)



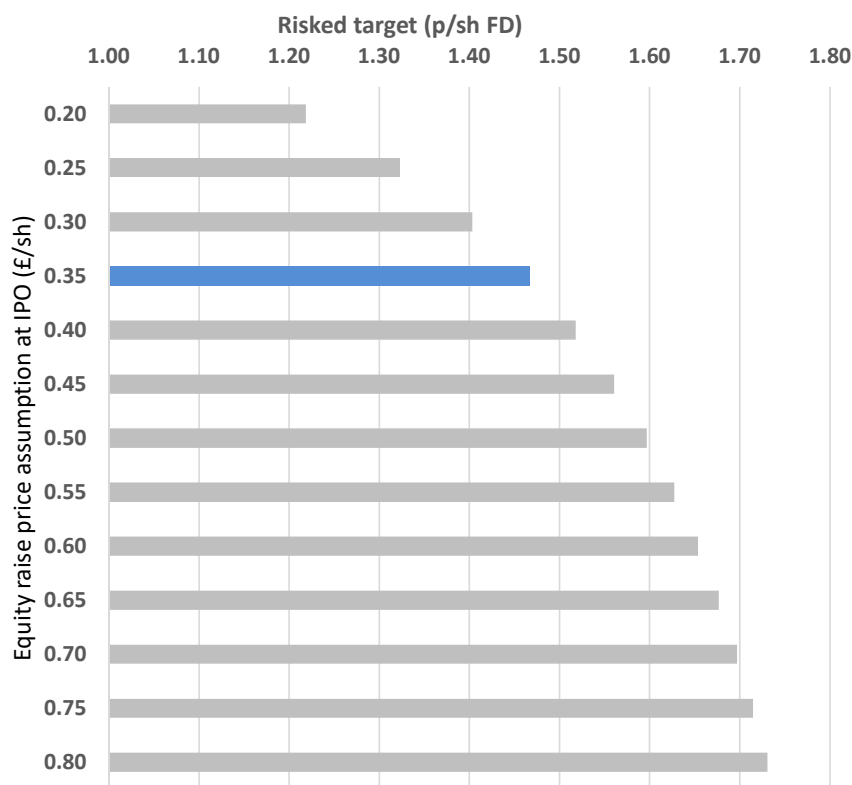
Source: Optiva estimates

Figure 9 Indicative target price sensitivities – discount rate versus equity funding price assumption

Equity raise price at IPO (p/sh)	Discount rate			
	5%	8%	10%	12%
0.20	2.07	1.62	1.40	1.22
0.25	2.25	1.76	1.51	1.32
0.30	2.39	1.86	1.61	1.40
0.35	2.50	1.95	1.68	1.47
0.40	2.58	2.02	1.74	1.52
0.45	2.66	2.07	1.79	1.56
0.50	2.72	2.12	1.83	1.60
0.55	2.77	2.16	1.86	1.63
0.60	2.81	2.20	1.89	1.65
0.65	2.85	2.23	1.92	1.68
0.70	2.89	2.25	1.94	1.70
0.75	2.92	2.28	1.96	1.71
0.80	2.95	2.30	1.98	1.73

Source: Optiva estimates

Figure 10 Indicative target price sensitivities



Source: Optiva estimates

Corporate structure, recent events and IPO plans

Incorporation and seeding

Tirupati Graphite plc (“TG”) was incorporated in London in April 2017, and was formed with four major shareholders; 1.) Shishir Poddar and 2.) Hemant Poddar – co-founders of Tirupati India, and 3.) Optiva Securities and 4.) Christian Dennis (CEO of Optiva). Each party subscribed for 500,000 shares at a nominal value of 2.5p.

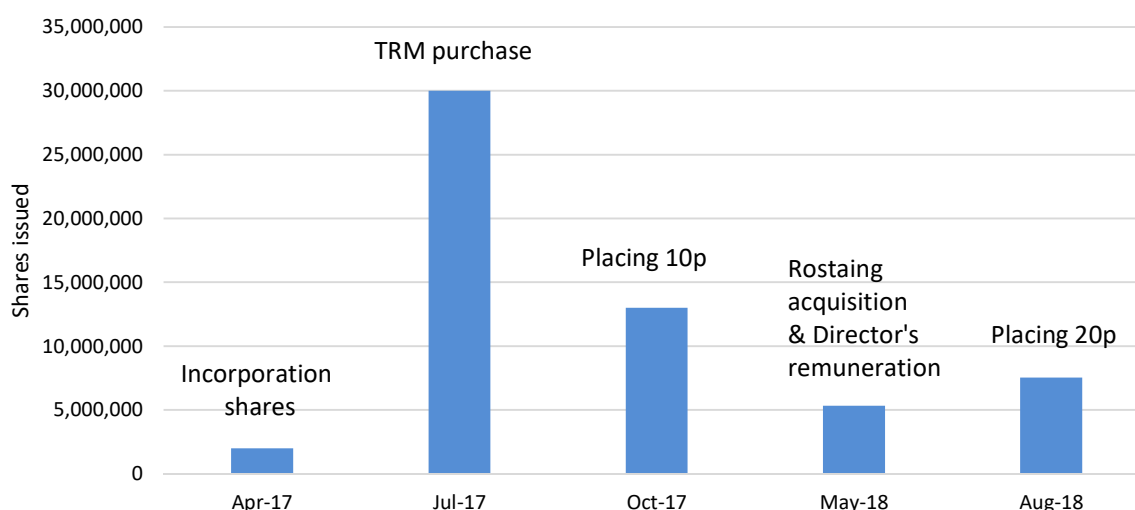
Share exchange with Tirupati

Post the completion of the incorporation, TG executed a share exchange and relationship agreement with Tirupati Carbons & Chemicals Ltd (“TCCPL”) and Stratmin Global Resources plc (“Stratmin”, AIM: STGR), being the shareholders of Tirupati Resources Mauritius (“TRM”), the 100% holder of the Vatomina flake graphite project in Madagascar. The exchange agreement resulted in TG acquiring 100% of TRM against the issue of 30m shares at 10p/sh, making TRM a wholly-owned subsidiary of TG.

Two rounds of funding completed

TG has no completed two major rounds of equity funding. The initial seed pre-IPO round at 10p/sh was completed for proceeds of £1.15m. A second round provided follow on capital of £1.5m. The company plans to raise further equity funds at a further pre-IPO round and IPO, planned for 2019.

Figure 11 - TG – equity issues since incorporation



Source: Optiva estimates

Sahamamy (Rostaing) acquisition completed

In October 2017, TG entered into a binding agreement to acquire the Sahamamy graphite project from Etablissement Roastaing, a private company in Madagascar. Sahamamy is a producing flake graphite mine located 8km from Vatomina. The acquisition of the project has been completed and resulted in the issue of 4.6m shares to satisfy the 75% balance of the \$800,000 acquisition cost. Shares were issued at 10p/sh.

Current shareholders

TG currently has 57.8m ordinary shares in issue. The main shareholder is TCCPL, a private Indian company and the founder of TSG. 10m shares are due to be issued for the TSG acquisition and 1.2m for employee share remuneration which will bring total share capital to c.69m.

Figure 12 - TG – current shareholders >3%

Shareholder	# shares	%
Tirupati Carbons and Chemicals Pvt Limited	29,565,778	51%
Nicolas Petitjean	4,615,300	8%
Huntress (Ci) Nominees Ltd	2,888,852	5%
Momentum Investments Limited	2,500,000	4%
Optiva Securities Ltd	2,392,608	4%
Momentum Trading Limited	2,299,999	4%
Cape Light Investments Limited	1,755,435	3%
Total shares in issue	57,868,096	

Source: TG

Restructuring and acquisition of TSG – a downstream Indian graphite business

TG has also completed the acquisition of Tirupati Speciality Graphite Pvt Ltd (“TSG”), a private Indian company founded by the TCCPL India. The acquisition brings TSG’s downstream value-add flake graphite processing business under the TG umbrella. TSG also includes the development of a technology centre, Tirupati Graphene and Mintech Research Centre (“TGMRC”) as an integrated centre for research and development into graphite, graphene, minerals and materials technology.

IPO Plan – focussing on near-term cash flow potential

TG plans to list on the LSE in H1 2019. In conjunction with the listing, the company plans to raise development capex required to complete Phase 1 of the growth strategy. This includes putting Vatovina into production, installing the new plant at Sahamamy and ramp up both projects to total combined graphite output of 27,000tpa. In addition, Phase 1 includes capex for investment in the downstream businesses; TSG and TGMRC. TG anticipates that the total funding requirement for Phase 1 is £20m including £4.5m in working capital. This will develop the Madagascar projects to 27,000tpa. This will be achieved in two steps; £2m at Pre-IPO to move to 9,000tpa and then the balance at IPO – see next page.

Figure 13 - TG’s Pre-IPO funding requirement for 9,000tpa capacity

9,000tpa	£m	Source of funding	£m
Madagascar projects to 9,000tpa	1.0	Pre-IPO Equity	2.0
Indian Projects	0.8		
Corporate and IPO costs	0.2		
Total funding required	2.0	Total funding	2.0

Pre-IPO and IPO funding combined

Phase 1 27,000tpa	£m	Source of funding	£m
Madagascar projects	6.2	Pre-IPO Equity (to 9,000tpa capacity)	2.0
TSG	5.4	IPO Equity (to 27,000tpa capacity)	9.0
TGMRC	4.9	Term debt post-IPO	9.0
Sub-total	16.5		
Capex sunk	-1.6		
Working capital required	4.5		
Total funding required	19.4	Total funding	20.0

Source: TG, Optiva estimates

Funding in two stages; Another round of Pre-IPO and IPO

We understand that TG is targeting to raise £2m in a pre-IPO round and £9m at IPO. The £2m pre-IPO will provide capex and working capital to support initial production to c.9,000tpa in Madagascar (£1m), progress the Indian projects with land acquisition and other activities (£0.8m) and corporate/IPO costs (£0.2m).

