

Perpetuus

A report to the Secretary of State for the Department for Business, Energy and Industrial Strategy on the anticipated acquisition by Taurus International Ltd and others of the Perpetuus Group (including Perpetuus Energy Limited, Perpetuus Advanced Materials plc and Perpetuus Carbon Technologies Limited)

7 February 2022



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Please note that [X] indicates figures or text which have been deleted or replaced in ranges for reasons of commercial confidentiality.

1. EXECUTIVE SUMMARY

- 1.1 This report is hereby given to the Secretary of State for Business, Energy and Industrial Strategy (the **Secretary of State**) in response to the [public interest intervention notice](#) (the **Notice**) issued on 5 September 2021 pursuant to section 42(2) of the Enterprise Act 2002 (the **Act**) on the public interest ground of national security.
- 1.2 The Notice was issued in relation to the anticipated acquisition of the Perpetuus Group (including Perpetuus Energy Limited, Perpetuus Advanced Materials plc and Perpetuus Carbon Technologies Limited) (**Perpetuus as defined under the Notice**) by Taurus International Ltd (**Taurus**), Dr Zhongfu Zhou (**Dr Zhou**) or any enterprise associated with him or Taurus, or any subsidiary or any affiliates of either (together, **the Parties mentioned in the Notice**).
- 1.3 The Notice was accompanied by a Pre-Emptive Action Order (the **Order**), which, among other things, prevents any merger between the Parties mentioned in the Notice from taking place pending the Secretary of State's decision on this matter. The Order was followed by a High Court injunction application.

The CMA's report and decisions

- 1.4 The Notice requires the CMA to investigate and report to the Secretary of State by midnight at the end of 7 February 2022. The CMA's decisions in this report are summarised below.

The Parties

- 1.5 '**Perpetuus**' is a UK-based group of companies consisting of Perpetuus Advanced Materials plc (**PAM**) and its subsidiaries Perpetuus Carbon Technologies Limited (**PCT**), Perpetuus Research & Development Limited, Perpetuus Electronic Materials Limited. Perpetuus also comprises Perpetuus Energy Limited. Perpetuus is active in functionalisation of graphene and other nanomaterials, including graphite, using a plasma gas reactor.
- 1.6 Dr Zhou is a scientific adviser to Perpetuus and a director and 25% shareholder of Shanghai Kington Technology Limited (**SKT**).
- 1.7 SKT is a China-based company and customer of Perpetuus that researches and develops products based on polyimide fibres.

- 1.8 Taurus is a UK-based company designed as an investment/transactional vehicle which, in the CMA's understanding, does not currently undertake any business activities. Its sole shareholder is Dr Victor Gembala (**Dr Gembala**).¹

Jurisdiction

Perpetuus-Dr Zhou-SKT

- 1.9 The CMA found that in 2020-2021 shareholders of Perpetuus and Dr Zhou discussed a potential acquisition by Dr Zhou of a 'controlling stake' in Perpetuus - [REDACTED] (the **Contemplated Arrangements**). The CMA believes that the Contemplated Arrangements were discussed between Perpetuus and Dr Zhou either acting on behalf of, or in connection with SKT, or on his own account.
- 1.10 On the basis of the evidence gathered in its investigation, the CMA believes that it may be the case that a relevant merger situation (the **Merger**) has been created. Specifically, the CMA believes that it is or may be the case that:
- (a) The Contemplated Arrangements constitute arrangements in progress or in contemplation which if carried into effect would lead two enterprises, Perpetuus and SKT respectively, to cease to be distinct.
 - (b) Perpetuus is a relevant enterprise undertaking an activity specified under section 23A of the Act.
 - (c) Perpetuus is active in the supply of functionalised graphene and other nanomaterials (including graphite) using a plasma gas reactor in the UK and has at least a 25% of the UK capacity in relation to such supply.
 - (d) The requisite 25% share of supply is met in connection with an activity by virtue of which Perpetuus is a relevant enterprise for the purposes of the Act.

Taurus

- 1.11 Dr Gembala told the CMA he had some early-stage and 'barely exploratory' interest in buying shares in Perpetuus.
- 1.12 Based on the available evidence, the CMA believes that the prospect of Dr Gembala wishing to invest in Perpetuus is at best speculative. Accordingly, the CMA considers that the evidence is insufficient to conclude that it is or may be the case that arrangements are in progress or in contemplation between Perpetuus and Dr Gembala at the time of this report.

¹ Perpetuus, Dr Zhou, SKT and Taurus are together referred to as the '**Parties**'.

The CMA's competitive assessment

- 1.13 The CMA does not believe that it is or may be the case that the Merger may be expected to result in a substantial lessening of competition (**SLC**) within a market or markets in the UK.
- 1.14 For this reason, it has not been necessary to assess whether any of the exceptions to the duty to refer apply or to state, pursuant to section 44(4)(f) of the Act, whether the CMA believes that it is, or may be, the case that it would be appropriate to deal with the matter (disregarding any public interest considerations mentioned in the Notice) by way of undertakings under paragraph 3 of Schedule 7.

Public interest

- 1.15 As required by section 44(3)(b) of the Act, the CMA has summarised representations received by it from third parties which relate to the national security public interest consideration mentioned in the Notice.
- 1.16 This report also contains advice or recommendations on the public interest consideration mentioned in the Notice under section 44(6) of the Act. The CMA considers that it would be appropriate for the Secretary of State to accept undertakings which amount to a binding structural remedy in lieu of a reference to a phase 2 inquiry on public interest grounds.

2. THE NOTICE

- 2.1 On 5 September 2021, the Secretary of State issued the Notice pursuant to section 42(2) of the Act on the public interest ground of national security. The Notice was issued in relation to the anticipated acquisition of the Perpetuus as defined under the Notice by Taurus, Dr Zhou or any enterprise associated with him or Taurus, or any subsidiary or any affiliates of either.²
- 2.2 The Notice requires the CMA to investigate and report to the Secretary of State by midnight at the end of 7 February 2022.

² Department for Business, Energy and Industrial Strategy (**BEIS**), Public Interest Intervention Notice pursuant to section 42 of the Act, 5 September 2021.

- 2.3 The Notice was accompanied by the Order³ and a High Court injunction,⁴ which, among others, prevent any merger from taking place pending the Secretary of State decision on this matter.

3. LEGAL FRAMEWORK

- 3.1 In relation to anticipated mergers which are not subject to the public interest regime, the CMA is required to make a reference for an in-depth phase 2 inquiry where it believes that it is or may be the case that the creation of a relevant merger situation may be expected to result in an SLC within any market or markets in the UK for goods or services (section 33(1) of the Act).
- 3.2 The Act permits intervention by the Secretary of State in cases where he or she believes that it is or may be the case that one or more than one public interest consideration is relevant to a consideration of the relevant merger situation concerned.⁵ In such a case, section 33(1) does not apply⁶ and instead the CMA is required to give a report to the Secretary of State within such period as he or she may require.⁷ The report must contain:⁸
- (a) advice on the considerations relevant to the making of a reference under section 22 or 33 of the Act which are also relevant to the Secretary of State decision as to whether to make a reference under section 45 of the Act; and
 - (b) a summary of any representations about the case received by the CMA and which relate to any public interest consideration mentioned in the intervention notice concerned (other than a media public interest consideration) and which is or may be relevant to the Secretary of State decision as to whether to make a reference under section 45 of the Act.
- 3.3 In particular, the report must include⁹ decisions as to whether the CMA believes it is or may be the case that:

³ [UK Statutory Instruments 2021 No. 993: The Public Interest Merger Reference \(Perpetuus Advanced Materials plc\) \(Pre-emptive Action\) Order 2021, issued on 5 September 2021](#). In addition to preventing changes in the ownership or control of Perpetuus (as defined in the Order) as well as any integration of the Perpetuus business (as defined in the Order) with any other enterprise, the Order includes provisions requiring that - except in the ordinary course of business - 'none of the assets of the Perpetuus business (nor any parts of any of those assets) is disposed of', 'no interest in the assets of the Perpetuus business (or in any parts of any of those assets) is created or disposed of', and that 'Perpetuus does not perform or continue to perform any existing agreement between it and the Acquiring entities' identified in the Order.

