

## Applied Graphene Materials

Tech hardware & equipment

13 September 2021

### Delivering the potential of graphene

Applied Graphene Materials (AGM) specialises in providing graphene in the form of dispersions of nanoplatelets that can be readily incorporated by customers into their products. It is initially concentrating on the global protective coatings and composite materials markets where the financial benefits of the performance enhancements achievable from incorporating graphene may be calculated, encouraging adoption.

### Graphene has exceptional properties

Graphene's novel single layer structure gives it unusual and desirable properties. However, incorporating graphene into materials so that these desirable properties are transferred has proved difficult, so graphene as a materials technology has taken a long time to live up to its early hype.

### Enhancing performance of coatings with graphene

AGM's commercialisation strategy addresses the key issues delaying graphene adoption. (1) Although its products have attracted interest from potential customers in a diverse range of markets, AGM is currently focusing primarily on the global protective coatings market where it has recently established a global network of distributors to accelerate roll-out. (2) Rather than investing in the development and marketing of end-products containing graphene, AGM is selling graphene additive dispersions to customers with extensive experience of the coatings market, which use the material to enhance the performance of their products. (3) AGM sells customers graphene formatted as additive dispersions of nanoplatelets. This makes it easier for them to incorporate graphene in their products in a repeatable, consistent fashion at volume, thus helping cut the time it takes for customers to develop their graphene-enhanced products. Similarly, AGM is engaged in programmes incorporating graphene into composite materials used in the aerospace industry and into thermal adhesives for a broad range of applications.

### Scenario analysis

Engagement so far has been with numerous relatively small coatings customers, so at the end of January 2021, management had identified an opportunity pipeline totalling £7.6m annual revenues (£3.0m probability weighted). Our scenario analysis extends to annual revenues of £25m, which is a very small proportion of the total global protective coatings market (2019: US\$146.2bn). This analysis shows that the pipeline at end January 2021 is not sufficient to take AGM to cash break-even, which is reached at annual revenues of around £10m. We note that AGM will require additional capital investment of around £2m to support £10m annual revenues.

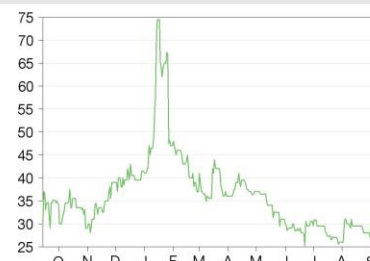
#### Historical performance

Year end	Revenue (£m)	EBITDA (£m)	PBT* (£m)	EPS* (p)	DPS (p)	P/E (x)
07/18	0.1	(4.0)	(4.2)	(7.5)	0.0	N/A
07/19	0.1	(4.6)	(4.8)	(7.9)	0.0	N/A
07/20	0.1	(3.1)	(3.5)	(6.1)	0.0	N/A

Source: Company data. Note: \*PBT and EPS are normalised, excluding amortisation of acquired intangibles, exceptional items and share-based payments.

Price **28.5p**  
Market cap **£18m**

#### Share price graph



#### Share details

Code	AGM
Listings	AIM, OTCQX
Shares in issue	64.3m
Net cash (£m) at end January 2021 excluding finance leases and cash from January placing of £5.5m net	2.3

#### Business description

Applied Graphene Materials (AGM) develops graphene dispersions that are used by customers to enhance the properties of coatings, composites and functional materials. It also manufactures high-purity graphene nanoplatelets using readily available raw materials instead of graphite.

#### Bull

- Understanding of dispersion technology enables AGM to support customers developing commercial applications.
- Standardisation of some graphene dispersion products reduces length of sales cycle.
- Expansion of distribution network accelerates the pace of introducing AGM's dispersions.

#### Bear

- Revenue development dependent on success of individual customer product launches.
- Extensive testing required prior to customer acceptance.
- COVID-19 pandemic prolonging sales cycles and dampening demand from end-users who cannot access sites to deploy coating products.

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**Applied Graphene Materials is a research client of Edison Investment Research Limited**

## Investment summary

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### **Company description: Enhancing materials' performance with easy-to-incorporate graphene**

AGM develops graphene dispersions that are used by customers to enhance the properties of coatings, composites and functional materials. It also manufactures high-purity graphene nanoplatelets using a proprietary process based on sustainable, readily available raw materials instead of graphite. In October 2019 management announced it was re-aligning resources around dispersion and application technology to better support product development with those customers presenting the nearest-term revenue opportunities. This focus has supported six customer launches of coating products containing AGM's graphene dispersion during CY19, six in CY20 and four so far in CY21. The product launches so far have been for both mass-market and specialist applications, although with relatively small-sized companies. AGM is also working on longer-term projects incorporating graphene into composite materials used in the aerospace industry and into thermal adhesives for space and other applications.

### **Financials: Cash runway well into calendar 2023**

Revenue from the sale of production orders of graphene and evaluation quantities of graphene to commercial partners grew by 20% year-on-year during H121 to £42k. EBITDA losses (adjusted for exceptional costs but not share-based payments) narrowed by £0.3m to £1.6m, reflecting the impact of the realignment programme on staffing costs. Net cash (there is no debt except for modest IFRS 16 lease liabilities) reduced by £1.4m during H121 to £2.3m at the end of January. This excludes £5.5m (net) raised during January through a placing, subscription and PrimaryBid offer at 41p/share and a £0.5m R&D tax credit, neither of which were received until after the period end. Management estimates that the funds raised have extended the company's cash runway from October 2021 well into CY23, enabling it to convert the current opportunity pipeline into meaningful recurring revenues during the period.