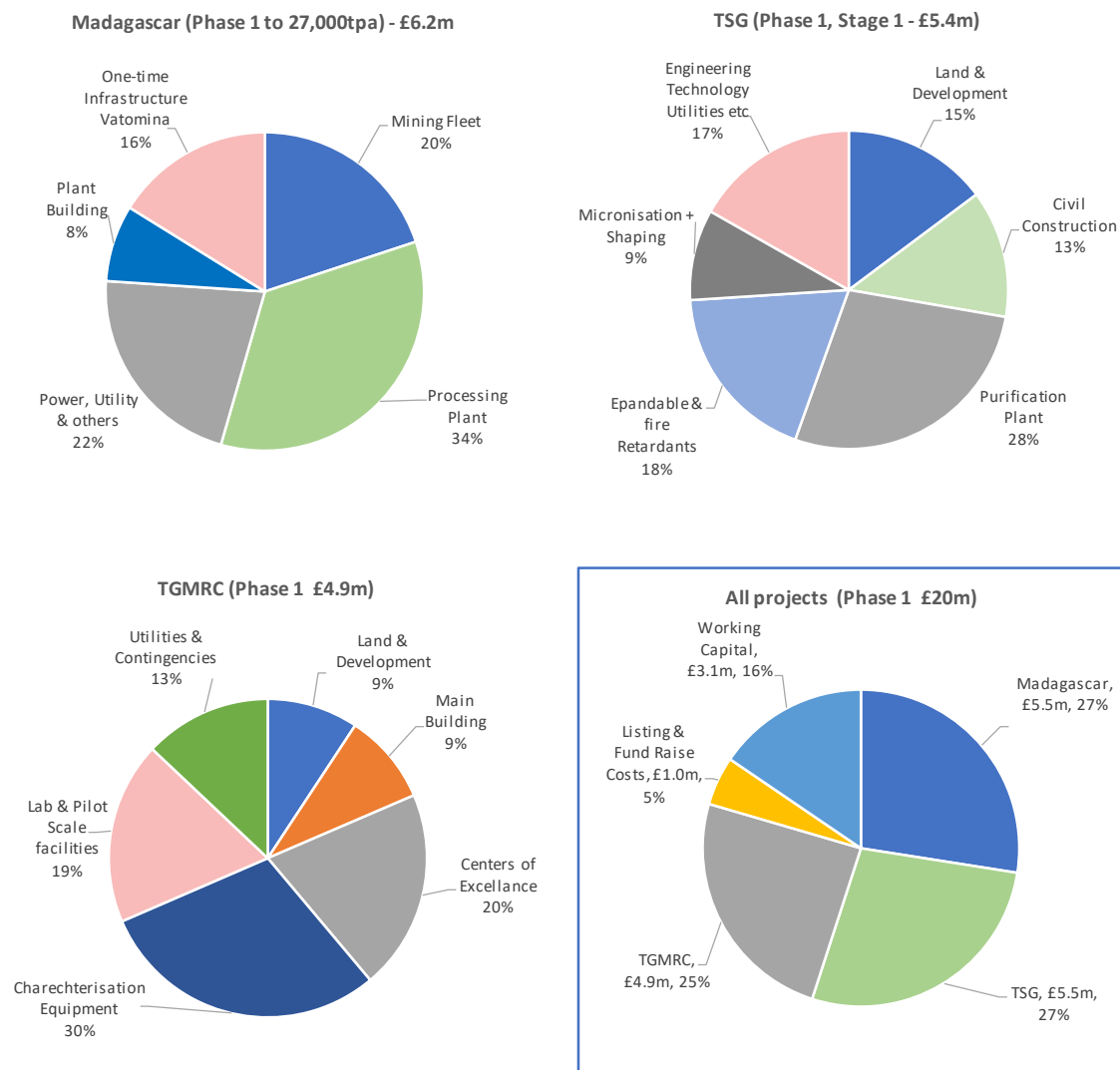
TG then plans to IPO on the back of being a fully-fledged producer to take production to 27,000tpa. We believe this may make it easier to secure IPO funds by demonstrating that the first production stage at Vatomina and the new plant at Sahamamy are fully-operational and producing 9,000tpa. This would also have the added benefit of putting the company in a stronger position to ramp up to 27,000tpa and potentially reducing future equity dilution. The initial funds required for Madagascar would be prioritised from the initial funding rounds to focus on near-term cash-flow potential.

Capex and budget plans

Phase 1 to 27,000tpa

TG's total capex requirement to complete Phase 1 ramp up to 27,000tpa in Madagascar plus the downstream TSG and TGMRC businesses is £16.6m of which £15.5m remains to be invested. Adding in the £4.5m working capital requirement and listing cost brings the total funding requirement to £20m. We note that only 31% of the total (£6.2m) is required to complete Phase 1 in Madagascar. This is important as the Madagascar assets have potential for near-term cash flow and to drive the downstream business.

Figure 14 - Budget and funding requirement up until planned IPO



Source: TG

Phase 2 to 81,000tpa

The remaining capex for all three business areas to increase production to 81,000tpa (in Madagascar) amounts to approximately £25m. TG expects that the cost of this incremental capex will be met from internally generated cash flow.

Phased Development has started

TG's strategy of pursuing a phased development plan remains intact. Since our last note in November 2017, the rationale for modular expansion remains the same:

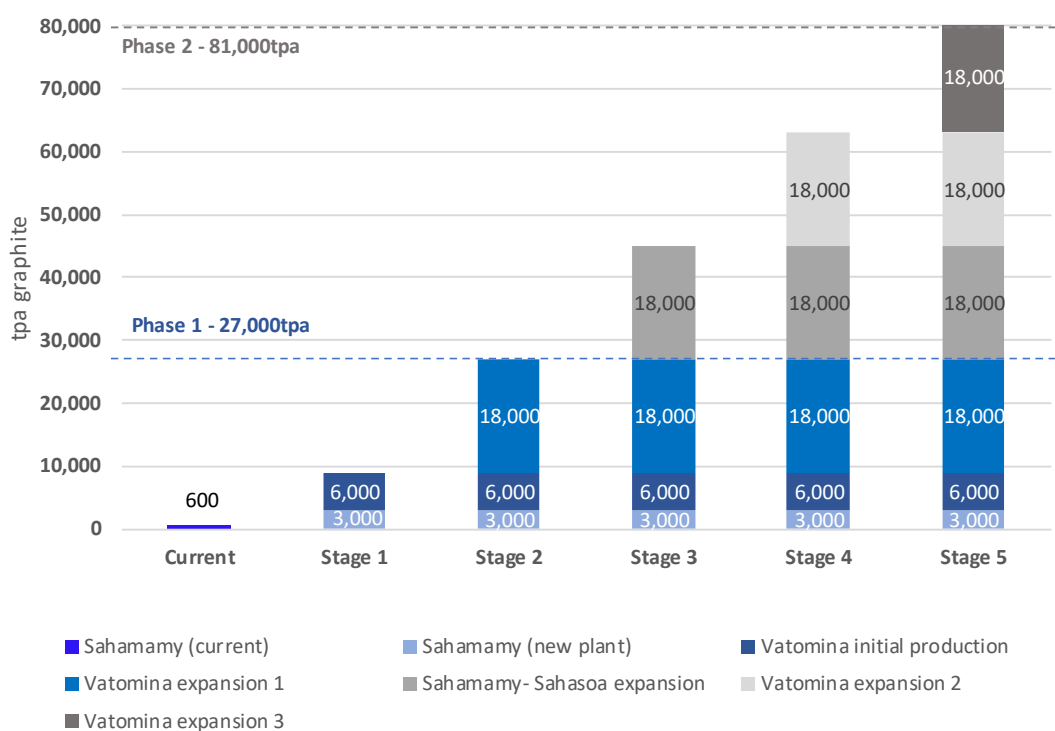
- Minimise initial capital outlay.
- Minimise upfront equity dilution.
- De-risk the production ramp-up to full capacity of 81,000tpa graphite.
- Position the majority of future growth to be funded organically by future potential cash flow
- Grow the business at the correct rate to match the prevailing graphite market and to dovetail with the downstream graphite division in India.

Figure 15 - TG's modular ramp-up and expansion plan

Project/ Expansion	Current	Phase 1		Phase 2		
		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Sahamamy (current)	600	0	0	0	0	0
Sahamamy (new plant)		3,000	3,000	3,000	3,000	3,000
Vatomina initial production		6,000	6,000	6,000	6,000	6,000
Vatomina expansion 1			18,000	18,000	18,000	18,000
Sahamamy- Sahasoa expansion				18,000	18,000	18,000
Vatomina expansion 2					18,000	18,000
Vatomina expansion 3						18,000
Total	600	9,000	27,000	45,000	63,000	81,000

Source: TG, Optiva estimates

Figure 16 - TG's ramp-up and expansion plan



Source: TG, Optiva estimates

Phase 1 – getting commercial production underway

TG's current plan is to ramp up to 27,000tpa graphite in Madagascar by the end of 2019. This will be achieved by the commissioning of three separate processing plants:

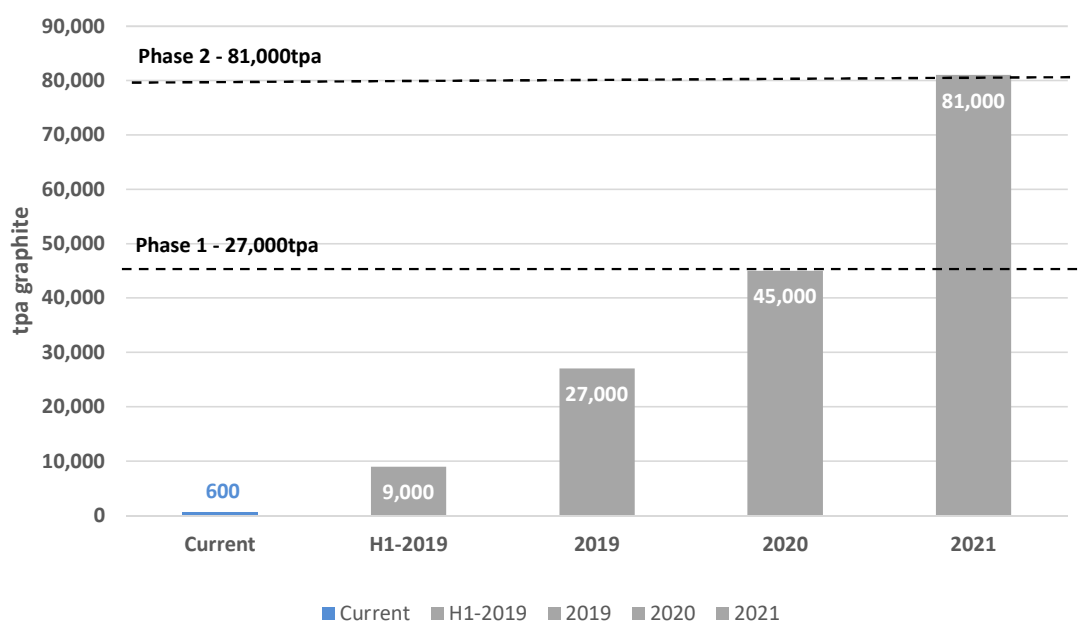
1. **Sahamamy.** 3,000tpa from the new plant currently being installed at Sahamamy; which will replace the c.600tpa from the existing processing plant which will be retired once the new plant is fully operational.
2. **Vatomina.** 6,000tpa from the new Stage 1 production plant at Vatomina.
3. **Vatomina.** Installation of the first 18,000tpa module.

Phase 2 – flexible expansion

The Phase 2 plan is to ramp up to full capacity of 81,000tpa. Note that TG retains significant flexibility in terms of exactly how the total ramp up is achieved. This means that decisions on plant location can be made organically as expansion progresses. This means that instead of developing 3x 18,000tpa plants at Vatomina and 1x 18,000tpa at Sahamamy, the plan could change to two plants at each mine site depending on the future strategy. This would likely not result in any major negative changes to capex or operating costs. Each module is effectively a carbon copy, has a small footprint the capital cost is well constrained.