⁴ Final Order for an injunction by consent issued by the High Court of Justice on 20 September 2021.

⁵ Section 42(2) of the Act. As to public interest mergers more generally, see Chapter 16, [Mergers: Guidance on the CMA's jurisdiction and procedure](#) (CMA2revised), December 2020 (**Guidance on the CMA's jurisdiction and procedure**).

⁶ Section 33(3)(d) of the Act.

⁷ Section 44(2) of the Act.

⁸ Section 44(3) of the Act.

⁹ The full list of requirements is set out in section 44(4) of the Act.

- (a) a relevant merger situation has been created or arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation;
- (b) the creation of that situation has resulted or may be expected to result in an SLC within any market or markets within the UK for goods and services;
- (c) it would be appropriate to deal with the matter (disregarding the relevant public interest consideration) by way of undertakings in lieu of a reference to phase 2.¹⁰

3.4 Following receipt of the CMA's report, the Secretary of State may¹¹ make a phase 2 reference to the CMA on public interest grounds. In deciding whether to make such a reference, the Secretary of State is required to accept the CMA's decision on the matters listed above.¹²

4. PARTIES AND TRANSACTION

Parties' relevant activities

4.1 Perpetuus is a UK-based group of companies consisting of PAM and its subsidiaries PCT, Perpetuus Research & Development Limited, Perpetuus Electronic Materials Limited. PAM's shareholders include Ian Walters (**Mr Walters**) (39.02%), John Buckland (**Mr Buckland**) (39.02%) and Kim Buckland (13.77%).¹³ Perpetuus also comprises Perpetuus Energy Limited, whose 100% shareholder is Mr Buckland.¹⁴

4.2 Perpetuus presents itself as having made 'significant progress in establishing a commercial graphene production, supply and commercial application business [...] having established probably a world leading patented method of producing surface-engineered graphenes (**SMG**)'.¹⁵

4.3 In the financial year ending 31 March 2021 Perpetuus had a turnover of

██████████ Perpetuus submitted that it is ██████████
 The CMA was also informed that one of its subsidiaries, PCT, ██████████
 ██████████

¹⁰ Under paragraph 3 of Schedule 7 of the Act.

¹¹ Pursuant to section 45 of the Act.

¹² Section 46(2) of the Act. The Secretary of State is also required by section 46(2) to accept the CMA's decision as to whether it believes that it is or may be the case that it would be appropriate to deal with the matter (disregarding any public interest considerations mentioned in the intervention notice) by way of undertakings under paragraph 3 of Schedule 7 of the Act.

¹³ Shareholding of PAM per 3 September 2021 – document received by the CMA from BEIS on 5 September 2021.

¹⁴ Perpetuus' response to the section 109 notice dated 23 December 2021, page 7.

¹⁵ Perpetuus Advanced Materials (PAM) Information Memorandum, 7 October 2018, page 2, submitted by Dr Zhou in response to CMA RFI 1 dated 1 October 2021.

¹⁶ Perpetuus' response to the section 109 notice dated 18 November, page 7. Perpetuus submitted that this figure includes 'other income' such as ██████████

- [REDACTED]
- [REDACTED]
- 4.4 Dr Zhou is a scientific adviser to Perpetuus in light of his expertise in nanomaterials.¹⁸ Dr Zhou submitted that he is also a director and 25% shareholder of SKT.¹⁹
- 4.5 SKT is a China-based company that researches and develops products based on polyimide fibres.²⁰ Its products include an enhanced fertiliser which helps to retain moisture in arid regions.²¹ SKT is a customer of Perpetuus.²² In particular, SKT submitted that in 2019 and 2020 SKT made a series of pre-paid orders for Perpetuus' SMG.
- 4.6 Taurus is a UK-based company designed as an investment/transactional vehicle within the 'new materials' field. Dr Gembala is its sole shareholder.²³ The CMA understands that Taurus does not currently undertake any business activities.²⁴

Transaction

- 4.7 The Notice was issued in relation to the proposed acquisition of all or part of Perpetuus as defined under the Notice by Taurus, Dr Zhou or any enterprise associated with him or Taurus, or any subsidiary or any affiliates of either.

Equipment purchase

- 4.8 The CMA has received evidence indicating that, since before the start of the COVID-19 pandemic, Perpetuus has been discussing with Dr Zhou (who was understood by Perpetuus to be acting as a representative of SKT)²⁵ the purchase by Dr Zhou of graphene manufacturing equipment from Perpetuus, in connection with a production and distribution licence for mainland China and India.²⁶

17 [REDACTED]

¹⁸ Dr Zhou's response to the CMA RFI 2 dated 12 November 2021, page 5.

¹⁹ Dr Zhou's response to the CMA RFI 1 dated 1 October 2021, page 4; note of the call with Perpetuus dated 20 October 2021, page 2, paragraph 3; Perpetuus' response to the section 109 notice dated 26 October 2021, page 12; Taurus' response to the CMA RFI 1 dated 27 September 2021, page 1; [Perpetuus' website](#), accessed by the CMA on 1 February 2022.

²⁰ Dr Zhou's response to the CMA RFI 2 dated 12 November 2021, page 5.

²¹ SKT's response to the CMA RFI dated 10 December 2021, page 2.

²² Perpetuus' customer information submitted in response to the section 109 notice dated 18 November 2021.

²³ [Certificate of incorporation of Taurus dated 20 October 2020](#).

²⁴ Taurus' response to the CMA RFI 1 dated 27 September 2021, page 1.

²⁵ Perpetuus' response to the section 109 notice dated 26 October 2021, pages 10-11.

²⁶ Dr Zhou's response to the CMA RFI 2 follow-up dated 25 November 2021, Q(e). The CMA has seen evidence indicating that Dr Zhou was negotiating the purchase of this manufacturing equipment on behalf of a Chinese company named Huachu Technology (see purchase order dated 14 February 2021 issued in relation Perpetuus' manufacturing equipment). The CMA understands that Huachu Technology was a shareholder of SKT (see Dr Zhou's email to the CMA dated 24 January 2022). In this regard, Taurus submitted that Huachu Technology and SKT were both 'connected in the same group' (see Taurus' email to the CMA dated 21 January 2022).

- 4.9 Evidence received by the CMA also indicates that Dr Zhou planned to use Taurus as an ‘intermediary agent’ for this purchase.²⁷
- 4.10 The purchase of the graphene manufacturing equipment had a value [REDACTED] [REDACTED] (hereinafter, the **Manufacturing Equipment Deal**) but the agreement was not ultimately concluded.²⁹ The CMA understands the Manufacturing Equipment Deal was a matter of interest to Her Majesty’s Government.

Equity purchase

- 4.11 In parallel, between 2020 and 2021, Dr Zhou and Perpetuus also discussed an equity investment by Dr Zhou in Perpetuus.³⁰ The CMA has received evidence indicating that these discussions were still ongoing when the Secretary of State issued the Notice and the related Order on 5 September 2021.³¹
- 4.12 There is insufficient evidence to allow the CMA to conclude that Taurus had any involvement in these discussions.
- 4.13 These points are further discussed in section 6 below.

5. BACKGROUND ON GRAPHENE AND GRAPHITE

- 5.1 As mentioned above and further explained in section 6 below, evidence gathered by the CMA indicates that Perpetuus is active in the functionalisation of graphene and other nanomaterials (including graphite) using a plasma gas reactor. In particular, the available evidence indicates that Perpetuus purchases the relevant raw material from third parties and uses a plasma gas reactor to functionalise it.³²
- 5.2 There is not an industry standard definition of ‘graphene’. Graphene generally refers to a range of two-dimensional (**2D**) materials up to 10 graphene layers for electrical measurements, beyond which the electrical properties of the material are not distinct from those for the bulk (also sometimes referred to as graphite – further described below). A graphene layer is a single layer of carbon atoms with each atom bound to three neighbours in a honeycomb structure.³³

²⁷ Dr Zhou’s response to the CMA RFI 1 dated 1 October 2021, page 4; Dr Zhou’s response to the CMA RFI 2 dated 12 November 2021, page 5.