### **Scenario analysis**

Management has not provided any guidance regarding revenue growth. At the end of January 2021, management had identified a probability weighted sales opportunity pipeline totalling £3.0m annual revenues, which we believe it is reasonable to assume would be converted in the next year or two. Our scenario analysis extends to annual revenues of £25m, which is a very small proportion of the total global protective coatings market (US\$146.2bn in 2019 according to Grand View Research). While higher revenues are possible, we are not presenting these at present because AGM has yet to achieve product approval with any of the larger players in the protective coatings market, which management notes are highly conservative, and the projects in the aerospace sector have not yet reached the commercial stage. The analysis shows that this pipeline is not sufficient to take AGM to cash break-even, which is reached at annual revenues of c £10m. We note that AGM will require additional capital investment of c £2m to support £10m of revenues.

### **Sensitivities: Dependent on the success of customer launches**

The key sensitivities as we see them are the following: (1) the dependence of AGM's revenue development on the success of individual customer product launches; (2) AGM's ability to protect its IP and process know-how; (3) restrictions on use of new materials, which have to be extensively tested by regulatory bodies for toxicity; and (4) we do not believe that AGM will have achieved break-even by the time it reaches the end of the current cash runway, but it should be in a good position to raise additional finance if it is generating meaningful revenues by that point.

## Company description: The graphene solution

AGM develops graphene dispersions that are used by customers to enhance the properties of coatings, composites and functional materials. It also manufactures high-purity graphene nanoplatelets using a proprietary process based on sustainable, readily available raw materials instead of graphite. In October 2019 management announced that it was re-aligning resources around dispersion and application technology to better support product development with those customers presenting the nearest-term revenue opportunities. This focus has supported six customer launches of coating products containing AGM's graphene dispersion during CY19, six in CY20 and four so far in CY21, albeit all with relatively small companies. These launches are for both mass-market and specialist applications. AGM is also working on longer-term projects incorporating graphene into composite materials used in the aerospace industry and into thermal adhesives for space and other applications. Revenues are still modest, £42k in H121, but the opportunity pipeline at the end of January 2021 totalled £7.6m (£3.0m when probability weighted).

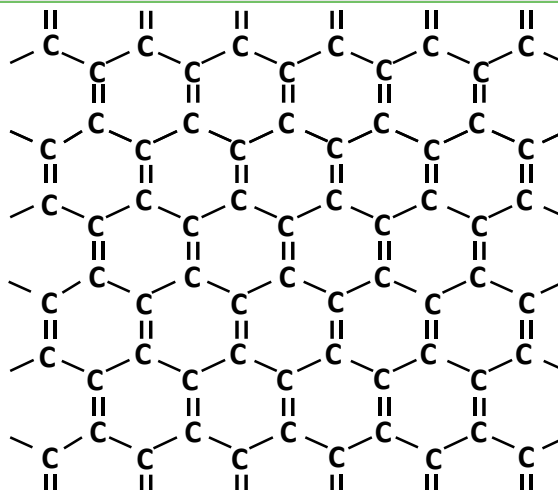
When graphene was discovered by researchers at the University of Manchester in 2004, it was dubbed a 'wonder material' because of its unusual and desirable properties. However, incorporating graphene in materials such that these desirable properties are transferred has been elusive, so graphene has failed to live up to its early hype. AGM stands out from other graphene manufacturers because it offers graphene in a format that is safer and easier for volume manufacturers to incorporate in their products. Additionally, it is working with customers on applications where the enhanced performance attributable to the incorporation of graphene nanoplatelets delivers quantifiable economics benefits, helping justify the price premium for graphene-enhanced materials.

AGM was founded by Professor Karl Coleman in 2010 to commercialise the technology he initially developed at Durham University. It is located in Redcar in the north-east of England and currently employs around 30 people including a direct sales team based in the US and the UK. It has built up a global network of distributors, taking the number of people selling its products to around 80. The company listed on AIM in November 2013 and commenced trading on the US OTCQB Venture Market in August 2020, upgrading to OTCQX in July 2021.

## Harnessing the properties of graphene

### Graphene: The 21st century's new 'wonder-material'

Exhibit 1: Structure of graphene



Source: Edison Investment Research

Graphite, which is used in pencil 'leads' and electrodes and as a dry lubricant, is formed from multiple sheets of graphene, each consisting of a one-atom-thick layer of carbon atoms arranged in a honeycomb shaped lattice. Graphene was first isolated from graphite in 2004 by two researchers at the University of Manchester, Professor Andre Geim and Professor Konstantin Novoselov. In 2010, the pair were awarded the Nobel Prize for Physics for their discovery. Before the discovery of graphene, the prevailing belief was that materials composed of single layers of atoms would be too unstable to exist. As scientists studied the new material, they found that its novel structure gave it exceptional properties (Exhibit 2).

Exhibit 2: Properties of graphene	
Property	Graphene
Physical/mechanical	100x stronger than steel, harder than diamond. Highest surface area of all materials. Highly flexible, able to stretch to 120% of its length.
Electrical conductivity	60x higher conductivity than copper
Thermal conductivity	5x conductivity of aluminium
Lubrication	Very low surface shear
Permeability	Vacuum tight even to helium gas
Transparency	Around 98% optical transmission

Source: AGM, Edison Investment Research

From a commercial viewpoint, the goal of companies such as AGM was to incorporate small quantities of graphene into other materials, such that the special properties of graphene would be retained, thus creating higher-value materials with enhanced characteristics. One of the earliest applications was top-of-the-range sports equipment. For example, in 2013 graphene was used in the YouTek SPEED racquet series from HEAD. The graphene was incorporated in the material forming the racquet's shaft, enabling the shaft to be lighter so that the bulk of the weight resided in the head and the grip of the racquet, allowing players such as Novak Djokovic to play shots travelling at over 170 miles per hour.