1. **Sahamamy** – first 18,000tpa module
2. **Vatomina** – second 18,000tpa module
3. **Vatomina** – third 18,000tpa module

Figure 17 - TG's ramp-up timeline



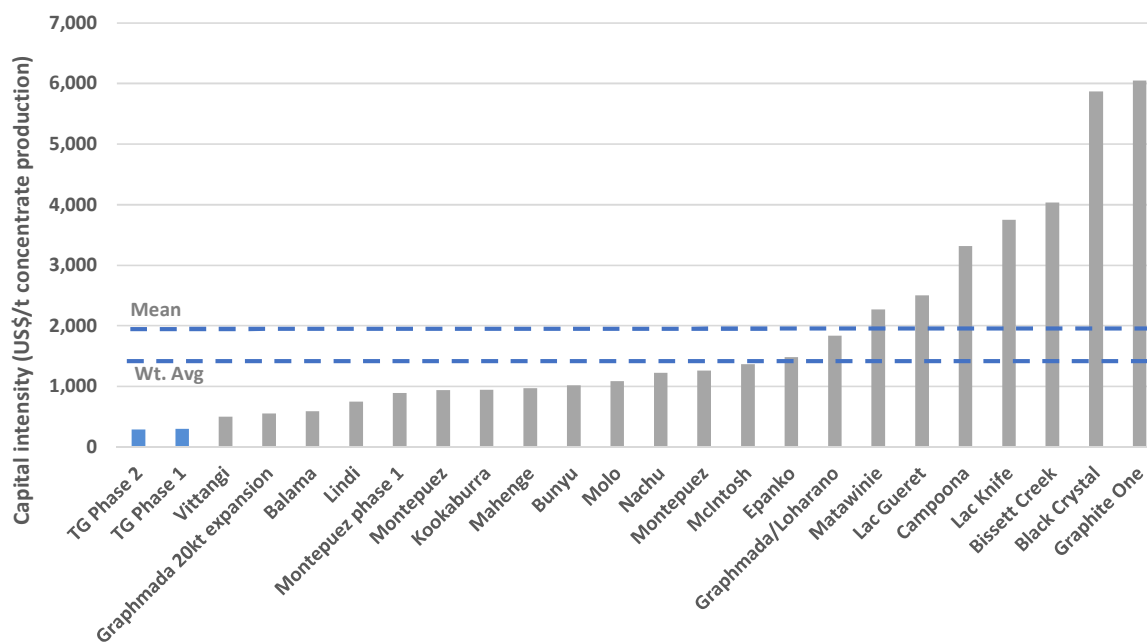
Source: TG, Optiva estimates

TG’s Madagascar projects in context

Low capital intensity

- **TG’s capital cost estimate** for Phase 1 (27,000tpa) is £6.22m and Phase 2 (81,000tpa) at its Madagascar projects. This equates to sector-leading capital intensity bases on our universe of graphite development projects and recent production start-ups.
- **TG’s capital intensity** for Phase 1 equates to US\$300/t and Phase 2 equates to US\$290/t of annual production capacity. This compares to other global development projects which typically range from \$1,000-2,000/t; the mean in our dataset is currently \$1,950/t and the production weighted average is \$1,500/t.
- **Drives of low capex.** TG’s low capital intensity is a result of the in-house equipment manufacture and Tirupati’s stream-lined plant design based on the company’s technology and engineering expertise, and low input costs in Madagascar. The real linchpin is TG’s ability to leverage its graphite experience from Tirupati.
- **Recent site visit.** On our recent site visit we had the opportunity to work through development plans and the equipment required. The key take away from our visit is that TG’s processing plant equipment is designed to work but is not in any way over-engineered. It’s certainly not the “Rolls Royce” of processing plant technology that can be found in other parts of world. TG manufacture all processing plant equipment internally which results in significantly lower costs. Nevertheless, TG’s equipment design and manufacture is based on years’ of the experience of producing quality graphite products.

Figure 18 - TG’s Madagascar projects have an exceptionally low capital intensity relative to peers

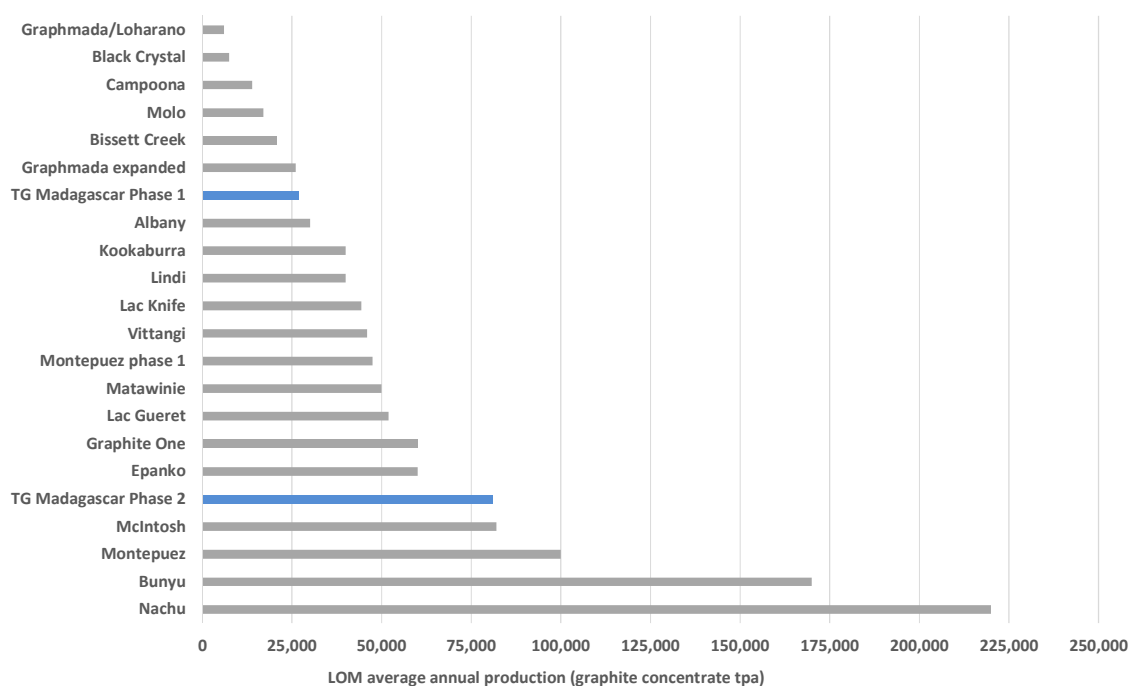


Source: Optiva, Company reports, SEDAR

Production scale

- **Global scale.** If TG successfully executes its ramp-up and expansion plans, the company’s combined Madagascar production output will potentially be one of the largest-scale graphite producers globally.
- **Limited number of projects produce >75ktpa.** If TG successfully expands operations to 81,000tpa it will be part of a select group of graphite producers. There are only a handful of projects slated to produce more than 75,000tpa, and five projects in our universe slated to produce more than 100,000tpa, Balama-Syrah Resources (350ktpa), Mahenge-Blackrock Mining Ltd (250ktpa), Nachu-Magnis Resources (220ktpa) being the three largest.

Figure 19 - Vatomina will be a globally significant producer of graphite

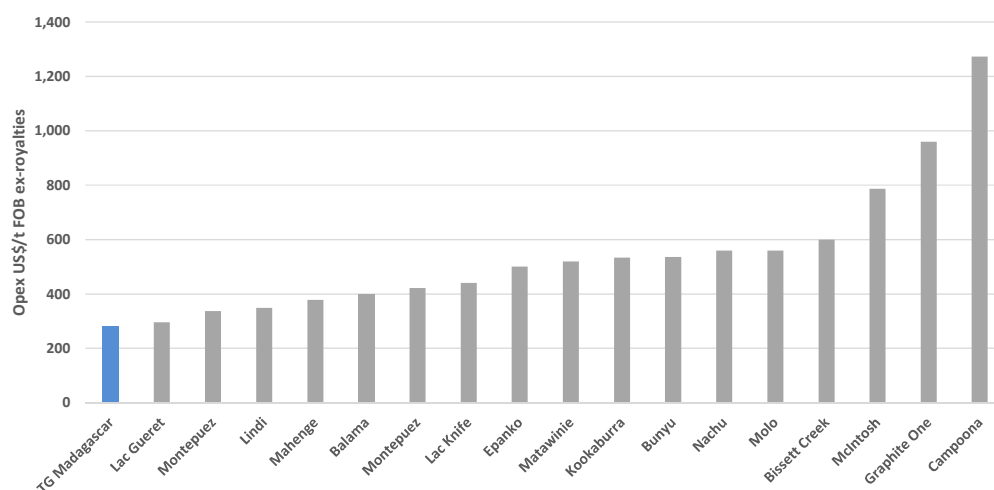


We exclude Mahenge (250ktpa) and Balama (350kt) from the graph for readability Source: Optiva estimates

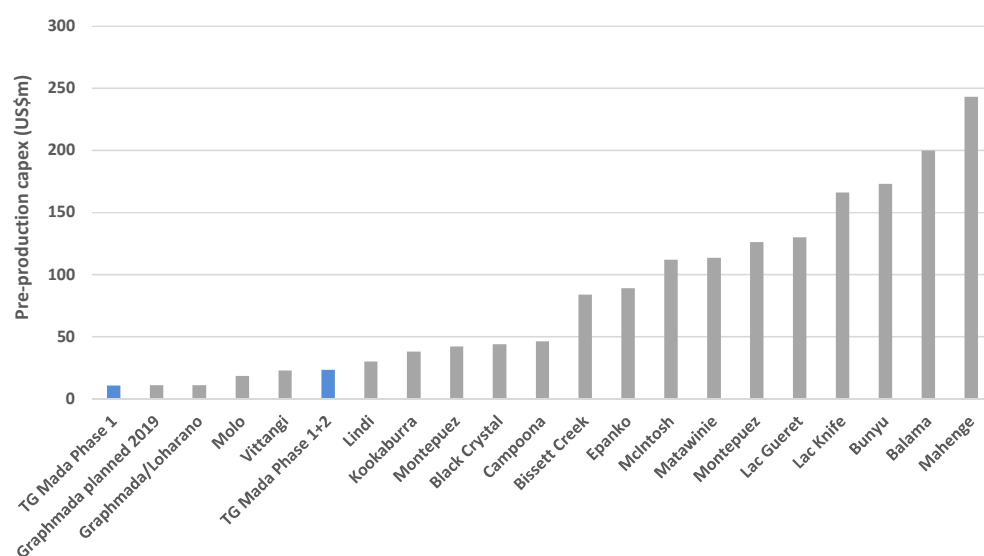
Low Cost operation

- Competitive costs.** TG's mine plan indicates very low operating costs. TG forecasts total opex per tonne at c.£217/t (\$280/t), which is extremely low compared to global graphite development projects which typically have cash operating costs in the region of \$400-\$500/t plus.
- Flake size and low input-costs.** TG's low operating cost in Madagascar is largely a result of the large flake particle size distribution which means that liberation of the graphite is much easier, translating to fewer processing circuits required to fully liberate the graphite product. The deposit is also free dig and mining and labour costs are very low. As TG ramps up production, the company envisages further opex reductions, due to economies of scale.
- Near-term production.** It is also worth noting that Sahamamy is already in production and Vatomina is in construction. Relative to peers, Vatomina is one of the most advanced projects with production expected to start ramping up from mid-2019. Most of the other graphite projects globally are still in the PFS to Feasibility stage, or in the process of trying to secure funding for very large capex requirements.