²⁸ Note of the call with Perpetuus dated 20 October 2021, pages 2-3; Perpetuus’ response to the section 109 notice dated 26 October 2021, pages 10-11.

²⁹ Perpetuus’ response to the section 109 notice dated 26 October 2021, pages 10-11; Perpetuus’ response to the section 109 notice dated 18 November, page 8; Taurus’ response to the CMA RFI 1 dated 27 September 2021, page 1; Dr Zhou’s response to the CMA RFI 1 dated 1 October 2021, page 4.

³⁰ Perpetuus’ response to the section 109 notice dated 26 October 2021, page 10; Dr Zhou’s response to the CMA RFI 1 dated 1 October 2021, page 4.

³¹ See paragraphs 6.14-6.20 below.

³² Perpetuus’ response to the section 109 notice dated 23 December 2021, page 9-10; [REDACTED].

³³ See definition provided by the International Organization for Standardization: [ISO/TS 80004-13:2017](https://www.iso.org/standard/72431.html), section 3.1.2.1.

- 5.3 Graphene has unique properties that differ from those of three-dimensional (**3D**) materials. For example, graphene is transparent, flexible, 200 times stronger than steel, more conductive than copper, and can act as a perfect membrane.³⁴
- 5.4 Graphene is primarily used as an additive to improve the properties of other products. For example, graphene layers can be utilised to make plastics stronger, or airplane wings lighter.³⁵
- 5.5 The term ‘graphite’ refers to an allotropic form of the element carbon, consisting of graphene layers (see above) stacked parallel to each other in a three-dimensional, crystalline, long-range order.³⁶
- 5.6 Graphene and graphite can be seen as part of a spectrum that goes from ‘monolayer’ graphene to 3D graphitic materials to carbon black (which is made of millions of carbon layers).³⁷ The CMA understands that along this spectrum there are different ‘inflection points’ where the material transforms changing its properties.³⁸
- 5.7 Graphene/graphite properties (eg strength, electrical and thermal conductivity) can be further improved through a process called ‘functionalisation’. Specifically, this process modifies a graphene/graphite material with various chemical functional groups to produce a bespoke graphene/graphite material (also referred to as surface modified or surface engineered graphene (ie SMG) or graphite, respectively).³⁹
- 5.8 Graphene/graphite (as well as functionalised graphene and graphite) are typically used in conjunction with other materials to improve the characteristics of the end-product.⁴⁰ In this regard, a Perpetuus Investment Memorandum dated January 2021 mentions that Perpetuus’ SMG is currently targeted at the elastomer and polymer enhancing material market, focussing in particular on the tyre production rubber sector.⁴¹
- 5.9 Graphene/graphite can be functionalised, among other methods, using a plasma gas reaction.⁴² As further explained below, the CMA received evidence that functionalisation through a plasma gas reaction is environmentally friendly, and, as opposed, eg to functionalisation using a chemical process, does not involve

³⁴ [REDACTED].

³⁵ [REDACTED].

³⁶ See definition provided by the International Organization for Standardization [ISO/TS 80004-13:2017](#), section 3.1.2.2.

³⁷ See [REDACTED].

³⁸ See [REDACTED].

³⁹ [REDACTED].

⁴⁰ [REDACTED].

⁴¹ High Court of Justice proceedings – Witness Statement of Jacqui Ward, Exhibit 9: Perpetuus Advanced Materials (“PAM”) Information Memorandum January 2021, page 2. The document adds that Perpetuus has ‘work[ed] and collaborat[ed] in the elastomer field with about 10 tyre manufacturers’ and that its ‘product development ranges from industrial and passenger vehicle tyres, to truck, aviation and electric vehicle tyres’ (page 3).

⁴² The CMA understands that functionalised graphene/graphite can also be referred to as ‘surface modified’ graphene/graphite. [REDACTED].

an acid treatment, enhancing functional performance, structural integrity and mechanical strength of the final product.⁴³

6. JURISDICTION

Legal Framework

- 6.1 The CMA has jurisdiction over transactions where it believes that it is or may be the case that a relevant merger situation has been created. In the case of an anticipated transaction, a relevant merger situation has been created when:
- (a) arrangements are in progress or in contemplation which, if carried into effect, will lead to two or more enterprises⁴⁴ ceasing to be distinct.⁴⁵ Two enterprises will cease to be distinct if they are brought under common ownership or control;⁴⁶ and
 - (b) for mergers that involve an enterprise being taken over which is active in the areas specified under section 23A of the Act, either the thresholds under sections 23(1)(b)(i) or 23(2)(b) of the Act are satisfied.⁴⁷

Assessment

- 6.2 The Notice states that the Secretary of State had reasonable grounds to suspect that, as a result of the proposed acquisition of all or part of Perpetuus as defined under the Notice by Taurus, Dr Zhou or any enterprise associated with him or Taurus, or any subsidiary or any affiliates of either, it is or may be the case that arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation, as defined in section 23 of the Act.
- 6.3 The Parties' submissions and the CMA's assessment are set out below.

⁴³ Perpetuus Advanced Materials (PAM) Information Memorandum, 7 October 2018, submitted by Dr Zhou in response to CMA RFI 1 dated 1 October 2021, pages 2 and 5; [X].

⁴⁴ 'Enterprise' is defined in section 129 of the Enterprise Act 2002 as the activities, or part of the activities, of a business. Guidance on the CMA's jurisdiction and procedure, paragraph 4.10.

⁴⁵ Section 33(1)(a) of the Act and Section 23 of the Act.

⁴⁶ Section 26 of the Act.

⁴⁷ Section 23A was repealed and section 23(1)(b) amended, by the National Security and Investment Act 2021. However, the unamended Act continues to have effect in this case because the Secretary of State issued the Notice before 4 January 2022. See the National Security and Investment Act 2021 (Commencement No. 2 and Transitional and Saving Provision) Regulations, SI 2021/1465, regulation 4.

Arrangements in progress or in contemplation

Parties' submissions

- *Perpetuus*

6.4 Perpetuus told the CMA that in 2020, while Perpetuus was discussing with Dr Zhou the Manufacturing Equipment Deal, Dr Zhou asked Mr Buckland if he was interested in selling to Taurus a 'controlling stake' in Perpetuus. According to Perpetuus, Dr Zhou intended to use Taurus as a vehicle for this investment. Mr Walters confirmed Mr Buckland's interest⁴⁸ in selling to Dr Zhou (via Taurus) a controlling stake in Perpetuus given that [REDACTED] [REDACTED] Perpetuus submitted that Dr Zhou was sent terms to that effect but did not reply and the proposal lapsed.⁴⁹

6.5 Perpetuus submitted that, subsequently, in early September 2021 (noting the Notice was issued on 5 September 2021), Dr Zhou contacted Mr Walters mentioning that, following completion of the Manufacturing Equipment Deal, he intended to discuss the terms of [REDACTED] Mr Buckland told the CMA that he informed Mr Walters that he was not interested in [REDACTED] [REDACTED] According to Mr Buckland, the matter was 'never discussed again' (again noting the Notice was issued on 5 September).⁵² The CMA has not been able to communicate with Mr Walters, nor obtain his direct communications on the matter, during the course of the investigation [REDACTED].

- *Dr Zhou*

6.6 Dr Zhou submitted that he had some discussions with Mr Walters about a possible equity investment in Perpetuus. According to Dr Zhou, Mr Walters told him that (i) Perpetuus was [REDACTED], (ii) Mr Buckland's and Kim Buckland's shares were available, and (iii) the prepayments for material made in 2019 and 2020 by SKT would be accounted for 'under the deal'.⁵³ According to Dr Zhou, the proposal to make an equity investment in Perpetuus originated from Mr Walters (ie, from Perpetuus).⁵⁴

⁴⁸ Mr Buckland has told the CMA that these exchanges occurred via Mr Walters who was directly in contact with Dr Zhou.