## Graphene has not lived up to the early hype

Despite the early promise and hyped expectations, widespread adoption of graphene-enhanced products has not yet occurred. We believe there are four reasons for this. (1) Customers using graphene-enhanced products need to see quantifiable performance benefits before paying a premium for graphene-enhanced products. Going back to the tennis racquet example, only the most expert amateurs paying extra for a graphene-enhanced version will see an improvement in their game. (2) It is difficult for companies manufacturing plastic mouldings, composite materials or any of the other diverse materials that could benefit from including graphene to incorporate pure graphene in their products in a repeatable fashion. (3) It is time consuming and costly for a technology company manufacturing graphene alone to move up the supply chain and design, manufacture and sell products that contain graphene. (4) Given graphene's potential to enhance so many different products, it is tempting for a new company offering graphene to address multiple sectors, expending significant effort without return.

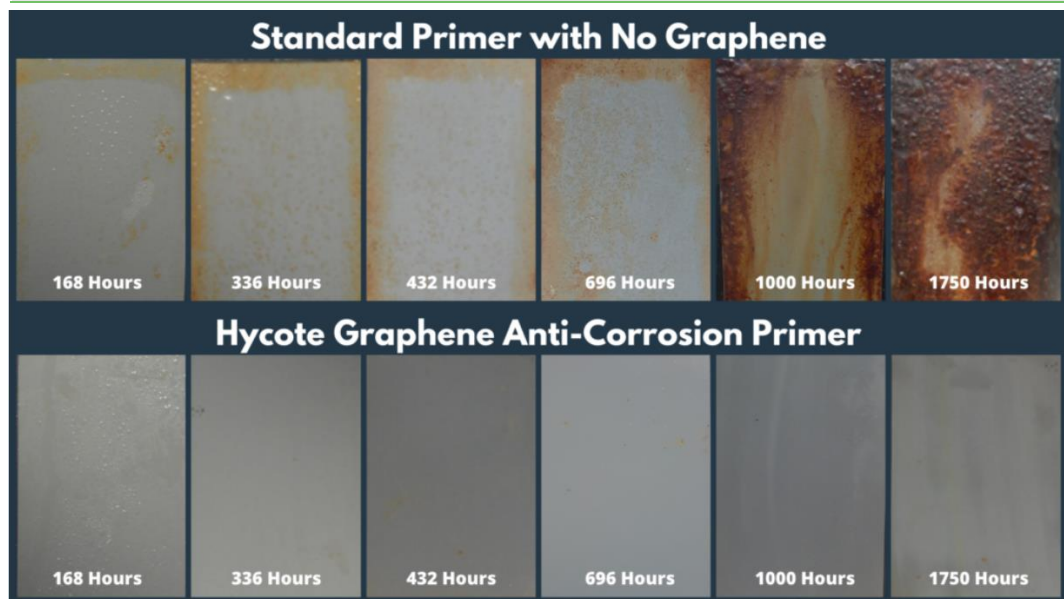
AGM's commercialisation strategy addresses all of these issues. It is focusing initially primarily on the global protective coatings market, where graphene-enhanced products give clear economic and performance advantages. It sells customers graphene in the form of easy-to-use dispersions of nanoplatelets. Customers use the dispersions to enhance the performance of their own products. AGM is also working on longer-term projects incorporating graphene into composite materials used in the aerospace industry and into thermal adhesives for space and other applications.

## Graphene-enhanced coatings give quantifiable benefits

Exhibit 2 notes that graphene in its pure form is impermeable even to helium gas. Adding graphene to protective coatings in a few layer nanoplatelet form should therefore potentially reduce their permeability to water and gases, reducing corrosion. AGM has formulated a range of dispersions of graphene in different solvents that clearly demonstrate substantial reduction in corrosion in a range

of coating scenarios. For example, AGM's customer James Briggs has conducted trials that show that adding graphene to its automotive respray primers gave a threefold increase in corrosion resistance as well as eliminating the zinc present in conventional anti-corrosion primers. This property is highly desirable for coatings and paints that need to withstand aggressive corrosion in automotive, heavy industry and harsh marine environments. Reducing corrosion has economic benefits because the time between repainting can be extended. When Alltimes Coatings launched its Advantage Graphene liquid coating roofing system for industrial and commercial buildings, it was able to extend the product warranty from 20 years to 30 years because of the significantly enhanced anti-corrosion performance resulting from the inclusion of AGM's graphene dispersions into its system. Reducing the number of times that assets such as telecoms towers and ships need to be repainted over the lifetime of the asset gives a clear, quantifiable benefit that helps justify the price premium for graphene-enhanced products.

**Exhibit 3: Comparison of primers**



Source: AGM

### Graphene-enhanced coatings give environmental benefits

Reducing corrosion also has environmental benefits because it extends the life of assets made from steel and aluminium, both of which are finite resources. Moreover, thinner coatings can be applied, reducing the volume of volatile organic compounds used in each application. As discussed below, AGM has also developed dispersions suitable for incorporation in water-based coatings.

### Easy for customers to develop graphene-enhanced products

#### Providing graphene in easy-to-use dispersions

Unlike some of its peers (see Exhibit 4) that have developed products such as face masks or barriers for treating oil spills, which they sell across different markets, AGM's route to market is through supplying graphene that its customers use to enhance their own products. Most graphene manufacturers supply graphene as a powder. AGM sells customers graphene in the form of dispersions of nanoplatelets in a range of organic solvents, resins and water. The patented formulation keeps the platelets separated until the coating containing the dispersion is applied. The format is convenient for customers to use because the graphene dispersions can be added to the customers' products using standard equipment without needing to modify the manufacturing process. Importantly, adding dispersions containing nanoplatelets enables customers to distribute the graphene material in their products uniformly and repeatably in high volumes. We note that a



study published by The Graphene Council in January 2021 interviewing around 800 respondents showed that dispersibility was considered the most important challenge for successful use of graphene, with around 50% of people interviewed citing it as essential for graphene adoption.