Figure 20 - Opex comparison



Capex comparison



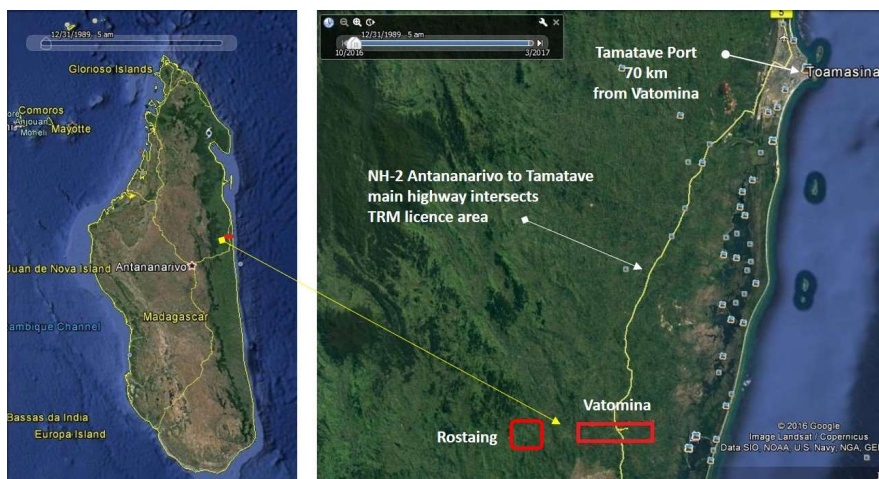
Source: Optiva, Company reports

Location advantage in Madagascar

Vatomina and Sahamamy are located on the east coast of Madagascar in the Toamasina Province. Whilst large portions of Madagascar are undeveloped with minimal infrastructure, TG's projects are strategically located in one of the more developed provinces where infrastructure is relatively good.

- **Road network.** Notably, the main NH2 highway that runs from the capital Antananarivo to Toamasina and actually passes through Vatomina. The travel time along on the highway to the Tamatave port is approximately 2 hours.
- **Close to port.** The projects are located only 70-80km from the Tamatave port, a deep-water port and the main import/export hub for Madagascar. The port has plenty of spare capacity and TG's maximum product load at full capacity is only 81,000tpa.
- **Major Hub.** Toamasina is a major city in Madagascar and well equipped with all amenities required to support mining operations.
- **Power.** Grid power is minimal in Madagascar outside of the main centres of population meaning there is little alternative apart from diesel generators, solar and hydro. TG's power requirements are small. The camp at Vatomina is powered by solar energy and the main processing plants at both projects will be powered by gen-sets. There is also potential for hydro power which could result in cost savings.

Figure 21 - Located close to road and port infrastructure in Madagascar



Source: TG

Figure 22 - Tamatave is a major port in Madagascar



Source: Optiva Securities

Fully permitted for production

- **Madagascar's mining code** provides tenement security, and 100% foreign ownership is permitted.
- **Vatomina is fully permitted**, and the Mining Permit was granted in January 2016, and is valid for 40 years and is renewable. The project has also been granted Environmental Authorisation which means that all permits are in place allowing construction activities and commercial operations on site.
- **Sahamamy permits in place for 3,000tpa.** The project currently has a 8km² mining permit with an additional 8km² applied for grant and currently being processed. TG currently holds Exploitation Permit PE 21 (1.56Km²) & 23608 (6.25km²). The entire processing infrastructure will remain located within PE21.

Figure 23 - Vatomina is fully permitted for construction and mining

The image shows two official documents from Madagascar. The left document is a Mining Permit (FAHAZOAN-DALANA HITRANDRAKA) issued to TIRUPATI MADAGASCAR VENTURES S.A.R.L. in Antananarivo. It details the permit's validity, the company's address, and the mining area's location. The right document is an Environmental Permit (PERMIS ENVIRONNEMENTAL) for the exploitation of graphite, also issued to TIRUPATI Madagascar Ventures in Antananarivo. It references the mining permit and provides details about the environmental assessment and the company's address.

Source: TG

Madagascar - some of the best flake graphite in the world

- **Jumbo flakes, high purity.** Flake graphite from Madagascar is generally accepted to be some of the best flake graphite on the market by virtue of the relatively high proportion of crystalline, large flake graphite mineralisation. This generally translates to a higher price basket.
- **Free Dig.** The graphite host rock is shallow, highly weathered and friable which means that blasting is not required and mining is “free dig” by conventional excavating equipment.
- **Easy separation.** TG has demonstrated in recent testwork at Vatomina and actual production at Sahamamy that the graphite can be easily separated. TG has developed a streamlined process resulting in considerable advantages for purification, flake size retention and efficiency.
- **Proximity to consuming markets.** Madagascar’s location is ideal for the distribution of product to the main graphite consuming centres of Europe, America and Asia. In particular, Madagascar is well located for export of product to India and China.
- **Premium pricing likely.** TG believe that Vatomina will have an attractive flake-size distribution with approximately 35% of revenue being generated from a jumbo flake size, 35% from large flakes, and the 30% balance from small flakes. The two most important attributes of graphite mineralisation are the flake size and purity, which have a major impact on pricing. Metallurgical tests using Tirupati yield a c.96% purity and with the predominance of jumbo sized flakes, attract premium pricing.

Figure 24 - TG’s estimated flake size distribution and indicative pricing

Category	Particle size	Distribution	Indicative price (\$/t)
Jumbo Flakes	+50# 30% up to 96% FC	35%	\$1,350
Large Flakes	-50+80# 35% - Up to 96% FC	35%	\$900
Small Flakes	-80# 35% Up to 96% FC	30%	\$650

Source: TG

- **Product flexibility.** A key advantage of TG’s planned process plant is the inbuilt flexibility to produce various products to satisfy specific customer requirements. The high purity and particle size distribution in conjunction with TG’s process flowsheet means that various products can be blended in the finishing section of the plant. This will allow the company to tailor production to individual customer requirements. Ore does not need to be “campaigned” through the plant in order to achieve this, as the blending is undertaken at the back-end of the plant through screening. Initially the company plans to offer the following products; -20+50#, -20+80#, -20+100#, -50+80#, -50+100#, -80#, -100#, +30#, +40#, or other tailored products on demand.

Figure 25 - High quality graphite concentrate from Sahamamy



Source: Optiva Securities

Site visit observations

General observations

- **November 2018 site visit.** We visited TG's Madagascar operations in November 2018. This was an informative process and resulted in us coming away with a lower risk perception for the project after having seen both operational sites in the country.
- **Expansion and footprint.** The striking element about the TG's processing plant design is that it has a very small footprint. For example, the layout for an 18,000tpa module at Sahamamy is contained within a 48m by 12m footprint. Another key advantage is that as a result of the modular nature, each expansion module is effectively self-contained and has its own front-end, which means that TG will not need to shut down the plant to undertake an expansion.

Sahamamy site visit

- **TG is already producing graphite.** Although Sahamamy is the smaller of TG's two projects at present, it was instructive to see that a quality graphite concentrate is currently being produced. Currently graphite is being produced from the existing processing plant which was inherited as part of the acquisition of Rostaing, and uses fairly rudimentary technology. The plant clearly works and we were impressed by the quality of the graphite concentrate produced. However, the plant is old and inefficient and bottlenecks exist that would inhibit further output expansion.
- **New plant at Sahamamy will improve efficiency.** The new plant will be more streamlined and will utilise TG's graphite experience to create a processing operation which is more efficient, lower cost and produces a higher purity graphite product.
- **TG has already made significant progress at Sahamamy.** The project was previously owned by a private family-run business in Madagascar for around 75 years, being the second graphite mine to start operations in the country in 1942. The mine has always been relatively small and constrained by both capital and the project's remote location. The plant was producing at a rate of approximately 20tpd at the time of acquisition with highly variable production rates. After implementing some basic plant improvements, TG had already increased production to between 50tpd and 60tpd.
- **The road is on the critical path.** The remoteness of Sahamamy means that the project has never been developed to its full potential. At present, accessing the project requires a 45min boat journey from Brickaville to Gismay, followed by a 13km approach road. Whilst TG has upgraded the approach road, a boat journey is still required. However, TG has lodged an application to the Environment Department for a new 12km road. This would connect to an existing road that runs from Vatomina to Berano. This will provide much quicker access for personnel and equipment as well as having the added bonus of allowing direct travel between Vatomina and Sahamamy. We view the road as a critical item as it has the potential to delay the construction timelines if not completed on time.
- **No opposition noted.** TG has renewed the focus on social and community relations since acquiring the project. We understand that the local villages are supportive of the project and the plans for the new road. We also witnessed that the mining activity at Sahamamy is beneficial for both the community and the environment. In times when Sahamamy has not been operating, the local population have returned to foresting activities (logging) and developing rice paddies, both of which have environmental implications.
- **Construction is underway.** We viewed the ball mill that is now at site and viewed the site of the new plant where concrete foundations being put in place for the new plant. This is virtually adjacent to the current processing operation.

Vatomina site visit

- **Good location.** Vatomina is not yet in production but the location is good, being easily accessible from the regional road network.
- **Own drill rig.** Preparation for the current drilling programme at Vatomina started in April 2017 and drilling commenced in January 2018. A significant advantage has been afforded by TG buying and operating its own rig. This has several advantages including lower drilling costs, increased flexibility, no standing time payable to contractors, and increased control over core recovery and the technical execution. The rig is also mounted on caterpillar tracks providing much better access for the rig, especially in the wet season.
- **Fully Permitted.** TG's Mining Permit covers the entire 25km² area and is valid for 40 years. This means that new resources identified in the area will not need to go through a lengthy permitting process other than standard disclosures and reporting.
- **Access and base camp improved.** Access to the site has been improved with the construction of internal roads that connect the base-camp with the National Highway. Around 15km of new road has been built, including a new bridge which covers a stream at the entrance to the permit area.
- **Construction is in full swing.** The earthworks and civils are underway ready for the construction of the processing plant. We visited the site of the new warehouse and site being levelled and cleared ready for the construction of the first 6,000tpa module. New earth moving equipment and trucks are now on site.
- **Outcrops and pits.** We visited numerous outcrops and locations of exploratory pits and examined the high-grade graphite resource in-situ.

Vatomina progress update

Vatomina remains TG's flagship project, of which TG now holds 100% equity. Work over the last 12 months has focused on de-risking the resource and metallurgy of the project. Construction is underway and TG expects to have the first 3,000tpa plant commissioned by April 2019.

Exploration and drilling – new CPR and JORC resource on the way

- **Additional resource drilling is well underway.** Around 2,700m of the current Phase 1 (3,500m) drill programme had been completed at the time of our site visit. This has been expedited by the purchase and use of TG's own diamond core drilling rig. This has reduced drilling costs measurably and improved operational flexibility. The rig is track-mounted and means that drill locations can be accessed with much greater ease and during the wet season.
- **Aim of drilling.** The aim of the drilling programme is to increase the resource base but primarily to increase the confidence in the resource, especially for the areas that will provide ore for the initial years of mining operations. Drilling is not a lengthy process as the depth of a typical hole is between 50m and 80m due to the shallow nature of the graphite mineralisation.