⁴⁹ Perpetuus' response to the section 109 notice dated 26 October 2021, page 10.

⁵⁰ Perpetuus' response to the section 109 notice dated 26 October 2021, page 10.

⁵¹ Perpetuus' response to the section 109 notice dated 23 December 2021, page 9.

⁵² Perpetuus' response to the section 109 notice dated 23 December 2021, page 9.

⁵³ Dr Zhou's response to the CMA RFI 2 dated 12 November 2021, page 4.

⁵⁴ Dr Zhou's response to the CMA RFI 2 dated 12 November 2021, page 4.

6.7 Dr Zhou also told the CMA that he did not make any determination as to the possible use of a vehicle for his investment in Perpetuus, this being something he would have considered only after 'conclusive negotiations being completed'.⁵⁵

6.8 Lastly, Dr Zhou submitted that, when participating in these discussions, he was not acting on behalf of any company.⁵⁶

- *Taurus*

6.9 Dr Gembala, director, secretary, and sole shareholder at Taurus told the CMA that he met with Mr Walters in 2018 (or possibly earlier) with a view to becoming a private shareholder of Perpetuus but ultimately decided not to invest in the company at that time [REDACTED]

6.10 In initial exchanges with the CMA, Dr Gembala described some early-stage and 'barely exploratory' interest in acquiring some shares in Perpetuus and said that Dr Zhou had no connection with this.⁵⁹ Dr Gembala added that he was no longer interested in buying any part of Perpetuus.⁶⁰

6.11 At a later stage of the CMA investigation, Dr Gembala stated he had not had any recent discussion with Perpetuus in relation to the acquisition of shares in Perpetuus. According to Dr Gembala, the only exchanges he (or Taurus) had with Perpetuus related to the Manufacturing Equipment Deal, which was ultimately not concluded.⁶¹

6.12 Dr Gembala also submitted that, in any case, he (and Taurus) would not be interested in investing in a company which is [REDACTED]

Dr Gembala also expressed doubts [REDACTED]

- *SKT*

6.13 SKT has denied having (or having had in the past) any interest in making an equity investment in Perpetuus directly or via Dr Zhou.⁶³

⁵⁵ Dr Zhou's response to the CMA RFI 2 follow-up dated 28 November 2021, question (g).

⁵⁶ Dr Zhou's email to the CMA dated 24 January 2022.

⁵⁷ Taurus' response to the CMA RFI 1 dated 27 September 2021, page 2.

⁵⁸ Taurus' response to the CMA RFI 1 dated 27 September 2021, page 2.

⁵⁹ Note of the call with Taurus dated 6 September 2021, paragraph 10; Taurus' email to the CMA dated 11 September 2021.

⁶⁰ Taurus' email to the CMA dated 11 September 2021.

⁶¹ Taurus' email to the CMA dated 21 January 2022.

⁶² Taurus' email to the CMA dated 21 January 2022.

⁶³ SKT's email to the CMA RFI dated 24 January 2022.

CMA assessment

- *Whether arrangements remain in contemplation*

- 6.14 The above-described submissions by Perpetuus and Dr Zhou indicate that in 2020-2021 shareholders of Perpetuus and Dr Zhou discussed a potential acquisition by Dr Zhou of a 'controlling stake' in Perpetuus, [REDACTED] (the Contemplated Arrangements, as per paragraph 1.9 above).
- 6.15 In addition to the Parties' submissions in this regard, the CMA has been provided with an (only partially legible) email exchange dated Friday 3 September 2021 (the **September Email Exchange**), two days before the Notice was issued, which shows that Dr Zhou and Mr Walters intended to discuss Dr Zhou's acquisition of Mr Buckland's 39.02% shareholding and Kim Buckland's 13.77% shareholding in PAM.⁶⁴ Dr Zhou explained that the email thread originated from a request made by Mr Walters to send him an email 'relative to a potential investment'.⁶⁵
- 6.16 From the September Email Exchange, whose subject was 'Investment', it can be inferred that Mr Walters and Dr Zhou were going to meet to discuss a 'collaboration', which could have included, among others, the 'purchase of John and Ki[m] Buckland's shares'. The September Email Exchange shows that the reference to the share purchase was added upon Mr Walter's suggestion.
- 6.17 The September Email Exchange also suggests that Dr Zhou's investment would have helped to make Perpetuus' [REDACTED], 'building the business into a significant player' within its industry.
- 6.18 The September Email Exchange does not specify whether Dr Zhou was acting on behalf of SKT or intended to use Taurus as a vehicle for that investment.⁶⁶
- 6.19 The documentary evidence made available to the CMA by Dr Zhou and Perpetuus does not contain any material supporting Mr Buckland's statement that he informed Mr Walters that he was not interested in [REDACTED] [REDACTED] or that Mr Walters had contacted Dr Zhou to this effect.⁶⁷

⁶⁴ See partially legible emails provided by Dr Zhou in response to the CMA RFI 2 dated 25 November 2021 and in response to the CMA RFI 2 follow-up dated 28 November 2021.

⁶⁵ Dr Zhou's response to the CMA RFI 2 dated 12 November 2021, page 4.

⁶⁶ As mentioned in paragraph 6.4 above, according to Mr Buckland, Dr Zhou proposed to sell a 'controlling stake' in Perpetuus to *Taurus*. The CMA, however, has not seen any evidence showing that *Taurus* was aware of this proposal. Additionally, as mentioned in paragraph 6.7 above, Dr Zhou submitted that he did not make any determination as to the possible use of a vehicle for his investment in Perpetuus.

⁶⁷ As of today, Perpetuus did not provide any evidence supporting this submission. Mr Buckland mentioned that Mr Walters' IT equipment could not be searched [REDACTED] (Perpetuus' email to the CMA dated 17 November 2021).

- 6.20 Very shortly after, on Sunday 5 September 2021, BEIS issued the Notice and the Order. This is a significant intervening event which halted the arrangements immediately and interrupted communications between Dr Zhou and Mr Walters. In particular, the CMA notes that the Notice and the Order were issued within two days from the last email Dr Zhou sent to Mr Walters and that the provisions of the Order would not have allowed any transfer of Perpetuus' ownership or control, as well as limiting other, potentially associated, activity of the parties subject to the Order.⁶⁸
- 6.21 In light of this, although the discussions described above were still at an early stage, the CMA cannot rule out the possibility that the Contemplated Arrangements would continue to be progressed, ie that they would continue to be in contemplation, had the Secretary of State not issued the Notice and associated Order. The CMA accordingly considers that there is a realistic prospect that the Contemplated Arrangements would continue, in the absence of an Order preventing it.
- 6.22 For these reasons, the CMA believes that the Contemplated Arrangements are sufficient to constitute arrangements in progress or contemplation for the purposes of the Act.⁶⁹
- *Perpetuus and SKT*
- 6.23 Dr Zhou submitted that, in the context of the discussions relating to the Contemplated Agreements, Perpetuus told Dr Zhou that SKT's prepayments for Perpetuus' material in 2019 and 2020 (described at paragraph 4.5 above) would have been accounted for 'under the deal'.⁷⁰
- 6.24 In this respect, the CMA notes that SKT denied having (or having had) an interest in acquiring a stake in Perpetuus,⁷¹ and that Dr Zhou submitted (at a late stage of the investigation) that he did not act on behalf of any company when discussing the Contemplated Arrangements.⁷²
- 6.25 Nonetheless, in the CMA's view, the fact that pre-paid orders for Perpetuus' SMG made by SKT would have been accounted for in the context of the Contemplated Agreements provides a strong indication that Dr Zhou's offer may have been made on behalf of SKT.
- 6.26 Furthermore, in the September Email Exchange between Mr Walters and Dr Zhou, Dr Zhou mentioned that 'I got confirmed that we will have the fund[incomplete]' and that 'we will start the procedure for other collaborations'

⁶⁸ For more details on the provisions of the Order, please see footnote 2 above.

