**PUBLIC**

**UNITED STATES OF AMERICA**
**FEDERAL TRADE COMMISSION**
**OFFICE OF ADMINISTRATIVE LAW JUDGES**

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**DOCKET NO. 9377**

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**In the Matter of**

**TRONOX LIMITED**
**a corporation,**

**NATIONAL INDUSTRIALIZATION COMPANY (TASNEE)**
**a corporation,**

**NATIONAL TITANIUM DIOXIDE COMPANY LIMITED (CRISTAL)**
**a corporation, and**

**CRISTAL USA INC.**
**a corporation,**

**Respondents.**

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# INITIAL DECISION

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**D. Michael Chappell**
**Chief Administrative Law Judge**

**Date: December 14, 2018**

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# I. INTRODUCTION

## A. Summary of the Case

This action, issued by the Federal Trade Commission ("FTC" or "Commission") on December 5, 2017, challenges a proposed acquisition by Respondent Tronox Limited ("Tronox") of the titanium dioxide business of The National Titanium Dioxide Company Limited ("Cristal")[1] (the "Acquisition" or "Transaction"). In summary, the Complaint alleges that the Acquisition may substantially lessen competition in the market for the sale of chloride process titanium dioxide ("chloride TiO2") in North America, in violation of Section 7 of the Clayton Act, as amended, 15 U.S.C. § 18, and Section 5 of the Federal Trade Commission Act ("FTC Act"), 15 U.S.C. § 45. Respondents deny that the Acquisition will substantially lessen competition and further assert that the Acquisition will be procompetitive because it will result in substantial synergies and efficiencies that outweigh any anticompetitive effects. Answer of Tronox ¶ 3 and affirmative defense ¶¶ 9-13; Answer of TASNEE and Cristal ¶ 3 and affirmative defense ¶ 10.

The FTC did not file an ancillary action for a preliminary injunction against the Acquisition in federal district court under Section 13(b) of the FTC Act at the time the Complaint was filed, as is customary in unconsummated merger cases. The reason provided by Complaint Counsel for not filing for a preliminary injunction at that time was that Tronox and Cristal were not in a position to close the Transaction until they received approval from the European Commission.

The evidentiary hearing in this matter, which commenced May 18, 2018, was conducted over 16 days and was completed on June 22, 2018. Thereafter, the parties

[1] Respondent The National Industrialization Company ("TASNEE") is the majority owner of Respondent The National Titanium Dioxide Company and the ultimate parent of Respondent Cristal USA Inc. Both TASNEE and The National Titanium Dioxide Company are Saudi Arabian entities. Cristal USA Inc. is a Delaware corporation. Complaint ¶¶ 10-12; Answer of TASNEE and Cristal ¶¶ 10-12; Joint Stipulations of Jurisdiction, Law, and Fact ¶ 4. For ease of reference, the name "Cristal" is used herein to refer to the subject of the Acquisition, as well as to the three affiliated corporate entities, unless the context otherwise dictates.

submitted post-trial briefs, proposed findings of fact, and replies to each other's briefs and proposed findings of fact.[2]

The European Commission granted conditional approval of the Acquisition on July 4, 2018. *See* http://europa.eu/rapid/press-release_IP-18-4361_en.htm. On July 10, 2018, after completion of the evidentiary hearing and more than seven months after the administrative complaint was filed, the FTC filed an action for a preliminary injunction in federal district court. That action was submitted for decision based on the administrative record in this matter and an abbreviated court hearing. On September 5, 2018, the district court entered a preliminary injunction against the Acquisition, pending final agency action and conclusion of any appeals, finding, *inter alia*, that the FTC demonstrated a likelihood that the proposed transaction will substantially lessen competition for the sale of chloride TiO2 in North America. *FTC v. Tronox Ltd*., 2018 U.S. Dist. LEXIS 155127, at *3-4 (D.D.C. Sept. 12, 2018) ("Preliminary Injunction Opinion").

Upon full consideration of the entire record, and as more fully explained below, the evidence in this proceeding proves a strong prima facie case that the Acquisition may substantially lessen competition in the relevant market for the sale of chloride TiO2 in North America, by creating a highly concentrated market and increasing the likelihood of coordinated effects. Respondents have failed to rebut this proof, including by failing to demonstrate that entry or expansion would be timely, likely, and sufficient to counteract the likely anticompetitive effects of the Acquisition, or to demonstrate cognizable synergies or efficiencies that might justify the likely anticompetitive effects of the Acquisition. Accordingly, the evidence proves that the Acquisition may substantially lessen competition. Therefore, pursuant to Section 7 of the Clayton Act and Section 5 of the FTC Act, the Acquisition will be enjoined.

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[2] Rule 3.51(a) of the Commission's Rules of Practice states that "[t]he Administrative Law Judge shall file an initial decision within 70 days after the filing of the last filed initial or reply proposed findings of fact, conclusions of law and order . . . ." 16 C.F.R. § 3.51(a). The last reply proposed findings and conclusions and briefs were filed on September 7, 2018. Seventy days from the last filed reply proposed findings and conclusions and briefs was November 19, 2018, and, absent an order pursuant to Rule 3.51, the Initial Decision was to be filed on or before November 19, 2018. Based on the voluminous and complex record in this matter, an Order was issued on November 9, 2018, finding good cause for extending the time period for filing the Initial Decision by 30 days. Accordingly, issuance of this Initial Decision by December 19, 2018 is in compliance with Commission Rule 3.51(a).

### B. Summary of Evidence Presented

The record in this matter consists of the testimony of a total of 63 witnesses, presented live or by deposition. Over 3,690 exhibits were also admitted into evidence. Individuals referenced in this Initial Decision include current and/or former employees of Tronox and Cristal, competing TiO2 producers, and TiO2 customers.

This Initial Decision is based on a consideration of the whole record relevant to the issues and addresses the material issues of fact and law. The briefs and proposed findings of fact and conclusions of law, and the replies thereto, submitted by the parties, and all contentions and arguments therein were thoroughly reviewed and considered. Proposed findings of fact submitted by the parties that were not accepted in this Initial Decision were rejected, either because they were not supported by the evidence or because they were not dispositive or material to the determination of the merits of the case. Similarly, legal contentions and arguments of the parties that are not addressed in this Initial Decision were rejected, because they lacked support in fact or law, were not material, or were otherwise lacking in merit.[3] In addition, all expert opinion evidence submitted in this case has been fully reviewed and considered. Except as expressly relied on or adopted in this Initial Decision, such opinions have been rejected, as either unreliable, unsupported by the facts, or unnecessary to the findings and conclusions herein.

[3] Ruling upon a decision of the Interstate Commerce Commission, and interpreting language in the Administrative Procedure Act ("APA") that is almost identical to language in Commission Rule 3.51(c)(1), the United States Supreme Court held that "[b]y the express terms of [that Act], the Commission is not required to make subordinate findings on every collateral contention advanced, but only upon those issues of fact, law, or discretion which are 'material.'" *Minneapolis & St. Louis Ry. Co. v. United States*, 361 U.S. 173, 193-94 (1959). *Accord Stauffer Labs., Inc. v. FTC*, 343 F.2d 75, 82 (9th Cir. 1965). *See also Borek Motor Sales, Inc. v. NLRB*, 425 F.2d 677, 681 (7th Cir. 1970) (holding that it is adequate for the Board to indicate that it had considered each of the company's exceptions, even if only some of the exceptions were discussed, and stating that "[m]ore than that is not demanded by the [APA] and would place a severe burden upon the agency"). Furthermore, the Commission has held that Administrative Law Judges are not required to discuss the testimony of each witness or all exhibits that are presented during the administrative adjudication. *In re Amrep Corp.*, 102 F.T.C. 1362, 1670, 1983 FTC LEXIS 17, at *566-67 (Nov. 2, 1983).

All findings of fact in this Initial Decision are supported by reliable, probative, and substantial evidence. Citations to specific numbered findings of fact in this Initial Decision are designated by "F."[4]

Pursuant to Commission Rule 3.45(b), several orders were issued in this case granting *in camera* treatment to material, after finding, in accordance with the Rule, that its public disclosure would likely result in a clearly defined, serious injury to the entity requesting *in camera* treatment or that the material constituted "sensitive personal information," as that term is defined in Commission Rule 3.45(b). In addition, when the parties sought to elicit testimony at trial that revealed information that had been granted *in camera* treatment, the hearing went into an *in camera* session. Commission Rule 3.45(a) allows the Administrative Law Judge ("ALJ") "to grant *in camera* treatment for information at the time it is offered into evidence subject to a later determination by the [administrative] law judge or the Commission that public disclosure is required in the interests of facilitating public understanding of their subsequent decisions." *In re Bristol-Myers Co.*, 90 F.T.C. 455, 457, 1977 FTC LEXIS 25, at *6 (Nov. 11, 1977). As the Commission later reaffirmed in another leading case on *in camera* treatment, since "in some instances the ALJ or Commission cannot know that a certain piece of information may be critical to the public understanding of agency action until the Initial Decision or the Opinion of the Commission is issued, the Commission and the ALJs retain the power to reassess prior *in camera* rulings at the time of publication of decisions." *In re General Foods Corp.*, 95 F.T.C. 352, 356 n.7, 1980 FTC LEXIS 99, at *12 n.7 (March 10,

[4] References to the record are abbreviated as follows:
PX – Complaint Counsel's Exhibit
RX – Respondents' Exhibit
JX – Joint Exhibit
Tr. – Transcript of testimony before the Administrative Law Judge
Dep. – Transcript of Deposition
IHT – Transcript of Investigational Hearing
CCB – Complaint Counsel's Post-Trial Brief
CCRB – Complaint Counsel's Post-Trial Reply Brief
CCFF – Complaint Counsel's Proposed Findings of Fact
CCRRFF – Complaint Counsel's Reply to Respondent's Proposed Findings of Fact
RB – Respondents' Post-Trial Brief
RRB – Respondents' Post-Trial Reply Brief
RFF – Respondents' Proposed Findings of Fact
RRCCFF – Respondents' Reply to Complaint Counsel's Proposed Findings of Fact

1980). Thus, in instances where a document or trial testimony had been given *in camera* treatment, but the portion of the material cited to in this Initial Decision does not in fact merit *in camera* treatment, such material is disclosed in the public version of this Initial Decision, pursuant to Commission Rule 3.45(a) (the ALJ "may disclose such *in camera* material to the extent necessary for the proper disposition of the proceeding"). Where *in camera* information is used in this Initial Decision, it is indicated in bold font and braces ("**{ }**") in the *in camera* version and is redacted from the public version of the Initial Decision, in accordance with Commission Rule 3.45(e).

## II. ANALYSIS

### A. Background

#### 1. TiO2 generally

Titanium dioxide, or TiO2, is an industrial chemical used primarily as a pigment.[5] F. 1. TiO2 is used to add whiteness, brightness, opacity and durability to paints, industrial and automotive coatings, plastics, and other specialty products. As discussed in more detail below, there are five major TiO2 producers. These are, in addition to Tronox and Cristal, Kronos Worldwide, Inc. ("Kronos"), the Chemours Company ("Chemours"), and Venator Materials PLC ("Venator"). F. 41-43, 192.

TiO2 is produced by mining heavy materials that are concentrated in sand dunes, such as ilmenite, which is a combination of titanium oxide and iron oxide. F. 4, 338, 340. A smelting process separates the iron and converts the material into TiO2 "feedstock," or "slag," which is the raw material that gets transformed into TiO2 pigment. F. 4, 342. TiO2 can be manufactured from feedstock using either a chloride process ("chloride TiO2") or a sulfate process ("sulfate TiO2"). F. 4. In summary, the chloride process is a continuous process that uses chlorine gas, while in the sulfate process, feedstock is combined in batches with sulfuric acid. F. 4-5.

The primary customers of TiO2 are paint and coatings manufacturers and plastic producers. F. 6. These include paint and coatings manufacturers The Sherwin-Williams Company ("Sherwin-Williams"), which also includes the Valspar brand of paint (F. 47); PPG Industries ("PPG"), which manufactures paint (F. 46); Masco Coatings Corporation ("Masco"), which includes the Behr and Kilz brands (F. 45); and True Value Company ("True Value") (F. 48); and plastics manufacturer Deceuninck North America. F. 44.

[5] The terms "titanium dioxide" and "TiO2" are used interchangeably in this Initial Decision. Although TiO2 can have two different crystal structures – rutile and anatase – they have different characteristics and uses, and it is undisputed that anatase TiO2 is not in issue in this case. F. 2; RB at 4 n.1. Accordingly, references to titanium dioxide in this Initial Decision are intended to refer only to rutile TiO2.

Approximately 60% of TiO2 is used in coatings applications, 25% in plastics, 10% in paper, and 5% in other uses, including inks, foods,[6] and pharmaceuticals. F. 6.

### 2. Respondents and the challenged transaction

Tronox is a corporation headquartered in Stamford, Connecticut. F. 8. Tronox owns and operates three chloride TiO2 plants, which are located in Hamilton, Mississippi; Botlek, Netherlands; and Kwinana, Australia. F. 12. In addition, Tronox owns and operates titanium feedstock mining and smelting assets in Australia and South Africa. F. 11. The only type of TiO2 that Tronox manufactures is chloride TiO2. F. 13.

Cristal consists of three legal entities. Cristal USA Inc. is a Delaware corporation and an indirectly owned subsidiary of Saudi Arabian companies The National Industrialization Company ("TASNEE") and The National Titanium Dioxide Company. F. 15. Cristal owns and operates a total of five chloride TiO2 plants, two of which are located in Ashtabula, Ohio; one in Yanbu, Saudi Arabia; one in Stallingborough, United Kingdom; and one in Bunbury, Australia. F. 19. Cristal also owns and operates three sulfate TiO2 plants, located in Thann, France; Bahia, Brazil; and Fuzhou, China. F. 18. While Cristal manufactures both chloride TiO2 and sulfate TiO2, Cristal's plants in the United States manufacture only chloride TiO2. F. 19.

Tronox began conversations with Cristal regarding a potential acquisition in 2015. F. 21. In October 2016, Tronox and Cristal agreed to a preliminary framework. F. 22. The following month, Tronox and Cristal agreed to a non-binding deal construct, and due diligence commenced. F. 23. On February 21, 2017, Tronox announced a definitive agreement to acquire Cristal's TiO2 business. F. 24.

The structure of the proposed Transaction is cash and shares, providing for $1.673 billion in cash and 37.58 million Class A shares representing 24% of the combined entity. F. 25. Shareholders approved the transaction on October 2, 2017. F. 25.

[6] Chloride TiO2 cannot be used in products that are ingested. F. 6 n.23. Food-grade TiO2 can only be made from sulfate TiO2 or anatase TiO2, and can be an additive to toothpaste, powdered donuts, or cookie filling. F. 6 n.23. Food-grade TiO2 is also used to prevent spoilage and increase the shelf life of foods. *See* https://www foodsight.org/titanium-dioxide-fda-food-coloring-additive-ingredient-donuts.

## B. Applicable Legal Standards

### 1. In general

Under Commission Rule 3.51(c)(1), "[a]n initial decision shall be based on a consideration of the whole record relevant to the issues decided, and shall be supported by reliable and probative evidence." 16 C.F.R. § 3.51(c)(1); *see In re Chicago Bridge & Iron Co.*, 138 F.T.C. 1024, 2005 FTC LEXIS 215, at **3 n.4 (Jan. 6, 2005). Under the Administrative Procedure Act, an Administrative Law Judge may not issue an order "except on consideration of the whole record or those parts thereof cited by a party and supported by and in accordance with the reliable, probative, and substantial evidence." 5 U.S.C. § 556(d).

The parties' burdens of proof are governed by Commission Rule 3.43(a), Section 556(d) of the APA and case law. Pursuant to Commission Rule 3.43(a), "[c]ounsel representing the Commission . . . shall have the burden of proof, but the proponent of any factual proposition shall be required to sustain the burden of proof with respect thereto." 16 C.F.R. § 3.43(a). Under the APA, "[e]xcept as otherwise provided by statute, the proponent of a rule or order has the burden of proof." 5 U.S.C. § 556(d). The APA, "which is applicable to administrative adjudicatory proceedings unless otherwise provided by statute, establishes '. . . the traditional preponderance-of-the evidence standard.'" *In re Rambus, Inc.*, 2006 FTC LEXIS 101, at *45 (Aug. 20, 2006) (quoting *Steadman v. SEC*, 450 U.S. 91, 95-102 (1981)), *rev'd on other grounds*, 522 F.3d 456 (D.C. Cir. 2008).

### 2. Merger law

#### a. Statutory framework

Section 7 of the Clayton Act prohibits mergers or acquisitions "the effect of [which] may be substantially to lessen competition, or to tend to create a monopoly" in "any line of commerce or . . . activity affecting commerce in any section of the country."

15 U.S.C. § 18.[7]

"Congress used the words '*may be* substantially to lessen competition' to indicate that its concern was with probabilities, not certainties." *Brown Shoe Co. v. United States*, 370 U.S. 294, 323 (1962); *accord FTC v. CCC Holdings, Inc.*, 605 F. Supp. 2d 26, 35 (D.D.C. 2009). "Congress enacted Section 7 to curtail anticompetitive harm in its incipiency." *In re Polypore Int'l Inc.*, 150 F.T.C. 586, 2010 WL 9549988 at *8 (2010), *aff'd* 686 F.3d 1208 (11th Cir. 2012). Thus, it is not necessary to demonstrate certainty that a proposed merger will produce anticompetitive effects, or even that such effects are highly probable, *FTC v. Elders Grain, Inc.*, 868 F.2d 901, 906 (7th Cir. 1989), "but only that the loss of competition is a 'sufficiently probable and imminent' result of the merger or acquisition." *CCC Holdings*, 605 F. Supp. 2d at 35 (quoting *United States v. Marine Bancorp.*, 418 U.S. 602, 623 n.22 (1974)); *accord In re Promedica Health Sys., Inc.*, 2012 WL 1155392, at *12 (Mar. 28, 2012). *See FTC v. Univ. Health, Inc.*, 938 F.2d 1206, 1218 (11th Cir. 1991) ("[T]o satisfy section 7, the government must show a reasonable probability that the proposed transaction would substantially lessen competition in the future."). "Of course the word 'may' [in Section 7] should not be taken literally, for if it were, every acquisition would be unlawful. But the statute requires a prediction, and doubts are to be resolved against the transaction." *Elders Grain*, 868 F.2d at 906.

The allegation that an acquisition is a Section 5 violation, as well as a Section 7 violation, "does not require an independent analysis . . . ." *In re Chicago Bridge*, 2005 FTC LEXIS 215, at **8 n.23, *aff'd, Chicago Bridge & Iron Co. v. FTC*, 534 F.3d 410, 423 n.5 (5th Cir. 2008). *Accord FTC v. PPG Indus., Inc.*, 798 F.2d 1500, 1501 n.2 (D.C. Cir. 1986) (stating that Section 5 of the FTC Act "may be assumed to be merely repetitive of [Section] 7 of the Clayton Act").

[7] Section 11 of the Clayton Act vests jurisdiction in the FTC to determine the legality of a corporate acquisition under Section 7. 15 U.S.C. § 21(b); *In re R.R. Donnelley & Sons Co.*, 1995 FTC LEXIS 450, at *11 (July 21, 1995). Corporations are included within the definition of "persons" that are subject to jurisdiction under the Clayton Act, 15 U.S.C. § 12(a), and the FTC Act, 15 U.S.C. § 44. The parties have stipulated that both Tronox and Cristal USA Inc., are corporations and engage in activities in or affecting commerce, within the meaning of Section 4 of the FTC Act, 15 U.S.C. § 44, and Section 1 of the Clayton Act, 15 U.S.C. § 12. F. 14, 20. Thus, the Commission has jurisdiction over this matter pursuant to Section 5 of the FTC Act, 15 U.S.C. § 45, and Sections 7 and 11 of the Clayton Act, 15 U.S.C. § 18, 21(b).

### b. Burden shifting framework

"Courts have traditionally analyzed Section 7 claims under a burden-shifting framework. *See, e.g.*, *FTC v. H.J. Heinz Co.*, 246 F.3d 708, 715 (D.C. Cir. 2001); *United States v. Baker Hughes Inc.*, 908 F.2d 981, 982-83 (D.C. Cir. 1990)." *Polypore*, 2010 WL 9549988, at *9. Under this framework, for its prima facie case, a plaintiff may establish a presumption of liability by defining a relevant product and geographic market, and showing that the transaction will lead to undue concentration in the relevant market. *Id.* (citing *Baker Hughes*, 908 F.2d at 982-83).

The plaintiff can bolster a prima facie case based on a market concentration presumption by adducing evidence showing that anticompetitive unilateral or coordinated effects are likely. *Polypore*, 2010 WL 9549988, at *9 (citing *Heinz*, 246 F.3d at 717). In this regard, ordinary course business documents of the merging parties "are often highly probative of both industry conditions and the likely competitive effects of a merger." *Polypore*, 2010 WL 9549988, at *9. *See Chicago Bridge*, 2005 FTC LEXIS 215, at **44 (noting that qualitative evidence on pre-acquisition competition may support conclusions based on market structure and can provide an independent basis for a prima facie case under Section 7). "Evidence that sheds light on the strategic objectives of the merging parties is also probative of likely competitive effects." *Polypore*, 2010 WL 9549988, at *9 (citing *FTC v. Whole Foods Market, Inc.*, 548 F.3d 1028, 1047 (D.C. Cir. 2008) (Tatel, J., concurring); 4A Phillip E. Areeda & Herbert Hovenkamp, Antitrust Law ¶ 964, at 18-19 (3d ed. 2009); 2010 U.S. Department of Justice and Federal Trade Commission Horizontal Merger Guidelines § 2.2.1) (hereinafter "Merger Guidelines § __").

If the plaintiff establishes a prima facie case, the burden shifts to the defendant to show that "traditional economic theories of the competitive effects of market concentration are not an accurate indicator of the merger's probable effect on competition in these markets or that the procompetitive effects of the merger are likely to outweigh any potential anticompetitive effects." *CCC Holdings*, 605 F. Supp. 2d at 46. *See also FTC v. Penn State Hershey Med. Ctr.*, 838 F.3d 327, 347 (3d Cir. 2016) (stating that in order to rebut the prima facie case, defendants "must show either that the combination

would not have anticompetitive effects or that the anticompetitive effects of the merger will be offset by extraordinary efficiencies resulting from the merger"). Although the courts have not defined a precise standard that must be met to rebut a prima facie case, the courts advise that "[t]he more compelling the prima facie case, the more evidence the defendant must present to rebut [the presumption] successfully." *Baker Hughes*, 908 F.2d at 991; *Heinz*, 246 F.3d at 725; *Polypore*, 2010 WL 9549988, at *9.

The defendant "can rely on a variety of types of evidence to meet its burden on rebuttal, including evidence that casts doubt on the significance or accuracy of the plaintiff's market share and concentration evidence, factors that indicate that collusion is improbable, and evidence of likely efficiencies." *Polypore*, 2010 WL 9549988, at *9 (citing *Baker Hughes*, 908 F.2d at 985). "If the defendant successfully rebuts the presumption [of illegality], the burden of producing additional evidence of anticompetitive effect shifts to the government, and merges with the ultimate burden of persuasion, which remains with the government at all times." *Baker Hughes*, 908 F.2d at 983; *Heinz*, 246 F.3d at 715; *Polypore*, 2010 WL 9549988, at *9.

### C. Relevant Market

The first step in evaluating whether an acquisition may substantially lessen competition in any "line of commerce" in any "section of the country" is to determine the "line of commerce" and the "section of the country"; in other words, to determine the relevant product market and the relevant geographic market. *United States v. Oracle Corp.*, 331 F. Supp. 2d 1098, 1110 (N. D. Cal. 2004). Complaint Counsel bears "the burden of proving a relevant market within which anticompetitive effects are likely as a result of the acquisition." *In re R.R. Donnelley & Sons*, 1995 FTC LEXIS 450, at *38.

#### 1. Product market

##### a. Legal standards

A relevant product market consists of "products that have reasonable interchangeability for the purposes for which they are produced – price, use and qualities considered." *United States v. E.I. du Pont de Nemours Co.*, 351 U.S. 377, 404 (1956).

"The outer boundaries of a product market are determined by the reasonable interchangeability of use or the cross-elasticity of demand between the product itself and substitutes for it." *Brown Shoe*, 370 U.S. at 325; *see du Pont*, 351 U.S. at 395 (1956). "Interchangeability of use and cross-elasticity of demand look to the availability of products that are similar in character or use to the product in question and the degree to which buyers are willing to substitute those similar products for the product." *FTC v. Swedish Match*, 131 F. Supp. 2d 151, 157 (D.D.C. 2000) (citing *du Pont*, 351 U.S. at 393).

While the outer boundaries of a product market are determined by the reasonable interchangeability of use or the cross-elasticity of demand between the product itself and substitutes for it, "within [a] broad market, well-defined submarkets may exist which, in themselves, constitute product markets for antitrust purposes." *Brown Shoe*, 370 U.S. at 325 (citing *United States v. E. I. du Pont de Nemours Co.*, 353 U.S. 586, 593-95 (1957)). "The boundaries of such a submarket may be determined by examining such practical indicia as industry or public recognition of the submarket as a separate economic entity, the product's peculiar characteristics and uses, unique production facilities, distinct customers, distinct prices, sensitivity to price changes, and specialized vendors." *Id*. "[E]vidence of industry or public recognition of the submarket as a separate economic unit matters because we assume that economic actors usually have accurate perceptions of economic realities." *United States v. H&R Block, Inc.*, 833 F. Supp. 2d 36, 53 (D.D.C. 2011). In addition, ordinary course of business documents reveal the contours of competition from the perspective of the parties, who may be presumed to "have accurate perceptions of economic realities." *Whole Foods*, 548 F.3d at 1045 (concurring op.) (quoting *Rothery Storage & Van Co. v. Atlas Van Lines, Inc.*, 792 F.2d 210, 218 n.4 (D.C. Cir. 1986)).