Figure 26 - TG's new track-mounted diamond rig on site at Vatomina



Source: Optiva Securities

- **Resource update due in late 2018.** TG has drilled 57 holes at Vatomina so far which covers approximately 33% of the mineralised area. On the back of this drilling a new CPR is currently being prepared in order to provide an updated resource which TG plans to release before the end of the year.

- **New JORC resource to replace Exploration Target.** The previous 2015 CPR outlined ascribed an initial Exploration Target of 6.5Mt to 13.1Mt with grades ranging from 2-11% fixed carbon. Note that this exploration target was based on only 1.15km² of the total 6km² licence area, and only down to a depth of 30m, with depth limited more by the available geophysical data, not by a mineralisation cut-off. The new resource will replace the Exploration Target with a Mineral Resource compiled to JORC standards.
- **50Mt potential.** TG believes that there is potential to outline a JORC-compliant resource of up to 50Mt at c.8% TGC, containing 4Mt of flake graphite. The next iteration of the resource is unlikely to be of this magnitude, but this remains the company's overall project target.
- **Well-explored.** The permit area is well explored and along with the historical data, TG has undertaken comprehensive mapping and test pitting which in combination with the recent drilling provides more confidence on the scale of the potential resource.

Figure 27 - Graphite in outcrop and test pit at Vatomina



Source: Optiva Securities

- **Further drilling to come.** The CPR is being prepared based on the current drilling to date (57 holes) but with the advantage of owning its own rig, TG plans to continue drilling to continue to resource expansion process with balanced exploration across both projects.
- **Rig to move to Sahamamy.** The rig will shortly move to Sahamamy to commence the process of updating the CPR and a resource update at the project.

Successful metallurgical testing

- **Ongoing de-risking.** As part of the process to de-risk the processing component of the project, TG has undertaken further metallurgical test work. TG commissioned the services of the Institute of Minerals and Materials (IMMT) in India. IMMT performed detailed metallurgical tests in order to optimise the process flow sheet. In conjunction, TCCPL were engaged to advise on the selection and manufacture of technology and equipment.
- **Lab results received.** In October 2018, TG received the results of laboratory test work and based on the mineralogical and liberation studies, IMMT developed a new front end of the plant with the following benefits:

Processing benefits:

- A new graphite flake extraction step prior to the use of grinding was proposed.
- The new process resulted in the removal of a substantial portion of the impurities, including the clay component which can inhibit efficient processing
- An added benefit is also the reduction in the onward quantity of material entering the grinding process, resulting in higher throughput.

Pilot-scale testing – slightly higher capex but considerable reduction in opex

- **Capacity expansion.** TG sent 20 tonnes of graphite ore mined from Vatomina as part of an exploratory mining programme to IMMT for pilot-scale testing. IMMT's testwork helped define the final process flow sheet and the design for various plant modules. The result was that the capacity of the modular plants was reassessed with a 20% increase in capex, but resulting in a 50% increase in module capacity from 12,000tpa to 18,000tpa.
- **Lower opex.** Although this increased the initial capital cost, it also resulted in a concomitant reduction in forecast operating costs.

Equipment manufacture is underway, construction has commenced

TG has identified a non-mineralised area within the licence area which has been deemed suitable for the location of the process plant and site construction is underway. The process flowsheet and engineering design has been completed by utilising TG's proven expertise in designing and manufacturing graphite process plants.

- **Manufacturing underway.** Equipment manufacturing process for the first plant has already commenced and is being built entirely in-house at TG's engineering facility in India. TG estimates that the manufacture of plant equipment will be completed during the current quarter. A number of containers have already been shipped from India and are enroute to Tamatave port.
- **Construction.** Early Civil works and construction of the foundations for the main plant and ancillary buildings has commenced. Earthmoving equipment is on site with the capacity to move c.300m³ of earth per day, with initial activities starting in September.

Figure 28 - Earth moving equipment on site and site clearance well advanced



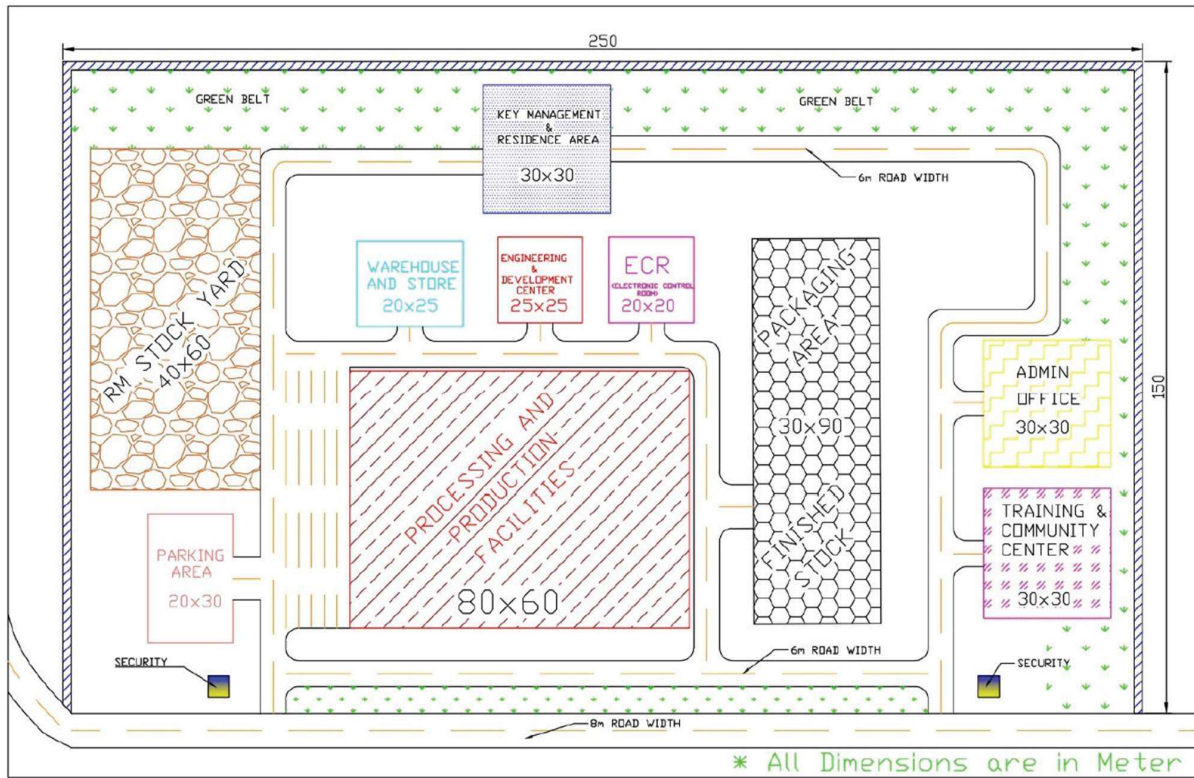
Source: Optiva Securities

Figure 29 - Foundations for warehouse and site clearance for processing plant



Source: Optiva Securities

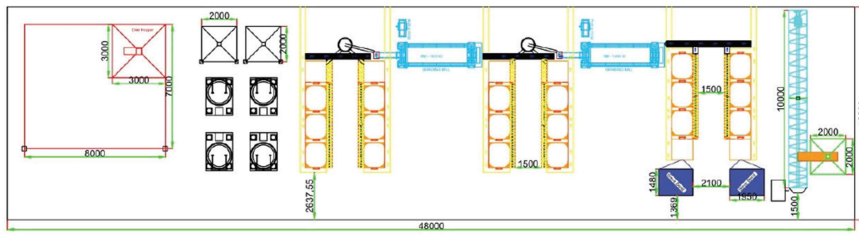
Figure 30 - Key layout plan for the plant area at Vatovina for total 60,000tpa capacity



Key layout plan for the plant area for 60,000 TPA build-up

Source: TG

Figure 31 - Proposed plant layout – 18,00tpa plant



Source: TG

Infrastructure upgraded

- **Getting ready to become a producing asset.** TG has made considerable progress in upgrading the infrastructure on site at Vatovina, as we saw on our recent site visit. The external infrastructure, i.e. the access to National Highway No 2 to Antananarivo and Tamatave port is in a good state and so the focus was on the internal infrastructure within the permit area. As part of this upgrade process, TG has constructed an 11m bridge to cross a stream near the entrance to the permit area. The all-weather bridge ensures the connection to the highway is passable and will be a critical element during both the construction and production stage. Internal roads connecting the base-camp, processing plant site and highway have all been upgraded, amounting to 15km.

Figure 32 - New bridge on the Vatovina permit



Source: Optiva Securities

Sahamamy Progress Update

- **Acquisition completed.** In October 2017, TG entered into a binding agreement to acquire the Sahamamy graphite project from Etablissement Roastaing, a private company in Madagascar. Sahamamy is a producing flake graphite mine located 8km from Vatomina. The Project is located approximately 63km from the seaport of Tamatave and 130km from Brickaville, the nearest town in central eastern Madagascar. TG took effective control of the project on 1st January 2018.
- **Approach road upgraded.** One TG's priorities after acquisition was to rehabilitate the internal roads at the project, namely the 13km approach road from the river to the mine site. The road has been widened to 6m and appropriate drainage and stope stabilisation installed.
- **Link to Vatomina on the critical path.** The next key priority for TG is to construct a new 12km road to link up with the existing road that runs from Vatomina to Berano providing access to the main highway that runs to the capital Antananarivo and Tamatave port. The route has been surveyed and agreed and TG just awaits the final environmental permit. We view the road as a very important component of the construction phase given the remote location of the project. Once constructed the road will allow much quicker access for equipment and machinery coming in from Tamatave port and also expedite the movement of personnel and equipment between Sahamamy and Vatomina. TG anticipates that the road will be completed during 2019. Once in place, this will make it possible to travel between Sahamamy and Vatomina in 30-45mins.

Figure 33 - Upgraded approach road to Sahamamy and view of existing plant site



Source: Optiva Securities

- **Expanding the footprint.** The mine and existing plant at Sahamamy are spread over 8km² of mining permits, and TG has applications underway to secure a further 8km² in an area highly prospective for graphite mineralisation. Historically, mining has been focused on 1km band of graphite trending east-west, with most of the activity concentrated on a well-investigated 400m strike length, where the graphite exposures develop a width of between 40m and 50m.
- **Sahamamy potentially higher grade and more drilling to come.** TG sees significant potential to expand the resource base at Sahamamy and drilling will commence again once the rig finishes the current programme at Vatomina. Furthermore, TG believes that Sahamamy may have a grade advantage over Vatomina which may have an impact on the company's future expansion strategy.