⁶⁹ Section 33(1)(a) of the Act.

⁷⁰ Dr Zhou's response to the CMA RFI 2 dated 12 November 2021, page 4.

⁷¹ SKT's response to the CMA RFI dated 10 December 2021, page 2.

⁷² Dr Zhou's email to the CMA dated 24 January 2022.

(emphasis added). Dr Zhou's use of the plural form 'we' indicates that Dr Zhou was not acting solely in his own capacity but in collaboration with or as an intermediary of someone else. This is in line with Perpetuus' understanding that Dr Zhou is a representative of SKT (see above, paragraph 4.8).

6.27 In light of this, the CMA believes that it is or may be the case that the Contemplated Arrangements were discussed between Perpetuus and Dr Zhou acting on behalf of, or in connection with SKT.

- *Dr Zhou and SKT*

6.28 The CMA has also considered whether Dr Zhou exercised material influence over SKT. The assessment of material influence requires a case-by-case analysis of the overall relationship between the concerned parties⁷³ in particular having regard to the fact that in this case the concerned parties are overseas-based persons. In making its assessment, the CMA had regard to following:

- (a) Dr Zhou submitted that he is a director and a 25% shareholder in SKT⁷⁴ (although he stated that he has not acted in SKT's management since 2019).⁷⁵
- (b) Dr Zhou submitted that, when discussing the Contemplated Arrangements, Mr Walters told him that the prepayments for material made in 2019 and 2020 by SKT would be 'accounted for under the deal'. This indicates that Dr Zhou was seen by Perpetuus as having some form of influence over SKT decision making.
- (c) The CMA understands that Dr Zhou and SKT have been in touch on the status of the CMA's investigation (with SKT being willing to be briefed by Dr Zhou about the State of Play call). The CMA also notes that Dr Zhou's submissions to the CMA have always been sent via a SKT inbox account. This indicates that Dr Zhou has a significant role within SKT and corresponded with the CMA with SKT's consent.

6.29 For these reasons, the CMA believes that Dr Zhou may exercise a material influence over SKT and that any acquisition of a controlling stake in Perpetuus by Dr Zhou may therefore also result in Perpetuus and SKT ceasing to be distinct as a consequence of both being under Dr Zhou's control.

⁷³ Guidance on the CMA's jurisdiction and procedure, paragraph 4.22.

⁷⁴ Dr Zhou's response to the CMA RFI 1 dated 1 October 2021, page 4.

⁷⁵ Dr Zhou's email to the CMA dated 24 January 2022.

- *Taurus-Perpetuus*

6.30 As mentioned above, Dr Gembala told the CMA that he explored the acquisition of some shares in Perpetuus only in 2018 (if not earlier) but he ultimately decided not to invest in the company on that occasion.⁷⁶

6.31 In a call with the CMA held on 6 September 2021, Dr Gembala mentioned some early-stage and 'barely exploratory' interest in buying shares in Perpetuus and, should that arise, in having some level of control over the strategic direction of Perpetuus, or at least 'influence the process of the business'.⁷⁷

6.32 However:

- (a) The available evidence indicates that Dr Gembala had only initial conversations with Perpetuus, with his interest largely resulting in unilateral research into Perpetuus' [REDACTED], which did not result in written communications, and did not enter into any discussions of the terms of or practical arrangements in respect of a possible deal.
- (b) At a later stage of the CMA investigation, Dr Gembala stated that he did not have any discussion with Perpetuus in relation to the acquisition of shares in Perpetuus.⁷⁸ Dr Gembala also said that he did not have an interest in investing in Perpetuus due to its [REDACTED]
[REDACTED]
- (c) The issuance of the Notice and the Order by [REDACTED]
[REDACTED] Perpetuus further and made an investment in Perpetuus even less attractive.

6.33 For these reasons, based on the available evidence, the CMA believes that the prospect of Dr Gembala wishing to invest in Perpetuus and the existence of what can be described as 'arrangements' are at best speculative. The CMA accordingly considers the evidence is insufficient to conclude that arrangements are or may be in progress or in contemplation between Perpetuus and Dr Gembala.⁸⁰

⁷⁶ Note of the call with Taurus dated 6 September 2021, paragraphs 5 and 10; Taurus' response to the CMA RFI 1 dated 27 September 2021, page 2.

⁷⁷ Note of the call with Taurus dated 6 September 2021, paragraphs 5 and 10.

⁷⁸ Taurus' email to the CMA dated 21 January 2022.

⁷⁹ Taurus' email to the CMA dated 21 January 2022.

⁸⁰ Taurus will not be considered further in this report.

Enterprises ceasing to be distinct

The Contemplated Arrangements

- 6.34 Each of Perpetuus and SKT is an enterprise as described at paragraphs 4.1-4.2 and 4.5 above.
- 6.35 Should the Contemplated Arrangements have proceeded, Dr Zhou (either by himself, or acting on behalf of SKT) would have acquired a controlling interest in Perpetuus (ie John and Kim Buckland's total 52.79% shareholding in Perpetuus).
- 6.36 Accordingly, the CMA considers that there is a realistic prospect of SKT and Perpetuus ceasing to be distinct as a result of the Contemplated Arrangements (the '**Merger**').

Perpetuus as a 'relevant enterprise'

- 6.37 Section 23A of the Act applies in mergers that involve an enterprise being taken over which is active in the areas specified under section 23A of the Act. In particular in the circumstances of this case, the CMA has considered whether Perpetuus is a 'relevant enterprise' on account of:
- (a) its activities consisting in or including developing or producing advanced materials pursuant to sections 23A(3)(a)(i) and 23A(4)(a) and (d) of the Act;
 - (b) owning, creating or supplying intellectual property relating to the functional capability of advanced materials pursuant to section 23A(3)(b) of the Act; and
 - (c) developing anything designed as an enabler pursuant to section 23A(3)(f) and 23A(4) of the Act or providing know-how or the use of enablers pursuant to section 23A(3)(g) and 23A(4) of the Act.
- 6.38 Evidence received by the CMA indicates that Perpetuus is active in functionalisation of graphene and other nanomaterials, including graphite.⁸¹ To that effect, Perpetuus employs a patented process which uses a plasma gas reactor.⁸²
- 6.39 In particular, Perpetuus uses a plasma gas reactor to functionalise nanomaterials. Whilst this process can be used to functionalise graphene, evidence gathered by the CMA shows that, so far, it has been used to produce

⁸¹ Perpetuus' response to the section 109 notice dated 18 November, pages 9-10; note of the call with Perpetuus dated 20 October 2021, page 2, paragraph 2; Perpetuus' response to the section 109 Notice dated 23 December 2021, page 7; [redacted].

⁸² Perpetuus' response to the section 109 notice dated 23 December 2021, page 7.

functionalised 'nano graphite' provided by [REDACTED], a [REDACTED] firm who has no functionalisation capabilities.⁸³

Parties' submissions

- 6.40 Perpetuus submitted that, to the best of its knowledge, it is not a 'relevant enterprise' under the Act as its activities do not consist in developing or producing advanced materials, research into advanced materials, developing or producing anything designed as an enabler, and/or providing know-how about the use of enablers.⁸⁴
- 6.41 Perpetuus did not make any submission as to whether Perpetuus owns, creates or supplies intellectual property relating to the functional capability of advanced materials and pointed the CMA towards its patents.⁸⁵

CMA assessment

- 6.42 Evidence from subject matter experts gathered during the CMA's investigation indicates that graphene (including functionalised graphene) falls within the definition of 'advanced material' under section 23A(4)(a) and (d) of the Act respectively.⁸⁶
- 6.43 In particular, in relation to section 23A(4)(a), examples include the use of graphene (i) to camouflage objects in the thermal wavebands (1e14 Hz to 2e13 Hz) and (ii) in connection to the modulation of signals in the optical fibre waveband (1.9e14 Hz to 2.3e14 Hz) for encryption to avoid interception and detection.⁸⁷
- 6.44 Subject matter experts consulted by the CMA explained that section 23A(4)(d) is engaged in light of 'graphene being a constitute element in metamaterials, or being a platform, to which spatial arrangements are patterned to produce metasurfaces with specific properties, such as the absorption and reflection of electromagnetic radiation in the range specified in the Enterprise Act 2002'.⁸⁸
- 6.45 The CMA was told by subject matter experts that graphene is also an 'enabler' pursuant to section 23A(4) as it can be functionalised to produce another advanced material with different properties.⁸⁹
- 6.46 Additionally, the CMA received evidence that graphite (and functionalised graphite) can be a component in a device or large area material that falls under

⁸³ Perpetuus' response to the section 109 notice dated 23 December 2021, page 10.