In the instant case, Complaint Counsel alleges that the relevant market is the sale of chloride TiO2 to North American customers. CCB at 10-26. Respondents contend that the relevant market is the sale of rutile TiO2 (both chloride process and sulfate process) in a global market. RB at 46-53. In this case, the analysis of the product market

and of the geographic market are dependent on each other. In section II.C.2. below, the geographic market is determined to be the North America region, consisting of the United States and Canada. In this section, which analyzes the product market, the focus is on the type of TiO2 sold to North American customers. As detailed in section III.B.1. and summarized below, the evidence proves that chloride TiO2 and sulfate TiO2 have distinct characteristics; that because of these distinct attributes, sulfate TiO2 is not suitable in the vast majority of coatings' manufacturers' products; and that North American customers are unwilling to substitute sulfate TiO2 for chloride TiO2, even when the price of chloride TiO2 has been significantly higher than sulfate TiO2. Therefore, chloride TiO2 and sulfate TiO2 are not reasonably interchangeable. Accordingly, Complaint Counsel has met its burden of showing that the relevant product market is chloride TiO2.

### b. Distinct characteristics of chloride TiO2 and sulfate TiO2

Chloride TiO2 and sulfate TiO2 have distinct characteristics. Manufacturers of TiO2 recognize that there are important differences between chloride TiO2 and sulfate TiO2. *E.g.*, F. 52-57, 62-63. As acknowledged in Tronox's business documents, chloride TiO2 is a higher quality product than sulfate TiO2. *E.g.*, F. 52 ("Chloride process uses higher-quality feedstocks and makes better quality TiO2."). Kronos, a TiO2 producer that sells both chloride TiO2 and sulfate TiO2 (F. 41), recognizes that chloride TiO2 is a superior product to sulfate TiO2 on many measures used to evaluate a grade of TiO2, including on the product's optical properties, its color undertone, tinting strength, and durability. F. 53, 56, 62.

Chloride TiO2 is a brighter pigment than sulfate TiO2 due to its bluer undertone. F. 54-61. As explained in one Tronox investor presentation, "[c]hloride technology yields consistently whiter, brighter pigment grades preferred for many of the largest end-use applications (e.g., paints and plastics) as compared to the sulfate process." F. 54. As Kronos explained, the most noteworthy difference between chloride TiO2 and sulfate TiO2 is the general color and undertone of the product produced. F. 56. Chloride TiO2 has a brighter white or a blueish undertone, whereas sulfate TiO2 has a yellowish

undertone. F. 56, 59. TiO2 producers, including Tronox, recognize that North American consumers prefer the blue tone of chloride TiO2 over the yellow tone of sulfate TiO2. F. 54-58. For example, one Tronox presentation notes, "US consumers have gotten used to a more blue tone and prefer it over the more yellow tone of white." F. 55.

At trial, North American paint manufacturers consistently testified that sulfate TiO2 is not a reasonable substitute for chloride TiO2 for most of the products they sell in North America because the pigment is not as bright, tends not to be as durable, and does not allow for point of sale tinting. *E.g.*, F. 59-61, 64-65. Paint manufacturers use chloride TiO2 instead of sulfate TiO2 because it is brighter in appearance and allows manufacturers to produce crisp, clean colors and "bright whites." F. 59-61. As George Young of Sherwin-Williams, the largest paint producer in North America, explained, sulfate TiO2 does not meet Sherwin-Williams' standards for North America because it "tends to have a yellow undertone. Our market in North America requires clean colors, bright colors." F. 61. As Mario Pschaidt of Masco, the manufacturer of the Behr paints sold through Home Depot, explained, sulfate TiO2 "gives you a yellowish undertone, and that doesn't achieve that clean crisp look that you get from a chloride-produced TiO2, and therefore, we cannot use the sulfate-grade TiO2 for our main product lines." F. 61.

Coatings manufacturers use chloride TiO2 instead of sulfate TiO2 also because it tends to be more durable. F. 64-65. For example, Sherwin-Williams has found that its formulas with chloride TiO2 have better durability; True Value has found that sulfate TiO2 failed to meet its durability requirements in laboratory testing; and Mississippi Polymers, Inc. ("Mississippi Polymers") has found that sulfate TiO2 "tends not to weather as well," and "tends not to have the same longevity in an application as a TiO2 that's produced from the chloride process." F. 64-65.

Another reason paint manufacturers use chloride TiO2 and cannot substitute sulfate TiO2 is "point-of-sale tinting," where a customer picks a color at a store and a can of paint is customized to that customer's request. F. 66. In the North America market, almost all paint is tinted at the point of sale. F. 67. Paint manufacturers have found that they must use chloride TiO2 in order to get the color consistency that customers expect.

F. 68. As John Vanderpool of True Value explained, "the last thing we want to have is phone calls coming in to our customer service department, one after another, that color 57 is no longer color 57; it's really 28." F. 69. Sulfate TiO2 does not provide the same consistent results as chloride TiO2 to allow for tinting at the point of sale. F. 68. A Tronox presentation acknowledges that "[t]he US also has point of sale tinting which requires a very consistent pigment base." F. 68.

Coatings manufacturers also described other attributes that prevent them from substituting sulfate TiO2 for chloride TiO2, including: sulfate TiO2 "didn't meet all the criteria that [True Values needs] in terms of scrubbability, durability, dry time, recoat time, sag [downward movement of paint], low odor, all those kinds of things, and compatibility with the other raw materials that we're using in our formulas" (F. 71); sulfate TiO2 is inferior to chloride TiO2 in terms of [redacted] (F. 72); and, sulfate TiO2 "is ill suited for [redacted]. (F. 73).

Respondents assert that the different properties of sulfate TiO2 and chloride TiO2 can be controlled through the finishing process and that coatings produced with chloride TiO2 and sulfate TiO2 can look the same. RB at 52. This assertion, based on the testimony of Jeffrey Engle, Tronox's vice president of marketing and sales, is contrary to Tronox documents touting its chloride technology, as compared to the sulfate process, for yielding the consistently whiter, brighter, pigment grades that are preferred for many of the largest end-use applications (e.g., paints and plastics). F. 54. *See also* F. 52 (internal Tronox email describing competitive advantages of the chloride process). Moreover, Respondents' assertion is not consistent with the actions of manufacturers who purchase chloride TiO2 instead of sulfate TiO2 because of the superior performance characteristics of chloride TiO2. Furthermore, even if the different properties could be controlled through the finishing process, manufacturers would need to reformulate their product lines to make such substitution, which, as addressed below, is a lengthy and expensive process.

### c. Reasonable interchangeability

Chloride TiO2 and sulfate TiO2 are not reasonably interchangeable. As shown above, end-use customers in the United States and Canada demand high quality, premium coatings products, are accustomed to the blueish tone of chloride TiO2, and almost exclusively purchase paint that is tinted at the point of sale. Because of the differences in the attributes of chloride TiO2 and sulfate TiO2 and the demands of North American customers, North American coatings companies and plastics manufacturers overwhelmingly buy chloride TiO2 and do not consider sulfate TiO2 to be a suitable substitute. Section III.B.1.b.

Respondents argue that North American TiO2 customers use both sulfate and chloride process TiO2 in their products, asserting that True Value buys sulfate TiO2 from Lomon Billions Group ("Lomon Billions"), a Chinese supplier; Behr has switched from chloride TiO2 to sulfate TiO2 for its Kilz brand paint; and Masco has approved a sulfate process grade for use in some of its formulations. RB at 52. However, the evidence shows that North American paint companies do not use significant amounts of sulfate TiO2. In fact, sulfate TiO2 is used in less than 10% of their products and only in "very basic, entry level paints," and low-end applications such as primers and ceiling paint, traffic marking paint, and some other select products. F. 84, 86, 88, 90.

Mr. Vanderpool of True Value described sulfate TiO2 and chloride TiO2 as "apples and oranges," and would not consider switching True Value from its current use of chloride TiO2 to sulfate TiO2 for the vast majority of its paints because the products are "not the same." F. 85. Similarly, [redacted] have tested sulfate TiO2 and would not switch to sulfate TiO2 because it does not result in consistent brightness of color or consistent whites and, thus, is not suitable for most of their applications. F. 89, 91. Greg Arrowood of Deceuninck North America, a vinyl manufacturer, believes chloride TiO2 is superior to sulfate TiO2 in purity and quality, and has never purchased sulfate TiO2. F. 93.

Brian Christian of Kronos testified that "the North American market commands CP [chloride process TiO2] products." F. 94. Mr. Christian further testified that the "overwhelming preference" of Kronos' North American coatings and plastics customers is for chloride TiO2, explaining, "A lot of these customers require [chloride TiO2] grades to hit the quality level that they need for their products, so while technically feasible that you could put a sulfate grade into those applications, it would significantly reduce the quality of their products, and that's not acceptable for their business plan." F. 95.

In a conference call with investors, Tom Casey, then chairman and chief executive officer ("CEO") of Tronox, recognized that coatings companies' "ability to substitute sulfate for chloride . . . is limited by their need to maintain the quality levels of their own products." F. 96 ("I don't see as much of a shift or a material shift from chloride-processed pigment to sulfate-processed pigment because the major customers of the pigment, whether it is chloride or sulfate, are coatings companies who have requirements in their own products [such] that the use of sulfate versus chloride will affect their . . . end product.").

An additional attribute that prevents North American paint customers from switching from chloride TiO2 to sulfate TiO2 is the form in which the TiO2 is delivered. North American customers purchase TiO2 either in a bagged dry powder form or in liquid slurry form. F. 76. TiO2 slurry is made by dispersing TiO2 powder in water with other additives, is delivered to customers by rail cars or tank cars, and can be pumped directly into customers' storage tanks. F. 77, 80. More than a third of the chloride TiO2 sold in North America is in slurry form. F. 172. In North America, TiO2 slurry is only made from chloride TiO2. F. 82.

Whether one product is reasonably interchangeable for another depends on the ease and speed with which customers can substitute it, the desirability of doing so, and the cost of substitution. *Whole Foods*, 548 F.3d at 1037 (citing *United States v. Microsoft Corp.*, 253 F.3d 34, 53-54 (D.C. Cir. 2001) (en banc)). To substitute sulfate TiO2 for chloride TiO2 and maintain the quality levels of their products, coatings and plastics manufacturers would have to reformulate their product lines and complete extensive

testing, a process that would be costly and could take several years to complete. Section III.B.1.c. *E.g.*, F. 101 (qualifying a new grade of TiO2 is a multi-step process that includes tests on outdoor weathering and subjective feedback from customers, and can take as long as three years); F. 101 ("It takes a minimum of [redacted] to qualify a TiO2 grade for use in one of our core architectural or industrial coatings products, and it may take as long as [redacted]."). For industrial coatings, qualification has additional steps. F. 102. Depending on the application, some industrial coatings require customer or regulatory approval. F. 102. When asked for his perspective of what a customer would need to do to reformulate a product from using chloride process TiO2 to sulfate process TiO2, Mr. Christian of Kronos testified, "I don't have a lot of examples of that happening. That would be pretty rare, but it would entail a significant amount of work, a lot of trials, a complete reformulation of their product and grade . . . ." F. 98.

Respondents assert that Masco switched from chloride process TiO2 to sulfate process TiO2 for its Kilz brand and [redacted]. RB at 52. However, the evidence shows that Masco's switch to sulfate TiO2 was limited to Kilz' low-end primers. F. 100. Furthermore, the [redacted]. F. 100.

### d. Price differential

As shown below, the evidence proves that North American TiO2 customers do not, and would not, substitute sulfate TiO2 for chloride TiO2, despite the price differential. Complaint Counsel's economic expert witness, Dr. Nicholas Hill, analyzed actual sales data obtained from customers and producers and found that, on average, chloride TiO2 was 21% more expensive than sulfate TiO2 for North American customers from 2012 through mid-2017 and that, despite this significant price disparity, the proportion of chloride TiO2 sales in North America has remained steady. F. 111-114.

Indeed, chloride TiO2 accounted for around 90% of TiO2 sales in North America from 2012 through mid-2017, despite the price differential. F. 50, 112-113. *See also* F. 51 (Tronox investor presentation ("The North American market is ~90% chloride."). This evidence indicates that North American TiO2 customers do not substitute sulfate TiO2 for chloride TiO2, even when the price of chloride TiO2 is significantly higher.

Moreover, customers consistently testified that they have not switched, and would not switch, from chloride TiO2 to sulfate TiO2, even in the face of a significant price difference. For example, even when sulfate TiO2 was 40% cheaper than chloride TiO2, Sherwin-Williams did not switch its North American products from chloride TiO2 to sulfate TiO2 "because [of] the performance gap between the two materials." F. 108. True Value and Masco testified that if the price of chloride TiO2 increased by at least 10% compared to the price of sulfate TiO2, they would not switch to sulfate for their main product lines because they do not want to sacrifice the quality of their product lines. F. 107, 109. In 2011, when the price that Deceuninck North America paid for chloride TiO2 was very high, Deceuninck North America did not consider switching to sulfate TiO2, explaining, "the only way that Deceuninck would even consider sulfate TiO2 would be if chloride TiO2 was unavailable." F. 110.

Tronox's statements to investors affirm that North American customers purchase chloride TiO2 and do not substitute sulfate TiO2, notwithstanding higher pricing for chloride TiO2. In a 2014 Tronox earnings call, Mr. Casey reported, "In various markets, the customers have responded to what happened on pricing a year ago in different ways. For example in the North American market, it was 95% or 98%, or some very, very high number chloride[.] [I]t remains, essentially the same number market share for chloride. That was true when prices were over $4,000 a ton[[8]], it is true now [when chloride prices

[8] The word "ton" is a British and American measure. *Common Mistakes in Business English*, https://blog.harwardcommunications.com/2012/01/23/the-difference-between-ton-and-tonne/. In the United States and Canada, a ton is equal to 2,000 pounds. Documents and testimony in this case also refer to the metric measure, "tonne," also known as "metric ton," which is equal to 1,000 kilograms (2,205 lbs). *Id.*; https://www rapidtables.com/convert/weight/kg-to-pound.html. The term "metric ton" may also be abbreviated as "MT." https://englishplus.com/grammar/00000058.htm. In some instances, such as where a witness is being quoted, the Initial Decision cannot determine from the transcript of testimony whether or not the transcribed word "ton" was intended by the witness to refer to a metric ton.

are lower]." F. 106. During a 2013 question and answer session with investors, Tronox acknowledged that sulfate TiO2 is not a meaningful substitute for chloride TiO2 in North America:

> Q. When TiO2 prices were going up last year some of your customers were pretty vocal about substituting to other less expensive products, how much of this do you think occurred and how much is ongoing?
>
> [Tronox CEO A.:] You're right, there was significant commentary last year about substantial amounts of substitution. There has been some but limited effect from substitution. Some customers substituted 3-5% of sulfate-based pigment in an otherwise 100% chloride pigment gallon of paint. This was done primarily in industrial paint markets and in certain regions of the world. Very limited if any substitution was done by architectural coatings companies or here in North America.

F. 106. Thus, as Tronox's own CEO recognized, customers are not willing to substitute sulfate TiO2 for chloride TiO2 in the vast majority of their products, notwithstanding the price differential.

**e. Respondents' opposing arguments**

Respondents argue that sulfate TiO2 and chloride TiO2 are substitutes, and therefore in the same product market, because it is possible for TiO2 customers to use either sulfate TiO2 or chloride TiO2 in approximately 80% of TiO2 end-use products, provided the quality is the same, and that only 10% of TiO2 end-use products must use chloride only. RB at 51; RX1503 at 0014. However, as shown above, customers do not find the quality to be the same. Even if it is possible, as a technical matter, for paint companies to make paint with either chloride TiO2 or sulfate TiO2, the fact is that they overwhelmingly choose not to do so. Furthermore, the proper antitrust inquiry, as set forth in the Merger Guidelines, is not whether it is theoretically possible for customers to substitute, but whether customers *would reasonably* substitute sulfate TiO2 for chloride TiO2 in sufficient volumes to render a small but significant non-transitory increase in price ("SSNIP") (commonly 5%) unprofitable. Merger Guidelines §§ 4.1.1, 4.1.2 (emphasis added). As addressed in more detail in section II.C.3. below, Dr. Hill

conducted an empirical analysis and found that a hypothetical monopolist of all chloride TiO2 sales to customers in North America would find it profitable to impose a SSNIP.

Respondents further argue that sulfate and chloride are in the same product market because, according to Respondents' proffered economic expert witness, Dr. Ramsey Shehadeh, "there is a long-term relationship between sulfate and chloride titanium dioxide prices" characterized by "statistically and economically significant co-movement of prices." RB at 53. This argument is unconvincing. Even if the prices are correlated, this does not show that the products are reasonably substitutable for each other, especially in light of the proof that TiO2 customers do not substitute. *See also* Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *21 (stating that "the mere fact that the prices of two goods move upward or downward together need not mean that they are substitutes"). As Dr. Hill explained, "[t]he prices of two goods may be correlated, but they may not be in the same market. . . . One [example of this] would be, hamburger buns and hot dog buns are made from the same thing, and their demands highly correlated. Their prices will be correlated over time, but they are not close substitutes for one another." Hill, Tr. 1707-08.

#### f. Summary

As shown above, North American coatings and plastic manufacturers demand particular characteristics that are provided by chloride TiO2, but which are not provided by sulfate TiO2. The two products are not reasonably interchangeable. Customers do not substitute, and would not substitute, sulfate TiO2 for the vast majority of their products, notwithstanding higher pricing for chloride TiO2. For all these reasons, the evidence proves that chloride TiO2 is a relevant product market.

### 2. Geographic market

#### a. Legal standards

The boundaries of the relevant geographic market, like the boundaries of the relevant product market, depend on reasonable interchangeability and cross-elasticity of demand. *Brown Shoe*, 370 U.S. at 336. The relevant geographic market is the region "in

which the seller operates, and to which the purchaser can practicably turn for supplies." *Tampa Elec. Co. v. Nashville Coal Co.*, 365 U.S. 320, 327 (1961); *FTC v. Freeman Hosp.*, 69 F.3d 260, 268 (8th Cir. 1995). The "proper question" is "not where the parties to the merger do business or even where they compete, but where, within the area of competitive overlap, the effect of the merger on competition will be direct and immediate." *United States v. Philadelphia Nat'l Bank*, 374 U.S. 321, 357 (1963).

Where suppliers can set prices based on customer location, and customers cannot avoid targeted price increases through arbitrage (by purchasing at a lower price from a seller in one geographic area and then transporting the product to another geographic region), the relevant geographic market may be defined around the locations of customers. *Polypore*, 2010 WL 9549988 at *16 (applying Merger Guidelines § 4.2.2). Under the Merger Guidelines, "if price discrimination based on customer location is feasible as is often the case when delivered pricing is commonly used in the industry, the Agencies may define geographic markets based on the locations of customers. . . ." Merger Guidelines § 4.2.

Courts apply the "hypothetical monopolist test" to ask whether a "hypothetical profit-maximizing firm . . . that was the only present and future seller of [the relevant] products . . . likely would impose at least a small but significant and non-transitory increase in price ('SSNIP'). . . ." *FTC v. Sysco Corp.*, 113 F. Supp. 3d 1, 33 (D.D.C. 2015) (quoting Merger Guidelines § 4.1.1). "If buyers would respond to the SSNIP by shifting to products produced *outside* the proposed geographic market, and this shift were sufficient to render the SSNIP unprofitable, then the proposed geographic market would be too narrow." *FTC v. Arch Coal, Inc.*, 329 F. Supp. 2d 109, 123 (D.D.C. 2004).

In the instant case, the Complaint alleges that the relevant geographic market is North America, which Complaint Counsel defines as the United States and Canada. Complaint ¶ 30; CCB at 20 n.19. Respondents contend that the geographic market is global. Answer of Tronox ¶ 30; RB at 47-50. As further explained below, the evidence shows that Respondents set prices on a regional basis; that the North America region includes the United States and Canada, but not Mexico; that chloride TiO2 manufacturers

deliver their product to their North American customers' locations; and that North American customers could not defeat a price increase through arbitrage. Therefore, the relevant geographic market is North America, defined as the United States and Canada.

### b. Regional pricing by TiO2 suppliers

Respondents' documents and testimony confirm that they charge different prices to customers depending on the region in which the customer is located ("regional pricing"). F. 116-129. In a 2015 earnings call, Tronox's then-CEO stated, "[A]re there different prices in the regional markets in which we do business? The answer to that question is yes." F. 121. Tronox has also informed customers that it does not have a global, single-price arrangement with any of its customers and that pricing is regional because it is based on the prevailing market price in individual countries. F. 123. For example, in a July 23, 2016 email to Sherwin-Williams, Ian Mouland, vice president of sales for the Americas at Tronox, wrote, "As always, regional pricing varies over time and magnitude. Pricing in the four regions; U.S. [United States], LATAM [Latin America], EMEA [Europe, Middle East and Africa] and APAC [Asia Pacific] are not comparable. . . . There is no global price." F. 119. In a March 2016 internal Tronox email, Mr. Mouland wrote, "What happens in the US is not connected to [Latin America], totally separate markets." F. 120. John Romano, Tronox's senior vice president and chief commercial officer, confirmed that "[c]ustomers in different regions, global customers, may pay different prices in different parts of the world." F. 126. Arjen Duvekot, Tronox's vice president of global sales for EMEA, APAC and the Americas, also confirmed that Tronox does not have a single global price for its customers; that Tronox's pricing for customers is based on the prevailing market price in individual countries; and that, for Tronox's multinational customers that buy TiO2 for delivery in multiple countries, individual regions are priced separately. F. 125.

Cristal's documents show that it also charges different prices for TiO2 in different regions and that "region" is the main driver of price variance for TiO2. *See* F. 127-128. Cristal's vice president for TiO2, Jean-Yves Gigou, confirmed in testimony that Cristal sets regional price floors and price targets. F. 127. Similarly, TiO2 producer Kronos sets

different price levels by region to reflect the competitive conditions in each region. F. 137.

Customers confirmed that they purchase chloride TiO2 separately for each geographic region and pay different prices in each region. F.130-133. For example, Sherwin-Williams has manufacturing facilities in North America, South America, Europe, and Asia, but maintains regional contracts with its TiO2 suppliers. F. 130. These contracts provide for regional pricing because supply and demand conditions may create different regional pricing environments. F. 130. Mr. Young of Sherwin-Williams explained, "There's really not a universal global market" for TiO2. Rather, prices are "openly negotiated in each of the regions" because of "different market dynamics" and "different availability." F. 130.

Furthermore, the evidence shows that TiO2 suppliers know the locations of their customers, and deliver TiO2 to them, typically pricing on a delivered basis. *See* F. 152-159. Geographic markets based on customer location "often apply when suppliers deliver their products or services to customers' locations." Merger Guidelines § 4.2.2. For Tronox's North American customers, the cost of shipping is covered in the price paid to Tronox. F. 154. Nearly all of the TiO2 that Venator sells to its customers in North America is delivered to its customers' locations and sold on a delivered pricing basis. F. 155. Paint manufacturers explained that the TiO2 they purchase is delivered to their facilities, typically in railcars or tank wagon trucks, and that the price they pay for chloride TiO2 includes the cost of delivery. F. 80, 156-159.

**c. North America region is the United States and Canada**

Although Tronox includes Mexico in its designated "NAFTA" region (North American Free Trade Agreement), along with the United States and Canada, (Mouland, Tr. 1248), its Latin American ("LATAM") strategy for 2015 through 2017 defines "Latin America (LATAM) [as] Central & South America, Mexico, Caribbean," and notes that Mexico's "[p]ricing [is] consistent with Latin American pricing and not that of the USA." F. 135. Indeed, Mr. Mouland of Tronox admitted that, while prices ebb and flow, Tronox's prices in Mexico generally fall in between the prices in the United States and

Latin America. F. 142. Additionally, Tronox has charged different prices to TiO2 customers in Mexico compared to the United States. F. 141 ("We pointed out [to the customer] that different regions have different prices and that Mexico had gravitated to LATAM price as opposed to U.S. price which it generally used to track.").

It is also significant that other TiO2 producers – Cristal, Kronos, Chemours, and Venator – define their North America region as United States and Canada, and place Mexico in their Latin American region. F. 136-138. In addition, a report prepared for Tronox by the consulting company TZ Minerals International ("TZMI") titled, "TiO2 Pigment Supply/Demand Q1 2016" ("TZMI report"), in analyzing demand for TiO2, excluded Mexico from the North America market and included Mexico in the Central and South America market. F. 139.

**d. Higher prices in North America**

From 2012 through 2016, chloride TiO2 prices in North America were higher than in other regions. Respondents' documents consistently recognize this. F. 146 (Tronox reporting in a 2016 earnings call that TiO2 prices in Europe and Asia were lower than prices in North America); F. 147 (June 2016 Tronox TiO2 Variance Analysis showing that the net sales price in North America was [redacted] per metric ton higher than in the other regions for Q2 2016); F. 148 (Tronox reporting in 2015 earnings call that TiO2 prices in North America were higher than the TiO2 prices in the European, Asian, and Latin American markets); F. 149 (March 2015 Cristal analysis of TiO2 prices and revenues for the year March 2014 to March 2015 reporting that North American TiO2 prices were [redacted] higher than in other regions). At trial, Mr. Romano of Tronox acknowledged that in 2015 and December 2014 the price for chloride TiO2 was higher in North America than in other regions and that in December 2013 there was a "significant price disparity" between North America and the rest of the world, with North American prices for chloride TiO2 being higher than prices in the rest of the world. F. 145.