- **TG is familiar with the graphite product at Sahamamy.** For the last three years TG has been buying 100% of the graphite produced. Consequently, TG is comfortable with the particle size distribution, grade and quality, with production demonstrating that the flake size is good, being predominately large to jumbo flake size, and similar to the product generally received at TG’s Indian facility.
- **CPR completed.** After acquisition, TG inherited significant amounts of historical data. No systematic exploration or drilling had previously been conducted on the site. As such, TG commenced various activities including compilation of historical data, new topographic surveys, geophysics, sampling and auger drilling. This work supported the production of a CPR and maiden resource estimate prepared to JORC standards which was published in October 2018.
- **Two blocks.** The project is split into two areas; the southern block termed “Sahamamy” which hosts the current resource and where mining and processing activity is currently being undertaken. The northern block termed Sahasoa is earlier stage and only geological mapping and topographic data has been collected so far. Nevertheless, due to the long history of mining in the area the presence of graphite-bearing gneisses is well documented and has been traced throughout the area at up to a 50m vertical depth.
- **Excellent geology.** Graphite mineralization occurs in the strata bound form and the main host rock is graphitic gneiss in which graphite occurs as small to jumbo size flakes. Concentrated high grade graphite ore occurs along shear zones in powdered and small flakes forms. In highly weathered graphitic gneiss (sapolite) up to 25m depth graphite flakes occurs as free disseminated medium to jumbo size flakes.
- **Maiden JORC resource.** The maiden resource estimate is based solely on the Sahamamy block with resources estimated down to a vertical depth of 10m for the Indicated category and 50m for the Inferred category. The Total resource amounts to 13.6Mt at 5.5% GC. TG believes that there is considerable potential to expand the current resource base.

Figure 34 - Sahamamy Resource

Category	Tonnes (Mt)	Grade %GC	Contained GC (kt)
Measured	-	-	-
Indicated	2.9	5.5%	160
Inferred	10.7	5.5%	589
Total	2.9	5.5%	160

Source: TG

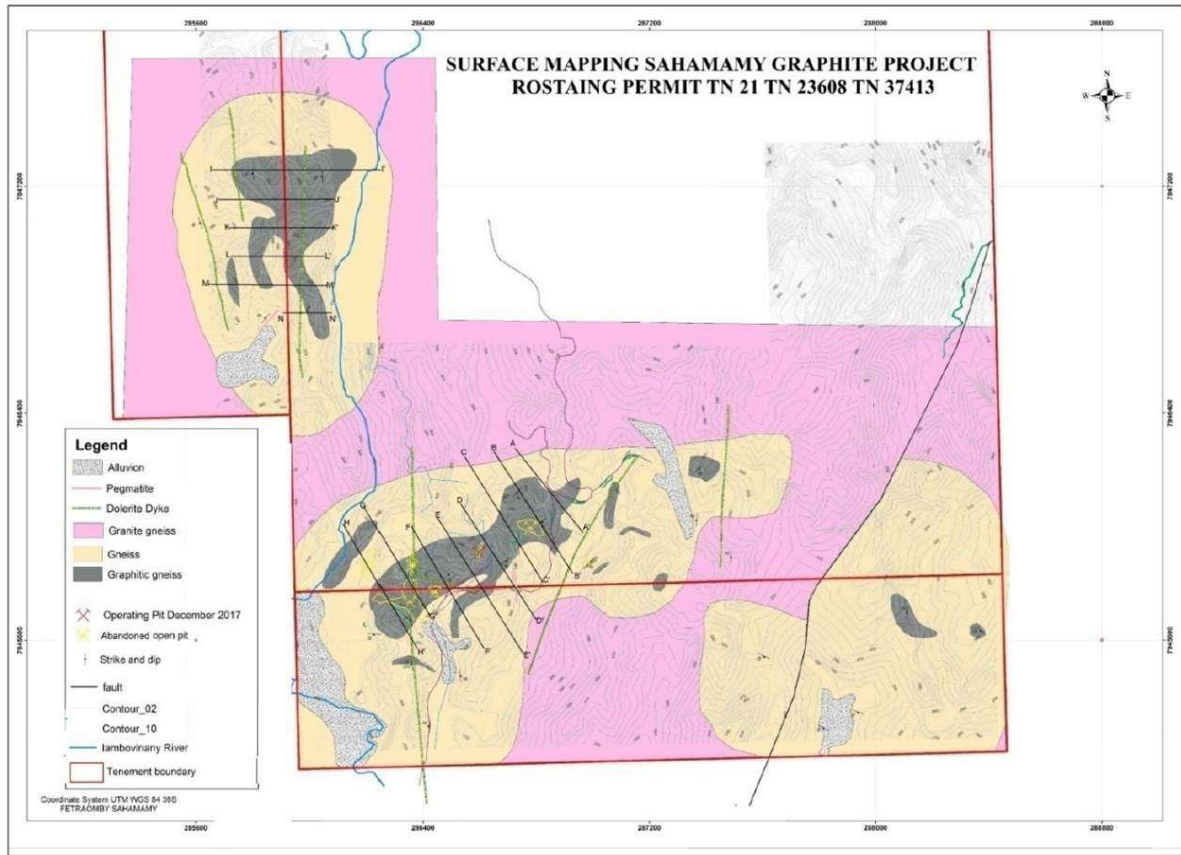
- **Exploration target.** Given that comprehensive exploration has not been undertaken at Sahasoa and the limited data density, it has only been possible to define an Exploration Target and not a Mineral Resource estimate. The Exploration Target amounts to 15.1Mt at 5.5% GC. This is based on geological mapping, tracing the host gneiss body across the permit area and similar geological assumptions derived from the Sahamamy block.

Figure 35 - Sahamamy Exploration Target

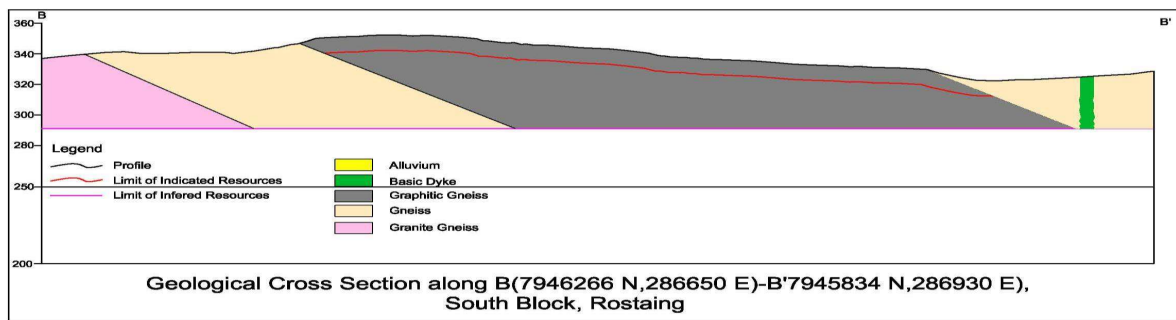
Target Estimation	Tonnes (Mt)	Grade %GC	Contained GC (kt)
Exploration target	15.1	5.5%	830
Total	15.1	5.5%	830

Source: TG

Figure 36 - Sahamamy Geology



Cross section through Sahamamy resource



Source: TG

- Production turn-around at existing plant.** Prior to the acquisition by TG, the Sahamamy was producing graphite at the rate of approximately 250tpa, or about 20tpm. By taking some remedial steps and implementing various low-cost optimisations at the existing plant, TG has successfully improved plant availability and increase production. The plant is running a 40-50tpm equating to annualised rate of 600tpa. Whilst this is highly encouraging and demonstrates TG’s graphite processing expertise, TG deemed that the plant is not capable of being expanded to 3,000tpa. Thus the strategy is to build new plants which are more efficient and close down the existing plant.
- Construction underway.** TG plan is to build the new process plant adjacent to the existing plant. Construction has started and on our recent site visit we saw the foundations for the new plant being installed. In addition to the new plant, TG is in the process of strengthening the earth-moving fleet. As at Vatomina the plant will be constructed according to TG’s high standards and will be significantly more efficient compared to the existing plant.

Figure 37 - Construction photos – new mill being installed at site of new plant

New plant foundations



Ball mill being installed (November 2018)



Graphite concentrate bagged and read for shipping



New generator on site



Source: Optiva Securities and TG

- **Initial 3,000tpa plant.** The first stage of development will be the planned installation of a 3,000tpa plant. TG expects the plant to be up and running by the end of 2018. The modern plant will produce a completely finished graphite product suitable for direct sale to customers.
- **21,000tpa.** Stage 2 will be to add 18,000tpa module, bringing total production at the project to 21,000tpa. Stage 2 would be contemplated once the road is complete.
- **Opportunity for Hydro-power.** Current power at Sahamamy is provided by diesel gensets, but the project has existing hydropower infrastructure in place. This would need to be rehabilitated and TG plans to look into the potential to for hydro to power the project. Advantages include potentially lower power costs, stability and logistics benefits, with hydro negating the need to transport fuel to site.

Tirupati Speciality Graphite (TSG)

- **Downstream business acquired.** TG has now acquired a 100% interest in TSG – “Tirupati Speciality Graphite” which was established by TCCPL India to develop downstream value-added flake graphite processes. We view this as a pivotal development for TG by exposing the company to the entire flake graphite value chain.
- **Raw material source from Madagascar.** The raw graphite material for use in the TSG downstream process will be sourced from TG’s operations in Madagascar which will/already produce high-quality flake graphite ideal for further processing.
- **Two main markets.** The downstream markets for flake graphite can broadly be split into two parts, of which TSG will have exposure to both:
 - **Particle-size graded normal purity products** – this are the conventional grades used in typical mainstream industrial applications, as well as being the input material for further downstream processing. These products typically have a purity range of 90-96% and sizes ranging from >300µ (50#) to <150µ (100#).
 - **Special graphite products.** This includes processed and shaped products and high purity flake products for high-tech applications. These include products such as spherical graphite, micronized graphite and graphene.
- **Four main value areas to produce a total of 20,000tpa value-add graphite flake products.** TG anticipates developing this in two stages using modular design with each stage being 10,000tpa.
- **Phase 1** – High purity and expandable graphite production totalling 10,000tpa.
- **Phase 2** – Additional purification capacity, micronizing and shaped graphite production and other derivatives, increasing production to 20,000tpa.
- **A low-cost / high-margin business.** TG estimates that on average, the downstream graphite products will have an EBITDA per tonne of >\$1,000/t.

Figure 38 - 20,000tpa total capacity – four main downstream product streams at TSG

Expandable graphite	Spherical graphite	Colloidal and micronized graphite	Graded high-purity graphite flakes
6,000 tpa	4,000 tpa	4,000 tpa	6,000 tpa
Fire retardants Sheets & gaskets Thermal management	Lithium-ion batteries	Lubrication Friction & insulation Conductive polymers Composites	High-end refractories Graphene Input material for further processes
US\$2,500 - \$5,000	US\$3,200 - \$3,700	US\$2,000 - \$3,000	US\$1,750 - \$3,000

Source: TG

Pilot plant already operating

- **Pilot plant.** TG is in the process of completing the development of a 1,200tpa pilot-scale flake graphite fire retardant additive plant. The plant is located in Patalganga, near Mumbai, India.
- **Capex sunk.** The capital expenditure for the plant has already been completed and TG is in the process of final commissioning. Flake graphite finishing facilities (screening and blending) are also being installed in order to accurately tailor conventional graphite products for various end uses.
- **Developing markets.** The ability to accurately product specific product qualities and blends is part of TG's strategy to develop end-user based markets for its high quality production, with the Indian market being a key focus.
- **Commercial operations to commence by the end of the year.** TG anticipates that commissioning will be completed by the end of 2018. TG starting shipping graphite product from Sahamamy in October 2018.