### **Availability of standard dispersions**

There are additional ways in which AGM helps its customers develop graphene-enhanced products. As well as creating bespoke dispersions for them (over 200 in the last two years), it has created several ranges of standard dispersions under the Genable brand. These are based on commonly used carrier solvents and resins including epoxy, butyl acetate, xylene, methyl ethyl ketone (MEK), ethyl acetate and water. Aqueous dispersions are important for engaging with environmentally focused customers who want to avoid the use of solvents containing harmful volatile organic compounds (VOCs). The Genable dispersions are supported by application guidelines, extended performance datasets and considerable formulation know-how from AGM's technical team. Having the extended performance datasets means that potential customers can predict in advance how the dispersions will behave, reducing the time that they need to conduct trials. Cutting the customer product development cycle should, we believe, help accelerate AGM's revenue growth. The different Genable dispersions are suitable for incorporation in protective paints and coatings, composites and adhesive systems designed to be used for bonding, potting, sealing and encapsulation of electronics, space and automotive components.

### **Availability of eco-friendly dispersions**

In July 2021, AGM launched a range of eco-friendly graphene nanoplatelet dispersions that will enable paints, coatings and composite materials customers to improve the sustainability of their product formulations in response to growing market pressures. The new range is based on the company's Genable technology but integrated with a selection of certified, fully biobased solvents and resins already available in the market.

### **Support package for customers developing graphene-enhanced products**

In October 2020, AGM formalised the support process it offers customers as they develop graphene-enhanced products, launching its Innovation Accelerator research and development partnership service. Partners pay a one-off fee for a package that includes research and development, quality control testing, ongoing stability trials and a starter kit of a graphene dispersion. Tailored dispersions made to customers' product specifications are priced separately. The initiative recognises that the support provided to customers during the product development phase can extend over a year and represents a new revenue stream for the company.

### **AGM's bottom-up graphene manufacturing technique simplifies dispersion creation**

Initially graphene was manufactured by separating graphite into individual layers using mechanical or chemical exfoliation processes. Many graphene manufacturers continue to use this type of top-down technique. However, exfoliation processes can create product of variable quality, depending on the source of the graphite. (For example, integrated graphene company Talga Group benefits from owning high-quality graphite deposits from which it extracts the mineral.) It can be difficult to control the number of layers of graphene in a nanoplatelet when using exfoliation processes, giving considerable performance variability. In contrast, AGM synthesises graphene from hydrocarbon materials. The details of this process are commercially sensitive and have not been disclosed.

Importantly, the bottom-up technique that AGM has developed for manufacturing graphene can simplify the production of dispersions. AGM's graphene manufacturing process outputs graphene nanoplatelets that are of consistently high quality to use in commercial dispersions that give repeatable performance enhancements in volume production environments.

## Market size and growth

AGM is currently focused on the global protective coatings market, though it continues to work on projects with customers in the composites and aerospace industries. In April 2020 MarketsandMarkets predicted that the global market for coating resins would grow from US\$38.7bn in 2020 to US\$48.8bn by 2025, ie a CAGR of 4.7%. In August 2020 Grand View Research noted that the global paints and coatings market size was valued at US\$146.2bn in 2019 and predicted that it would grow at a CAGR of 4.3% from 2020 to 2027. Mordor Research notes that the global graphene market was valued at US\$127.1m in 2020 and predicts that it will grow with a CAGR of more than 70% between 2021 and 2026.

## Competitive environment

AGM is unusual in focusing on protective coatings for architectural and industrial applications and in supplying the graphene in easy-to-use dispersions, which it sells to third parties to enhance their products, rather than selling graphene powder. Talga Resources has developed Talcoat, a graphene-enhanced coating that is currently being trialled on two container ships, but the group appears much more interested in the electric vehicle battery market. Some of the other companies are engaged in the composites market.

**Exhibit 4: Non-exhaustive selection of companies offering graphene**

Company	Ticker	Market cap	Annual revenues	Gross margin	Product portfolio
Directa Plus	DCTA:LN	£80m	£6.4m	49%	Graphene-enhanced barriers for tackling oil spills and treating wastewater, textile treatments, multi-functional membranes, graphene-enhanced garments including face masks, elastomers, super-modifier for road surfaces, masterbatches for injection moulding.
First Graphene	FGR:ASX	£53m	£0.2m	22%	Graphene powder used in composites, elastomers, fire retardant paint, additives for concrete and textile coatings.
G6 Materials	GGG:CVE	£13m	£0.7m	22%	Graphene-enhanced air filtration materials, electrically conductive adhesives for replacing solder, composite formulations.
Garnor	N/A				Additives for polymers and cement.
Haydale Graphene	HAYD:LN	£30m	£3.0m	70%	Graphene-enhanced carbon fibre composite, graphene impregnated fabric face masks, nanomaterial dispersions in process oils for enhancing the properties of elastomer compounds, graphene inks for printed electronics.
HeiQ	HEIQ:LN	£179m	Not known*		Developing graphene membrane for use in batteries and desalination to complement existing non-graphene products.
NanoXplore	GRA:CVE	£623m	£35.5m	16%	Graphene powder for use in industrial markets. Standard and custom graphene-enhanced plastic and composites.
Paragraf	N/A				Draper Esprit (GROW:LN) investment. Graphene for electronic devices.
Talga Group	TLG:ASX	£226m	£0.01m*	-	Graphene primarily for use in batteries.
Versarien	VRS:LN	£60m	Not known*	-	Graphene inks for printed electronics, composites, energy storage, materials for super-capacitors and metal-air batteries, graphene-enhanced plastic products.