⁸⁴ Perpetuus' response to the section 109 notice dated 26 October 2021, page 8.

⁸⁵ Perpetuus' response to the section 109 notice dated 26 October 2021, page 8.

⁸⁶ [REDACTED].

⁸⁷ [REDACTED].

⁸⁸ [REDACTED].

⁸⁹ Enabler is defined in the Act as any material or process which is not an advanced material but is used in the manufacture of an advanced material. [REDACTED].

section 23A(4)(a) of the Act.⁹⁰ Furthermore, the CMA was told that the layers within graphite can be separated by a number of different processes to produce graphene.⁹¹

6.47 In light of what described above, the CMA considers that:

- (a) by being active in the production of functionalised nanomaterials (including graphene and graphite), Perpetuus' activities consist in or include producing advanced materials pursuant to sections 23A(3)(a)(i) and 23A(4)(a) and (d) of the Act;
- (b) Perpetuus owns intellectual property (specifically, patents) relating to a graphene/graphite functionalisation process which uses a plasma gas reactor.⁹² Perpetuus' patents relate to the 'functional capability of advanced materials' given the connection between this patented process and the production of advanced materials (ie functionalised graphene/graphite) pursuant to section 23A(3)(b) of the Act.

6.48 In view of the CMA's conclusions at paragraphs 6.47(a) and (b) above, it has not been necessary to conclude on whether Perpetuus develops anything designed as an enabler under section 23A(3)(f) of the Act or provides know-how about or the use of enablers under section 23A(3)(g).

6.49 For these reasons, the CMA considers that Perpetuus may be a 'relevant enterprise' undertaking an activity specified under section 23A of the Act. As such, the jurisdictional thresholds set out in section 23(1)(b)(ii) and 23(2)(b) of the Act apply, ie either:

- (a) the relevant enterprise's annual UK turnover exceeds £1 million (**the turnover test**);
- (b) the share of supply test is met if before the merger, the relevant enterprise being acquired or merged has a share of supply or purchase of 25% or more of relevant goods or services in the UK or in a substantial part of it (**the share of supply test**).

Turnover test

6.50 The turnover test is not met because Perpetuus had less than £1 million turnover in its last financial year.⁹³

⁹⁰ [REDACTED].

⁹¹ [REDACTED].

⁹² See patents held by Perpetuus listed on the European Patent Office's patent search website [Espacenet](#).

⁹³ See paragraph 4.3 above. Perpetuus stated that its turnover has never been greater than £1 million per year (Perpetuus' response to the section 109 notice dated 26 October 2021, page 7).

Share of supply test

- 6.51 Under section 23(2A)(b) of the Act, for mergers in which the enterprise being taken over (or part of it) is a relevant enterprise, the share of supply test is met if, before the merger, the relevant enterprise being acquired or merged has a share of supply or purchase of 25% or more of relevant goods or services in the UK or in a substantial part of it. This test is met even if the share of supply does not increase as a result of the merger.⁹⁴ The supply of relevant goods or services for the purposes of deciding whether the share of supply test is met must be made in connection with the activities of the enterprise by virtue of which the target enterprise qualifies as a relevant enterprise.⁹⁵
- 6.52 The CMA has a broad discretion to identify a specific category of goods or services supplied or acquired by the merging parties for the purposes of the share of supply test.⁹⁶ The Guidance on the CMA's jurisdiction and procedure identifies a number of considerations to which the CMA will have regard when describing the relevant category of goods or services.⁹⁷ In particular, it notes that:
- (a) the CMA will have regard to any reasonable description of goods or services; and
 - (b) the share of supply test is not an economic assessment of the type used in the CMA's substantive assessment and therefore the group of goods or services to which the test is applied need not amount to a relevant economic market. Therefore, it is not necessary that the description of services for the purposes of the share of supply test aligns with the market definition analysis for the purposes of the substantive assessment.
- 6.53 In addition, the CMA has a wide discretion to apply whatever measure (eg value, cost, price, quantity, capacity, number of workers employed), or combination of measures, it considers appropriate to calculate the merging parties' share of supply and to determine whether the 25% threshold is met.⁹⁸

Reasonable description of goods or services within the field of advanced materials

- 6.54 Within this context, the CMA will have regard to any reasonable description of a set of goods or services to determine whether the share of supply test is met. In this regard, section 128(3) of the Act explicitly provides that the supply of services includes: (a) performing for gain or reward any activity other than the

⁹⁴ This provision adds to, rather than replaces, the share of supply test set out in section 23(2A)(a).

⁹⁵ Sections 23A(4A)(b) and 23(4B)(b) of the Act. See also Guidance on the CMA's jurisdiction and procedure, paragraph 4.71.

⁹⁶ Section 23(8) of the Act.

⁹⁷ Guidance on the CMA's jurisdiction and procedure, paragraph 4.63.

⁹⁸ Section 23(5) of the Act.

supply of goods; (b) rendering services to order; and (c) the provision of services by making them available to potential users.

The Parties' views

- 6.55 The Parties mentioned in the Notice submitted that the CMA does not have jurisdiction to review the Merger as the share of supply test is not met.
- 6.56 Taurus submitted that Perpetuus does not supply 25% of graphene produced in the UK and that other companies, [REDACTED] would be able to confirm this point.⁹⁹
- 6.57 Dr Zhou submitted that Perpetuus does not supply graphene but instead supplies a product of lesser quality.¹⁰⁰
- 6.58 Perpetuus estimated that its share of supply is less than 1%, but did not provide the methodology and data sources used as a basis for this estimate.¹⁰¹ On the other hand, Perpetuus stated that it is uniquely able to produce graphene in industrial quantity and that it does not know any competitors to its business.¹⁰²
- 6.59 The CMA has considered the Parties' submissions along with information provided by third parties.

The CMA's assessment

- *Reasonable description of goods within the field of advanced materials*
- 6.60 As explained above, Perpetuus has the capability to functionalise graphene and other nanomaterials using a plasma gas reactor.¹⁰³
- 6.61 Evidence gathered by the CMA from a number of third parties, and having regard to Perpetuus' own description of its business activities¹⁰⁴ also shows that Perpetuus and [REDACTED] are the only two companies in the UK able to functionalise graphene and other nanomaterials (including graphite) through this process.¹⁰⁵ For example, [REDACTED] submitted that apart from Perpetuus, the only other company who uses a similar process is [REDACTED].¹⁰⁶ [REDACTED] believes that some universities and laboratories may potentially use the same process, but produce only low quantity

⁹⁹ Email from Taurus dated 11 September 2021.

¹⁰⁰ Email from Dr Zhou dated 29 September 2021.

¹⁰¹ Perpetuus' response to the section 109 notice dated 26 October 2021, page 7; Perpetuus' response to the section 109 notice dated 18 November 2021, page 7.

¹⁰² Note of the call with Perpetuus dated 20 October 2021, page 2, paragraph 2; Perpetuus' response to the section 109 notice dated 26 October 2021, pages 13-14.

¹⁰³ [REDACTED].

¹⁰⁴ Note of the call with Perpetuus dated 20 October 2021, paragraph 2. Perpetuus also stated that it doesn't know any competitors to its business (Perpetuus' response to the section 109 notice dated 26 October 2021, pages 13-14).

¹⁰⁵ [REDACTED].