Figure 39 - 1,200tpa fire retardant facility near Mumbai India

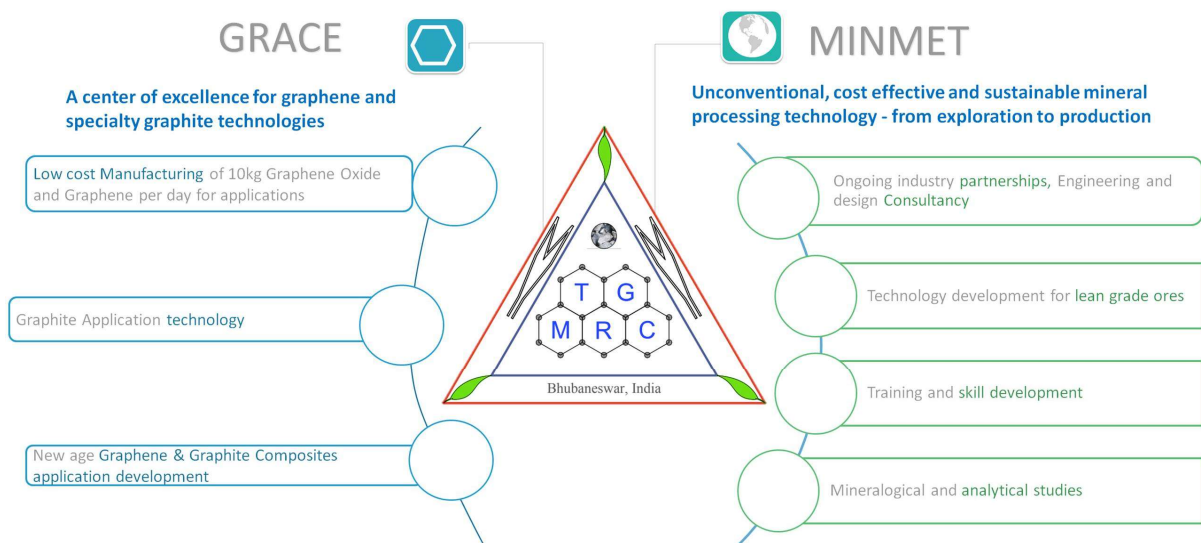


Source: TG

Tirupati Graphene and Mintech Research Centre

- **A graphite industry focused centre.** TSG is also in the process of establishing a TGMRC, or to give it its full name the Tirupati Graphene and Mintech Research Centre. This will be a fully integrated technology and research centre and has two primary aims:
 - To support TG’s downstream graphite business with a focus on advanced graphite applications, composites and graphene. The primary aim is to develop commercially viable graphene oxide and graphene production technology. This includes developing products for energy devices, coatings, membranes and conductivity applications.
 - Generate revenue in its own right through technology development, research services and consultancy.
- **Two major divisions:**
 - GRACE – A centre for excellence for graphene and speciality graphite products
 - MINMET – Mineral processing technology, research and consulting

Figure 40 - TGMRC – Division overview



Source: TG

GRACE

GRACE will be a comprehensive centre for the development of advanced knowledge and technology on the processing and application of natural graphite and industrial carbons. A real focus here is on high value, high-purity products such as colloidal graphite and graphene, for electrodes, cathodes, refractories, lithium-ion batteries and other downstream products. TG is developing a 10kg per day production facility.

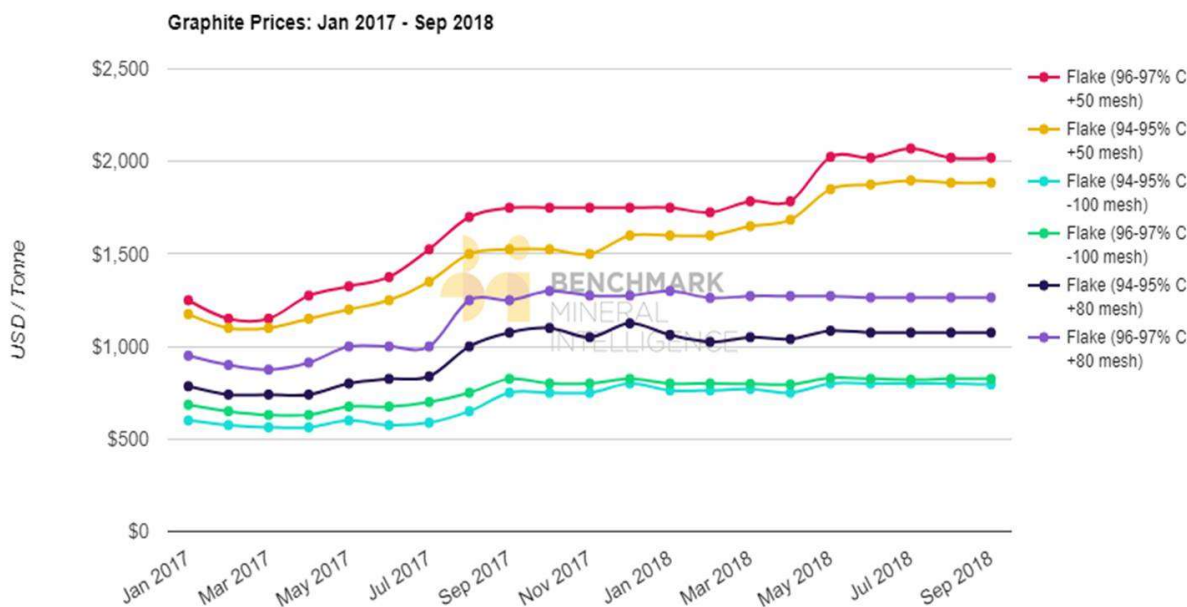
MINMET

MINMET will be the research division that will focus on research and development into graphite related processing technologies. The division will also branch out into revenue generating consultancy services.

Recent Graphite Market Developments

- A strategic mineral.** Graphite remains a critical strategic mineral, classified as supply critical by the US Government, and a critical raw material by the European Union. Currently, market interest remains focused on the large and jumbo flake-size graphite, as there continues to be a considerable decrease in the supply of premium concentrates in the market.
- Special properties make it hard to replace.** Graphite remains a fairly unique mineral – a crystalline form of carbon and importantly, it is not a metal. Graphite has extremely high electrical and thermal conductivity, it is inert, has high chemical stability, a low weight and superior expansion properties. Furthermore it is resistant to corrosion and very high (c.3,000°C temperatures).
- A vast number of applications and growing... EV is not the only game in town.** We view the graphite market as being in a transitional phase with several key macro and micro trends driving new applications of graphite. The projected build out of EV capacity is clearly a key driver, however, we see a raft of other technology and construction applications that along with EVs and batteries have considerable scope to disrupt the graphite market.
- Strong price growth for high purity and large flake.** Flake graphite prices are dictated by three primary factors; **1.)** Carbon purity (most consumers require purity up to 96%), **2.)** Flake size with larger mesh sizes demanding a premium, typically prices increase rapidly for sizes greater than +80 mesh. **3.)** Value-add product; customers are becoming more discerning and have tighter specifications for value-add downstream graphite products. Recently, the industry has seen price increases across all flake-size distributions.

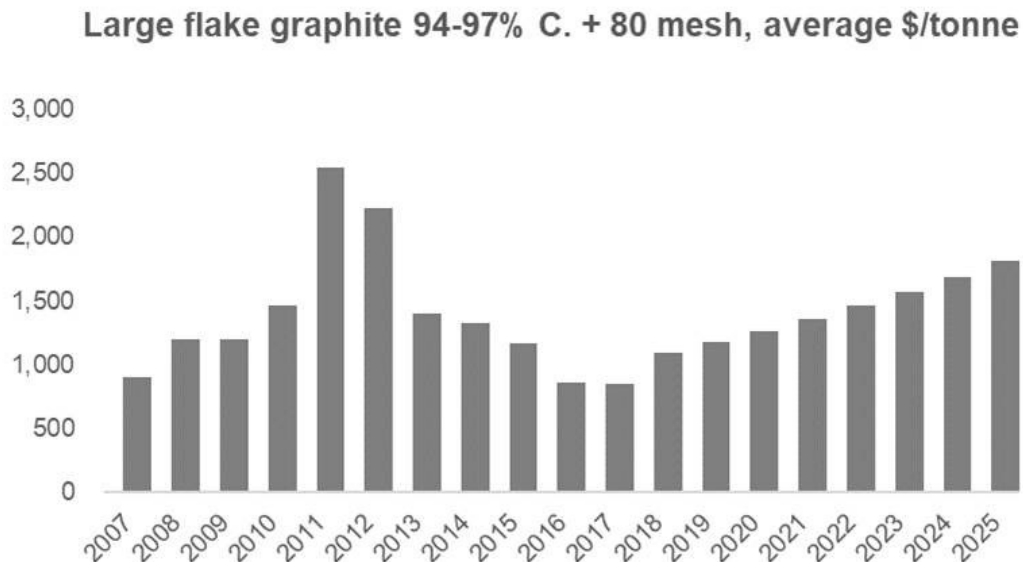
Figure 41 - Prices on the turn for high-purity, larger flakes



Source: Benchmark Mineral Intelligence

- **Strong price CAGR expected.** Fast Markets, the specialist consultancy, forecasts strong CAGR price growth in the high purity and large flake distribution. Whilst the market stabilised in 2016 and 2017, large flake graphite prices remain under upwards pressure and we see the start of a new growth phase.

Figure 42 - Strong CAGR forecast for larger flake sizes



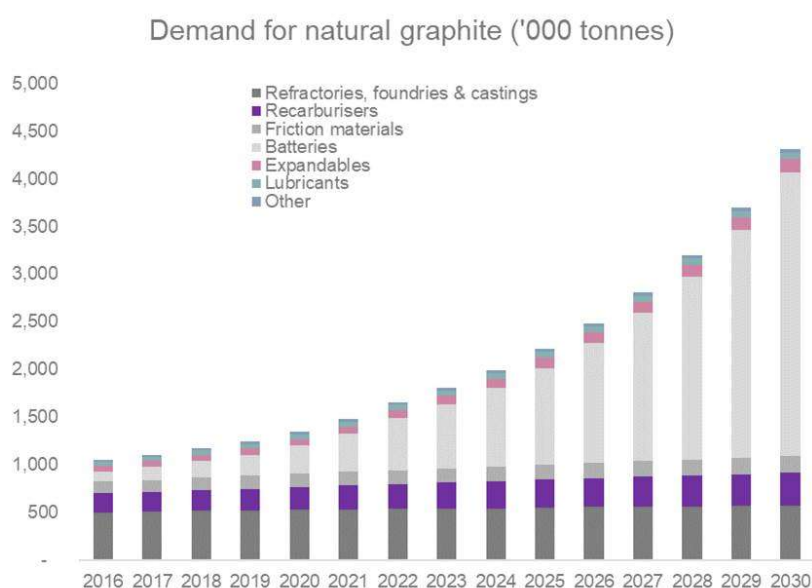
Source: Fast Markets

- **China's 3-year Blue Sky policy.** Weaker supply coming out of China is being exacerbated by the continued environmental crackdown in the country to counter the growing pollution problem. In July, China released a three year "blue sky" action plan, aimed at tackling the problem and producing tangible results by 2020. The plan extends pollution controls to 82 major cities across China. Under the plan, "polluters" will receive punitive charges with the introduction of a national pricing system for carbon emissions amongst a raft of other stringent measures.
- **Impact on graphite production.** These measures will continue to impact production from blast furnaces and sinter plants, shuttering a component of low-quality and polluting stainless steel supply. Whilst this results in lower steel production, it has prompted a rise in scrap recycling and steel production from greener sources (e.g., more from EAF furnaces and less from Blast furnaces). The key point here being that electric arc furnaces do not require coal to produce steel like blast furnaces, instead an EAF utilises a graphite electrode to generate heat through electrical conduction to produce crude steel from scrap. According to Nikkei, China is urging domestic steel producers to switch to EAFs, with the aim of raising the proportion of such output to 20% from less than 10% currently. As well as the impact on the steel industry, the regulation also affect producers of graphite electrodes and many graphite operations in Shandong have been affected by the regulations, resulting in the closure of some operations.