Economic analysis performed by both parties' expert witnesses confirms that prices paid by Respondents' North American customers were significantly higher than

prices paid by Respondents' customers in other regions from 2012 through 2016. F. 150 (Hill); F. 151 (Shehadeh). Complaint Counsel's expert witness determined that the prices for chloride TiO2 charged by North American plants owned by Tronox and Cristal were at least 10% and often more ($250 to $525) per metric ton than the prices Tronox and Cristal charged its customers in the rest of the world from 2012 to 2017. F. 150.

**e. Arbitrage**

Under the Merger Guidelines, a region forms a relevant geographic market if a SSNIP would not be defeated by arbitrage, e.g., customers in the region travelling outside it to purchase the relevant product and transport it back. Merger Guidelines § 4.2.2. Arbitrage between customers at different geographic locations may be impractical due to transportation costs. Merger Guidelines § 3. The evidence in this case shows that North American customers have not engaged in arbitrage despite higher prices in the North America region and that they would not engage in arbitrage to defeat a SSNIP.

The principle reason North American customers do not engage in arbitrage is the cost. As Tronox's Mr. Duvekot explained, if a customer wanted to buy TiO2 in one region where it is less expensive and ship it to a different region where it is more expensive, the price difference would have to cover shipping costs, external handling costs (costs to pay the freight forwarder), internal handling costs (the customer's internal costs for the logistics of exporting the product from one region to another), warehousing costs, and import duties. F. 161. Duties to import chloride TiO2 into North America vary, depending on the location from which it is shipped and when the orders are placed, but have been around 5.5%. F. 162. Kronos explained that it would be "cost prohibitive due to the 6% import duty and the cost of transatlantic shipping" for Kronos to import non-specialty grades of TiO2 to the United States from Europe. F. 163.

Furthermore, as Tronox acknowledges, "[a] large portion of the US market is satisfied by slurry shipment, which adds a logistical barrier to entry." F. 176. As noted earlier, slurry is shipped by rail cars and pumped directly into customers' storage tanks. F. 80. For those customers, switching from slurry to dry TiO2 would present logistical challenges and costs such as building new infrastructure and redesigning manufacturing

processes. F. 175. Shipping slurry internationally would be cost prohibitive because of the weight of the water in the slurry. F. 173. It is also impractical because the slurry would settle in transit, meaning that the pigment separates from the water. F. 174. In addition, the slurry could grow bacteria during transit, which would contaminate the shipment. F. 174.

Another reason North American customers do not engage in arbitrage is because they want on-time delivery and do not want to incur long lead times, as both Tronox and Cristal have recognized. F. 169-171. North American customers consistently testified that they purchase chloride TiO2 from North American suppliers so that they do not have to incur long lead times from importing TiO2. F. 164-167. As Mr. Arrowood explained, Deceuninck North America has not purchased TiO2 from locations outside of North America because of potential problems with transportation resulting in extremely long lead times to get product to its factory. F. 164-165. If a TiO2 customer ships TiO2 from China to North America, it may take 12 weeks to arrive at the facility. F. 164. Because of long lead times when importing TiO2, a North American TiO2 customer would have to stock its own warehouse at least 12 weeks in advance. F. 165. In addition, North American customers could face shipping delays when importing TiO2. F. 167. Deliveries from North American suppliers are more reliable, which helps customers better manage their production cycle times. *See* F. 164-171.

Customers explained why they did not engage in arbitrage. [redacted] explained that it looked into possibly moving TiO2 from one of its European plants to a plant in Ohio, but decided against it because it is "very expensive to [transport] the titanium dioxide from Europe to the U.S., [and] the economics didn't make sense for us to do that. . . ." F. 177. [redacted] has evaluated arbitrage, but chose not to do so for TiO2 because after it "factor[ed in] all of the costs of securing the material in another geography, the transportation, the tariffs, the handling, all factors involved," the "benefit was negligible or it didn't justify the amount of effort." F. 178. [redacted] does move TiO2 from one region to another in severe shortage situations, but explained that it does not undertake general arbitrage opportunities for two reasons:

(1) its volumes are too high; and (2) when [redacted] TiO2 suppliers give pricing to [redacted] for its different regions, the suppliers clearly convey that the material is to be consumed in that region and not transferred for use in another region. F. 179.

Expert opinion is consistent with the foregoing real-world proof that North American TiO2 customers do not, and would not, engage in arbitrage. Based on a quantitative analysis using invoice data produced by Tronox and Cristal, Complaint Counsel's expert witness, Dr. Hill, concluded that even when there were "significant price differences" between the price for chloride TiO2 in North America and the price in the rest of the world, customers have not engaged in arbitrage to defeat higher prices in North America by buying TiO2 in a lower priced region and transporting it to North America. F. 181.

Finally, North American customers do not buy TiO2 from regions outside North America because the amount of chloride TiO2 manufactured outside North America is limited. Imports account for only 3% of North American chloride TiO2 sales. F. 115.

**f. Respondents' opposing arguments**

Respondents argue that North America is not the relevant geographic market because, according to Respondents, all rutile TiO2, whether produced by the chloride or the sulfate process, competes in a global market. RB at 47-48. But the antitrust market inquiry focuses not just on where the sellers compete, but the region to which the purchasers can practicably turn for supplies. *Tampa Elec.*, 365 U.S. at 327. The evidence, detailed in section III.B.2. and summarized above, shows that North American TiO2 customers cannot practicably turn to other regions for chloride TiO2, which is the relevant product in this case. Respondents also assert that North American prices are "correlated" and "co-integrated" with global prices and that this shows that the market is global. RB at 48-49. Correlation and co-integration analyses look only at prices. They do not address the relevant antitrust question of whether customers change their purchases in response to relative price changes. "[T]he mere fact that the prices of two goods move upward or downward together need not mean that they are substitutes." Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *21.

### 3. Economic evidence

As further support for finding a relevant market for the sale of chloride TiO2 in North America, Complaint Counsel relies on certain economic evidence developed by its economic expert witness, Dr. Hill. Dr. Hill conducted a "hypothetical monopolist test" on the candidate market for chloride TiO2 in North America. The hypothetical monopolist test asks whether a hypothetical firm that is the only seller of the candidate product (chloride TiO2) to customers in the candidate geographic area (North America) could profitably impose a SSNIP. *See* Merger Guidelines §§ 4.1.1, 4.2.2. If this hypothetical monopolist can profit from imposing a SSNIP without losing a critical mass of customers, then the candidate market passes the hypothetical monopolist test and the relevant antitrust market is defined correctly. If, on the other hand, customers can defeat the price increase "by substitution away from the relevant product or by arbitrage," the market definition must be broadened. *Id*.

Dr. Hill conducted the hypothetical monopolist test several ways. Dr. Hill conducted a critical loss analysis[9] using three different measures to determine whether it would be profitable for the hypothetical monopolist to increase the price by at least a SSNIP. F. 183-185. First, Dr. Hill used his estimate of North American customers' willingness to switch from chloride TiO2 to sulfate TiO2 (the "price elasticity of demand" measure) to determine whether enough North American customers would switch to another product to defeat a SSNIP by the hypothetical monopolist. F. 186. That measure showed that demand for chloride TiO2 by North American customers was inelastic (-0.45). F. 186. As a result, switching to other products by North American customers would prove inadequate to defeat a SSNIP. F. 186. Second, Dr. Hill used a "substitution components" measure, using data from Respondents, to ascertain whether

[9] Critical loss analysis is a standard tool used to implement the hypothetical monopolist test to determine whether a candidate market constitutes a relevant antitrust market. Merger Guidelines § 4.1.3. A critical loss analysis has two stages: (1) calculation of the critical loss, which means the percentage of sales a hypothetical monopolist would have to lose to keep its profit unchanged if it increased its price by a small amount; and (2) calculation of the predicted loss, which means the percentage of sales that the hypothetical monopolist would likely lose given a particular price increase and keep its profit unchanged. If the predicted loss is smaller than the critical loss, then the price increase will increase the hypothetical monopolist's profit. F. 183.

increased imports or repatriated exports responding to a SSNIP, combined with lost sales, would render the SSNIP unprofitable for the hypothetical monopolist. F. 187. Using this approach and data, Dr. Hill found a SSNIP would be profitable. F. 187. Third, Dr. Hill relied on Tronox's estimate of the maximum North American sulfate TiO2 demand to determine whether a sufficient number of North American customers would switch to sulfate TiO2 to defeat a SSNIP and found that they would not. F. 188. In each of his three critical loss analyses, Dr. Hill found that the predicted loss is lower than the critical loss, and thus opined that the market passes the hypothetical monopolist test. F. 186-188.

In addition, Dr. Hill used the measure of price elasticity of demand for chloride TiO2 in North America to determine whether demand would remain inelastic if prices increased by a SSNIP. F. 189. Dr. Hill found that it would, and thus opined that the sale of chloride TiO2 to North American customers passes the hypothetical monopolist test. F. 189. Based on these calculations, Dr. Hill concluded that the relevant market consists of North American chloride TiO2 sales. F.190.

Respondents, through their economic expert witness, Dr. Shehadeh, dispute Dr. Hill's methodology and urge that Dr. Hill's analyses in this regard be rejected. RB at 50; RX0170 (Shehadeh Expert Report at 0028-30 ¶¶ 35-41). However, even if Dr. Hill's analyses as to the effect of a theoretical price increase are ignored, as urged by Respondents, the practical, real world evidence presented by the record, summarized above, is more than sufficient to conclude that customers have not substituted sulfate TiO2 for chloride TiO2 and have not engaged in arbitrage, despite the differences in price, and that they would not do so in the face of a price increase by a hypothetical monopolist.

### 4. Conclusion

For all the reasons set forth above, the relevant market is the sale of chloride TiO2 to North American customers.

### D. Prima Facie Case

#### 1. Market shares and concentration

After determining the relevant product and geographic market, the next step is to "consider the likely effects of the proposed acquisition on competition within that market." *Swedish Match*, 131 F. Supp. 2d at 166. The government can establish a presumption that the transaction will substantially lessen competition by showing that the acquisition would produce "'a firm controlling an undue percentage share of the relevant market, and [would] result[ ] in a significant increase in the concentration of firms in that market.'" *Heinz*, 246 F.3d at 715 (quoting *Philadelphia Nat'l Bank*, 374 U.S. at 363); *see also Baker Hughes*, 908 F.2d at 982.

"Market concentration . . . is often measured using the Herfindahl-Hirschmann Index ('HHI')." *Heinz*, 246 F.3d at 716; *Swedish Match*, 131 F. Supp. 2d at 166 n.11. As the court explained in *Swedish Match*:

> The HHI calculates market power [by] summing the squares of the individual market shares of all the firms in the market. The HHI takes into account the relative size and distribution of the firms in a market, increasing both as the number of firms in the market decreases and as the disparity in size among those firms increases.

*Id.* Sufficiently high HHI figures establish a prima facie case of anticompetitiveness. *H&R Block*, 833 F. Supp. 2d at 71 (citing *Heinz*, 246 F.3d at 715 n.9).

The Merger Guidelines consider markets with an HHI above 2500 to be "highly concentrated," and state that "[m]ergers resulting in highly concentrated markets that involve an increase in the HHI of more than 200 points will be presumed to be likely to enhance market power." Merger Guidelines § 5.3; *Heinz*, 246 F.3d at 715 (citing *Baker Hughes*, 908 F.2d at 982) (noting that significant increase in market concentration "establishes a 'presumption' that the merger will substantially lessen competition.").

The North American chloride TiO2 market is dominated by five major producers. Tronox, Cristal, Chemours, Kronos, and Venator account for over 99% of chloride TiO2 sales in North America. F. 192-193. Based on producer invoice and other pricing data

analyzed by Dr. Hill, the market participants and their market shares in 2016 were as follows: Tronox [redacted], Cristal [redacted], Chemours [redacted], Kronos [redacted], and Venator [redacted]. F. 194. Post-Acquisition, the combined firm would have a market share of [redacted] [nearly 40%] of North American sales of chloride TiO2. F. 200.

Dr. Hill also calculated HHIs, based on the market share data. F. 202-203. Dr. Hill's calculations show that the Acquisition would increase the HHI by over 700 points, to a level of over 3000, which, under the Merger Guidelines, would render the post-Acquisition North American chloride TiO2 market a "highly concentrated" market. F. 203. *See* Merger Guidelines § 5.3. These market share statistics demonstrate that the proposed Acquisition is presumptively anticompetitive. *See FTC v. Staples, Inc.*, 190 F. Supp. 3d 100, 128 (D.D.C. 2016); *Sysco*, 113 F. Supp. 3d at 52-53.

Accordingly, based on the foregoing, Complaint Counsel has established a presumption that the effect of the Acquisition may be to substantially lessen competition. Under applicable authorities recited in section II.B.2., this presumption is sufficient to establish a prima facie case under Section 7 and shift the burden of rebuttal to Respondents. Moreover, in the instant case, the presumption is strengthened by additional evidence demonstrating a reasonable probability of anticompetitive effects, as discussed below.

### 2. Reasonable probability of anticompetitive effects

#### a. Overview

As the court explained in *ProMedica Health Systems v. FTC*, anticompetitive effects of a merger can include coordinated effects and/or unilateral effects.

> [T]he idea behind coordinated effects is that, "where rivals are few, firms will be able to coordinate their behavior, either by overt collusion or implicit understanding in order to restrict output and achieve profits above competitive levels." *H&R Block*, 833 F. Supp. 2d at 77. . . . Unilateral-effects theory, on the other hand, holds that "[t]he elimination of competition between two firms that results from their merger may alone

> constitute a substantial lessening of competition." *Merger Guidelines* § 6 at 20.

749 F.3d 559, 568-69 (6th Cir. 2014). In the instant case, to support the argument that the Acquisition is likely to have anticompetitive effects, Complaint Counsel asserts: (1) the Acquisition will facilitate coordination among competitors, in a highly concentrated market that is vulnerable to coordination (coordinated effects); and (2) the Acquisition will enable the combined entity to engage in strategic output withholding, in a market with incentives for and a history of such conduct (unilateral effects). *See* CCB section II.A., B. Respondents dispute that anticompetitive effects are likely, arguing that the evidence fails to show that coordination among competitors or unilateral strategic output withholding by the combined entity is likely. *See* RB section II.B., C. The question of likely coordinated effects is analyzed below.

### b. Likelihood of coordinated effects

#### i. Legal principles

"Tacit collusion, sometimes called oligopolistic price coordination or conscious parallelism, describes the process, not in itself unlawful, by which firms in a concentrated market might in effect share monopoly power, setting their prices at a profit-maximizing, supracompetitive level by recognizing their shared economic interests and their interdependence with respect to price and output decisions." *Brooke Group v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 227 (1993). *See also* Merger Guidelines § 7 (Coordinated interaction includes an implied understanding or parallel accommodating conduct not pursuant to a prior understanding.).

> Coordinated interaction involves conduct by multiple firms that is profitable for each of them only as a result of the accommodating reactions of the others. These reactions can blunt a firm's incentive to offer customers better deals by undercutting the extent to which such a move would win business away from rivals. They also can enhance a firm's incentive to raise prices, by assuaging the fear that such a move would lose customers to rivals.

Merger Guidelines § 7.

"It is a central object of merger policy to obstruct the creation or reinforcement by merger" of market structures in which tacit coordination can occur. *Heinz*, 246 F.3d at 725. "Tacit coordination is feared by antitrust policy even more than express collusion, for tacit coordination, even when observed, cannot easily be controlled directly by the antitrust laws." *Id.* "[P]ermit[ting] mergers to be challenged prior to their occurrence and thus before the harm from coordinated interaction has materialized . . . is particularly valuable in situations where coordinated interaction is difficult to detect and remedy directly under § 1 of the Sherman Act." Herbert Hovenkamp, *Prophylactic Merger Policy*, HASTINGS L.J. (August 2018) at 12.

It is not necessary to prove that tacit coordination has already occurred in order to demonstrate a reasonable probability of future coordination. *See Arch Coal*, 329 F. Supp. 2d at 116 ("While proof of prior cooperative behavior is relevant, it is not a necessary element of likely future coordination in violation of Section 7.").

**ii. Analysis**

Under the Merger Guidelines, a merger may substantially lessen competition if: (1) the merger would significantly increase concentration and lead to a moderately or highly concentrated market; (2) that market shows signs of vulnerability to coordinated conduct; and (3) the merger is likely to enhance that vulnerability. Merger Guidelines § 7.1. As shown above, the evidence proves that the Acquisition in this case would significantly increase concentration in the relevant market and lead to a highly concentrated market. As discussed below, the evidence further proves that the North American chloride TiO2 market is vulnerable to coordinated conduct, and that this vulnerability will be enhanced by the Acquisition. *See generally* Merger Guidelines § 7.2 (discussing factors evidencing vulnerability to coordination).

*First*, with only five participants selling chloride TiO2 in North America (F. 192), the number of firms in the relevant market is small. "The fewer competitors there are in a market, the easier it is for them to coordinate their pricing without committing detectable violations of section 1 of the Sherman Act . . . ." *Hosp. Corp. of Am. v. FTC*, 807 F.2d 1381, 1387 (7th Cir. 1986). In the instant case, the Acquisition will reduce the number of

firms to four, thereby making it easier for the remaining firms to coordinate on price or output. *See Elders Grain*, 868 F.2d. at 905 (holding that acquisition reducing firms from six to five would make it easier for leading members of the industry to collude on price and output); *Univ. Health*, 938 F.2d at 1219 (holding that four businesses remaining after merger could easily collude to raise price and decrease output without committing detectable violations of the Sherman Act). In particular, the Acquisition would not only simplify coordination by eliminating Cristal, a current competitor, but would also create a new firm of a similar size to Chemours, the current market leader. *See* F. 194, 196, 200. Indeed, the Acquisition will result in only two firms – Tronox and Chemours – in control of [redacted] [nearly three-quarters] of North American sales, and over [redacted] of North American capacity. F. 201. "With only two dominant firms left in the market, the incentives to preserve market shares would be even greater, and the costs of price cutting riskier, as an attempt by either firm to undercut the other may result in a debilitating race to the bottom." *CCC Holdings*, 605 F. Supp. 2d at 67.

*Second*, chloride TiO2 is a commodity product. F. 247-249. Markets for homogenous products are more susceptible to coordination. F. 250. One reason for this is that reactions by rivals to attempts to steal their business are likely to be strong, given that each firm's product is largely interchangeable with its rivals' products. F. 250. In this case, given the small number of market participants in the relevant market, and the commodity nature of chloride TiO2, the market is fairly characterized as an oligopoly. *See* Areeda ¶ 1429a at 221; *Blomkest Fertilizer, Inc. v. Potash Corp. of Saskatchewan, Inc.*, 203 F.3d 1028, 1031 n.3 (8th Cir. 2000) (quoting Black's Law Dictionary 1086 (6th ed. 1990)); *see also* Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *7 ("The titanium dioxide market has been described as an 'oligopoly,' as TiO2 is a 'commodity-like product with no substitutes, the market is dominated by a handful of firms, and there are substantial barriers to entry.'" (quoting *Valspar Corp. v. E.I. Du Pont De Nemours & Co.*, 873 F.3d 185, 190 (3d Cir. 2017)).

*Third*, mutually recognized interdependence is indicative of a market that is vulnerable to coordination. In such a market,each [competitor] knows that his choice will affect the others, who are likely to respond, and that their responses will affect the profitability of his initial choice. Each knows that expanding his sales or lowering his price will reduce the sales of rivals, who will notice that fact, identify the cause, and probably respond with a matching price reduction. Unless he can somehow conceal his price reduction, or unless his own position is improved by a lower market price, he will hesitate to reduce prices at all. Areeda ¶ 1410b at 65 (emphasis and footnote omitted). Recognized interdependence is a distinct characteristic of an oligopolistic market. Areeda ¶ 404a; *see also Rebel Oil Co. v. Atlantic Richfield Co.*, 51 F.3d 1421, 1443 (9th Cir. 1995) ("[b]y definition, oligopolists are interdependent . . ." (citation omitted); *In re Flat Glass Antitrust Litig.*, 385 F.3d 350, 359 (3rd Cir. 2004) (explaining that a participant in an oligopoly market "'must take into account the anticipated reaction of the other [] firms'") (citation omitted)).

In the instant case, the evidence proves that the North American chloride TiO2 market is characterized by mutually recognized interdependence. F. 204. As acknowledged in a November 2016 Tronox presentation, the "TiO2 market shows oligopoly pricing behavior (one supplier can drive price down, action of all suppliers needed to pull prices up)." F. 206. Indeed, the record is replete with testimony and documents from Tronox and Cristal demonstrating recognized interdependence among market participants. F. 205-246. *E.g.*, F. 207 (Tronox's Mr. Romano testifying that "it only takes one to make the price go down. The whole market has to go up. But any one competitor can make pricing go down."); F. 212 (Tronox's Mr. Romano testifying that success of a price increase "depends on what our competition is doing"); F. 213 (Tronox's Mr. Casey stating in an email: "[T]he success of this [Tronox December 2015 price increase] initiative will be materially affected by how Huntsman [now Venator], Cristal and Kronos respond. Chemours announced an equivalent price increase yesterday . . . ."); F. 208 (Mr. Gigou of Cristal testifying that when considering whether to issue a price increase and for what amount, Cristal takes into account information from

customers regarding other TiO2 suppliers); F. 217 (Mark Stoll, general manager of mergers and acquisitions for Cristal, stating in a 2012 email: "In current market conditions of excessive inventory we cannot raise price and gain market share at the same time unless all suppliers support the price movement.").

In addition, the evidence shows mutual accommodating conduct by chloride TiO2 producers in order to support market discipline and avoid triggering adverse competitor responses. F. 228-246. For example, in a July 2015 email discussing pricing for a customer, Mr. Duvekot of Tronox wrote: "Especially on a highly visible account like [this particular customer] any price move will be seen by the competitors, even more so if we use it to take a piece of the pie. That will cause a reaction from the competition, at this account or elsewhere in the market, which will just lead to more price erosion in the market. Tronox does not want to play this game (anymore)." F. 244. In a March 2016 email, Tronox's Mr. Mouland wrote to two salespeople: "We will have to pass on this opportunity as I do not want to undercut a competitor. The price increase is taking hold and any attempt to get volume at the expense of price could undermine our progress." F. 246. *See also* F. 231 ("The problem we face is that pricing is falling and if we take action to go after market share, price will deteriorate further and we do not want [to] facilitate or fuel that process. Everyone is defending their business and matching offers from the competition to maintain their share as no one want[s] to loose [sic] business."); F. 235 (Cristal email stating: "All of the large global TiO2 suppliers are still acting in a disciplined manner, respecting each other's market positions and share and holding on to price. No volume stalking of any great consequence is taking place yet, which is very good news.").

*Fourth*, "[a] market typically is more vulnerable to coordinated conduct if each competitively important firm's significant competitive initiatives can be promptly and confidently observed by that firm's rivals. . . . Regular monitoring by suppliers of one another's prices or customers can indicate that the terms offered to customers are relatively transparent." Merger Guidelines § 7.2. *See also Oracle*, 331 F. Supp. 2d at 1166 ("Without homogeneity or transparency, the market conditions are not conducive to

coordinated effects, either tacit or express."). The evidence in this case shows that TiO2 suppliers monitor, and are able to observe, significant moves by their competitors, including as to price and output, from public statements by competitors and information obtained from customers. *See* section III.C.2.c.

Tronox and Cristal monitor and analyze public statements by competitors such as quarterly earnings updates, presentations at industry conferences, and ratings agency meetings. F. 259. For example, Tronox's Mr. Engle, vice president of marketing, listens to competitors' earnings calls to learn about their production plans and other announcements, and to obtain competitive intelligence. F. 260. Indeed, these sources represent Tronox's largest source of competitor intelligence. F. 260. Reports and analyses are provided to Tronox's executives. F. 259, 264. Cristal also monitors TiO2 competitors' public calls and circulates detailed analyses to executives, highlighting information such as production curtailments, capacity utilization, and planned price increases. F. 265-266.

The information provided in public earnings calls and similar public presentations can be specific. Tronox discusses in its quarterly results earnings calls such matters as changes in sales volume, changes in the selling prices by region, margin information, and operation related information such as relative plant utilization rate and inventory levels. F. 257, 267. Tronox publicly announced in a second quarter 2015 earnings call its decision to reduce production at two facilities, including Tronox's Hamilton plant, and specifically noted that "these processing line curtailments represent approximately 15% of total pigment production." F. 268. In a first quarter 2016 conference call, Tronox described its plan to continue to be "disciplined" about production and not to bring back "full production" on the first sign of price recovery. F. 269. In a second quarter 2016 earnings call, Chemours stated its prediction that for "the rest of the year, you'll see a cadence up in our price as you look at third quarter . . . ." F. 262. At a basic materials conference sponsored by Goldman Sachs, the executive vice president of Huntsman (now Venator) stated: "Well, there's the April 1 effective price increase. It was roughly $235 a ton, nominated. And we have communicated and signaled that we would expect the

realization on that price would be on the upper end of what we've been realizing over the last 3 or 4 quarters. That is closer to 2/3, 70% realization." F. 263.

Publically disclosing information in a market characterized by interdependence can serve as a signal to the market, enhancing predictability and the potential for tacit coordination. North American chloride TiO2 producers over the years have increased TiO2 prices typically in close proximity to each other in time. F. 219. For example, Chemours announced a price increase of $150 per metric ton on December 17, 2015. F. 221. Within about a half hour of learning this information, Mr. Casey of Tronox reacted by directing that "[w]e will put out a [redacted] global price increase announcement of our own before 9:30 tomorrow," which Tronox did. F. 221, 222. In an internal email, Tronox explained that, with its price increase, Tronox was "testing whether [the market] is ready for price increases or at least to stop declines." F. 222. Cristal learned of the price increase by Tronox on the same day it was announced, and remarked in an internal email: "Tronox follows the trend. . . . Expectedly, other TiO2 manufacturer's [sic] may follow the trend." F. 215. Cristal characterized these announced pricing moves as "an initiative to taste the market readiness to accept this announced price increase." F. 215. Later that day on December 18, 2015, Cristal confirmed that both Chemours and Huntsman had also announced price increases. F. 215. From Cristal's perspective, the December 2015 price increase announcements were "[n]ot based on supply/demand dynamics." F. 223.