Source: Edison Investment Research. Note: \*Attributable to graphene.

## Commercialising the technology

In October 2019 management announced it was re-aligning resources around dispersion and application technology for the protective coatings industry. This is because the customers it was working with in this sector are able to develop new products more quickly than customers in the aerospace industry, which it continues to work with on composites and thermal adhesive applications. The strategy resulted in six customer launches of coating products containing AGM's graphene dispersion in CY19, six in CY20 and four so far in CY21. These launches are for both mass-market and specialist applications. Revenues are still modest, £42k in H121, as these customers are small and most have not been selling their graphene-enhanced products for long, but the current opportunity pipeline totals £7.6m or £3.0m applying a probability of success factor.

## Extending the number of customers

### Near-term opportunity in protective coatings market

Customers successfully integrating AGM's graphene nanoplatelet dispersions into their products and subsequently bringing performance-enhanced products to market create a revenue stream for AGM. Customer product launches during FY20 included a graphene-containing primer for Halford's retail range and a Hycote-branded aerosol primer from James Briggs, which is sold to consumers via Amazon and to professional automotive paint shops. Coatings innovator Blocksil introduced a high-performance, anti-corrosion top coat for industrial applications that was approved by Avanti for application on its large satellite communications dishes. So far during FY21 customer Infinity Wax has launched first its QDX graphene detailing spray, which is used to enhance shine and enable car owners to wipe away dirt more easily, and then its new Graphene Wax, which offers better water beading and sheeting properties as a result of increased hydrophobicity, resulting in long-term paint protection. EZ Car Care has introduced two graphene-enhanced car polishing wax products. Constellation Chemicals has launched two new sealants in its car detailing product range and Tru-Tension has launched a detailing spray for motorbikes. These products have taken AGM into the car care sub-sector of protective coatings technology. Blocksil has recently introduced a graphene-enhanced primer for use with its existing graphene-enhanced top coat and has started work on an epoxy version. Adding primers to its range has created a 'one-stop shop' which is attractive to end-users. Customer Kent Europe, which is based in Germany, has launched an aerosol anti-corrosion primer. AGM has begun to evaluate the potential of its dispersions in coatings that offer protection to chemical attack, which would be applied to structures such as pipelines. We note that all of these customers are relatively small companies, most of which have not been offering graphene-enhanced products for very long. We believe it is likely that larger coatings manufacturers, which have been less interested in graphene up to now, will change their minds should their end-users begin to ask for graphene-enhanced coatings.

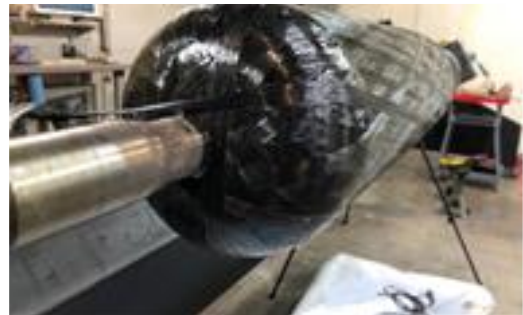
The current opportunity pipeline and technology development activity encompass a wide range of coatings applications. These include anti-corrosion and erosion coatings for wind turbines, chemical resistant floor coatings for use in factories, anti-corrosive coatings for aluminium in aircraft, passenger vehicles and mass transit vehicles, anti-corrosive coatings for offshore structures and marine vessels and chemical resistant coatings for industrial process equipment.

**Exhibit 5: Graphene-loaded car wax**



Source: Infinity Wax

**Exhibit 6: Graphene-enhanced composite tank**



Source: Infinite Composites Technology

### Longer-term opportunities in composites and thermal adhesive markets

While the protective coatings market is the short-term revenue driver, AGM continues to work with customers on graphene-enhanced composites. For example, Infinite Composites Technology is using graphene-enhanced material for linerless carbon fibre pressure vessels used to store gas on spacecraft. Graphene enables composite materials, which are lighter than metals, to be used to store liquid gases at temperatures lower than minus 300°F. In the longer term, graphene-enhanced



composite tanks may be used to transport liquid hydrogen used to generate electricity in fuel cells for stationary power generation and transportation applications.

AGM has developed two ranges of thermal adhesives, one for space and defence applications, the other for bonding, potting, sealing and encapsulation of industrial, electronic and automotive components. Management notes that an undisclosed customer trialling the thermal adhesive product is close to potentially approving it. Management hopes that this will lead to further opportunities within the aerospace sector. In the longer-term it intends to adapt the technology to prevent batteries from overheating by improving the heat conducted out of the battery stacks by the surrounding assembly.

## Building out sales network

Since AGM has developed a range of standard dispersions with well-documented properties, it has simplified the sales and support process, enabling it to use distributors. Over the last two years AGM has expanded its distribution network, bringing the total number of salespeople acting for AGM to around 80 compared with 17 in H119. Given the relatively lengthy sales cycle and relatively recent addition of distributors, the proportion of revenues currently attributable to distributors is very small.