Supply and demand issues

- **Increased scrutiny.** Similar to the diamond, cobalt and tantalite industry, the graphite supply chain is increasingly being put under scrutiny. Working from the top down, battery manufacturers are being put under growing pressure to ensure that the supply of graphite is sourced from environmentally responsible producers.
- **China production may have peaked.** BMI believes that China may have reached peak graphite production, due to the raft of environmentally led closures, in addition to the shuttering of marginal producers and high cost mines. Many of the new domestic projects coming on stream in China are lower grade, and have a lower proportion of flake graphite. This compounds the issues for the Chinese supply pipeline, where domestic production has been in decline since 2011.
- **Chinese flake production declined.** Plant inspections and closures of Chinese graphite operations in 2016 and 2017 have reduced Chinese domestic flake graphite production by approximately 30%. Limited supply is due to come on stream from the rest of the world, and the majority of new projects are located in Africa. Fast Markets believes that China's dominance in natural graphite production will reduce, and although the country will continue to control the majority of production and processing, it is being reported that Chinese mines lack significant resources of large and jumbo flake graphite.
- **New supply response is uncertain.** Despite numerous projects in the development pipeline, significant barriers to entry, especially within higher-value add processing applications. Graphite deposits are not rare per se, but defining a resource of sufficient size with favourable graphite quality is more problematic. Furthermore, although processing is technologically simple, it remains difficult to consistently produce a graphite product that meets the ever more stringent specification of end users.
- **Balama is now in production but still room for others.** Syrah Resources' Balama project in Mozambique, with the world's largest graphite resource, is now in production and will produce most of the incremental increase in global supply over the next couple of years. However, production ramp up has been challenging and the company has not yet met initial guidance. Even with Balama at full pelt, most industry commentators continue to forecast a significant global deficit by 2020.

Figure 43 - Natural flake graphite forecasts out to 2030



Source: Roskill

- **No new projects.** Fast Markets reports that “No new projects are expected to come on stream in 2019 except Tirupati Graphite”.
- **Demand growth.** Natural graphite production in 2017 amounted to 1.1Mt but Fast Markets estimates that this will increase to over 2.7Mt, a 150% increase by 2027.
- **Applications and key demand growth issues.** There are hundreds of various uses for graphite, but the key growth application is in the manufacture of lithium-ion batteries, where graphite is used to manufacture the anode. Traditionally, graphite demand was driven by industrial use and applications in steel, but the future demand landscape now looks to be dominated by battery applications, both for lithium-ion batteries for electric vehicles and large-scale energy storage such as vanadium redox batteries. The end-use split is currently Steel (50%), Batteries (15%), Other (35%).

Figure 44 - Graphite uses – over 150 applications

<u>Large Flake 20 – 80 mesh</u>	<u>Medium Flake 80 – 150 mesh</u>	<u>Small Flake 100 mesh to Micronised</u>
Gaskets and Seals	Basic Refractory:	Paintings & Coatings
Flame Retardants	Magnesia Carbon	Pencils
Thermal sheets	Alumina Carbon	Dry & Ni MH Batteries
Fuel cells	Unshaped Refractory	Lubrication
Plugging Agents	Flame Retardants	Friction Materials
Expandable Graphite		Composites
Thermal Management		Li-ion Batteries
		Aviation & Space Technology
		Nuclear Technology

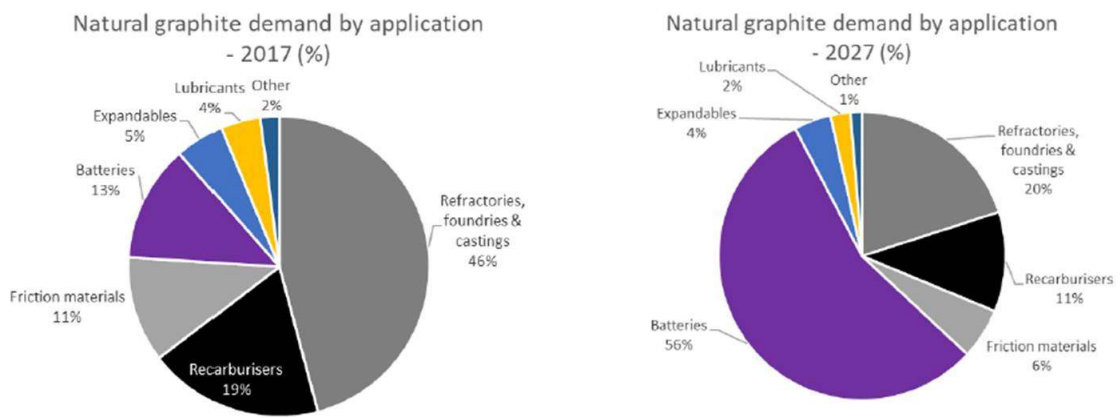
Sectors = High growth, over 7% CAGR projected

Source: Fast markets

- **EVs remain the future driver.** The build-out and penetration rate of electric vehicles (EV) remains uncertain, but the over the last 2 to 3 years EV penetration rates have increased markedly. Under almost any forecast regarding the rate of EV adoption, lithium-ion battery use increases exponentially which should have a positive impact on graphite demand. It can take up 3 times more graphite than lithium to manufacture a lithium-ion battery, and based on current battery technology, electric vehicles can contain anywhere between 45kg and 100kg of graphite. Despite the name, lithium-ion batteries are actually much bigger consumers of graphite than lithium. **Fast Markets forecasts a 32% CAGR for batteries between 2017 and 2022.**
- **Flake graphite preferred.** Significantly for upcoming producers such as TG, large flake graphite is the preferred feed for the Lithium-ion battery industry. World consumption of flake graphite is approximately 650ktpa, but this is expected to grow significantly.

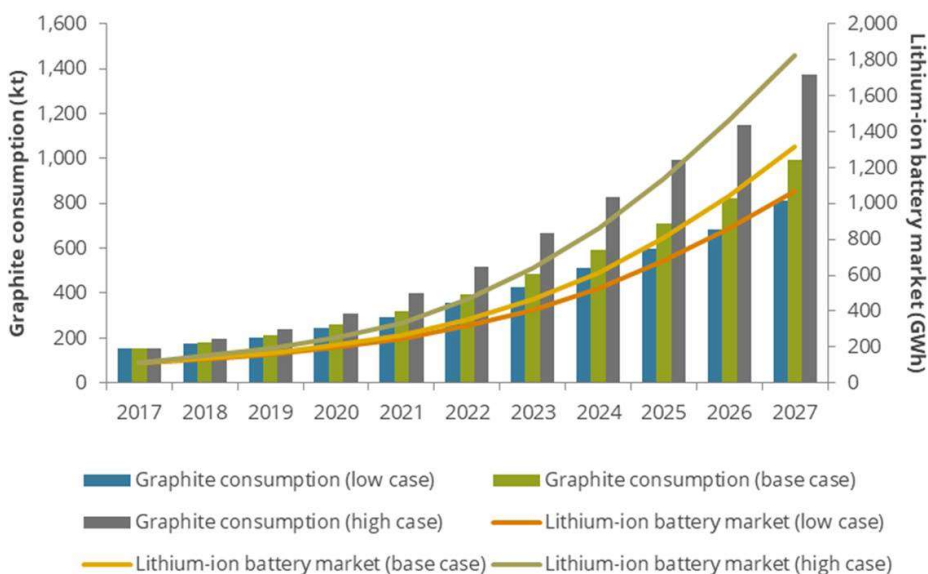
- Battery use and electric vehicles will increasingly underpin demand.** The key growth area for batteries is clearly electric vehicles (EVs) and the growth of dedicated mega-factories such as Tesla’s new Gigafactory in Nevada which will produce 500,000 batteries annually (c.42kt of graphite requires). BMI predicts that the mega-factory capacity in the pipeline alone will require 440kt of graphite anode, up from 100kt. Furthermore, this is based on the demand scenario for 372GWh by 2021, and by 2025, the group forecasts that EV demand will put this figure up to 500GWh. There are approximately 15 lithium-ion mega-factories planned worldwide by various companies.
- New registrations of EVs** hit an all-time high in 2017, with over 1 million sales worldwide, according to IEA data. Norway achieved the fastest growing deployment of EVs, but in terms of overall size, China still leads the way, accounting for more than 40% of all electric cars sold worldwide, double the amount sold in the US. The global stock of EVs has now surpassed the 3 million mark, an expansion of 50% from 2016.

Figure 45 - The changing face of graphite demand by application – rise of the battery



Source: Fast markets

Figure 46 - Forecast graphite consumption and Li-ion market



Source: Roskill

Demand for graphite in steel applications is stable/flat

Demand for graphite in steel applications remains stable and still represents approximately 50% of global graphite consumption. In part, sluggish demand from the steel sector was one of the primary causes for the price erosion seen from 2012 onwards. Graphite is used in the electrodes for both electric arc furnaces and ladle furnaces, and as well as a refractory for furnace linings, and as an agent to increase the carbon content of steel. We see any declines in graphite demand for steel being outweighed by increases in other areas.

Flame retardants and other expandable graphite applications. The market for flame retardant building materials and other expandable graphite applications is growing rapidly. The potential demand growth for flame retardants has been highlighted recently by the Grenville Tower tragedy in London. Furthermore, the Chinese and South Korean governments have now recommended the use of flame retardant building materials in future construction.

Small but high-value. Thus, what was once a relatively small and specialised sector of the graphite market could be set to grow considerably. This is particularly good news for large flake producers such as TG because coarser flake graphite typically has higher expansion ratios than smaller flakes. Other growth areas include graphite foil which is widely used in LEDs, smart phones, tablets, laptops and other electronic products. The fire-retardant demand segment is high value per tonne but at present a relatively low volume market. We see this as a major growth market for graphite.

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