In another example, shortly after Tronox publicly announced in its second quarter 2015 earnings call its decision to reduce production at its Hamilton plant, Chemours closed its Edge Moor plant in Delaware, and shut down a production line at its Johnsonville, Tennessee plant, removing 150,000 metric tons of capacity. F. 225, 268. Tronox considered this "Good news!!" with then-CEO Mr. Casey responding that "[i]t's good that [Chemours] can follow the leader!" F. 226.

The Acquisition will increase the competitive information available to market participants through earnings calls and similar public presentations. Tronox, Chemours,

Kronos, and Venator are publically traded companies, F. 251, and therefore required to report earnings and similar business information to investors and others in the ordinary course of business. Presently, Cristal is a privately held company. F. 252. With the merger, all participants will be reporting as public companies.

Chloride TiO2 producers also monitor competitive actions in the market through information obtained from their customers. F. 270-288. It is part of Tronox's price increase implementation process to collect competitive intelligence on its competitors' pricing in order to assess whether its competitors are "maintain[ing] a disciplined approach" with respect to a price increase. F. 277. Customer-provided information is included in reports provided to senior management and is used to make pricing decisions. F. 271, F. 275. In many instances, this can include specific pricing information. *E.g.*, F. 276 ("Per [redacted], Purchasing Mgr, Kronos and DuPont have moved their price by [redacted]"); F. 276 ("customer confirmed Kronos is taking them up [redacted]"; F. 276 (describing that Cristal is offering [redacted] per pound lower than Tronox at [redacted]); F. 279 (Cristal email reporting that customer "indicated that Huntsman offered [redacted] for volume . . . "); F. 279 (internal Cristal email stating: "Our refusal to . . . meet [redacted] price resulted in [a customer] moving 5 trucks per month away from us and over to [redacted] . . ."). Competitor price information, once disclosed, gets further communicated within the market "from competitor to customer to other supplier." F. 280.[10]

*Fifth*, the fact that the chloride TiO2 market has low demand elasticity makes coordination more profitable, which increases incentives to coordinate. Price elasticity of demand is how responsive demand is to changes in price. F. 289. Inelastic demand

[10] Respondents contend that customer-provided pricing information is not reliable because customers in a negotiation may not necessarily be truthful about competing offers. RRFF 476-85. However, the fact that suppliers report and rely on customer-provided competitor pricing information in making their own pricing decision is indicative of the information's reliability. In addition, Cristal's redbook, a data compilation, uses customer-provided sales information to track suppliers' sales volumes, and market share data calculated from the data proved to be a close match to market shares calculated from actual data derived from suppliers' invoices. F. 282-285. The totality of the evidence belies the notion that customers routinely provide false information as part of the negotiation process.

makes a market more susceptible to coordination because if prices of all firms were to rise, few sales would be lost, which makes the reward for coordinating greater. F. 289. Here, the price elasticity of demand for chloride TiO2 in North America is low. F. 189.[11]

### iii. Respondents' opposing arguments

Respondents argue that Complaint Counsel has failed to prove that coordinated effects are likely, citing *United States v. Oracle Corporation*, 331 F. Supp. 2d 1098 (N.D. Cal. 2004). RB at 57. *Oracle* does not support Respondents' argument. In that case, the court denied a preliminary injunction under Section 7, finding, among other things, that "the products of Oracle and SAP are not homogeneous, but are differentiated products, and that the pricing of these products is not standardized or transparent." 331 F. Supp. 2d at 1109. Indeed, the plaintiffs in *Oracle* did not contend that any of those conditions were present in the proposed merger. *Id.* at 1113. In the instant case, by contrast, the evidence proves that chloride TiO2 is a commodity product and suppliers are able to gain relatively detailed and specific information about competitors' pricing.

Respondents further assert that the evidence fails to show coordination has occurred in the past. RB at 59-62. However, as explained above, proof of prior tacit coordination is not necessary to demonstrate a reasonable probability of future coordination. *See Arch Coal*, 329 F. Supp. 2d at 116. Respondents additionally contend that coordination would be difficult to conceive, monitor, or enforce because announced prices are not necessarily the actual price paid by customers; rather, prices are individually negotiated with each customer. RB at 61. Respondents' argument ignores the facts that suppliers obtain reliable information about actual prices being offered by the competition directly from customers, among other sources, and that such information spreads to other suppliers in the market. Moreover, knowledge of precise competitor pricing is not necessary to be able to coordinate price movements through parallel price

[11] It is also noteworthy that customers in the relevant market are concerned about the increased consolidation of suppliers post-Acquisition. F. 293 (Mr. Vanderpool of True Value testifying: "[We're] going from five major suppliers down to four major suppliers . . . . [redacted]. So we see raw material prices continue to go up and tightening in the market from allocation, and that's a very big concern of ours"); F. 294 (Ampacet email stating, "The acquisition of Cristal by Tronox is cause for concern for Ampacet" noting the "20% reduction in [its] supply base").

increases, which are publicly disclosed. In any event, it is not necessary to demonstrate that market participants can form and enforce an agreement. Coordinated interaction includes a range of conduct, and can involve parallel conduct "in which each rival's response to competitive moves made by others is individually rational, and not motivated by retaliation or deterrence but nevertheless emboldens price increases and weakens competitive incentives to reduce prices or offer customers better terms." Merger Guidelines § 7.

Respondents also argue that TiO2 sales are subject to "fierce competition." RB at 58-59. Respondents assert that most customer contracts do not set price but rather provide for prices to be negotiated; that contracts typically contain an option to switch suppliers if they find a better price (a "meet or release" clause), which can result in a lower price; and that buyers "pit" suppliers against each other to obtain a lower price. *See, e.g.*, RB at 59; RFF 533. However, such evidence does not logically preclude a finding that the market is also vulnerable to coordination, particularly where, as here, the market is characterized by oligopolistic interdependence, exacerbated by relative transparency and product homogeneity.[12] Furthermore, "[a]s the statutory language suggests, Congress enacted Section 7 to curtail anticompetitive harm in its *incipiency*." *Polypore*, 2010 WL 9549988 at *8 (citing *Chicago Bridge*, 534 F.3d at 423) (emphasis added). *See also* Merger Guidelines § 7.1 ("Pursuant to the Clayton Act's incipiency standard, the Agencies may challenge mergers that in their judgment pose a real danger of harm through coordinated effects, even without specific evidence showing precisely how the coordination likely would take place.").

[12] According to the Merger Guidelines, "meet or release" clauses tend to increase the vulnerability of a market to coordinated interaction by increasing visibility of competitive initiatives. *See* Merger Guidelines § 7.2 ("A market typically is more vulnerable to coordinated conduct if a firm's prospective competitive reward from attracting customers away from its rivals will be significantly diminished by likely responses of those rivals. This is more likely to be the case, the stronger and faster are the responses the firm anticipates from its rivals. The firm is more likely to anticipate strong responses if there are few significant competitors, if products in the relevant market are relatively homogeneous, if customers find it relatively easy to switch between suppliers, or if suppliers use meeting-competition clauses.").

#### iv. Summary

Based on the foregoing, the evidence proves that the North American chloride TiO2 market is vulnerable to coordinated conduct, and that this vulnerability will be enhanced by the Acquisition.

### 3. Conclusion

As set forth above, market concentration evidence warrants the presumption that the Acquisition is likely to have anticompetitive effects in the relevant market. That presumption is bolstered by substantial evidence demonstrating that anticompetitive coordinated effects are in fact likely. The foregoing amply demonstrates a strong prima facie case that the Acquisition may substantially lessen competition.[13]

The analysis now turns to Respondents' rebuttal evidence.

## E. Rebuttal

As noted in section II.B.2. above, a defendant may rebut a prima facie showing of likely anticompetitive effects with evidence that anticompetitive effects are not likely to result from the merger, or that procompetitive benefits, such as efficiencies, outweigh any likely anticompetitive effects. *See, e.g.*, *Baker Hughes*, 908 F.2d at 985; *Polypore*, 2010 WL 9549988, at *9. "The more compelling the prima facie case, the more evidence the defendant must present" to successfully rebut that case. *Baker Hughes*, 908 F.2d at 991; *Heinz*, 246 F.3d at 725; *Polypore*, 2010 WL 9549988, at *9. Respondents have failed to meet this burden, as explained below.

[13] Complaint Counsel's additional theory of likely anticompetitive effects, that the Acquisition will enable the combined entity to engage in strategic output withholding (unilateral effects), has been fully considered, together with the relevant evidence in the record. However, findings or conclusions as to the likelihood of anticompetitive unilateral effects are unnecessary because the presumption of anticompetitive effects, based on market concentration evidence, combined with the evidence of likely coordinated effects, is already sufficient to make a strong prima facie case of likely anticompetitive effects. Further determining the likelihood of unilateral effects would not affect this result. *See Polypore*, 2010 WL 9549988, at *9 ("A plaintiff can bolster a *prima facie* case based on market structure with evidence showing that anticompetitive unilateral *or* coordinated effects are likely.") (emphasis added). *See also* 5 U.S.C. § 557(c)(3)(A) (Administrative Procedures Act); 16 C.F.R. § 3.51(c)(1) (Commission rule on Initial Decisions) (both requiring findings and conclusions only for "material" issues of fact and law). Issues of fact or law that do not affect the result are not fairly deemed "material," notwithstanding that there may be allegations or evidence presented on such issues.

### 1. Entry

#### a. Applicable legal standards

Even in highly concentrated markets, such as the relevant market in the instant case, "if there is sufficient ease of entry, enough firms can enter to compete with the merging firms, undercutting any of the likely anti-competitive effects of the proposed mergers. In other words, entry is one way in which post-merger pricing practices can be forced back down to competitive levels." *FTC v. Cardinal Health*, 12 F. Supp. 2d 34, 55 (D.D.C. 1998). *See also United States v. United Tote, Inc.*, 768 F. Supp. 1064, 1072 (D. Del. 1991) ("[I]f alternative sources of supply could enter the market with relative ease, then no hypothetical monopolist or cartel could achieve or maintain supra-competitive pricing . . . ."); *In re Echlin Mfg. Co., Inc.*, 105 F.T.C. 410, 1985 FTC LEXIS 46, at *25 (June 28, 1985) ("An attempt to exercise market power in an industry without entry barriers would cause new competitors to enter the market. This additional supply would drive prices back to the competitive level.").

Entry can be demonstrated either by new firms entering the relevant market or by expansion into the relevant market by existing firms. *See Baker Hughes*, 908 F.2d at 988-89 (affirming finding of entry where evidence showed, among other things, that at least two companies had entered the United States market immediately prior to the challenged acquisition and that a number of firms competing in Canada and other countries were likely to do so).

Determining whether there is ease of entry hinges upon an analysis of the barriers to new firms entering the market or to existing firms expanding into the relevant market. *Cardinal Health*, 12 F. Supp. 2d at 55 (citing *Baker Hughes*, 908 F.2d at 987). Entry barriers have been explained as follows:

> Expertise in the industry, a fair amount of capital, a positive reputation, and the need to have specialized equipment are all barriers to entry. *Fruehauf Corp. v. FTC*, 603 F.2d 345, 357 (2d Cir. 1979); *Cardinal Health*, F. Supp. 2d at 58; *United States v. Blue Bell, Inc.*, 395 F. Supp. 538, 549 (M.D. Tenn. 1975). . . . In some markets, "the need for

> reliability is so great and the consequences of new product failure so dire that, even if the competitive nature of the market deteriorated, consumers would still be reluctant to switch to new entrants." *Tote*, 768 F. Supp. at 1076 (finding proven ability to provide reliable systems and service an important factor in a racetrack's selection of a totalisator supplier to preserve the track's revenue and goodwill). The unwillingness of customers to use a company with an unproven track record is a barrier to entry. *See Tote*, 768 F. Supp. at 1078.

*In re Chicago Bridge & Iron Co.*, 138 F.T.C. 1024, 2003 FTC LEXIS 96, at **242-43 (June 18, 2003), *aff'd,* 2005 FTC LEXIS 215 (Jan. 6, 2005), *aff'd*, 534 F.3d 410 (5th Cir. 2008).

A fundamental step in determining ease of entry is timeliness. *Cardinal Health*, 12 F. Supp. 2d at 55 ("The first step in determining ease of entry is timeliness."). In this regard, the Merger Guidelines state: "In order to deter the competitive effects of concern, entry must be rapid enough to make unprofitable overall the actions causing those effects and thus leading to entry, even though those actions would be profitable until entry takes effect." Merger Guidelines § 9.1. Entry must also be proven to be "*likely*, and *sufficient* in its magnitude, character and scope to deter or counteract the competitive effects of concern." *Cardinal Health*, 12 F. Supp. 2d at 55 (quoting Merger Guidelines (1992 ed.) § 3.0 (emphasis added)).

The burden of proving that entry will be timely, likely, and sufficient to deter or counteract anticompetitive effects is on Respondents. *Staples*, 190 F. Supp. 3d at 133; *Sysco*, 113 F. Supp. 3d at 80. As shown below, Respondents have failed to meet their burden.

**b. Analysis**

Respondents argue that Chinese suppliers are a current, and growing, competitive threat. Respondents rely in particular on an announced plan by Lomon Billions, discussed further below, to expand its chloride TiO2 capacity. Respondents further contend that Chinese suppliers benefit from low costs and a regulatory environment that facilitate entry. RB at 71-74.

Complaint Counsel argues that Chinese producers provide very little chloride TiO2 and that there are significant barriers to Chinese chloride TiO2 becoming a meaningful competitive presence in North America. CCB at 61-63. Whether Chinese producers will be able to overcome these barriers is highly uncertain, according to Complaint Counsel, and in any event they would be unlikely to do so in a timely and sufficient manner to counteract the competitive harm resulting from the Acquisition. CCB at 63-67.

Respondents assert that China dominates the TiO2 export market, exporting a million tons a year. However, the vast majority of production in China is sulfate TiO2, which is not typically exported outside the Asia-Pacific region (F. 297, 298), and which, as shown in section II.C.1., is not a reasonable substitute for chloride TiO2 in North America.

In fact, only a small amount of chloride TiO2 is sold by Chinese suppliers to the North American market. Chloride TiO2 sales by suppliers other than Tronox, Cristal, Kronos, Chemours, and Venator, accounted for a 0.5% share of the total 831,132 metric tons of chloride TiO2 sold in North America in 2016. F. 296. Lomon Billions, which is the fourth largest TiO2 producer globally by capacity, sold approximately 3,000 to 4,000 metric tons of chloride TiO2 in the United States in 2017. F. 300, 303. Major paint manufacturers, such as [redacted], determined after testing that Chinese-produced chloride TiO2 did not meet their quality standards, F. 309, 310, 312, which no doubt contributes to the relatively low sales volume in North America. *See also* F. 313 (Kronos does not see chloride TiO2 from China in the markets in which it competes, and has observed that such products are used for "lower quality products"). Moreover, as explained in section II.C.2., import costs, lead times, and other logistical and supply issues deter North American customers from purchasing chloride TiO2 from China.

Industry participants do not expect easy or rapid entry by Chinese chloride TiO2 producers, citing numerous barriers, including lack of technological know-how. The chloride process for TiO2 is technically more difficult than the sulfate process to master

and operate. F. 299. In 2016, Tronox observed that China "struggles" to commission chloride TiO2 plants, which "suffer[] from poor profitability, uptime, and quality." F. 323. Tronox also noted in 2016 that it is "[s]till expected to take a while for appreciable profitable tonnes to start flowing," and cited as reasons: "Legitimacy of base technology [is] questionable," "Chinese made adjustment to base technology," "Recommendation on equipment specs/sourcing ignored," "Limited commissioning support," and lack of "know-how/experience of running CP [chloride process] plant." F. 322. Tronox further acknowledged in 2017 that "[i]t could take years before the Chinese chloride based TiO2 industry is mature and stable enough to bring the same quality and consistency as their international competitors." F. 324; *see also* F. 321 (Mr. Casey of Tronox stating in a 2015 email, "I think it is a very remote prospect that China will be producing chloride capacity of any magnitude in the next 3-5 years"). Similarly, in 2016, Cristal observed: "It's been exceedingly difficult for the Chinese to acquire and successfully employ the proprietary chloride technology . . . [and it is] difficult to predict when, to what extent, and how fast this will occur. Very small inroads have been made to date." F. 325.

In addition, Venator stated in 2017 that the "Chinese struggle with quality control, consistency of production, no automation and too much manual interruption - ultimately the know-how of how to run plants." F. 326. *See also* F. 327 (Venator citing "technology issues" as among the "headwinds" facing Chinese TiO2 producers). Kronos noted in a 2017 investor presentation that the Chinese threat was "manageable," due to the "[s]uperior chloride process technology" being "closely guarded by Western producers" and "[q]uality and reliability concerns." F. 315. Kronos believes that it is "highly unlikely" that Chinese chloride process TiO2 will constitute any threat to its business within the next two to three years. F. 319. Similarly, Chemours does not project that Chinese chloride TiO2 producers, to the extent they further develop their process and quality, will affect the North American market anytime within the next three to five years. F. 320.

The evidence further shows that North American TiO2 customers do not view Chinese chloride producers as a reliable supply source for chloride TiO2 in the

foreseeable future. F. 336. Cited reasons include lower product quality and the time required to qualify a new product for use. F. 336. For example, True Value's qualification process for chloride TiO2 products takes [redacted] for interior paint products and [redacted] for exterior paint products. F. 311. As noted above, past efforts to qualify Chinese chloride TiO2 have been unsuccessful. F. 312 ([redacted] found that the quality is "not yet satisfactory"); F. 310 (Lomon Billions' chloride process TiO2 did not pass [redacted]); F. 309 ([redacted]).

Furthermore, contrary to Respondents' arguments, low labor costs and relaxed environmental standards that might exist in China are not cost advantages that are applicable to chloride TiO2 production. F. 328. This is because chloride TiO2 production is much less labor intensive than sulfate TiO2 production. F. 328. In addition, the chloride process for TiO2 is environmentally cleaner than the sulfate process. F. 299. As Mr. Christian of Kronos testified: "[C]heap labor and relaxed environmental standards" are not applicable to chloride TiO2, as opposed to sulfate TiO2, "because [the latter is] much more labor-intensive and it generates a significant amount of waste or byproducts per ton of TiO2 . . . . So when you think about China as a potential competitor, a lot of their historic, perceived advantages over the western world just don't exist or at least aren't overly material in comparison to western producers." F. 328. In fact, chloride technology requires a highly skilled labor force and an uninterrupted power supply, which increase costs for producers. F. 315. Tronox acknowledged in a September 2017 presentation that the Chinese producers were facing "Inflationary Pressures" including "Higher Energy Prices" and "Wage Growth." F. 332. Similarly, Chinese producers have the added cost of importing high-grade feedstock, which is a large part of the cost of producing chloride process TiO2. F. 330, 344. *See also* F. 327 (Venator describing "headwinds" facing Chinese TiO2 producers, including feedstock cost and availability, wage growth, and increase in energy prices, technology issues, and financing availability). For all these reasons, the assertion that Chinese chloride TiO2 producers necessarily benefit from a lower cost structure is unsupported by the evidence.

Respondents rely in particular on Lomon Billions' announced expansion of chloride TiO2 production in China. According to a February 2018 press release, Lomon Billions plans to invest $285 million to construct two new chloride TiO2 manufacturing lines at its existing chloride production plant in Jiaozuo, China, with annual chloride TiO2 capacity of 200,000 tons, and to begin commercial production from the new lines "during 2019." F. 306. Lomon Billions also plans "[f]uture additional 300,000 tonne[s of] chloride capacity . . . mostly likely at a new coastal location in China." F. 306. Notwithstanding these announced plans, the numerous barriers to entry into the North American chloride TiO2 market that apply to Chinese producers generally, described above, also apply to Lomon Billions. For example, production from Lomon Billions' existing chloride production plant has been operating considerably below capacity, indicating that Lomon Billions is "not successfully utilizing the chloride technology . . . [and is] struggling with the technology they have now." F. 317.

Tronox itself has expressed doubts regarding Lomon Billions' expansion. In a 2017 fourth quarter earnings call, Mr. Romano described Lomon Billions' plan to expand production by 200,000 tons in 2019 as "a bit aggressive on timeline." F. 335. Mr. Casey also stated in 2017 that the projections [redacted] of expanded chloride capacity and production in China "seem[] aggressive since almost no commercial grade pigment is produced today" and that "the Chinese generally overstate their plant capacity." F. 314. Kronos also doubts Lomon Billions can bring new production on line "inside a year or two, for 200, 250 million dollars" and produce 200,000 metric tons. F. 317. As Mr. Christian explained, "I think those numbers are . . . difficult to achieve. I think that is an extremely low cost per metric ton. . . ." F. 317. Indeed, based on TZMI's 2016 producer cost study, Lomon Billions' Jinzhou plant in China has higher variable manufacturing costs than any plant in North America and is the highest cost chloride TiO2 plant in the world. F. 331.

In addition, it is unlikely that construction of a new chloride plant in coastal China, as announced by Lomon Billions, will be sufficiently timely. The evidence shows that construction of a new TiO2 plant from scratch takes at least four and a half years, which Mr. Romano testified is an aggressive timeline that assumes everything proceeds

according to plan. F. 307. Mr. Christian of Kronos testified that, even with a fully constructed plant, it can take five to seven years to "figure out how to make a quality CP [chloride process TiO2] grade." F. 307. As a point of reference, Chemours announced an expansion into Mexico in 2011 but the plant did not begin production until 2018. F. 307.

Moreover, it cannot be assumed that expanded chloride TiO2 production from China in the future, if it occurs, will result in additional supply to the North American market. In November 2016, Tronox predicted that Chinese producers would be limited in their ability to grow exports of TiO2 because Chinese demand growth is expected to exceed Chinese production growth. F. 333. As Mr. Casey stated in a 2016 third quarter earnings call: "As demand grows domestically [in China], more and more supply will go into the domestic market, which means less will be available for the export market. . . ." F. 334. *See also* F. 335 (Mr. Romano noting in a 2017 earnings call that supply and demand were "in balance" and Jeffry Quinn, chief executive officer of Tronox, adding that "all the incremental expansion over the next 18 to 24 months, will really kind of just be soaked up by the incremental global growth.").

**c. Summary**

Even if it is accepted that Chinese producers are likely to emerge, at some point, as true competition in the North American chloride TiO2 market, the "pertinent question here is whether the emergence . . . can be 'rapid enough to make unprofitable overall the [predicted] actions' that otherwise lead to the Commission's concerns about anticompetitive effects" from the Acquisition. Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *56 (quoting Merger Guidelines § 9.1). For the reasons explained above, the evidence fails to show that entry or expansion by Chinese producers is likely, or that such entry will be timely or sufficient to counteract the likely anticompetitive effects of the Acquisition. *See also* Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *60 (finding that "[t]he limited presence of Lomon Billions in the North American chloride market today, the substantial barriers to entry, and China's internal TiO2 demand trends do not paint a picture of rapid entrants ready to

replace the loss of Cristal as a source of competition").[14]

### 2. Efficiencies

#### a. Applicable legal standards

"[A] defendant may rebut the government's prima facie case with evidence showing that the intended merger would create significant efficiencies in the relevant market." *Univ. Health*, 938 F.2d at 1222. An anticompetitive merger cannot be justified on the basis of asserted efficiencies outside the relevant market. *Philadelphia Nat'l Bank*, 374 U.S. at 370.

Cognizable efficiencies are defined as "merger-specific efficiencies that have been verified and do not arise from anticompetitive reductions in output or service." *H&R Block*, 833 F. Supp. 2d at 89 (quoting Merger Guidelines § 10). A cognizable efficiency claim "must represent a type of cost saving that could not be achieved without the merger and the estimate of the predicted saving must be reasonably verifiable by an independent party." *Id.*

To be verifiable, the claimed efficiencies require "clear evidence showing that the merger will result in efficiencies that will offset the anticompetitive effects and ultimately benefit consumers." *Penn State Hershey Med. Ctr.*, 838 F.3d at 350. A merger specific efficiency is one that "cannot be achieved by either company alone because, if they can, the merger's asserted benefits can be achieved without the concomitant loss of a competitor." *Heinz*, 246 F.3d at 722.

The law requires "a rigorous analysis of the kinds of efficiencies being urged by the parties in order to ensure that those 'efficiencies' represent more than mere

[14] Respondents argue that Chinese TiO2 producers should be deemed "rapid entrants" because they could switch capacity to serve the North American market. RB at 72. *See* Merger Guidelines § 5.1 (stating that, in certain circumstances, "a supplier with efficient idle capacity, or readily available 'swing' capacity currently used in adjacent markets that can easily and profitably be shifted to serve the relevant market, may be a rapid entrant"). In support of this argument, Respondents assert that, after a fire at a Venator plant in Pori, Finland, Chinese TiO2 producers expanded their imports into Europe. *See* RB at 73-74; RFF 507. Given the logistical and cost barriers to importing chloride TiO2 from China to North America, among other barriers to entry described herein, Respondents' argument that Chinese producers would be rapid entrants into the North American market based on swing capacity is without merit.

speculation and promises about post-merger behavior." *Heinz*, 246 F.3d at 721. *Accord H&R Block*, 833 F. Supp. 2d at 89. As the court in *H&R Block* explained:

> Efficiencies are inherently "difficult to verify and quantify" and "it is incumbent upon the merging firms to substantiate efficiency claims" so that it is possible to "verify by reasonable means the likelihood and magnitude of each asserted efficiency, how and when each would be achieved (and any costs of doing so), how each would enhance the merged firm's ability and incentive to compete, and why each would be merger-specific."