**Exhibit 7: AGM's distribution network**

Announcement	Partner	Territory
April 2018	Inabata	Japan
May 2019	CAME	Italy
June 2019	Carst & Walker	South Africa
June 2020	Dichem Polymers	Greece
July 2020	Will & Co	Netherlands, Belgium and Luxembourg
August 2020	Maroon Group	United States and Canada
August 2020	Arpadis Benelux	United Kingdom, Germany, Spain, France, Portugal and Scandinavia
October 2020	GOBARR Kimya Ticaret ve Pazarlama	Turkey
December 2020	Manho Polymers	South Korea

Source: Edison Investment Research

## Production scaling

AGM is currently able to output around 500kg of graphene annually, which, depending on the loading density, is sufficient for 100 tonnes of dispersion. We note that First Graphene claims it has capacity to output 100 tonnes of graphene per year and NanoXplore claims that its facility can manufacture up to 4,000 tonnes of graphene annually. Management is currently developing plans for scaling up production of dispersions from 10–20 tonnes annually to around 100 tonnes. It estimates this will cost c £0.5m in capex, with procurement and integration taking around six months. Management notes that this volume output is sufficient to support the sales volumes expected from the existing qualified sales pipeline. AGM is adopting the lower-risk route of replicating existing equipment rather than creating equipment able to handle larger batches of product, though it is working on modifications that will improve efficiency without impairing product performance. Management has also stated its intention of bringing spraying capability in-house to support its test programmes.

## Management

Adrian Potts became CEO in August 2018 on the retirement of his predecessor. From January 2015, Adrian had been vice president for business development, leading the company's business development strategy in the United States. He previously worked at Cytec Process Materials in roles including global business development director, president of Cytec Process Materials, CA, and president of Umeco Structural Materials.

David Blain became CFO in October 2018. He joined AGM from Nanoco Group, where he was CFO and company secretary. Prior to that he spent seven years at Inspired Capital (formerly Renovo Group) where he played a significant role in the acquisition of Ultimate Finance Group. During this time the business increased its market capitalisation to £150m and employed 170 staff prior to its takeover by Tavistock in 2015.

## **Sensitivities**

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### **Dependent on customer roll-out**

AGM's revenue development is dependent on the success of individual customer product launches, so if a customer's product roll-out plans are held up, for example by the coronavirus pandemic (see commentary below on H121 performance), this has an adverse impact on AGM. We note that AGM is currently engaged with many smaller innovative companies in the protective coatings sector to demonstrate the practicality and commercial benefits of its technology, so the risk associated with each customer is reduced, although the revenues associated with each customer are modest, averaging around £14k/year for each product launched. The rate at which customers launch products is dependent on how quickly they can complete trials of graphene-enhanced variants and AGM's ability to support customer queries. Management's initiatives to create standard dispersions and to create a network of distributors are intended to help with both these effects. As noted previously, AGM's revenue growth trajectory will be significantly improved if one or more larger coatings company decides to deploy AGM's dispersions so they also can offer graphene-enhanced products or if the longer-term projects involving composites and thermal adhesives progress to commercialisation.

### **Price premium of graphene-enhanced formulations**

For each individual customer product, adoption will depend on whether end-users are prepared to pay a premium for graphene-enhanced variants. We do not have any data on the premiums that AGM's end-users are charging, but management notes that the cost-benefit analysis for protective coatings is favourable given the reduction in maintenance costs. It is not as easy to quantify the benefit in the car care market. We believe that the ability for end-users in the protective coating market to quantify the benefits in economic terms should make it easier for AGM's customers to promote their products.

### **IP protection**

In common with other technology companies, AGM's success will depend on its ability to protect its IP and process know-how. The group patents IP where appropriate and currently has three patents granted across 15 regions and nine patents pending.

### **Restriction on use of new materials**

As graphene is a relatively new material it needs to be extensively tested by regulatory bodies for toxicity. In January 2021 the European Chemical Agency (ECHA) raised the amount of graphene that can be manufactured annually by individual members of the Graphene REACH registration consortium from one to 10 tonnes of powder usage per annum of graphene products supplied. The permitted companies include AGM, which was a founder member of the consortium, as well as First Graphene, NanoXplore and Versarien's 2D-Tech Graphene. The REACH accreditation does not apply to the US, where companies are permitted to supply graphene for product evaluation but then the product needs to be certified before it can be sold in commercial volumes. Other jurisdictions such as South Korea and Turkey have their own safety accreditation systems, which may require individual products containing graphene to be certified before use. AGM is actively engaged in regulatory approvals to enable it to deal with local challenges to adoption.

## Cash runway

Management estimates that the funds raised in January 2021 extended the company's cash runway from October 2021 well into calendar 2023, enabling it to convert the current opportunity pipeline into meaningful annual revenues during the period. As will be discussed in the valuation section, we do not believe that AGM will have reached break-even by this point, but the ability to demonstrate meaningful revenue generation would put the company in a good position to raise additional finance.

## Financials

### H121 revenue growth affected by lockdown restrictions

Revenue from the sale of production orders of graphene and evaluation quantities of graphene to commercial partners grew by 20% year-on-year during H121 to £42k. Growth would have been even stronger had it not been for the restrictions on travel related to the coronavirus pandemic. AGM was not directly affected by pandemic, with management deciding not to furlough staff so it could continue with its long-term test programmes. However, some of its customers have been adversely affected, with some projects in the sales pipeline such as the launch of Teal & Mackrill's industrial epoxy primer being delayed. For example, Blocksil has some volume opportunities with Avanti network for refurbishing coating of large communication antennae and satellite communication structures but has been prevented from accessing customer sites and refurbishing structures with graphene-enhanced paint. Blocksil has been able to coat two or three antennae towers for RTE and is anticipating work on a further seven. The customer has also been working with Network Rail on the refurbishment of trackside enclosures, which could extend to over 200 units. Some customers have been affected by temporary problems procuring solvents and resins. A couple of smaller coatings projects, the collective value of which is not material, have been put on hold indefinitely. In addition, the programmes evaluating graphene-enhanced composite tooling and mass transit interiors with superior fire-performance have been delayed because customers have not had the staff available to complete on-site activity.