¹⁰⁶ [REDACTED].

of product and not for commercial purposes.¹⁰⁷ [REDACTED] confirmed that it uses plasma gas reactor to functionalise different materials (including graphene), and believes that Perpetuus is its only competitor who uses a plasma gas reactor for the functionalisation of graphene and other nanomaterials.¹⁰⁸

- 6.62 As also mentioned above, the CMA has been told that there is a number of advantages of functionalising graphene and other nanomaterials through a plasma gas reactor. In particular, in an Investment Memorandum Perpetuus provided to Dr Zhou, Perpetuus states that this process is environmentally friendly, cost efficient and significantly affects the resultant properties of graphene by improving physical properties and performance.¹⁰⁹
- 6.63 Furthermore, a third party submitted that functionalisation through a plasma gas reactor does not require an acid treatment of the material to be treated, thus preventing damage and enhancing functional performance, structural integrity and mechanical strengths of the final product. This third party also flagged that functionalisation using plasma gas reactor also poses less health and safety risks.¹¹⁰
- 6.64 Given the advantages of functionalisation through a plasma gas reaction, the CMA considers that it is reasonable, for the purposes of the application of the share of supply test, to distinguish functionalisation of graphene and other nanomaterials (including graphite) through a plasma gas reactor from other functionalisation processes.
- 6.65 Evidence gathered during the CMA's investigation also indicates that Perpetuus is active in functionalisation of graphene and other nanomaterials (including graphite) by making this service available to potential users based in the UK or overseas. In particular:
- (a) Perpetuus submitted that it supplied [REDACTED] of functionalised material to customers and achieved sales of [REDACTED] in 2019/2020 and 2020/2021 respectively.¹¹¹ The CMA did not receive details on who this material was supplied to but notes that Perpetuus' list of customers since 1 April 2020 includes [REDACTED] customers based in the UK.¹¹²

¹⁰⁷ [REDACTED].

¹⁰⁸ [REDACTED].

¹⁰⁹ Perpetuus Advanced Materials (PAM) Information Memorandum, 7 October 2018, submitted by Dr Zhou in response to CMA RFI 1 dated 1 October 2021, pages 2 and 5.

¹¹⁰ [REDACTED].

¹¹¹ Perpetuus' email to the CMA dated 16 December 2021.

¹¹² Perpetuus' customers contact information, submitted by Perpetuus in response to the section 109 notice dated 18 November 2021. The CMA notes that a Perpetuus Information Memorandum dated January 2021 mentions that one of Perpetuus customers is [REDACTED]

- (b) The CMA has also seen evidence that Perpetuus reached out to a UK firm, [REDACTED], offering to functionalise the latter firm's graphene in 2020.¹¹³
- 6.66 In light of this, the CMA believes that, for the purpose of assessing whether the share of supply test is or may be satisfied, Perpetuus is active in the supply of functionalised graphene (or the service of functionalising graphene) and other nanomaterials (including graphite) using a plasma gas reactor in the UK.
- *25% share*
- 6.67 Perpetuus submitted that it can produce approximately [REDACTED]t per year of functionalised nanomaterials. With respect to Perpetuus' capacity, the CMA also notes that a purchase order issued by Taurus in relation to the Manufacturing Equipment Deal in February 2021 refers to a '1 X 500 metric ton SMG production facility¹¹⁴ with all associated equipment, turnkey and ready for use within 4 weeks of delivery (...)', which represented only a first tranche of the manufacturing equipment that Dr Zhou intended to purchase via Taurus.
- 6.68 Furthermore, the market report on graphene published in 2020 by [REDACTED] mentions that, as of February 2020, Perpetuus had a 'reported capacity' of 100t to 500t per year of functionalised nanomaterials (specifically, in relation to functionalised graphene nanoplatelets).¹¹⁵
- 6.69 The only other firm falling within the same description of goods or services ([REDACTED]) told the CMA that its capacity depends on the material that needs to be functionalised and in any case it is not currently above [REDACTED] per year.
- 6.70 Based on all of the evidence described above, the CMA believes that the share of supply test is or may be met on the basis of Perpetuus' UK capacity. Specifically, based on the information available to the CMA, and even allowing for the possibility of a large margin of error in relation to Perpetuus' self-reported capacity, Perpetuus has more than 25% of the UK capacity in relation to functionalisation of graphene and other nanomaterials (including graphite) using a plasma gas reactor.¹¹⁶
- 6.71 The requisite 25% share of supply is therefore established in connection with an activity by Perpetuus specified under the Act and by virtue of which Perpetuus is a relevant enterprise for the purposes of the Act.

¹¹³ [REDACTED].

¹¹⁴ Perpetuus told the CMA that its capacity is achieved through a manufacturing facility of the same type (see Perpetuus' response to the CMA RFI dated 15 December 2021; and Perpetuus' response to the section 109 notice dated 18 November, page 8).

¹¹⁵ [REDACTED].

¹¹⁶ Taking Perpetuus' lowest self-reported estimate of capacity and [REDACTED]'s highest estimate, Perpetuus would still have [40-50]%% of total UK capacity.

6.72 For the reasons set out above, the CMA considers that the share of supply test is met.

Conclusion on jurisdiction

6.73 On the basis of the evidence set out above, the CMA believes that it may be the case that a relevant merger situation has been created. Specifically, the CMA believes that it is or may be the case that:

- (a) The Contemplated Arrangements constitute arrangements in progress or in contemplation which if carried into effect would lead two enterprises, Perpetuus and SKT respectively, to cease to be distinct.
- (b) Perpetuus is a relevant enterprise undertaking an activity specified under section 23A of the Act.
- (c) Perpetuus is active in the supply of functionalised graphene and other nanomaterials (including graphite) using a plasma gas reactor in the UK and has at least a 25% of the UK capacity in relation to such supply.
- (d) The required 25% share of supply is made in connection with activities of Perpetuus by virtue of which Perpetuus is a relevant enterprise.

6.74 The CMA has been informed that it is proposed that one of Perpetuus' subsidiaries, PCT, may [REDACTED] [REDACTED] The CMA notes, however, as of the date of this report, PCT remains under Perpetuus' control.

6.75 Accordingly, the CMA considers that PCT's [REDACTED] does not affect any of the findings in the CMA's jurisdictional assessment above, which pursuant to section 42(6) of the Act is made with reference to the date of this report.

7. COUNTERFACTUAL

7.1 The CMA assesses a merger's impact relative to the situation that would prevail without the merger (ie the counterfactual).¹¹⁷ In an anticipated merger the counterfactual may consist of the prevailing conditions of competition, or conditions of competition that involve stronger or weaker competition between the merger firms than under the prevailing conditions of competition.¹¹⁹

¹¹⁷ See [REDACTED]'s email to the CMA dated 1 February 2022. See also Perpetuus' representations to the CMA during the State of Play call held on 19 January 2022.

¹¹⁸ [Merger Assessment Guidelines](#) (CMA129), 18 March 2021 (**Merger Assessment Guidelines**), Chapter 3.

¹¹⁹ Merger Assessment Guidelines, paragraph 3.2.

- 7.2 In the present case, the CMA assessed the Merger against the prevailing conditions of competition.
- 7.3 In particular, the CMA considers that the prevailing conditions of competition involve an uncertain scenario in relation to Perpetuus' [REDACTED] for the following reasons:
- (a) Perpetuus has been affected by the COVID-19 pandemic: [REDACTED]
[REDACTED]
[REDACTED]
- (b) Perpetuus was in a [REDACTED] when the Notice was issued.¹²² In this regard, the CMA also notes that the Auditor's report included in PAM's 2020 financial statements mentioned that there was [REDACTED]
[REDACTED]
- 7.4 The CMA has been told that [REDACTED]
- 7.5 At a late stage of the investigation the CMA has also been informed that one of Perpetuus' subsidiaries (PCT) [REDACTED]
[REDACTED]. At the time of this report, PCT remains under Perpetuus' control, although it has [REDACTED]
[REDACTED]
- 7.6 Accordingly, the CMA believes the pre-Merger conditions of competition to be the relevant counterfactual in this case.