*Id.* (quoting Merger Guidelines § 10).

In addition, where a merger will substantially increase market concentration and result in a highly concentrated market, there must be proof of "extraordinary" efficiencies. *See Heinz*, 246 F.3d at 720-21 (quoting 4A Areeda, *et al.*, *Antitrust Law* P 971f, at 44 that extraordinary efficiencies are required where the "HHI is well above 1800 and the HHI increase is well above 100"); *Sysco*, 113 F. Supp. 3d at 81. As found in section II.D.1. above, the Acquisition would increase the HHI by over 700 points, to over 3000, which, under the Merger Guidelines, is a highly concentrated market. In the instant case, therefore, proof of extraordinary efficiencies is required.

To be able to offset a merger's likely anticompetitive effects, purported synergies and efficiencies must "represent more than mere speculation and promises about post-merger behavior." *Heinz*, 246 F.3d at 721. The burden of proving both that the asserted efficiencies are merger specific and that they are reasonably verified by an independent party is on Respondents. *Staples*, 190 F. Supp. 3d at 137 n.15. Respondents do not cite any case in which efficiencies alone have been deemed sufficient to defeat a showing of likely anticompetitive effects. *See Sysco*, 113 F. Supp. 3d at 82 (noting that courts have "rarely, if ever, denied a preliminary injunction solely based on the likely efficiencies") (quoting *CCC Holdings*, 605 F. Supp. 2d. at 72).

**b. Analysis**

Respondents argue that the Acquisition will increase global output of TiO2 by: (1) using Tronox's excess feedstock production to supply Cristal's plants; (2) restarting a

presently non-operating feedstock producing facility in Saudi Arabia, referred to as the Jazan slagger; and (3) increasing production at Cristal's pigment plant in Yanbu, Saudi Arabia. RB at 64-68. Such increased output is good for consumers, Respondents argue, and will also enable the merged firm to better compete with Chemours and Chinese producers such as Lomon Billions. Respondents further argue that efficiencies from the merger will result in significant savings in selling, general, and administrative costs ("SG&A") and in costs related to procurement, supply chain, and logistics. RB at 68-69.

Complaint Counsel responds that Respondents have failed to demonstrate that their purported efficiencies are legally cognizable. CCB at 72-78. Complaint Counsel asserts that Respondents have failed to provide independent verification of either their asserted output enhancing synergies or cost savings; have failed to show that the asserted output enhancing synergies or cost savings are merger-specific; and have failed to show that the asserted output enhancing synergies or cost savings would benefit competition or consumers in the relevant North American chloride TiO2 market. CCB at 72-80.

As further explained below, Respondents have failed to demonstrate that their asserted efficiencies are cognizable.

### i. Output increasing synergies

#### (a) Vertical integration

Respondents argue that combining the two companies' feedstock and TiO2-producing capabilities will create greater vertical integration, which will lower costs and ultimately lead to expanded output and lower pricing. In support of this argument, Respondents assert that Tronox presently produces more TiO2 feedstock than its TiO2 pigment plants can consume (i.e., Tronox is "long" on feedstock), while Cristal's feedstock production is insufficient to meet Cristal's TiO2 production requirements (i.e., Cristal is "short" on feedstock), which requires Cristal to purchase its additional requirements on the market. Respondents argue that the merger will eliminate middle-man margins, because Tronox's excess feedstock can "feed" Cristal's plants, and lead to increased TiO2 production. RB at 64-66.

Respondents do not quantify any middle-man margins assertedly eliminated from vertical integration, and fail to demonstrate how increased vertical integration, or alleged savings therefrom, would lead to increased chloride TiO2 output or lower pricing for North American chloride TiO2 purchasers. *See United States v. Aetna Inc.*, 240 F. Supp. 3d. 1, 98 (D.D.C. 2017) (stating that where defendant "has not attributed the claimed efficiencies to the particular markets challenged in the complaint, the Court cannot be confident that the consumers who are likely to be harmed by the merger would also share in its benefits").

Moreover, the weight of the evidence is inconsistent with Respondents' assertions as to the combined entity's post-Acquisition feedstock position. For a manufacturer to produce chloride TiO2, it needs access to high-grade feedstock.[15] F. 344. Tronox is presently "long" in high-grade feedstock by about [redacted] TiO2 kMT.[16] F. 346. Tronox projected that after the Transaction, it would be "significantly short on high grade feedstock," with an estimated deficit in 2018 of [redacted] TiO2 kMT. F. 347. Even if the Jazan slagger, which is currently not operating, were to begin operating at capacity, the combined entity would still be short of high-grade feedstock. F. 348, 352. This evidence indicates that the combined company would still need to purchase high-grade feedstock from third parties in order to meet chloride TiO2 demand, which undercuts the conclusion that integrating feedstock production will create efficiencies to the benefit of the North American chloride TiO2 market.

### (b) Planned improvements to Jazan slagger and Yanbu plant

Respondents contend that the Acquisition will result in increased TiO2 production in two ways: (1) by increasing production at Cristal's chloride TiO2 plant in Yanbu, Saudi Arabia (the "Yanbu plant"), which Respondents assert has been underperforming;

[15] The most common raw materials for feedstock are rutile and ilmenite. Natural rutile can be directly converted into TiO2 pigment and thus is a high-grade feedstock. Ilmenite must undergo further processing to be converted into TiO2. F. 338, 341.

[16] The abbreviation "kMT" is an acronym that "stands for kilo metric ton." https://www.acronymfinder.com/Kilo-Metric-Ton-(measurement)-(KMT) html.

and, (2) by repairing and restarting a smelting facility in Jazan, Saudi Arabia (the "Jazan slagger"), which Respondents assert will result in increased feedstock production, and ultimately, increased TiO2 output. RB at 66-68. Respondents have failed to demonstrate that these purported efficiencies are cognizable, for the reasons discussed below.

Respondents do not explain how, or point to evidence indicating that, improvements in performance and increased output from either the Yanbu plant or the Jazan slagger will benefit the relevant market for chloride TiO2 in North America. As Mr. Quinn, chief executive officer of Tronox, acknowledged in his testimony, the overwhelming majority of the asserted operating synergies are related to assets outside the United States, F. 431, and thus outside the relevant North America geographic market. Moreover, the customers served by Cristal's chloride TiO2 plant in Yanbu are predominantly located in Saudi Arabia, and none of the TiO2 grades produced at the Yanbu plant are sold in North America. F. 384. Furthermore, as explained in section II.C.2., import costs, lead times, and other logistical and supply issues deter North American customers from importing chloride TiO2. Respondents emphasize that the asserted synergies will increase output of TiO2 on the global market. However, allegedly procompetitive effects outside the relevant market do not rebut a prima facie case of anticompetitive effects in the relevant market. *See Philadelphia Nat'l Bank*, 374 U.S. at 370 (rejecting asserted justification for a merger that was based on procompetitive benefits outside the relevant market); *see also United States v. Anthem Inc.*, 855 F.3d 345, 363-64 (D.C. Cir. 2017) (rejecting claimed savings based on a broad market definition, and stating that the evidence was "unmoored from the actual market at issue"). Accordingly, Respondents fail to demonstrate that increased output from the Yanbu plant or the Jazan slagger will benefit the relevant market for chloride TiO2 in North America. For this reason alone, Respondents' synergies claims based on planned improvements to the Yanbu plant and the Jazan slagger fail to rebut the prima facie proof of likely anticompetitive effects. *See Univ. Health*, 938 F.2d at 1222 (defendant may rebut prima facie case with evidence showing significant efficiencies *in the relevant market*) (emphasis added).

Furthermore, the conclusion that planned improvements to the Jazan slagger and the Yanbu plant will lead to increased TiO2 output is speculative. Although Tronox may be sincere in its plans to make output enhancing improvements to the Jazan slagger and the Yanbu plant, whether or not these efforts will succeed cannot be reasonably verified before they occur. This was also the conclusion of the district court, evaluating virtually the same record. Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *64. As Respondents acknowledged in the synergies white paper that they submitted to the FTC in August 2017, [redacted]. F. 356. Dr. Fadi Trabzuni of TASNEE also admitted that [redacted]. F. 357. Willem Van Niekerk, senior vice president of strategy at Tronox, further acknowledged that Tronox cannot even fully determine the impact of [redacted]. F. 357.

Respondents' assertions as to the Jazan slagger are particularly speculative, given that the Acquisition at issue in this proceeding does not even include an acquisition of the Jazan slagger. F. 373. The Jazan slagger is not owned directly by Cristal, but is owned by another entity, AMIC, which is owned half by Cristal and half by TASNEE. F. 350. Approximately one year after the announcement of the Acquisition, Tronox signed an option agreement and technical services agreement with AMIC regarding the Jazan slagger. F. 374. Tronox chose to pursue an option agreement for the potential purchase of the Jazan slagger because the slagger's current inoperable state makes its value uncertain and Tronox did not want to acquire an asset that has not been proven to work. F. 377. The option agreement obligates Tronox to purchase the Jazan slagger in the future only if the facility achieves certain production levels. F. 376. If these performance metrics are met, then any amounts provided by Tronox under the option agreement are credited to the $125 million purchase price; otherwise, such amounts must be repaid to Tronox. F. 376. This deal structure reflects Tronox's own uncertainty that the planned improvements will succeed, by "remov[ing] the risk to Tronox if Jazan demonstrates unsurmountable weakness." F. 378. Ultimately, there is no certainty that Tronox will

even purchase the Jazan slagger. F. 379. *See also* Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *64-65 (characterizing the option agreement as a reflection of Tronox's uncertainty as to whether the improvements and output enhancements at the Jazan slagger would be actualized).

Respondents' assertions as to the Yanbu plant are based on a two-page document titled, "Preliminary Yanbu Improvement Plan." F. 386. This plan refers generally to implementing "best practices" and "operational excellence" techniques, and applying to Yanbu the "lessons learned" from Tronox's Hamilton, Mississippi plant, which Tronox asserts is "nearly identical in every material way" to Yanbu. F. 387; RB at 67. Even if Yanbu's plant design is similar to Hamilton, however, there are particular challenges to Tronox's successfully implementing planned changes at the Yanbu plant. F. 394-395. Richard Dean, vice president of global operations integration at Tronox, who provided the estimates contained in the Preliminary Yanbu Improvement Plan, identified organizational culture as "the biggest challenge [Tronox] face[s] at Yanbu." F. 389, 395. Christian Gunther, head of Cristal's titanium unit, explained the challenge of employee "accountability, meaning the challenge of making people in the plant at every level truly feel accountable for the success at the operations of the entire plant." F. 395. This is not the case at the Hamilton plant which, according to Mr. Dean, has "a very engaged and interested workforce," "interested in the success of not only Hamilton but Tronox as a whole." F. 396.

Respondents have also failed to provide independent verification for the planned improvements at either the Jazan slagger or the Yanbu plant, or for the projected impacts. For example, KPMG, which was hired to assist Tronox with Tronox's synergies assessment, "*assume[d]* that the Jazan Slagger will reach the production levels projected by [Tronox]" and that "the operational and technical improvements identified by [Tronox]" will enable Yanbu to exceed production forecasts. F. 381, F. 398 (emphasis added). Similarly, Respondents' proffered experts based their opinions as to likely output increases from improvements to the Jazan slagger and the Yanbu plant upon the assertions, judgments, and/or expectations of Respondents, without any apparent independent verification. F. 429. Respondents argue that this is sufficient verification,

because of the knowledge and experience of the Tronox personnel involved, and that the Merger Guidelines do not require any particular method of verification. *See* RRB at 46-49. As set forth in section II.E.2.a., however, Respondents have the burden of substantiating their efficiency claims, and to be cognizable, such claims must be reasonably verifiable by "an independent party." *H&R Block*, 883 F. Supp. 2d at 89. As the court in *H&R Block* explained, while reliance on the estimation and judgment of experienced executives about costs may be perfectly sensible as a business matter,

> the lack of a verifiable method of factual analysis resulting in the [claimed efficiencies] renders them not cognizable . . . . If this were not so, then the efficiencies defense might well swallow the whole of Section 7 of the Clayton Act because management would be able to present large efficiencies based on its own judgment and the Court would be hard pressed to find otherwise.

*Id.* at 91.

### (c) Summary

Respondents have failed to demonstrate that their claimed output enhancing efficiencies will increase output in the relevant market. Moreover, Respondents have failed to substantiate their claims with independent verification. For these reasons, Respondents have failed to demonstrate that their claimed output enhancing efficiencies are cognizable.[17]

[17] Respondents' claimed output enhancing efficiencies from planned improvements to the Jazan slagger and the Yanbu plant are also not cognizable because the evidence fails to show these efficiencies are merger-specific, i.e., that the Acquisition, and resulting removal of Cristal as a competitor in the relevant market, is necessary to achieve the claimed output enhancing efficiencies. Cristal has hired employees with expertise in the low-pressure technology used at the Yanbu plant and has implemented organizational and operational changes, which have led to improvements in production. F. 404-417. In addition, Mr. Dean, Tronox's vice president of operations integration, acknowledged that Cristal probably does not need a merger with Tronox to develop such beneficial practices as shift handover protocols, workflow management protocols, meeting protocols, short interval control protocols, or operator checklists. F. 420. Furthermore, in recent years, Cristal has engaged outside engineers and consultants to address the issues with the Jazan slagger, and as of February 2017, Cristal had completed several modifications. F. 360-370. In June 2017, a TASNEE press release stated that "work is still ongoing to solve the technical problems" at the Jazan slagger, and projected a trial operation during the first half of 2018. F. 372. AMIC has invested over [redacted] in the Jazan slagger and [redacted]. F. 380.

### ii. Cost savings

Respondents argue that the Acquisition will lead to "sizable cost savings synergies" in "SG&A" (selling, general, and administrative costs), primarily from reduction in personnel and services costs; and in procurement, supply chain, and logistics, including volume discounts. RB at 68-69. Respondents further contend that the consulting firm KPMG has assessed and validated Tronox's synergies estimates, noting that KPMG had access to the entire data room related to the Acquisition. As discussed below, Respondents' asserted cost savings efficiencies are not cognizable.

First, Respondents have failed to provide independent verification for their asserted cost savings. The objective of KPMG's engagement was to assist in the assessment of the potential synergies that Tronox anticipates in connection with the proposed Acquisition. F. 424. The procedures that KPMG agreed to perform [redacted]. F. 425. Moreover, as the district court in the preliminary injunction case also found, KPMG's synergies' conclusions were at least partially based upon estimates and assumptions provided by Respondents' management. F. 426-428. *See* Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *65-66. For example, part of KPMG's role was to build an Excel model which would track all of the synergies, including the synergies originally identified in the initial due diligence period and a revised estimate of synergies identified during the "sign-to-close diligence" period. F. 428. The revised estimates were provided by Tronox's business people, and KPMG fed those estimates into the tracking model. F. 428.

Second, Respondents have failed to demonstrate that the cost savings are merger-specific. KPMG does not purport to address whether cost savings could be achieved by either Tronox or Cristal alone. For this reason as well, Respondents' asserted costs savings efficiencies are not cognizable. *See Sysco*, 113 F. Supp. 3d at 83 ("Sysco did not hire McKinsey to identify merger-specific savings for antitrust purposes. . . . McKinsey was not given instructions on identifying merger-specific savings . . . ."). *See also* Preliminary Injunction Opinion, 2018 U.S. Dist. LEXIS 155127, at *66 (noting that

KPMG was not hired "to identify 'merger-specific' cost savings for antitrust purposes, but to 'provide consulting support' for the 'sign-to-close period' of the deal.").

Finally, even if it is assumed that the Acquisition will reduce the combined entity's general costs of doing business, Respondents have failed to show that such savings will benefit North American consumers of chloride TiO2, which is the relevant market in this case. *See CCC Holdings*, 605 F. Supp. 2d at 74 (rejecting asserted cost savings efficiencies, noting that there was "no evidence to suggest that a sufficient percentage of those savings will accrue to the benefit of the consumers to offset the potential for increased prices. . . . [T]hese advantages could show up in higher profits instead . . . ."). Indeed, Tronox has not evaluated how lowering its costs would affect TiO2 pricing, which is affected by many factors. Mr. Quinn acknowledged that lowering Tronox's costs is unlikely to have an impact on TiO2 pricing. F. 430.

Accordingly, for the reasons summarized above, Respondents have failed to demonstrate that their claimed cost savings are cognizable.

#### 3. Conclusion

Respondents have failed to rebut the prima facie proof that the Acquisition is reasonably likely to have anticompetitive effects in the relevant market for the sale of chloride TiO2 in North America. Accordingly, the evidence proves that the planned Acquisition may substantially lessen competition in violation of Section 7 of the Clayton Act and Section 5 of the FTC Act.

The analysis now addresses the appropriate remedy.

### F. Remedy

For the remedy in this case, Complaint Counsel seeks an order prohibiting any acquisition of Cristal by Tronox. *See* CCB Exhibit A (hereinafter "Proposed Order"). The Proposed Order contains four substantive provisions,[18] summarized as follows:

[18] Paragraph I of the Proposed Order is limited to definitions of the Respondents and the planned acquisition, all of which are consistent with the findings and conclusions of this Initial Decision.

Paragraph II.A., which requires Respondents to terminate the acquisition agreement and refrain from any actions to consummate the agreement; Paragraph II.B., which enjoins Tronox from acquiring Cristal, directly or indirectly, in whole or in part; Paragraph II.C., which requires Respondents to return all confidential information, and destroy all notes related thereto; and Paragraph II.D., which requires Respondents to submit written certification of their compliance with Paragraphs II.A. and II.C., together with supporting documentation, within 15 days of the Order becoming final.

Complaint Counsel asserts that the Proposed Order is appropriate to prevent Respondents from entering into the Acquisition, thereby preserving competition in the relevant market. Complaint Counsel argues that the Commission has broad discretion to fashion a remedy, so long as the provisions are reasonably related to the violation found to exist. Respondents do not address the Proposed Order in their post-trial briefing.[19]

The remedy for a violation of Section 7 of the Clayton Act is set forth in Section 11(b) of that act, as follows:

> If upon such hearing the Commission . . . shall be of the opinion that any of the provisions of [Section 7] have been or are being violated, it shall . . . issue and cause to be served on such person an order requiring such person to cease and desist from such violations . . . .

15 U.S.C. § 21(b). In addition, it is well established that the Commission has broad discretion in choice of remedy, so long as it bears a reasonable relation to the unlawful practice found to exist. *FTC v. National Lead Co.*, 352 U.S. 419, 428 (1957); *Jacob Siegel Co. v. FTC*, 327 U.S. 608, 611-13 (1946). "The touchstone principle for . . . analyzing remedies is that a successful merger remedy must effectively preserve competition in the relevant market." *Sysco*, 113 F. Supp. 3d at 73 (quoting Antitrust Div., U.S. Dep't of Justice, Antitrust Division Policy Guide to Merger Remedies 1 (June 2011)).

[19] Respondents maintain that no remedy is appropriate because Complaint Counsel has failed to prove that the planned acquisition is unlawful. As held above, the planned acquisition is unlawful. Thus, a remedy is appropriate.

Based on the foregoing, the Proposed Order, submitted by Complaint Counsel, will be issued herewith as the Order in this case (hereinafter "Order").[20] It has been determined that the Acquisition is unlawful because the effect may be to substantially lessen competition in the relevant market for the sale of chloride TiO2 in North America. The Order accomplishes the remedial objectives of the Clayton Act and the FTC Act by enjoining the Acquisition and preserving competition in the relevant market. In addition, its provisions are reasonably related to the proven violation.

[20] The Order contains no substantive changes from the Proposed Order.

## III. FACTS

### A. Background

#### 1. Titanium dioxide

1. Titanium dioxide ("TiO2") is an industrial chemical primarily used as a pigment. (Joint Stipulations of Jurisdiction, Law, and Fact, JX0001-002 ¶¶ 12-13). TiO2 is an essential pigment used to add whiteness, brightness, opacity[21] and durability to paints, industrial and automotive coatings, plastics, and other specialty products. (Young, Tr. 642; Pschaidt, Tr. 965; PX3011 at 012 (Kronos investor presentation); PX9020 at 006, 013, 045, 083, 117 (Chemical Economics Handbook); PX1001 at 005 (Tronox investor presentation)).

2. TiO2 can have two different crystal structures – rutile and anatase. (PX9020 at 013 (Chemical Economics Handbook)). Rutile TiO2 and anatase TiO2 have different physical characteristics and applications and are not substitutes for any use relevant to this matter. (PX1424 at 010 (Tronox presentation); PX9022 at 120 (Venator SEC Filing)).

3. The first step in developing TiO2 pigment starts by mining heavy materials that are concentrated in sand dunes. (Turgeon, Tr. 2585-87).

4. TiO2 is produced from feedstock (titanium-containing ores)[22] through one of two manufacturing processes that extract TiO2 from ore: (1) the chloride process that uses chlorine ("chloride TiO2"); and (2) the sulfate process that uses sulfuric acid ("sulfate TiO2"). (PX9020 at 021-23, 025-28 (Chemical Economics Handbook)).

5. The chloride process is a continuous process that uses chlorine gas to create titanium tetrachloride, which is then oxidized to create TiO2. In the sulfate process, feedstock is combined with sulfuric acid in batches, to make a "black liquor" from which solid titanium hydroxide is extracted and treated to create TiO2. (Turgeon, Tr. 2613-17).

6. The primary customers of TiO2 include paint and coatings manufacturers and plastic producers. Approximately 60% of TiO2 is used in coatings applications, 25% in plastics, 10% in paper, and 5% in other uses, including inks, foods,[23] and pharmaceuticals. (Mouland, Tr. 1211; PX9020 at 042 (Chemical Economics Handbook); Christian, Tr. 775).

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[21] Opacity is how well a paint covers the wall. (Engle, Tr. 2452).

[22] Feedstock is explained in more detail in F. 337-342.

[23] Chloride TiO2 cannot be used in products that are ingested. (Christian, Tr. 775). Food-grade TiO2 can only be made from sulfate TiO2 or anatase TiO2, and can be an additive to toothpaste, powdered donuts, or cookie filling. (Christian, Tr. 776, 782, 889). Food-grade TiO2 is also used to prevent spoilage and increase the shelf life of foods. *See* https://www foodinsight.org/titanium-dioxide-fda-food-coloring-additive-ingredient-donuts.

7. The term "coatings" encompasses architectural coatings, meaning paint, and industrial-type coatings, such as automotive coatings, marine coatings, packaging coatings, and other products that are for industrial application. (Malichky, Tr. 348; Young, Tr. 631; Christian, Tr. 773).

### 2. The parties and the proposed acquisition

#### a. Tronox

8. Tronox is a for-profit corporation headquartered in Stamford, Connecticut. (Joint Stipulations of Jurisdiction, Law, and Fact, JX0001-001 ¶ 1).

9. Tronox was spun off from the Kerr-McGee Corporation ("Kerr-McGee") in 2005. (PX0001 at 004; Dean, Tr. 2920).

10. Tronox went into chapter 11 bankruptcy in January 2009 and emerged from bankruptcy in February 2011. (Romano, Tr. 2209-10).

11. Tronox owns and operates three mines: one on the west coast of Australia near Perth (Cooljarloo), one on the east coast of South Africa (KZN Sands), and one on the west coast of South Africa (Namakwa Sands). Tronox owns and operates smelters in South Africa to produce titanium feedstock. (Turgeon, Tr. 2590, 2597; PX9040 at 010 (Tronox investor presentation); Mei, Tr. 3150-51).

12. Tronox owns and operates three chloride TiO2 plants, which are located in Hamilton, Mississippi; Botlek, Netherlands; and Kwinana, Australia. (PX9040 at 010 (Tronox investor presentation)).

13. The only type of TiO2 that Tronox manufactures is chloride TiO2. (Romano, Tr. 2177; Quinn, Tr. 2413).

14. Tronox engages in activities in or affecting "commerce" as defined in Section 4 of the FTC Act, 15 U.S.C. § 44 (2008), and Section 1 of the Clayton Act, 15 U.S.C. § 12 (2008). (Joint Stipulations of Jurisdiction, Law, and Fact, JX0001-001 ¶ 3).

#### b. Cristal

15. Three legal entities collectively constitute "Cristal." Cristal USA Inc. is a Delaware corporation and an indirectly owned subsidiary of Saudi Arabian companies The National Industrialization Company ("TASNEE") and The National Titanium Dioxide Company. (Joint Stipulations of Jurisdiction, Law, and Fact, JX0001-001 ¶ 4). For ease of reference, the name "Cristal" is used herein to refer to the subject of the Acquisition (F. 25), as well as to the three affiliated corporate entities, unless the context otherwise dictates.

16. Cristal owns and operates titanium feedstock mining assets in Australia. (PX9040 at 010 (Tronox investor presentation); PX7006 (Stoll, IHT at 42)).

17. Cristal owns and operates a titanium feedstock mining asset in Paraiba, Brazil. (PX9040 at 010 (Tronox investor presentation); PX0002 at 024 (Cristal's Narrative Response to the Second Request)).

18. Cristal owns and operates three sulfate TiO2 plants located in Thann, France; Bahia, Brazil; and Fuzhou, China. (PX9040 at 010 (Tronox investor presentation); PX7008 (Hewson, IHT at 11-12)).

19. Cristal owns and operates five chloride TiO2 plants, two of which are located in Ashtabula, Ohio; one in Yanbu, Saudi Arabia; one in Stallingborough, United Kingdom; and one in Bunbury, Australia. (PX9040 at 010 (Tronox investor presentation); PX7008 (Hewson, IHT at 11)).

20. Cristal USA engages in activities in or affecting "commerce" as defined in Section 4 of the FTC Act, 15 U.S.C. § 44 (2008), and Section 1 of the Clayton Act, 15 U.S.C. § 12 (2008). (Joint Stipulations of Jurisdiction, Law, and Fact, JX0001-002 ¶ 6).