#### Exhibit 8: H121 and H120 P&L summary

£000s	H121	H120	Notes
Sales revenue	42	35	Increased customer engagement
Cost of sales	(146)	(135)	Negative gross margin as very low levels of utilisation
Gross loss	(104)	(100)	
Normalised operating expenses	(1,407)	(1,650)	Reduced following realignment programme in H120
Share-based payments	(67)	(150)	
EBITDA	(1,578)	(1,900)	
Exceptional item	0	(168)	Restructuring costs
Depreciation and amortisation	(214)	(228)	
Reported operating loss	(1,792)	(2,296)	
Finance costs (net)	(2)	18	Smaller cash balances and low interest rates
Reported loss before tax	(1,794)	(2,278)	
Tax	178	300	Accrued R&D tax credits. Lower as costs reduced.
Reported loss after tax	(1,616)	(1,978)	
Adjusted EPS (p)	(3.3)	(3.7)	

Source: AGM data

EBITDA losses (adjusted for exceptional items but not share-based payments) narrowed by £0.3m to £1.6m in H121, reflecting the impact of the realignment programme on staffing costs. This progress on both revenue growth and EBITDA loss supports the FY21 consensus estimates of £0.2m revenues and a £3.2m EBITDA loss.

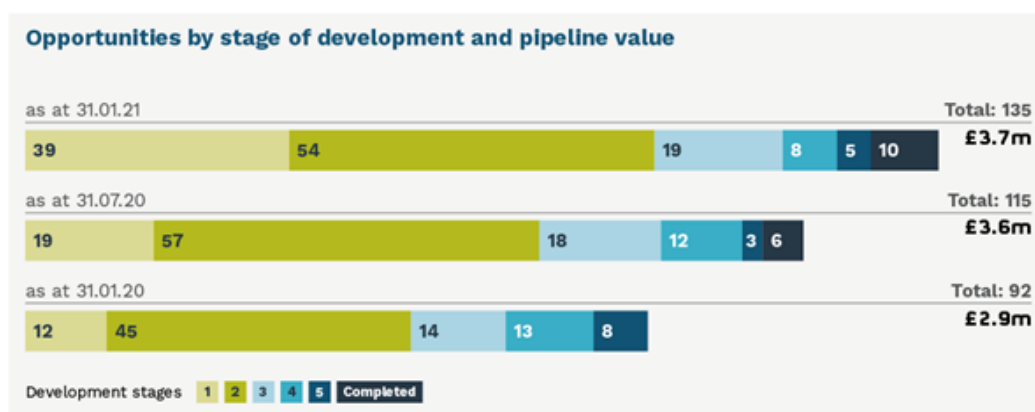
## Cash runway extended well into calendar 2023

Net cash (there is no debt except for modest IFRS 16 lease liabilities) reduced by £1.4m during H121 to £2.3m at the end of January. Capex was minimal (£13k). £0.1m was invested in intangibles related to patents as all R&D is expensed. Cash flow was flattered by a £0.2m decrease in working capital, primarily an increase in payables, which we expect will unwind during H221. Cash at the end of January excluded £5.5m (net) raised during January through a placing, subscription and PrimaryBid offer at 41p/share, which was not received until after the period end. It also excludes an R&D tax credit of £0.5m, which was received in February. Management estimates that the funds raised have extended the company's cash runway from October 2021 well into calendar 2023, enabling it to convert the opportunity pipeline into meaningful annual revenues during the period.

## Scenario analysis

AGM has seen progressive growth in its engagement pipeline over the last 12 months (Exhibit 9). This has resulted in the launch of 11 products, which management estimates could generate annual revenues of £0.5m/annum, and an opportunity pipeline totalling £7.6m that management estimates represents £3.0m annual revenues when a probability of success factor is applied.

### Exhibit 9: Pipeline development



Source: AGM

Noting that management has not provided any guidance as to when AGM might achieve this revenue level, we have created a scenario analysis to assess how EBITDA, graphene output and capex might track with revenue growth.

### Exhibit 10: Margins for speciality chemicals and fragrance companies

Name	Sales last year (£m)	Gross margin last year (%)	EBITDA margin last year (%)	Note
Arkema	6,859	-	15.0	Speciality chemicals and advanced materials
Clariant	3,049	30.4	15.0	Speciality chemicals
Croda International	1,390	45.5	27.9	Speciality chemicals
Elementis	541	34.2	17.7	Speciality chemicals
Evonik Industries	10,613	27.6	15.6	Speciality chemicals
Givaudan	4,994	42.1	22.1	Flavours, fragrances, active cosmetic ingredients
Holland Colours	88	43.9	-!	Colourants and other additives for plastics
Johnson Matthey	4,170	24.0	16.9	Speciality chemicals
Robertet	482	N/A	17.0	Fragrances, flavours, natural raw materials
Symrise	3,063	39.5	21.1	Flavours and fragrances
Trealt	109	29.2	15.6	Flavours and fragrances
Wacker Chemie	4,082	18.5	14.2	Speciality chemicals

Source: Edison Investment Research, company data

Our model makes the following assumptions:

- Average selling price of AGM's dispersions to customers of £50/kg (based on management guidance).

- Average percentage of graphene in dispersion formulation (range is from 0.5% to 20%) of 10%.
- Gross margin range of 35–45%. We have not based this on our sample of companies manufacturing graphene (Exhibit 4) because none of these is selling dispersions containing graphene and most are at an early stage of market development, so their current gross margins are not representative of potential gross margins when manufacturing graphene in high volumes. Instead, we are using a sample of established speciality chemicals and fragrance companies (Exhibit 10), which we consider a proxy for AGM because they typically produce substances that are added in relatively low proportions to enhance the performance of other materials. We have chosen a gross margin range which is towards the upper end of our sample in line with informal management guidance.
- Incremental operating costs at 10% of additional sales, which will require good cost discipline, using H121 as the base level.
- We have set the upper bound of the revenue range at £25m. While higher revenues are possible, we are not presenting these at present because AGM has yet to engage with any of the larger players in the protective coatings market, which management notes are highly conservative, and the projects for aerospace customers have not reached the commercial stage.