8. COMPETITIVE ASSESSMENT

- 8.1 In formulating theories of harm, the CMA will consider how a merger might affect rivalry between firms seeking to win customers' business over time by offering them a better deal. The theories of harm will depend on the levels of the supply chain at which the merger firms operate; the links between the merger firms and with their rivals; the nature of competition and how firms seek to win customers; and any long-run dynamics in the relevant sectors.¹²⁵ The CMA may consider several theories, sometimes affecting the same market.¹²⁶

¹²⁰ Perpetuus Advanced Materials Plc's Annual Report and Financial Statements for the year ended 31 March 2020, page 3.

¹²¹ Jacqui Ward's [BEIS] witness statement in the High Court proceedings, paragraph 8.

¹²² Perpetuus' response to the section 109 notice dated 26 October 2021, pages 10-11.

¹²³ PAM's Annual Report and Financial Statements – year ended 31 March 2020, pages 18-19.

¹²⁴ Perpetuus' response to the section 109 notice dated 23 December 2021, page 9.

¹²⁵ Merger Assessment Guidelines, paragraph 2.12.

¹²⁶ Merger Assessment Guidelines, paragraph 2.16.

Horizontal unilateral effects

- 8.2 The CMA notes that Perpetuus' and SKT's activities do not overlap as the first is active in functionalisation of graphene and other nanomaterials (including graphite) and the second specialises in research and development of products based on polyimide fibers. As such, there is no horizontal overlap as between Perpetuus and SKT.

Input and/or customer foreclosure

- 8.3 The available evidence indicates that functionalised graphene can be added as a resin or coating to polyimide fibres to change or enhance its properties (eg thermal resistance).¹²⁷ In this respect, the CMA notes that SKT purchased ██████████ of functionalised graphene from Perpetuus in 2019.¹²⁸ Functionalised material supplied by Perpetuus can therefore be used as an input by SKT.
- 8.4 The Merger does not, however, raise input foreclosure concerns because the available evidence consistently shows that Perpetuus' functionalised graphene is not a key input for the following reasons: (i) functionalised graphene can be sourced from anywhere in the world;¹²⁹ (ii) Perpetuus is just one of many suppliers of this material around the world;¹³⁰ (iii) third parties consulted by the CMA do not see Perpetuus as a leading provider in the graphene industry globally.¹³¹
- 8.5 Furthermore, the CMA has not received evidence indicating that SKT is a major purchaser of functionalised graphene in the UK, with no competitor or third party, among those contacted by the CMA, having knowledge of SKT.
- 8.6 For these reasons, the CMA does not believe that the Merger may result in anticompetitive foreclosure effects.
- 8.7 For the reasons set out above, the CMA does not believe that it is or may be the case that the Merger may be expected to result in an SLC within a market or markets in the United Kingdom.

9. PUBLIC INTEREST CONSIDERATION

Summary of interested parties

- 9.1 Section 44(3)(b) of the Act requires the CMA to provide a summary of representations it has received (i) which relate to the public interest consideration

¹²⁷ [REDACTED].

¹²⁸ Dr Zhou's response to the CMA's RFI 2 dated 12 November 2021, page 3.

¹²⁹ [REDACTED].

¹³⁰ [REDACTED].

¹³¹ [REDACTED].

in question (in this case, national security) and (ii) which are or may be relevant to the Secretary of State's decision as to whether to make a reference for a phase 2 assessment under section 45 of the Act.

The MoD

- 9.2 The CMA understands that the Ministry of Defence (MoD) is preparing advice for the Secretary of State on the public interest consideration of national security. This advice will be provided separately to the Secretary of State.

Third parties

- 9.3 The CMA received two specific representations, as set out below.
- (a) One third party submitted that Perpetuus is a leader in the UK in graphene and surface engineering which gives the UK expertise in new fields for 'future proofing' its economy. According to this third party, Perpetuus is a 'gem' that needs to be 'nurtured and developed by the UK (...) now that [the UK] is going alone'. This third party added that Perpetuus gives the UK security of material supply in an area where there are potential worldwide shortages. This third party considers that the acquisition of Perpetuus by Taurus, a company with 'no manufacturing expertise and whose only previous experience is in resident property management and media representation' is extremely suspicious.
 - (b) Another third party submitted that Dr Zhou is engaged with and is working for many state-owned educational and research bodies in China. This third party stated that that employees of such state-owned institutions (like all Chinese citizens) are legally required to serve the 'Chinese party-state'.
- 9.4 The CMA also received somewhat related comments from two third parties.
- (a) A third party submitted that the transfer of Perpetuus' technology [to an Asia-Pacific-based owner] would create 'significant and unfair state supported competition from Far East manufacturers'.
 - (b) Another third party submitted that the UK government has asked it to 'exercise caution when working with Chinese clients, and/or within China due to (i) potential dual use purpose applications; and (ii) risk of IP theft'.
- 9.5 Pursuant to section 44(6) of the Act the CMA also provided advice on the national security public interest consideration which is or may be relevant to the Secretary of State's decision as to whether to make a reference under section 45. The CMA advice is set out in paragraph 10.3 below.

10. REMEDIES AND UNDERTAKINGS IN LIEU

- 10.1 The CMA has decided that the relevant merger situation does not give rise to a substantial lessening of competition. Accordingly, it is not necessary for the CMA to state, pursuant to section 44(4)(f) of the Act, whether the CMA believes that it is, or may be, the case that it would be appropriate to deal with the matter (disregarding any public interest considerations mentioned in the intervention notice concerned) by way of undertakings under paragraph 3 of Schedule 7.
- 10.2 However, the CMA notes that Perpetuus and Dr Zhou have signalled the significant impact of the Notice and Order.¹³² Both Perpetuus and Dr Zhou have stated that would be willing to enter into binding undertakings to abandon the Merger.
- 10.3 Should Perpetuus and Dr Zhou and/or SKT, or Perpetuus unilaterally, be willing to offer undertakings in lieu of a reference not to pursue the Contemplated Arrangements or any other transaction that would lead to a relevant merger situation, the CMA considers this would be a binding structural remedy. Accordingly, while noting that this is a matter for the Secretary of State to decide, the CMA considers that it would be appropriate for the Secretary of State to accept such an undertaking in lieu of a phase 2 reference.
- 10.4 Furthermore, in light of the [REDACTED] involving part of Perpetuus (described above), the Secretary of State may also wish to consider the implications of any potential sale of Perpetuus' assets to other interested purchasers under the National Security and Investment Act 2021.

11. ASSESSMENT AND ADVICE TO THE SECRETARY OF STATE

- 11.1 The CMA produces this report to the Secretary of State pursuant to its duty under section 44(2) of the Act, following investigations carried out under section 44(7).
- 11.2 This report contains advice on considerations relevant to the making of a reference under section 33 of the Act which are also relevant to the Secretary of State's decision as to whether to make a reference under section 45 of the Act, namely that the CMA believes that is or may be the case that:
- (a) arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation; and

¹³² Dr Zhou's response to the CMA RFI 1 dated 1 October 2021, page 2.

- (b) the creation of that merger situation may not be expected to result in an SLC within a market or markets in the UK for goods or services.¹³³
- 11.3 This report contains a summary of the representations about the case which it has received which relate to the national security public interest consideration mentioned in the Notice.
- 11.4 This report also contains advice or recommendations on the public interest consideration mentioned in the Notice under section 44(6) of the Act. The CMA considers that it would be appropriate for the Secretary of State to accept undertakings which amount to a binding structural remedy in lieu of a reference to a phase 2 inquiry.

Alex Olive, Director
7 February 2022

¹³³ In view of the CMA's decision on SLC, it has not been necessary to advise whether any of the exceptions to the duty to refer apply or to state, pursuant to section 44(4)(f) of the Act, whether the CMA believes that it is, or may be, the case that it would be appropriate to deal with the matter (disregarding any public interest considerations mentioned in the Notice) by way of undertakings under paragraph 3 of Schedule 7.