#### c. Proposed acquisition

21. Tronox began conversations with Cristal regarding a potential combination in 2015. (Quinn, Tr. 2302; RX0236 at 0001).

22. In October 2016, Tom Casey, then-CEO of Tronox, reported to the board of directors that Tronox and Cristal had reached a preliminary framework for an acquisition. (Quinn, Tr. 2299-2300).

23. On November 23, 2016, Tronox and Cristal agreed to a non-binding deal construct, and due diligence between the parties commenced. (PX9053 at 018).

24. On February 21, 2017, Tronox announced a definitive agreement to acquire the titanium dioxide business of Cristal. (PX0009 at 001; PX0001 at 005).

25. The transaction for Tronox to acquire the titanium dioxide business of Cristal (the "Acquisition") is structured as a cash-and-shares transaction that includes $1.673 billion in cash and 37.58 million Class A shares representing 24% of the combined entity. (RX1257 at 0002). Shareholders approved the transaction on October 2, 2017. (PX9053 at 18).

#### d. Key employees of Respondents

##### i. Tronox

26. Brennan Arndt, Sr. is the senior vice president of investor relations at Tronox and has

worked at Tronox since May 2012. (Arndt, Tr. 1353; PX7011 (Arndt, Dep. at 8)).

27. Tom Casey was the former chief executive officer ("CEO") and chairman of the board at Tronox from May 2011 through May 2017. (Arndt, Tr. 1358, 1394; Mancini, Tr. 2740).

28. Richard Dean is the vice president of global operations integration at Tronox. He has been with Tronox since 1996 and has been vice president of global operations integration since 2017. (Dean, Tr. 2911; PX7023 (Dean, Dep. at 7-8)).

29. Arjen Duvekot is the vice president of sales for Europe, the Middle East, and Africa (EMEA) and the Asia Pacific region (APAC) at Tronox. He has been with Tronox since 2012 and became vice president of sales for the above regions in 2016. (Duvekot, Tr. 1290; PX7026 (Duvekot, Dep. at 14)).

30. Jeffrey Engle is the vice president of marketing and product development at Tronox. He has been with Tronox since 2006 and has been vice president of marketing and product development since 2012. (Engle, Tr. 2433-36).

31. Raoul Charles ("Chuck") Mancini is the senior vice president of organizational effectiveness of Tronox. He has been with Tronox since 2012 and has been chief of staff at Tronox since March 2018. (Mancini, Tr. 2739).

32. Rose Mei is director of sales and operation planning and global logistics at Tronox and has worked at Tronox for five years. (Mei, Tr. 3140).

33. Ian Mouland is the vice president of sales for the Americas at Tronox. He has worked at Tronox since 1998. (Mouland, Tr. 1140-41; PX7002 (Mouland, IHT at 20)).

34. John Romano is the senior vice president and chief commercial officer at Tronox. (Romano, Tr. 2135-36). He has worked at Tronox and its predecessor Kerr-McGee for 30 years. (PX7046 (Romano, Dep. at 7, 20)).

35. Jeffry Quinn is the chief executive officer at Tronox. (Quinn, Tr. 2292). Mr. Quinn started at Tronox as a member of the board of directors in 2011 after Tronox was emerging from bankruptcy. He became the chief executive officer in December 2017. (PX7014 (Quinn, Dep. at 19)).

36. Jean-Francois Turgeon is the executive vice president and chief operating officer at Tronox. He has worked at Tronox since 2014. (Turgeon, Tr. 2579).

37. Willem Van Niekerk is senior vice president of strategy at Tronox. He has worked at Tronox since 2012. (Van Niekerk, Tr. 3899, 3906; PX7007 (Van Niekerk, Dep. at 15-16)).

### ii. Cristal

38. Graham Hewson is the vice president of integration operations at Cristal. Mr. Hewson's responsibilities include developing the integration of Cristal and Tronox. (Hewson, Tr. 1600). Mr. Hewson has worked at Cristal since 2012 and previously worked at Tronox for approximately 21 years. (Hewson, Tr. 1601-03).

39. Jean-Yves Gigou is the vice president of the TiO2 business unit at Cristal International B.V. in Cologne. He has worked at Cristal for 15 years. (PX7043 (Gigou, Dep. at 8-9)).

40. Mark Stoll is the general manager of mergers and acquisitions at Cristal USA. (Stoll, Tr. 2062). Mr. Stoll has worked at Cristal for 33 years. (PX7006 (Stoll, Dep. at 7)).

## 3. Other TiO2 manufacturers

41. Kronos Worldwide, Inc. ("Kronos") is a TiO2 manufacturer that sells both chloride TiO2 and sulfate TiO2. (PX8002 (Christian, Decl. at 002 ¶ 6)). Brian Christian is an executive vice president of Kronos. (Christian, Tr. 744-45; PX7035 (Christian, Dep. at 16)).

42. Venator Materials Corporation ("Venator") is a TiO2 manufacturer that sells both chloride TiO2 and sulfate TiO2. (PX8005 (Maiter, Decl. at 001 ¶ 11)). Mahomed Maiter is the senior vice president for white pigments for Venator. (PX8005 (Maiter, Decl. at 001 ¶1)).

43. The Chemours Company ("Chemours") is a TiO2 manufacturer that sells only chloride TiO2. (PX8004 (O'Sullivan, Decl. at 001 ¶ 3)). Peter O'Sullivan is a commercial transformation executive with Chemours. (PX8004 (O'Sullivan, Decl. at 001 ¶ 2)).

## 4. TiO2 customers

44. Deceuninck North America is a manufacturer of vinyl window and patio door frames that are sold into the building materials market. Greg Arrowood is a commodities manager for Deceuninck North America. He has worked at Deceuninck North America for 32 years and has been a commodities manager for five years. (Arrowood, Tr. 1052, 1058).

45. Masco Coatings Corporation ("Masco") is a paint manufacturer. Its two brand names are Behr paints, sold through Home Depot, and Kilz paints. Mario Pschaidt is the vice president of procurement at Masco, and has worked at Masco for four years. (Pschaidt, Tr. 963-66).

46. PPG Industries ("PPG") is a paint and coatings manufacturer. PPG sells paint to consumers under its main brand name paints of Glidden and Pittsburgh Paint and also sells industrial or non-consumer paint. Paul Malichky is the director of raw materials sourcing at PPG. He has held this position for almost five years. (Malichky, Tr. 267-69).

47. The Sherwin-Williams Company ("Sherwin-Williams") is the largest paint and coatings manufacturer in North America. Some of Sherwin-Williams major brands include Valspar, which Sherwin-Williams acquired in 2017, and Dutch Boy. George Young is the senior vice president of global procurement and supply chain at Sherwin-Williams. (Young, Tr. 630-33; PX7020 (Young, Dep. at 121)).

48. True Value Company ("True Value") is a hardware cooperative that manufactures EasyCare brand paint and sells it through the True Value stores. (Vanderpool, Tr. 157, 160). John Vanderpool is the divisional vice president of paint at True Value. He has held this position since 2015. (Vanderpool, Tr. 153; PX7044 (Vanderpool, Dep. at 10)).

49. Four paint manufacturers, Sherwin-Williams, Valspar, PPG, and Masco, collectively account for 40% of all TiO2 purchases in North America in 2016. (PX5000 (Hill Expert Report at 047 n.204)).

## B. Relevant Market

### 1. Relevant product market

50. Between 2012 and mid-2017, chloride TiO2 accounted for around 90% of TiO2 sales in North America.[24] (Hill, Tr. 1684; PX5000 (Hill Expert Report at 047 Fig. 17)).

51. Tronox recognizes that the North American market is predominantly chloride TiO2 – "95% or 98% or some very, very high number." (PX9012 at 008 (Q4 2013 Tronox Earnings Call); PX1322 at 003 (Tronox presentation) ("The North American market is ~90% chloride.")).

#### a. Differences in attributes of chloride TiO2 and sulfate TiO2

52. Chloride TiO2 is a higher quality product than sulfate TiO2. (PX1427 at 003 (internal Tronox email) ("Chloride process uses higher-quality feedstocks and makes better-quality TiO2."); PX9015 at 011 (Q1 2013 Tronox Earnings Call) ("We are selling to customers that have demand for our higher-quality chloride product, and that cannot be met by Chinese manufacturers at this point, because they don't have any [chloride product]."); PX1324 at 001 (internal Tronox email) ("Consistency of quality is still an issue with the 2nd tier Sulfate producers"); PX2229 at 005 (Cristal email with attachment) ("Even the best performing Sulfate rutile requires 1.8X [times] more pigment to equal the performance of Tiona 595 [a chloride TiO2 grade]" in film thickness for latex paint.)).

53. Chloride TiO2 is a superior product to sulfate TiO2 on its optical properties, its color undertone, tinting strength, durability, and a whole host of different ways of evaluating a

[24] The product market and the geographic market are dependent on each other. In section III.B.2. *infra*, the geographic market is found to be the North America region, consisting of the United States and Canada. In this section, which finds the relevant product market, the focus is on the type of TiO2 sold to North American customers.

grade of TiO2. (Christian, Tr. 776-77, 960 ("[T]he market would say that our [chloride process] products are superior to our [sulfate process] products, and that is confirmed in a lot of instances based upon technical evaluations and lab work.")).

**i. Brightness**

54. Chloride TiO2 is a brighter pigment than sulfate TiO2. (PX1346 at 013 (Tronox investor presentation) ("Chloride technology yields consistently whiter, brighter pigment grades preferred for many of the largest end-use applications (e.g., paints and plastics) as compared to the sulfate process[.]")).

55. Tronox is aware that North American customers prefer the blue tone of chloride TiO2 over the yellow tone of sulfate TiO2. (PX1322 at 003 (Tronox presentation) ("US consumers have gotten used to a more blue tone and prefer it over the more yellow tone of white.")).

56. Chloride TiO2 is a brighter pigment than sulfate TiO2 due to its bluer undertone. (Christian, Tr. 773-74 ("[T]he most noteworthy [difference between chloride TiO2 and sulfate TiO2] is going to be in the general color and undertone of the product produced. An SP [sulfate process] product is going to produce what we would call a yellowish undertone, where the CP [chloride process] product is going to have a brighter white to it, or we call it a bluish undertone."); PX8005 (Maiter, Decl. at 002 ¶7) (Chloride TiO2 provides more whiteness than sulfate TiO2.)).

57. Brighter colors and brilliant whites are "achievable only through chloride manufactured pigment." (PX9121 at 007 (Chemours 2017 Form 10-K); PX7052 (O'Sullivan, Dep. at 160-61) (chloride TiO2 has a higher fundamental whiteness than sulfate TiO2)).

58. North American customers prefer chloride TiO2 over sulfate TiO2 because it is a brighter pigment. (PX8002 (Christian, Decl. at 004 ¶ 17) ("Chloride grades are preferable globally, and especially so in the U.S. The customer base in the U.S. prefers chloride grades because they are a more durable pigment and are a brighter pigment because of their bluish undertones."); PX8004 (O'Sullivan, Decl. at 002 ¶ 7) ("North American customers prefer chloride process titanium dioxide with a blue undertone.")).

59. Paint manufacturers use chloride TiO2 instead of sulfate TiO2 because it is brighter in appearance due to chloride TiO2's bluer undertone compared to sulfate TiO2's yellow undertone. (Vanderpool, Tr. 182-83 (chloride TiO2 is purer and brighter than sulfate TiO2, which is "dirtier" and has a yellow tint); Young, Tr. 643 (because sulfate TiO2 has an undertone, Sherwin-Williams has not been able to get consistent brightness of color and consistent whiteness with sulfate TiO2)).

60. For Masco, the "ultra pure white" feature of its Behr paints and crisp, clean colors are "very, very important." "That is how we differentiate ourselves in the marketplace, and that [is what] also . . . gives the quality of the paint that we want and we need." The ultra pure white feature is created by "the TiO2 that [Masco] use[s], and in order to achieve

that [Masco] need[s] to use TiO2 produced [by] the chloride process." (Pschaidt, Tr. 966, 971, 973, 977).

61. End-use consumers in North America demand crisp and brighter colors. (Young, Tr. 665 (Sulfate TiO2 does not meet Sherwin-Williams' standards for North America because it "tends to have a yellow undertone. Our market in North America requires clean colors, bright colors . . ."); Pschaidt, Tr. 978 ("[Sulfate TiO2] gives you a yellowish undertone, and that doesn't achieve that clean, crisp look that you get from a chloride-produced TiO2, and, therefore, we cannot use the sulfate-grade TiO2 for our main product lines.")).

**ii. Durability**

62. Chloride TiO2 tends to provide more durability than sulfate TiO2. (PX8005 (Maiter, Decl. at 002 ¶ 7); Christian, Tr. 776-77; PX8002 (Christian, Decl. at 004 ¶ 17) (chloride TiO2 is a "more durable pigment" than sulfate TiO2); Quinn, Tr. 2414 (acknowledging that some customers have a preference in certain applications for chloride TiO2 because it typically has greater durability)).

63. Durability is important for all products, but especially for exterior products that are exposed to sunlight and various other weather elements. (Christian, Tr. 780-81).

64. Paint manufacturers use chloride TiO2 instead of sulfate TiO2 because it provides more durability. (Young, Tr. 666-67 ("[I]n our formulas we've had better durability of our chloride product."); PX8003 (Young, Decl. at 003 ¶ 12) ("[T]he chemistry of sulfate TiO2 may result in . . . less durability than chloride TiO2 . . . ."); Malichky, Tr. 274-75, 295-96 (sulfate carries iron with the product, and that decreases the durability in the final application); Vanderpool, Tr. 195 (sulfate TiO2 failed to meet True Value's durability requirements in laboratory testing)).

65. Coatings manufacturers find chloride TiO2 tends to be more durable than sulfate TiO2. (PX7003 (DeCastro, IHT at 21) (RPM International ("RPM"), a coatings manufacturer of the Rust-Oleum brand, would not use sulfate TiO2 for exterior applications); PX7049, *in camera* [redacted], a manufacturer of plastic films, prefers not to use sulfate TiO2 because "it tends not to weather as well, in part because of the molecule structure, the crystalline structure, and also in part because of the sulfate process by which it's made. And so it . . . tends not to have the same longevity in an application as a TiO2 that's produced from the chloride process.")).

**iii. Consistency for point of sale tinting**

66. Point-of-sale tinting is where a customer picks a color at the retail store and a can of paint is customized to a customer's request. (Young, Tr. 643-44 (Tinting is "a process by which colorant is usually injected into a can of paint, it's put on a shaker, and it achieves the color that a customer desires, so it's basically customizing the product.")).

67. In the North American market, almost all paint is tinted at the point of sale. (PX7020 (Young, Dep. at 48); Pschaidt, Tr. 971-72 (the majority of paints Masco sells are tinted in-store); Malichky, Tr. 302-03 (only a small amount of paint in the United States is pre-tinted at manufacturing)).

68. For paint to be tinted at the point of sale, manufacturers must use chloride TiO2 in order to get the color consistency and bright whites that customers expect. (Young, Tr. 643-47; PX7020 (Young, Dep. at 47-49); PX7025 (Malichky, Dep. at 117-18) ("[I]f it's a tintable formula, we can't use [sulfate TiO2]")). Sulfate TiO2 does not provide the same consistent results as chloride TiO2 to allow for tinting at the point of sale. (Young, Tr. 646, *in camera* [redacted]; PX7020 (Young, Dep. at 47-49). *See also* PX1322 at 003 (Tronox presentation) ("The US also has point of sale tinting which requires a very consistent pigment base.")).

69. Color fidelity is very important to paint manufacturers and they do not want to substitute raw materials that may jeopardize their color schemes. (Malichky, Tr. 296-97 ("So [if by] switching the TiO2 and you're off a little bit in color, that's unacceptable for the consumer . . . ."); Vanderpool, Tr. 196 ("The last thing we want to have is phone calls coming in to our customer service department, one after another, that color 57 is no longer color 57; it's really 28.")).

70. Color fidelity is a challenge for the large paint companies, which can have tens of thousands of colors. (Malichky, Tr. 296-97; PX7025 (Malichky, Dep. at 124)). It is also a challenge for applications such as automotive coatings, which require color matching for all vehicles on the road today, including discontinued ones. (Malichky, Tr. 297).

### iv. Other performance attributes

71. Sulfate TiO2 "didn't meet all the criteria that [True Value needs] in terms of scrubbability, durability, dry time, recoat time, sag [downward movement of paint], low odor, all those kinds of things, and compatibility with the other raw materials that we're using in our formulas." (Vanderpool, Tr. 195).

72. Sulfate TiO2 is subject to [redacted]. (Young, Tr. 643, 666; PX8003 (Young, Decl. at 003 ¶ 12), *in camera*).

73. [redacted].

[25] "Chalking is when the surface starts to degrade and basically a dry, chalky material . . . starts to come out of the film." (Young, Tr. 666).

74. RPM has found that chloride TiO2 produces better gloss in higher gloss paint products whereas sulfate TiO2 may not give you the gloss you are looking for in higher gloss paint products. (PX7016 (DeCastro, Dep. at 97)).

75. Performance attributes that distinguish chloride TiO2 from sulfate TiO2 include paint manufacturers' ability to make paint that can be scrubbed without it flaking off the substrate ("scrubbability") and paint that can completely cover, from an optical standpoint, the color or coat of paint that was on the wall or substrate previously, to where you can't see what the previous color was, without having to apply a primer or more than one coat ("one-coat coverage"). (Christian, Tr. 774-76).

**v. Slurry**

76. North American customers purchase TiO2 either in: (1) a bagged dry powder form; or (2) a liquid slurry form. (PX9020 at 033 (Chemical Economics Handbook); Christian, Tr. 782).

77. TiO2 slurry is made by dispersing TiO2 powder in water with other additives. (Christian, Tr. 783; Engle, Tr. 2451-52; PX7007 (Van Niekerk, Dep. at 44)).

78. "A large portion of the US market is satisfied by slurry shipment . . . ." (PX1322 at 003 (Tronox presentation)).

79. Large paint and coatings manufacturers in North America purchase the majority of their TiO2 in a slurry form. (Young, Tr. 680-81, *in camera* (Sherwin-Williams purchases [redacted] of its TiO2 in North America in slurry form); Malichky, Tr. 303, *in camera* (PPG purchases [redacted] of its TiO2 in North America in slurry form); PX8002 (Christian, Decl. at 003 ¶ 13) (A significant portion of TiO2 sold by Kronos in the United States is in slurry form); PX8004 (O'Sullivan, Decl. at 002 ¶ 7), *in camera* [redacted].

80. TiO2 slurry is delivered to customers by rail cars or tank cars. (Christian, Tr. 782; Pschaidt, Tr. 981; Young, Tr. 648-49). Slurry TiO2 can be pumped directly into customers' storage tanks, which simplifies handling and manufacturing. (PX9020 at 045 (Chemical Economic Handbook); Young, Tr. 648-49; Pschaidt, Tr. 982; Engle, Tr. 2451-52).

81. Paint manufacturers use slurry TiO2 because it lowers their costs. (Young, Tr. 648-50; Malichky, Tr. 294; PX8006 (Pschaidt, Decl. at 002 ¶ 9)). Using TiO2 in slurry form allows Sherman-Williams to efficiently handle bulk deliveries of universal grades. (PX8003 (Young, Decl. at 002-03 ¶ 9)).

82. In North America, TiO2 slurry is made only from chloride TiO2. (Pschaidt, Tr. 985-86; PX7016 (DeCastro, Dep. at 84)).

### b. Unsuitability of sulfate TiO2

83. End-use customers in the United States and Canada demand high quality, premium coatings products. (Malichky, Tr. 294-95; Christian, Tr. 779-80 ("[M]ore developed economies and parts of the world . . . have higher standards for [paint] products . . . ."). As Sherwin-Williams explained, sulfate TiO2 is not suitable for most paint formulations in North America, which require clean, bright colors and which has the highest quality standard in the world. (Young, Tr. 642-44, 664-65).

84. True Value uses sulfate TiO2 in [redacted] or less of its paints, which are its very basic, entry-level paints. True Value has found that "there is definitely a difference" between paint made with sulfate TiO2 and paint made with chloride TiO2. True Value paints made with sulfate TiO2 do not cover or hide as well as its paints made with chloride TiO2, are not light reflectant, cannot be tinted with many colors, and cannot withstand as many scrubs as its paints made with chloride TiO2. (Vanderpool, Tr. 192-93, *in camera*).

85. True Value described sulfate TiO2 and chloride TiO2 as "apples and oranges," and would not consider switching from its current use of chloride TiO2 to sulfate TiO2 for the vast majority of its paints because the products are "not the same." (Vanderpool, Tr. 193-94 ("[T]here's no way" the sulfate TiO2 that True Value has tested could meet its benchmarking standards.)).

86. Over [redacted] of PPG's North American TiO2 purchases cannot be switched from chloride TiO2 to sulfate TiO2. (Malichky, Tr. 298, *in camera*). Due to differences in durability and other performance properties, sulfate TiO2 cannot be used in place of chloride TiO2 for many of PPG's architectural or industrial coatings. (Malichky Tr. 294 ("Q.: Why does PPG use chloride rather than sulfate in the vast majority of its coatings in the United States and Canada? A.: The first reason is the durability piece of it. So for exterior applications, anything that needs durability, we have to use chloride, so that's a large percent of our applications, are in that space.")).

87. PPG has used sulfate TiO2 only in specific interior low-end applications such as primers and ceiling paint. (Malichky, Tr. 298-99, 302; PX8000 (Malichky, Decl. at 003-04 ¶ 16)). Sulfate TiO2 can be used for these applications because these products have lower durability requirements and no color matching requirements. (Malichky, Tr. 302-03).

88. Sherwin-Williams uses "predominantly" chloride TiO2 in North America. Chloride TiO2 accounts for a percentage in the [redacted] of Sherwin-Williams' use. (Young, Tr. 643, 657, *in camera*). [redacted]. (PX8003 (Young, Decl. at 003 ¶¶ 12-13), *in camera*; Young, Tr. 642-43, 715).

89. [redacted]. Sulfate TiO2 is unsuitable for most of

Sherwin-Williams' applications in North America because it does not result in consistent brightness of color or consistent whites, and Sherwin-Williams has been "unwilling to compromise the quality of [its] goods" by using sulfate TiO2. In other regions of the world, where quality standards are different than in North America, Sherwin-Williams has found sulfate TiO2 suitable for use in its products. (Young, Tr. 642-43, 715, *in camera*; PX8003 (Young, Decl. at 003 ¶ 12), *in camera*).

90. Of Masco's purchases of TiO2, [redacted] are sulfate TiO2 and [redacted] are chloride TiO2. The proportion of sulfate TiO2 purchased by Masco has [redacted] over time. (Pschaidt, Tr. 985, *in camera*).

91. Masco uses sulfate TiO2 only for certain primer product lines, including the Kilz brand primer, and lower end contract paints. (Pschaidt, Tr. 966, 968, 983-84, 1043-44). Masco has tested sulfate TiO2 "over and over [and] found that [sulfate TiO2 grades] are not suitable for [its] main product lines." (Pschaidt, Tr. 978).

92. Ampacet Corporation ("Ampacet"), a multinational plastics manufacturer, purchases only chloride TiO2 for North America, but purchases sulfate TiO2 for other geographic regions. (PX7040 (Santoro, Dep. at 85)).

93. Deceuninck North America, a vinyl manufacturer, has never purchased sulfate TiO2. Deceuninck North America believes chloride TiO2 is a much purer grade that is superior to sulfate in quality. (Arrowood, Tr. 1065-66). "[T]he only way that Deceuninck [North America] would even consider sulfate TiO2 would be if chloride TiO2 was unavailable." (Arrowood, Tr. 1093).

94. In Kronos' experience, "the North American market commands CP [chloride process TiO2] products." (Christian, Tr. 813-14). North American customers have the lowest tolerance for sulfate TiO2 of any region in the world. (Christian, Tr. 778-79, 781-82; PX8002 (Christian, Decl. at 002 ¶ 6)).

95. The "overwhelming preference" for Kronos' North American coatings and plastics customers is for chloride TiO2. (Christian, Tr. 778-79, 897 (explaining that the word "preference" of Kronos' customers connotes "a larger threshold of requirement to make the products that they're in business to make. A lot of these customers require [chloride TiO2] grades to hit the quality level that they need for their products, so while technically feasible that you could put a sulfate grade into those applications, it would significantly reduce the quality of their products, and that's not acceptable for their business plan")).

96. Coatings companies' "ability to substitute sulfate for chloride . . . is limited by their need to maintain the quality levels of their own products." (PX9119 at 009 (2012 Tronox investor conference call transcript) ("I don't see as much of a shift or a material shift from chloride-processed pigment to sulfate-processed pigment because the major customers of the pigment, whether it is chloride or sulfate, are coatings companies who have requirements in their own products that the use of sulfate versus chloride will affect their . . . end product.")).

### c. Reformulation of products to switch from chloride TiO2 to sulfate TiO2

97. To switch from chloride TiO2 to sulfate TiO2, manufacturers would need to reformulate their products. (Mouland, Tr. 1225; Christian, Tr. 777; Malichky, Tr. 301).

98. North American customers cannot readily switch their formulation of products from chloride TiO2 to sulfate TiO2 due to high costs and testing time. (Christian, Tr. 777-78 ("Q.: . . . [I]n your experience, what would a customer need to do to reformulate a product from using chloride to sulfate? A: I don't have a lot of examples of that happening. That would be pretty rare, but it would entail a significant amount of work, a lot of trials, a complete reformulation of their product and grade . . . ."); PX8002 (Christian, Decl. at 004-05 ¶ 20) ("Even if a customer could change its formulations, that customer would face additional strategic challenges with its customers if the resulting product fundamentally changed.")).