Our analysis shows that the current pipeline is not sufficient to take AGM to cash break-even, which is reached at annual revenues of around £10m. Our table also shows the level of additional capital investment required, based on management guidance, with the caveat that investment will be required ahead of revenue generation. So, for example, the current capacity is sufficient to support c £2m of annual revenues, but by the time the company has hit that level of revenue generation it will have had to make £0.6m of investments to support the next stage of growth.

<b>Exhibit 11: Scenario analysis</b>					
<b>Volume of dispersion sold (kg)</b>	<b>40,000</b>	<b>72,000</b>	<b>100,000</b>	<b>200,000</b>	<b>500,000</b>
Revenue (£m)	2.0	3.6	5.0	10.0	25.0
Gross profit at 35% gross margin (£m)	0.7	1.3	1.8	3.5	8.8
Gross profit at 40% gross margin (£m)	0.8	1.4	2.0	4.0	10.0
Gross profit at 45% gross margin (£m)	0.9	1.6	2.3	4.5	11.3
Operating costs (£m)	(3.1)	(3.3)	(3.4)	(3.9)	(5.4)
EBITDA at 35% gross margin (£m)	(2.4)	(2.0)	(1.7)	(0.4)	3.3
EBITDA at 40% gross margin (£m)	(2.3)	(1.9)	(1.4)	0.1	4.6
EBITDA at 45% gross margin (£m)	(2.2)	(1.7)	(1.2)	0.6	5.8
Cumulative capital investment (£m)	0.6	0.9	1.2	2.7	5.6

Source: Edison Investment Research

We note that, even at the upper bound of revenues presented in our analysis, AGM's sales are a tiny percentage of the total global paints and coatings market (US\$146.2bn in 2019) or the sales of one of the major paints and coatings companies. For example, Sherwin-Williams' Performance Coatings division reported sales of US\$4.9bn in FY20.



**Exhibit 12: Financial summary**

	£'000s	2018	2019	2020
		IFRS	IFRS	IFRS
Year end 31 July				
<b>INCOME STATEMENT</b>				
Revenue (excluding grants)		77	50	83
Cost of Sales		(250)	(472)	(215)
Gross Profit		(173)	(422)	(132)
EBITDA		(3,984)	(4,559)	(3,084)
Normalised operating profit		(4,295)	(4,902)	(3,530)
Amortisation of acquired intangibles		0	0	0
Exceptionals excluding share-based payments		(307)	0	(168)
Reported operating profit		(4,602)	(4,902)	(3,698)
Net Interest		57	67	33
Profit Before Tax (norm)		(4,238)	(4,835)	(3,497)
Profit Before Tax (reported)		(4,545)	(4,835)	(3,665)
Reported tax		1,046	908	476
Profit After Tax (norm)		(3,192)	(3,927)	(3,021)
Profit After Tax (reported)		(3,499)	(3,927)	(3,189)
Minority interests		0	0	0
Net income (normalised)		(3,192)	(3,927)	(3,021)
Net income (reported)		(3,499)	(3,927)	(3,189)
Basic average number of shares outstanding (m)		42.7	49.4	49.4
EPS - normalised (p)		(7.5)	(7.9)	(6.1)
EPS - normalised fully diluted (p)		(7.5)	(7.9)	(6.1)
EPS - basic reported (p)		(8.2)	(7.9)	(6.4)
Dividend (p)		0.00	0.00	0.00
Revenue growth (%)		N/A	(35.1)	66.0
Gross Margin (%)		N/A	N/A	N/A
EBITDA Margin (%)		N/A	N/A	N/A
Normalised Operating Margin		N/A	N/A	N/A
<b>BALANCE SHEET</b>				
Fixed Assets		1,959	1,800	1,696
Intangible Assets		78	155	276
Tangible Assets		1,881	1,645	1,420
Investments & other		0	0	0
Current Assets		11,111	7,681	4,522
Stocks		56	52	74
Debtors		197	171	281
Cash & cash equivalents		10,443	6,135	3,685
Other		415	1,323	482
Current Liabilities		(949)	(993)	(929)
Creditors		(949)	(993)	(929)
Tax and social security		0	0	0
Short term borrowings		0	0	0
Finance leases		0	0	0
Long Term Liabilities		0	0	(4)
Long term borrowings		0	0	0
Lease liabilities				(4)
Other long term liabilities		0	0	0
Net Assets		12,121	8,488	5,285
Minority interests		0	0	0
Shareholders' equity		12,121	8,488	5,285
<b>CASH FLOW</b>				
Op Cash Flow before WC and tax		(3,984)	(4,559)	(3,084)
Working capital		(12)	72	(199)
Exceptional & other		(9)	303	(182)
Tax		631	0	1,316
Net operating cash flow		(3,374)	(4,184)	(2,149)
Capex		(319)	(193)	(342)
Acquisitions/disposals		0	0	0
Net interest		53	69	41
Equity financing		9,375	0	0
Dividends		0	0	0
Other		0	0	0
Net Cash Flow		5,735	(4,308)	(2,450)
Opening net debt/(cash) - excluding lease liabilities		(4,708)	(10,443)	(6,135)
FX		0	0	0
Other non-cash movements		0	0	0
Closing net debt/(cash) -excluding lease liabilities		(10,443)	(6,135)	(3,685)
Source: Company reports				

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