99. Before reformulating its products, Masco undertakes very extensive research. With respect to TiO2, Masco tests how it incorporates into its paint, what the titanium dioxide [redacted]. Masco also tests the [redacted]. (Pschaidt, Tr. 989-90, *in camera*).

100. For its Kilz' low-end primer paints, Masco [redacted]. (Christian, Tr. 941-42).

101. For coatings manufacturers, qualifying a new grade of TiO2 is a multi-step process that includes tests on outdoor weathering and subjective feedback from customers and can take as long as three years. (Young, Tr. 652-54; PX8003 (Young, Decl. at 004 ¶ 17) ("It takes a minimum of one year to qualify a TiO2 grade for use in one of our core architectural or industrial coatings products, and it may take as long as three years."); PX8006 (Pschaidt, Decl. at 002 ¶ 11) ("This [qualification] process can take up to [redacted] for interior formulations and [redacted] for exterior formulations.")). Outdoor testing is conducted in various climate zones in North America and multiple seasonal cycles. (Pschaidt, Tr. 990, *in camera*).

102. For industrial coatings, qualification has additional steps. Depending on the application, "some industrial coatings require customer or regulatory approval." (PX8003 (Young, Decl. at 004 ¶ 19)). In addition, the time needed for performance testing varies based on the industrial coating application. (PX8003 (Young, Decl. at 004 ¶ 19) ("Some industrial coatings, for instance, need to be tested in salt water for two years.")).

103. For Deceuninck North America, switching to a sulfate TiO2 grade, "would require extensive testing"; "a lot of time, a lot of money, a lot of effort"; and could take two years or longer. (Arrowood, Tr. 1088). Compared to qualifying a chloride TiO2 grade (which takes three to six months), it could take four times longer to qualify a sulfate TiO2 grade. (Arrowood, Tr. 1067, 1088).

**d. Price of chloride TiO2 compared to sulfate TiO2**

104. Sherwin-Williams found that from 2012 to 2017, the cost of chloride TiO2 was higher relative to the cost of sulfate TiO2; there was a wide range of the difference; and, the largest price difference was when sulfate TiO2 was 40% less expensive than chloride TiO2. (Young, Tr. 647-48).

105. Cristal sets two separate price floors for chloride TiO2 versus sulfate TiO2. (PX2366 at 003 (Cristal spreadsheet for Q4 2017) (showing different pricing floors for sulfate TiO2 and chloride TiO2 in North America); PX2369 at 004 (Cristal spreadsheet for Q1 2018) (showing different pricing floors for sulfate TiO2 and chloride TiO2 in North America); PX7043 (Gigou, Dep. at 23) (explaining that Cristal has separate price floors for chloride TiO2 versus sulfate TiO2, because "[c]hloride brings a higher value to the market than sulfate.")).

106. North American customers purchase chloride TiO2 instead of sulfate TiO2 regardless of the difference in price between them. (PX9012 at 008 (Q4 2013 Tronox Earnings Call) (Mr. Casey, then-chairman and CEO stating: "In various markets, the customers have responded to what happened on pricing a year ago in different ways. For example in the North American market, it was 95% or 98%, or some very, very high number chloride[.] [I]t remains, essentially the same number market share for chloride. That was true when prices were over $4,000 a ton,[[26]] it is true now [when chloride prices are lower]."); PX1399 at 004-05 (Sept. 2013 "Fireside Chat" Q&A with Tronox CEO) ("Q. When TiO2 prices were going up last year some of your customers were pretty vocal about substituting to other less expensive products, how much of this do you think occurred and how much is ongoing? [Tronox CEO A.:] You're right, there was significant commentary last year about substantial amounts of substitution. There has been some but limited effect from substitution. Some customers substituted 3 to 5% of sulfate-based pigment in an otherwise 100% chloride pigment gallon of paint. This was done primarily in industrial paint markets and in certain regions of the world. Very limited if any substitution was done by architectural coatings companies or here in North America.")).

[26] The word "ton" is a British and American measure. *Common Mistakes in Business English*, https://blog.harwardcommunications.com/2012/01/23/the-difference-between-ton-and-tonne/. In the United States and Canada, a ton is equal to 2,000 pounds. Documents and testimony in this case also refer to the metric measure, "tonne," also known as "metric ton," which is equal to 1,000 kilograms (2,205 lbs). *Id.*; https://.www rapidtables. com/convert/weight/kg-to-pound.html. The term "metric ton" may also be abbreviated as "MT". https://englishplus.com/grammar/00000058 htm. In some instances, such as where a witness is being quoted, the Initial Decision cannot determine from the transcript of testimony whether or not the transcribed word "ton" was intended by the witness to refer to a metric ton.

107. If the price of chloride TiO2 went up significantly compared to sulfate TiO2, True Value would not switch to use more sulfate TiO2. (Vanderpool, Tr. 197 ("[W]e can't – in my opinion, these are apples and oranges. We can't just substitute because the price went up. This is – we are a quality house [paint]. Again, we can't – we can't betray the consumer, and the consumers come to know these EasyCare products as high quality, and that's what they're getting.")).

108. Even when sulfate TiO2 was 40% cheaper than chloride TiO2, Sherwin-Williams did not switch its North American products from chloride TiO2 to sulfate TiO2 "because [of] the performance gap between the two materials." (Young, Tr. 669-70).

109. When the price of chloride TiO2 was increased by at least 10% compared to the price of sulfate TiO2, Masco was not willing to switch to sulfate TiO2 in its main product lines because Masco does not want to sacrifice the quality of its products. (Pschaidt, Tr. 979-80, *in camera* ("[I]f we cannot achieve that ultra pure white, crisp look, and being able to have thousands of colors tinted to the colors that our consumers want and ask for, we will not sacrifice that. So, therefore, we cannot switch away from the chloride-produced TiO2 for our [redacted] product lines.")).

110. In 2011, when the price that Deceuninck North America paid for chloride TiO2 was very high, Deceuninck North America did not consider switching to sulfate TiO2. (Arrowood, Tr. 1088, 1093 ("Just – on the sulfate TiO2, just to be, you know, very candid, the only way that Deceuninck would even consider sulfate TiO2 would be if chloride TiO2 was unavailable.")).

111. Based on data from customers and producers analyzed by Complaint Counsel's economic expert witness, Dr. Nicholas Hill, chloride TiO2 was, on average, 21% more expensive than sulfate TiO2 for North American customers between 2012 and mid-2017. (Hill, Tr. 1683-85; PX5000 (Hill Expert Report at 046-47 ¶ 100 & Fig. 17)).[27]

112. The price difference between chloride TiO2 and sulfate TiO2 varied significantly over the 2012 to mid-2017 time period, from a high of over $800 per metric ton to a low of just above $100 per metric ton, but there is very little change in the proportion of chloride TiO2 purchased. (Hill, Tr. 1683-85; PX5000 (Hill Expert Report at 047-48 ¶ 102 & Fig. 18)).

113. Regardless of the price difference between chloride TiO2 and sulfate TiO2 in North America, the proportion of sales between chloride TiO2 and sulfate TiO2 holds steady. (Hill, Tr. 1683-85; PX5000 (Hill Expert Report at 046-48 ¶¶ 100-02 & Figs. 17-18)).

[27] Dr. Hill derived the unit-weighted average price of sulfate TiO2 and chloride TiO2 using producer invoice data for North America sales, the price from the International Trade Commission, and the price from the United Nations Comtrade data for imports into Canada. (PX5000 (Hill Expert Report at 046 n.202)). Although Dr. Hill's data set was missing data from Kronos from 2012 and 2013 and Chemours from 2017, the missing data does not affect these results because the relationship between the proportion of sales that are chloride TiO2 and sulfate TiO2 is consistent over time. (Hill, Tr. 1949-51, 2058).

114. The lack of correlation between the price of chloride TiO2 and sulfate TiO2 and the proportion of sales of chloride TiO2 is not what would be expected if North American customers were willing and able to substitute sulfate TiO2 for chloride TiO2 in response to a change in their relative prices. (Hill, Tr. 1683-85; PX5000 (Hill Expert Report at 046 ¶100)).

### 2. Relevant geographic market

115. In 2016, 97% of chloride TiO2 sold in North America was manufactured in North America and 3% was imported from abroad. (Hill, Tr. 1725-26; PX5000 (Hill Expert Report at 032 ¶ 78)).

#### a. Regional pricing

116. Respondents charge different prices to customers depending on the region in which the customer is located ("regional pricing"). F. 117-129.

117. In a March 2017 internal Tronox email, responding to questions raised by a customer, [redacted], about pricing in the United States compared to pricing in Japan, vice president of sales for the Americas, Mr. Mouland, wrote: "[He] will need to know that regional pricing is regional pricing. If they expect [redacted] in the US then it will be bye-bye [redacted]. (PX1682 at 001, *in camera* (Mouland email to Larson)).

118. In a November 2016 TiO2 review, Tronox analyzed the TiO2 markets by region, including with charts evaluating "[r]egional TiO2 pricing" performance by region. (PX1006 at 010 (Tronox's November 2016 TiO2 Review)).

119. In a July 23, 2016 email to Sherwin-Williams, Mr. Mouland wrote: "As always, regional pricing varies over time and magnitude. Pricing in the four regions; U.S. [United States], LATAM [Latin America], EMEA [Europe, Middle East and Africa] and APAC [Asia Pacific] are not comparable. . . . There is no global price." (RX0281; Mouland Tr. 1176-78).

120. The prices Tronox offers for its TiO2 in one region of the world are not connected to Tronox's prices in other regions. (Mouland, Tr. 1281; PX1739 at 001 (Tronox March 2016 email) ("What happens in the US is not connected to [Latin America], totally separate markets.")).

121. In a 2015 earnings call, Tronox reported that TiO2 prices in North America were higher than TiO2 prices in the European, Asian and Latin American markets. (PX9008 at 008 (Tronox Q4 2014 Earnings Call) (Tronox then-CEO stating: "[A]re there different prices in the regional markets in which we do business? The answer to that question is yes.")).

122. Tronox does not offer a "one size" price to all regions. "Regional pricing . . . will vary." (PX1345 at 004 (August 2015 Mouland email to Duvekot)).

123. Tronox has informed customers that it does not have a global single-price arrangement with any of its customers, and that pricing is regional because it is based on the prevailing market price in individual countries. (PX1449 at 001 (February 2012 Tronox email)).

124. In a September 2011 internal Tronox email, Mr. Mouland wrote: "Once again PPG need[s] to stop being concerned about regional price differences and accept that regions are different just like it is for their sales unless he is telling you that PPG sell[s] a can of paint in Mexico for the same price as in Germany?!" (PX1085 at 001 (Mouland email to Duvekot)).

125. Tronox does not have a single global price for its customers. Tronox's pricing for customers is based on the prevailing market price in individual countries. (Duvekot, Tr. 1298-99; PX1454 at 001 (Duvekot email to Mouland); PX1451 at 001 (internal Tronox email) ("There is no global price to multinationals, we have regional pricing as you know with all of our customers. Therefore there is no reason for the Latin-American prices to influence the Asian prices.").

126. For Tronox's multinational customers that buy TiO2 for delivery in multiple countries, individual regions are priced separately. (Romano, Tr. 2151-52 ("Customers in different regions, global customers, may pay different prices in different parts of the world."); PX7001 (Romano, IHT at 145-46) ("[I]f we're selling to a company like PPG who buys from us in multiple regions of the world, all the dynamics may be a bit different, and the pricing isn't the same in every region."); Mouland, Tr. 1172-73 (Sherwin-Williams and PPG do business in multiple regions, but pay different prices in different regions of the world for TiO2 from Tronox; each region is different; and there can be significant gaps in the price of TiO2 between different regions).

127. Cristal sets regional price floors and price targets for TiO2. (PX7043 (Gigou, Dep. at 14-15); PX7037 (Pickett, Dep. at 46) PX7000 (Snider, IHT at 24, 30-31)).

128. Cristal charges different prices for TiO2 in different regions. (PX2025 at 008 (Cristal presentation breaking down sales by North America, Asia Pacific, Europe, Latin America, and MEAI [Middle East, Africa, and the Indian subcontinents]; PX2366 at 003 and PX2367 at 004 (Cristal spreadsheets) (showing different pricing floors for different geographic regions)).

129. For Cristal, "region" is the main driver of price variance for TiO2. (PX2116 at 013, 134 (Cristal August 2016 email with marketing and sales presentation attached); PX2356 at 009 (September 28, 2017 pricing discussion) (listing "geographical mix" as one of the reasons why prices differ between Cristal and a competitor; stating, "Cristal sells relatively more to lower-priced markets (e.g., MEAf [sic], Latin America, Asia-Pacific)").

130. Sherwin-Williams has manufacturing facilities in North and South America, Europe and Asia, but maintains regional contracts with its TiO2 suppliers. These contracts provide for regional pricing, since supply and demand conditions may create different regional

pricing environments. (PX8003 (Young, Decl. at 006 ¶ 28); Young, Tr. 672-73 (prices "are higher and lower in various regions, depending on supply-demand dynamics . . ."). Sherwin-Williams has found that "[t]here's really not a universal global market" for TiO2 because prices are "openly negotiated in each of the regions" because of "different market dynamics" and "different availability." (Young, Tr. 671-72).

131. PPG does not pay one global price for TiO2 from its suppliers but instead pays different prices for the different regions. (Malichky, Tr. 311-12).

132. AkzoNobel, a manufacturer of paints and performance coatings, uses TiO2 in multiple regions and pays regional prices when obtaining TiO2 from its suppliers. (PX7033 (Post, Dep. at 153-54) (TiO2 "markets are regional and considered regional by the industry")).

133. [redacted] is negotiating an annual contract with [redacted] that covers its chloride TiO2 purchases throughout the world, wherein the price terms vary by geographic regions. [redacted], *in camera*).

**b. The North America region**

134. The North America region is made up of the United States and Canada. The North America region does not include Mexico because market participants group Mexico in their Latin American markets (F. 135-140); and because of differences in pricing and other demand characteristics between Mexico and the United States and Canada. (F. 141-144).

135. Tronox's LATAM 2015-2017 Strategy document defines "Latin America (LATAM) [as] Central & South America, Mexico, Caribbean" noting Mexico's "[p]ricing [as] consistent with Latin American pricing and not that of the USA." (PX1327 at 005, 025 (Tronox LATAM 2015-2017 Strategy)).

136. Cristal's North America sales region includes the United States and Canada. Cristal's Latin American sales region includes Mexico. (PX7043 (Gigou, Dep. at 14-17); PX7000 (Snider, IHT at 24) (Cristal sets prices by region and the North America region is the United States and Canada); PX7037 (Pickett, Dep. at 65) (the sales manager for North America is responsible for sales in the United States and Canada; the sales manager for Latin America is responsible for sales in Mexico)).

137. Kronos organizes markets by geographic area and defines its North America market as Canada and the United States, and defines its Latin America market as Mexico, the Caribbean, South America, and Central America. (Christian, Tr. 778). Kronos sets different price levels by region to reflect competitive conditions in each region. (PX8002 (Christian, Decl. at 004 ¶ 15)).

138. Chemours and Venator view the North America market as United States and Canada. (PX8004 (O'Sullivan, Decl. at 002 ¶ 7) (Chemours organizes its chloride TiO2 businesses into different regions based on customer locations: "North America (United

States and Canada); Europe, the Middle East, and Africa; Asia-Pacific, excluding China; China; and Latin America (including Mexico)."); PX8005 (Maiter, Decl. at 002 ¶ 8) (describing Venator's North American customers as United States and Canada)).

139. TZ Minerals International ("TZMI"), a consulting company, prepared a report for Tronox titled, "TiO2 Pigment Supply/Demand Q1 2016." In analyzing demand for TiO2, this TZMI report excluded Mexico from the North America market and included Mexico in the Central and South America market. (PX9077 at 034-35 (TZMI Presentation: TiO2 Pigment Supply/Demand Q1 2016)).

140. Sherwin-Williams and PPG consider the North America market for TiO2 to refer to the United States and Canada. (Young, Tr. 632-33; Malichky, Tr. 311-12, 388).

141. Tronox charges different prices to TiO2 customers in Mexico compared to the United States. (PX1319 (October 26, 2015 internal Tronox email ("We pointed out [to the customer] that different regions have different prices and that Mexico had gravitated to LATAM price as opposed to U.S. price[,] which it generally used to track."); Mouland, Tr. 1181-83).

142. Tronox's prices in Mexico are generally lower than in the United States. While prices ebb and flow, Tronox's prices in Mexico usually fall between the prices in United States and Latin America. Tronox does not sell very much TiO2 in Mexico in part because the pricing in Mexico is low. (PX7002 (Mouland, IHT at 155)).

143. Based on producer invoice data for Cristal analyzed by Dr. Hill, Cristal's prices for North-American produced chloride TiO2 are similar when sold in the United States and Canada, but different when sold in Mexico. (PX5000 (Hill Expert Report at 025 ¶ 58 & Fig. 8)).

144. PPG pays a different price for TiO2 purchased for use in the United States and Canada than it does for TiO2 purchased for use in Mexico. (Malichky, Tr. 311-12). "[E]ven though TiO2 is produced in the U.S. and shipped to Mexico, the suppliers sell it at two different prices, one price in the U.S. and one price in Mexico." (Malichky, Tr. 610; PX1301 at 001-02 (November 14, 2014 Mouland email to Duvekot and Romano) (stating that Mr. Mouland "[r]eiterated [to PPG] that price should not spill over into US. [Pricing information provided was for] Mexico only, separate market.")).

**c. Price difference between North America and other regions**

145. Mr. Romano of Tronox acknowledged that in 2015 and December 2014 its prices for chloride TiO2 were higher in North America than in other regions and that in December 2013 there was a "significant price disparity" between North America and the rest of the world, with North American prices for chloride TiO2 being higher than prices in the rest of the world. (Romano, Tr. 2177-81; PX1620 at 025; PX1111 at 002; PX1349 at 009 (Tronox presentation) (noting that "[t]he significant price disparity between North

America and the rest of the world continues to be the focus of most of the price discussions with the large multinational accounts")).

146. In a 2016 earnings call, Tronox reported that TiO2 prices in Europe and Asia were lower than prices in North America. (PX9001 at 007 (Tronox Q3 2016 earnings call)).

147. Based on a Tronox summary of its TiO2 revenue, as of June 2016, the net sales price in North America was [redacted] per metric ton higher than those in the other regions for Q2 2016. (PX1008 at 011, *in camera* (Tronox TiO2 Variance Analysis)).

148. In a 2015 earnings call, Tronox reported that TiO2 prices in North America were higher than the TiO2 prices in the European, Asian and Latin American markets. (PX9008 at 008 (Tronox Q4 2014 earnings call)).

149. A March 2015 Cristal analysis of TiO2 prices and revenues for the year March 2014 to March 2015 reported that North American TiO2 prices were [redacted] higher than in other regions. (PX2050 at 005, *in camera* (Cristal email with report attached)).

150. Based on invoice data from Tronox and Cristal analyzed by Dr. Hill, the prices for chloride TiO2 charged by North American plants owned by Tronox and Cristal were at least 10% higher and often more ($250 to $525 per metric ton) than the prices Tronox and Cristal charged customers in the rest of the world from 2012 to 2017. (Hill, Tr. 1722-24; PX5000 (Hill Expert Report at 063-64 ¶ 144 & Fig. 24)).

151. Based on the analysis conducted by Respondents' economic expert witness, Dr. Ramsey Shehadeh, the prices Tronox charged its North American customers for chloride TiO2 were at least 10% higher than the prices Tronox charged in the next highest region between the first quarter of 2012 and the first quarter of 2016, with the exception of the third quarter of 2012. Cristal's North American TiO2 customers paid the highest average prices from the second quarter of 2012 through the first quarter of 2017. (Shehadeh, Tr. 3627-33; RX0170 (Shehadeh Expert Report at 108-09 Figs. 53 & 54)).

#### d. Delivery of chloride TiO2 to customers' locations, with delivered pricing

152. Delivered pricing means that the price the TiO2 supplier charges to its customers includes the cost of shipping the product to the customer. (Duvekot, Tr. 1306-07).

153. North American customers obtain nearly all their chloride TiO2 through deliveries by suppliers to their locations in North America, with delivered pricing. F. 154-159.

154. For Tronox's North American customers, the cost of shipping is covered in the price paid to Tronox when obtaining TiO2 from Tronox's North American plants. (Duvekot, Tr. 1307).

155. Nearly all of the TiO2 that Venator sells to its customers in North America is delivered to its customers' locations and sold on a delivered pricing basis. (PX7015 (Maiter, Dep. at 176)).

156. Masco's TiO2 suppliers deliver chloride TiO2 to Masco's facilities and the price that Masco pays for chloride TiO2 includes the cost of delivery. (Pschaidt, Tr. 980).

157. PPG pays a delivered price for its chloride TiO2 purchases for North America and the chloride TiO2 is delivered to PPG's locations in railcars or tank wagon trucks. (Malichky, Tr. 304-05; PX7025 (Malichky, Dep. at 208-09)).

158. RPM, a multinational coatings manufacturer, buys chloride TiO2 from domestic manufacturers on a delivered basis. (PX7016 (DeCastro, Dep. at 87-88)).

159. Ampacet, a multinational plastics manufacturer, pays delivered pricing for TiO2 purchased from North American producers. (PX7040 (Santoro, Dep. at 12)).

160. If a customer wanted to buy TiO2 in one region and ship it to another region, the customer would have to pay for the shipping. (Duvekot, Tr. 1303).

**e. Costs and logistical considerations of importing TiO2**

161. If a customer wanted to buy TiO2 in one region where it is less expensive and ship it to a different region where it is more expensive ("arbitrage"), the price difference would have to cover shipping costs, external handling costs (costs to pay the freight forwarder), internal handling costs (internal to the customer to cover the costs of the logistics of exporting the product from one region to another), warehousing costs, and import duties. (Duvekot, Tr. 1304-05).

162. Duties to import chloride TiO2 into North America vary, depending on the location from which it is shipped and when it is purchased, but have been around 5.5%. (PX0003 at 038 (Tronox Second Request Narrative Response to Specification 16) (5 to 6%); PX7050 (Mei, Dep. at 081-82, 112-13) (5.5%); PX8005 (Maiter, Decl. at 004 ¶ 20) (6%); PX8002 (Christian, Decl. at 003 ¶ 14) (6%)).

163. Costs to transport TiO2 pigment can add 5% to the cost of importing TiO2 to the United States. (PX0003 at 038 (Tronox September 2017 Narrative Responses). *See also* PX8005 (Maiter, Decl. at 004 ¶ 20), *in camera* (cost for Venator to import TiO2 to North America from Europe is approximately "[redacted] per tonne" for total freight and duty costs); PX8002 (Christian, Decl. at 003 ¶ 14) (for Kronos to import non-specialty grades of TiO2 to the United States from Europe is "cost prohibitive due to the 6% import duty and the cost of transatlantic shipping."); Malichky, Tr. 318 (PPG estimated that freight costs to import from China to the U.S. would add about 10% to the cost of the TiO2 that it purchases)).

164. North American customers purchase chloride TiO2 from North American suppliers so that they do not have to incur long lead times of importing TiO2. (Vanderpool, Tr. 199-200; Arrowood, Tr. 1084 (Deceuninck North America has not purchased TiO2 from locations outside of North America because of the "problems that [one] can run into with transportation, with product taking an extremely long lead time to get to [Deceuninck North America's] factory and just all the difficulties that you can face with transportation . . ."). If a North American TiO2 customer ships TiO2 from China, it may take 12 weeks to arrive at the facility. (PX7033 (Post, Dep. at 162)).

165. Because of long lead times when importing TiO2, a North American TiO2 customer would have to stock its own warehouse at least 12 weeks in advance. A TiO2 customer's warehouses may not be big enough to stock these products ahead of time. (PX7033 (Post, Dep. at 162)).

166. If True Value chose to import TiO2 from outside of the United States, it would be less equipped to deal with a spike in demand since it could not get additional supply quickly. (Vanderpool, Tr. 199-200).

167. North American customers purchase chloride TiO2 from North American suppliers so that they can avoid the risk of potential shipping delays. When TiO2 arrives from overseas, it can get stuck in the port or the ship can get delayed, creating timing issues. (Malichky, Tr. 310-11). [redacted] Lomon Billions Group ("Lomon Billions"), a TiO2 manufacturer in China (F. 300), is "not a reliable supplier" because "[t]hey don't ship on time." [redacted].

168. The logistics involved in obtaining chloride TiO2 from a North American supplier, i.e., the "planning and timing" of the procurement, are much easier. (Arrowood, Tr. 1084; Young, Tr. 670-71; [redacted] (stating that it is easier to source TiO2 from the U.S. TiO2 manufacturers on a delivered basis, so the TiO2 customer does not have to get involved with any of the logistics)).

169. TiO2 customers in North America that order TiO2 from Tronox's Hamilton plant will have reduced lead time and shipping time and a cost advantage over TiO2 ordered from Tronox's non-North American plants, based on differences in duty and shipping costs and warehousing. (PX7026 (Duvekot, Dep. at 84-85)).

170. TiO2 customers value a direct relationship with large suppliers, product consistency, and on-time delivery. (PX7002 (Mouland, IHT at 69, 102-03) ("[Customers] want to know they can rely on us for on-time delivery in full."); PX1000 at 005 (Tronox 2016 presentation) (recognizing that U.S. "customers are looking for . . . reliability to deliver")).

171. It is easier for Cristal's customers to be supplied by a production facility that is close to them because of the shorter lead times for delivery. (PX7043 (Gigou, Dep. at 83); *see also* PX7000 (Snider, IHT at 34-35) ("[A] lot of North American customers are under

contract," are more concerned with security of supply, and want just-in-time vendor-managed inventory)).

172. Based on data analyzed by Dr. Hill, more than a third of the chloride TiO2 sold in North America is in slurry form. (PX5000 (Hill Expert Report at 017 ¶ 39); *see* F. 79).

173. Shipping slurry internationally would be cost prohibitive because of the weight of the water in the slurry. (Christian, Tr. 783-84 ("When [you are] shipping an aqueous slurry, [you are] paying to basically ship water across the region where you are shipping it. So the freight is much more expensive."); PX7016 (DeCastro, Dep. at 83-84)).

174. Shipping slurry across the ocean is impractical because it would settle in transit, meaning that the pigment separates out of the water, and the slurry could grow bacteria during transit that would contaminate the shipment. (Malichky, Tr. 305; *see also* PX7041 (Veazey, Dep. at 53-54) (Tronox cannot ship slurry across the ocean because "[t]he product in transit settles.")).

175. Switching from slurry to dry TiO2 would present difficult logistical challenges and costs for the coatings customers that currently receive the majority of their chloride TiO2 in slurry form. (Malichky, Tr. 305-06 (Switching to dry TiO2 would require building new infrastructure at PPG's plants and redesigning PPG's manufacturing process.); Young, Tr. 682-83 (Switching to dry TiO2 would require a significant capital investment and it is not economical for Sherwin-Williams to make its own slurry.)).

176. As Tronox acknowledges, "[a] large portion of the US market is satisfied by slurry shipment, which adds a logistical barrier to entry." (PX1322 at 003 (Tronox presentation)).

**f. Arbitrage**

177. When TiO2 prices in North America were higher than those in Europe, Deceuninck North America looked into possibly moving TiO2 from one of Deceuninck's European plants to Deceuninck North America's Monroe, Ohio plant, but decided not to do that because "the cost, transportation cost, is very expensive to get the titanium dioxide from Europe to the U.S., the economics didn't make sense for us to do that . . . ." (Arrowood, Tr. 1089-90).

178. [redacted].

179. [redacted]

[redacted].

180. In a September 2011 email, Mr. Duvekot acknowledged that PPG could not purchase TiO2 in one region then ship it to another region for the price difference between Europe and the United States at the time. (Duvekot, Tr. 1302-03; PX1085 at 001 (September 2011 Duvekot email to Mouland)).

181. Based on a quantitative analysis of invoice data produced by Tronox and Cristal, conducted by Complaint Counsel's economic expert witness, Dr. Hill, even when there were "significant price differences" between the price for chloride TiO2 in North America and the price for chloride TiO2 in the rest of the world, customers have not engaged in arbitrage to defeat higher prices in North America by buying TiO2 in a lower-priced region and transporting it to North America. (Hill, Tr. 1720-25; PX5000 (Hill Expert Report at 063-64 ¶ 144 & Fig. 24)).

### 3. Hypothetical monopolist test

182. The Horizontal Merger Guidelines provide a test, called the hypothetical monopolist test, for evaluating whether a product or group of products in a particular geographic area is a relevant market. In applying the test, the analysis focuses on whether it would be profit maximizing for a hypothetical monopolist of all sales of a specific product in a specific region to increase price by a small but significant non-transitory increase in price ("SSNIP"). If the hypothetical monopolist can successfully impose a SSNIP in the proposed market, the proposed market passes the hypothetical monopolist test and the relevant market is defined correctly. Critical loss analysis is a standard tool economists use to implement the hypothetical monopolist test. (Hill, Tr. 1668-70; PX5000 (Hill Expert Report at 049-50 ¶¶ 104, 07; PX9085 at 011-14 (Horizontal Merger Guidelines §§ 4.1.1, 4.1.2)).

183. A critical loss analysis has two stages: (1) calculation of the critical loss, which means the percentage of sales a hypothetical monopolist would have to lose to keep its profit unchanged if it increased its price by a small amount, often 5 or 10 percent; and (2) calculation of the predicted loss, which means the percentage of sales that the hypothetical monopolist would likely lose given a particular price increase and keep its profit unchanged. If the predicted loss is smaller than the critical loss, then the price increase will increase the hypothetical monopolist's profit. (PX5000 (Hill Expert Report at 049 ¶¶ 104-06)).

184. To determine the critical loss, Dr. Hill divided the SSNIP to be tested by the sum of (1) the SSNIP of 10% and (2) the hypothetical monopolist's margin on lost chloride TiO2

sales of 55%[28] to calculate the critical loss percentage to be 15% (10 divided by 65). (Hill, Tr. 1668; PX5000 (Hill Expert Report at 050-51 ¶ 109 & Fig. 19)).

185. Dr. Hill conducted three separate critical loss analyses using three different estimates of the predicted loss to test whether chloride TiO2 sold to North American customers is a relevant antitrust market. (PX5000 (Hill Expert Report at 050-56 ¶¶ 108-22 & Figs. 20-22); Hill, Tr. 1690-92; F. 186-188).

186. In the first critical loss analysis, Dr. Hill used his estimate of the price elasticity of demand, which measures North American customers' willingness to switch from chloride TiO2 to sulfate TiO2, to determine whether enough North American customers would switch to an alternative product to defeat a SSNIP by the hypothetical monopolist. (PX5000 (Hill Expert Report at 051-52 ¶ 113)). Dr. Hill's estimate of the price elasticity of demand was -0.45, which means that a 10% increase in price is predicted to lower sales of chloride TiO2 in North American by 4.5%, which shows that the demand for chloride TiO2 by North American customers is inelastic. (PX5000 (Hill Expert Report at 051-52 ¶ 113)). As a result, switching to other products by North American customers would prove inadequate to defeat a SSNIP, which shows that the sale of chloride TiO2 to North American customers passes the hypothetical monopolist test. (PX5000 (Hill Expert Report at 052 ¶ 114); Hill, Tr. at 1692-96)). Because the predicted loss of 4.5% is well below the critical loss of 15%, the market passes the hypothetical monopolist test (F. 182). (PX5000 (Hill Expert Report at 052 ¶ 114 & Fig. 20)).

187. In his second critical loss analysis, Dr. Hill predicted substitution indirectly by using data from Tronox's White Paper[29] to ascertain whether increased imports or repatriated exports ("net imports") (which is a supply response, rather than demand substitution), combined with lost sales, would render a SSNIP unprofitable for the hypothetical monopolist. (PX5000 (Hill Expert Report at 052-54 ¶¶ 115-20)). Using this data, Dr. Hill calculated that in response to a 10% increase in the price of chloride TiO2, increased imports and decreased exports would displace 9% of chloride TiO2 sales in North America and that the loss of sales of chloride TiO2 to reduced purchases of TiO2 of any type would be 3.6%. Combining this loss with the net imports estimate yields a predicted loss of 13%. Because the predicted loss of 13% is lower than the critical loss of 15%, the market passes the hypothetical monopolist test (F. 182). (PX5000 (Hill Expert Report at 053-54 ¶¶ 117, 120 & Fig. 21)).

188. In his third critical loss analysis, Dr. Hill used a Tronox document that estimated that the share of Chinese sulfate in North America could increase from 10% to 15% of applications.[30] Assuming that a 10% SSNIP would reduce the share of chloride TiO2 by

[28] Dr. Hill calculated the hypothetical monopolist's margin using the average variable margin for all chloride plants currently operating in North America. (PX5000 (Hill Expert Report at 050 n.214)).

[29] On October 17, 2017, Tronox submitted a document to the FTC titled, "White Paper on Behalf of Tronox," which provided data on U.S. net imports and relative trade prices. (PX0016 at 047).

[30] PX1000 at 007 (2016 Tronox presentation). Based on data analyzed by Dr. Hill, currently, 10% of all rutile TiO2 sales in North America are sulfate TiO2. (PX5000 (Hill Expert Report at 055 ¶ 121)).

5% and the purchases of TiO2 of any type by 3.6%, Dr. Hill calculated that the resulting loss of sales to the hypothetical monopolist would be 8.7%. Because the predicted loss of 8.7% is lower than the critical loss of 15%, the market passes the hypothetical monopolist test (F. 182). (PX5000 (Hill Expert Report at 055-56 ¶¶ 121-22 & Fig. 22); Hill, Tr. at 1696-97)).

189. Dr. Hill additionally implemented the hypothetical monopolist test based on the price elasticity of demand for chloride TiO2 in North America. (PX5000 (Hill Expert Report at 056-58 ¶¶ 123-29 & Fig. 23); Hill, Tr. at 1692-96)). Dr. Hill found that the price elasticity of demand for chloride TiO2 after a 5% SSNIP is still inelastic, and therefore chloride TiO2 in North America passes the hypothetical monopolist test (F. 182) based on the price elasticity of demand. (PX5000 (Hill Expert Report at 056-58 ¶¶ 123-29 & Fig. 23); Hill, Tr. at 1692-96).

190. The hypothetical monopolist test (F. 182), implemented in four different ways (F. 186-189), indicates that demand for chloride TiO2 is strong and that North American customers will not substitute to sulfate TiO2 in significant amounts in the face of a SSNIP. (Hill, Tr. at 1698; PX5000 (Hill Expert Report at 050-58 ¶¶ 108-29 & Figs. 20-23)).

## C. Prima Facie Case

### 1. Market structure

191. All TiO2 produced in North America is chloride TiO2, with the exception of a small plant in Canada owned by Kronos that produces sulfate TiO2. (PX5000 (Hill Expert Report at 025-26 ¶ 59 & Fig. 9); Christian, Tr. 752).

192. There are five major producers in the North American chloride TiO2 market: Tronox, Cristal, Chemours, Kronos, and Venator. (Christian, Tr. 817-18; Vanderpool, Tr. 185; PX1230 at 019 (Tronox presentation) ("Concentrated supplier base for high-quality TiO2 (5 global players, few local champions.")).

193. Tronox, Cristal, Chemours, Kronos, and Venator account for over 99% of chloride TiO2 sales in North America and for 100% of North America chloride TiO2 production capacity.[31] (PX5000 (Hill Expert Report at 010, 025-26, 067-68 ¶¶ 13, 59, 152 & Figs. 9, 25)).

194. In 2016, the shares of the chloride TiO2 market of the five major producers were: Tronox [redacted], Cristal [redacted], Chemours [redacted], Kronos [redacted], and Venator [redacted]. (PX5000 (Hill Expert Report at 067-68 ¶ 152 & Fig. 25), *in camera*).

[31] Dr. Hill calculated market shares based on producer invoice data, as further explained in Appendix D.1 to his report. (PX5000 (Hill Expert Report at 068, 144, Fig. 25 & Appendix D.1)).

195. Chemours was spun off from E. I. du Pont de Nemours and Company ("DuPont") in 2015 and became its own publicly traded company. (PX7052 (O'Sullivan, Dep. at 13)).

196. Chemours is currently the largest TiO2 producer in North America and globally. (PX9020 at 011 (Chemical Economics Handbook); PX9040 at 008 (Tronox investor presentation)). Chemours has four TiO2 plants: DeLisle, Mississippi; New Johnsonville, Tennessee; Altamira, Mexico; and Kuan Yin, Taiwan. (PX8004 (O'Sullivan, Decl. at 001-02 ¶¶ 1, 6)). Chemours' TiO2 plants produce only chloride TiO2. (PX8004 (O'Sullivan, Decl. at 002 ¶ 3)).

197. Kronos has one TiO2 plant in Quebec, Canada and four plants in Europe. Kronos' Quebec facility consists of two plants, a chloride TiO2 plant and a small sulfate TiO2 plant. (Christian, Tr. 752). Kronos' sulfate plant in Quebec produces almost exclusively anatase TiO2 for food, pharmaceutical, and other niche applications. Kronos and Venator own a 50-50 joint venture that operates a chloride TiO2 plant in Lake Charles, Louisiana, with each company entitled to half of the facility's output. (PX8002 (Christian, Decl. at 002 ¶ 7); Christian, Tr. 751-53). Of Kronos' production of TiO2, 75% is chloride TiO2 and 25% is sulfate TiO2. (PX8002 (Christian, Decl. at 002 ¶¶ 7-8); Christian, Tr. 751-52, 781-82).

198. Venator was spun off from Huntsman Corporation in 2017 and became its own publicly traded company. (PX8005 (Maiter, Decl. at 001 ¶ 1)).

199. Venator operates six TiO2 plants in Europe and one plant in Asia. (PX8005 (Maiter, Decl. at 001-02 ¶¶ 1, 9)). Venator and Kronos own a 50-50 joint venture that operates a chloride TiO2 plant in Lake Charles, Louisiana, with each company entitled to half of the facility's output. (PX8005 (Maiter, Decl. at 002 ¶ 10)). Other than the Louisiana facility, only one of Venator's plants makes chloride TiO2. (PX8005 (Maiter, Decl. at 002 ¶ 11)). Unlike the other four major North American producers, Venator does not have any TiO2 slurry capacity in North America. (PX7015 (Maiter, Dep. at 53-54, 60)).

200. Post-Acquisition, the combined Tronox/Cristal firm would have a market share of [redacted] of sales of chloride TiO2 in North America. (PX5000 (Hill Expert Report at 067-68 ¶ 152 & Fig. 25), *in camera*).

201. Post-Acquisition, the combined Tronox/Cristal firm and Chemours would have a market share of [redacted] of North American chloride TiO2 sales and over [redacted] of North American chloride TiO2 capacity. (PX5000 (Hill Expert Report at 067-68 ¶ 152 & Fig. 25), *in camera*; PX5000 (Hill Expert Report at 25-26 ¶ 59 & Fig. 9), *in camera*).

202. The federal antitrust agencies measure concentration using the Herfindahl-Hirschman Index ("HHI"). (PX9085 at 021-22 (Horizontal Merger Guidelines, § 5.3)). The HHI is calculated by totaling the squares of the market shares of each firm in the relevant market. (PX9085 at 021-22 (Horizontal Merger Guidelines, § 5.3)).

203. The proposed Acquisition would increase the HHI by over 700 points, to over 3000. (PX5000 (Hill Expert Report at 067-68 ¶¶ 152-53 & Fig. 25)).

### 2. Coordinated effects

#### a. Interdependence

204. The North American chloride TiO2 market is characterized by mutually recognized interdependence. F. 205-264.

205. Tronox's five-year TiO2 strategy plan update from August 2016 states that, in the pigment industry, suppliers must "recognize that using price to grow faster than the market generally leads to no permanent market share gains but enduring revenue and margin losses." (PX1004 at 015 (Tronox TiO2 Strategy and 5-Year Plan Update, August 2016)).

206. A November 2016 Tronox presentation stated that the "TiO2 market shows oligopoly pricing behavior (one supplier can drive price down, action of all suppliers needed to pull prices up."). (PX1030 at 013).

207. Tronox recognizes that competitor pricing decisions impact their own pricing and sales volumes. (PX7001 (Romano, IHT at 214) ("[I]t only takes one to make the price go down. The whole market has to go up. But any one competitor can make pricing go down."); PX7001 (Romano, IHT at 223) ("Any one competitor can drive price down . . . . I can make it go down, but I can't make it go up by myself."); Romano, Tr. 2156-57; PX7002 (Mouland, IHT at 77) ("[D]epending on how the customer plays it and has the negotiations with their other suppliers, if something changes from supplier or competitor activity, then it makes it difficult for me to get an increase."); PX7026 (Duvekot, Dep. at 52) (Tronox "take[s] note of the competitor's price announcements or price actions" when setting its pricing strategy.)).

208. Cristal recognizes that competitor pricing decisions impact their own pricing and sales volumes. (PX7043 (Gigou, Dep. at 31-33) (When considering whether to issue a price increase and for what amount, Cristal takes into account information from customers regarding other TiO2 suppliers.)).

209. In a 2016 board of directors presentation discussing Tronox's price increase implementation process, Mr. Romano, Tronox's chief commercial officer, explained that "[t]he success of any increase will largely depend on the market conditions and the industries[']  ability to maintain a disciplined approach to the [price increase] implementation process." (PX1021 at 002 (Romano email to Turgeon); PX7001 (Romano, IHT at 143) ("It was a summary that I put together to review with our board on how we implemented price increases.")).

210. As part of Tronox's price increase implementation efforts, Tronox collects "competitive intelligence on [Tronox's] competitors' actions" to assess whether the other TiO2

producers are "maintain[ing] a disciplined approach." (PX1021 at 002 (Romano email to Turgeon)).

211. With respect to Tronox's implementing a price increase, "to the extent some other competitor is not doing what we're doing or they're doing less of a magnitude or giving more time, it has an impact on how we're going to be able to increase and the extent of what that increase would be." (PX7001 (Romano, IHT at 158-59)).

212. With respect to Tronox's implementing a price increase, "it all depends on what our competition is doing from the standpoint of being competitive. . . . [W]hen we're trying to implement a price increase and we've got other competitors that aren't raising the price, it has an impact on our ability to either lose volume or increase the price." (PX7001 (Romano, IHT at 138)).

213. In an email to Tronox's board members following a December 2015 price increase announcement by Tronox, Mr. Casey explained: "[T]he success of this initiative will be materially affected by how Huntsman [now Venator], Cristal and Kronos respond. Chemours announced an equivalent price increase yesterday . . . ." Mr. Nkosi, a Tronox board member, responded: "Great move Sir. Let's see whether they bite." (PX1047 at 001 (Casey email to Tronox board members)).

214. Earnings calls and industry conference remarks of Tronox's and Cristal's competitors refer to the need for "discipline" in their competitive behavior and in their responses to the behavior of others. (PX9075 at 004 (Huntsman [Venator] Q2 2016 Earnings Call) ("We continue to be disciplined with our sales volumes in an effort to maximize the effective capture of the announced TiO2 price increase."); PX9075 at 014 (Huntsman [Venator] Q2 2016 Earnings Call) ("I see greater pricing discipline taking place in TiO2."); PX9025 at 003 (Chemours at Goldman Sachs Basic Materials Conference Transcript) ("Now, reflecting on the dynamics of the past, we at Chemours conclude that our own response to market dynamics was a contributor to the volatility that we experienced in our business performance. And we've decided to take a more meaningful approach to the TiO2 market.")).

215. On December 18, 2015, the same day that Tronox announced a price increase (F. 222), the Tronox announcement was the subject of an internal Cristal email. A Cristal employee noted: "Tronox follows the trend. Tronox also[] announces global increase of US$150/tonne for all TiO2 grades, effective Jan. 1, 2016, or as contracts allow. Expectedly, other TiO2 manufacturer's [sic] may follow the trend. We would be keen to observe market acceptance of these price increase announcements in Q1 2016. It's an initiative to taste the market readiness to accept this announced price increase." Minutes later, a Cristal executive replied that Huntsman (Venator) and Chemours had also announced price increases. (PX2035 at 001-02).

216. A Tronox weekly regional sales report for the Americas from May 2016 reports: "We are prepping customers for a full increase [redacted] on July 1st given current market strength. Success will obviously depend on competitor behavior and the different

announcement levels." (PX1163 at 001, *in camera* (Tronox Americas weekly report); PX7002 (Mouland, IHT at 74-75), *in camera*).

217. In an email to Cristal's chairman, Cristal's sales vice president at the time observed: "In current market conditions of excessive inventory we cannot raise price and gain market share at the same time unless all suppliers support the price movement. If we see other such public price announcement information for other suppliers in the coming days, we will then assess whether or not we want to also make a price announcement and if market dynamics can support such an initiative." (PX2087 at 002 (Stoll email to Al-Shair)).

218. In October 2016, regarding an announced price increase by Huntsman, Mr. Gigou, Cristal's sales vice president, wrote to other Cristal senior executives: "This is good news as it seems that the momentum is getting more support. It is our plan to announce also a price increase before year end," to which Mr. Gunther, Cristal's head of TiO2 business, responded: "Indeed, great news. How fast do we need to react?" (PX2007 at 001 (Gigou email to Gunther)).

219. North American chloride TiO2 producers over the years have increased TiO2 prices typically in close proximity to each other in time. (PX1204 (December 2016 Tronox Excel spreadsheets tracking competitors' price increases); Pschaidt, Tr. 975 ("Usually the TiO2 manufacturers announce price increases very close to each other, so it normally is announced within a short period of time of each other."); Malichky, Tr. 328, 332 ("[I]f one announces a price increase of 150, you know, shortly after that another one will announce 140 or 170, and so they're not exactly matching up, but you can see that they're making the trend out there that, yeah, they're all announcing price increases or, you know, four out of five or three out of four are announcing similar increases at similar times."); PX8003 (Young, Decl. at 006 ¶ 29); PX8001 (Zamec, Decl. at 003 ¶ 17)).

220. In a 2017 email, Mr. Mouland, a Tronox sales vice president, requested approval for a [redacted] increase at some customers instead of the [redacted] increase that Tronox had announced, because competitors were agreeing to [redacted] increases. (PX1093 (Mouland email to Romano), *in camera*; PX1201, *in camera* (Mouland email to Romano) ("Based on multiple US data points, feedback indicates our competitors are gravitating towards an increase of [redacted]. I am requesting a floor of [redacted] for this reason."); Mouland, Tr. 1156-58, *in camera*; *see also* PX1212 at 003, *in camera* (January 2017 Price Approval Request regarding a plastics customer, [redacted]) ("Cristal reported they are taking the price up [redacted] to their customers based on Chemours doing the same.")).

221. When Chemours announced a price increase of [redacted] on December 17, 2015, Tronox learned about that increase when it came across the wire at around 4:45 that afternoon. Within about a half hour, Mr. Casey, formerly chairman and CEO of Tronox, reacted to the Chemours increase by directing "[redacted] price increase announcement of our own before 9:30 tomorrow." (PX1046 at 002, *in camera* (Casey email to Romano and Grebey)).

222. In a December 18, 2015 email to Tronox's board members, Mr. Casey wrote: "This morning, we announced a [redacted] this morning." Mr. Casey explained, "Given the importance of a continuing focus on cash generation in 2017, we are trying to see whether we can accelerate the recovery on TiO2 pricing, by testing whether it is ready for price increases or at least to stop declines." (PX1047 at 001, *in camera* (Casey email to Tronox board members)).

223. From Cristal's perspective, the December 2015 price increase announcements (F. 221-223) were "[n]ot based on supply/demand dynamics." (PX2055 at 022 (Cristal presentation)). The purpose according to Cristal's then-president was to "hopefully stop deterioration of price [and] increase purchasing." (PX2216 at 001 (Nahas email to VanValkenburgh)).

224. In Tronox's 2015 third quarter earnings call, Mr. Casey disclosed that Tronox had idled a portion of its TiO2 production, emphasizing the impact of this decision on pricing and that Tronox observed other TiO2 producers "acting in the same way." Mr. Casey stated: "[T]he question is, when will [the prices] turn? We're addressing that by managing our production so that inventories get reduced to normal or below normal levels. And when that happens, prices will rise. We – from what we see with Chemours and Huntsman and presumably the others as well, they're doing the same thing. We see them acting in the same way." (PX9005 at 010 (Tronox Q3 2015 Earnings Call)).

225. In 2015, shortly after Mr. Casey had publically stated that Tronox had idled part of its Hamilton plant (F. 268), Chemours closed its Edge Moor plant in Delaware, and shut down a production line at its Johnsonville, Tennessee plant, removing 150,000 metric tons of capacity. (Christian, Tr. 875-76; PX2055 at 024 (Cristal presentation)).

226. In August 2015, when Tronox learned that Chemours closed its Edge Moor plant in Delaware, an internal email was circulated that characterized these developments as "Good news!!" Tronox's then-CEO Mr. Casey replied, "[i]t's good that [Chemours] can follow the leader!" (PX1325; *see* PX2055 at 024 (Cristal presentation) (noting that Chemours had closed its Edge Moor plant in Delaware and shut down a production line at its Johnsonville, Tennessee plant, removing 150,000 metric tons of capacity)).

227. In a September 2011 email, Cristal's Mr. Stoll noted that the "discipline of taking supply off-line and allowing inventories to fall as demand improve[s] lead[s] to pricing discipline and pricing power over the following quarters." (PX2083 at 001 (Stoll email to Najjar)).

228. Tronox and Cristal documents demonstrate mutually accommodating conduct by chloride TiO2 producers in order to support market discipline and avoid triggering adverse competitor responses. (F. 229-246).

229. Mr. Casey of Tronox stated in a 2014 earnings call: "As you saw, we have not gained market share by trying to reduce price. We don't think that's the appropriate strategy going forward . . . ." (PX9010 at 005 (Tronox Q2 2014 Earnings Call)).

230. In 2011, in response to an email from Mr. Casey regarding "softness" in current orders, Mr. Romano explained the soft demand at that time and further explained Tronox's efforts to balance sales volume and pricing in that environment: "We have also been working very hard to maximize our price increase implementation in Q4. When customers have inventory to work with during the negotiation process, this can create pressure on the volumes as customers hold back on order placement on the expectation that this could create an opportunity for a smaller increase. . . . [I]n most cases, not all, the customer will want an incentive to take on additional inventory. If the customer is not willing to take on additional inventory[,] the volume could be taken from a competitor and that may lead to a competitive response[,] which could facilitate price erosion. We have to be selective on where we try to pick up additional volume because we do not want to facilitate a downward movement on price." (PX1090 at 001 (Romano email to Casey)).

231. In a July 2012 email, Mr. Romano wrote to Mr. Casey and to Mr. Greenwell, then-CFO of Tronox: "The problem we face is that pricing is falling and if we take action to go after market share, price will deteriorate further and we do not want [to] facilitate or fuel that process. Everyone is defending their business and matching offers from the competition to maintain their share as no one want[s] to loose [sic] business." (PX1015 at 001 (Romano email to Casey and Greenwell); Romano, Tr. 2161-63).

232. In the same email to Mr. Casey and Mr. Greenwell referenced in F. 231, Mr. Romano explained: "Using price to try to take market share in a soft market will create churn, destroy value and will take much longer for us to recover when the market does pickup. Price is the most significant lever we have and we need to do everything we can to prevent it from falling further." (PX1015 at 001 (Romano email to Casey and Greenwell); Romano, Tr. 2163-64).

233. In 2011, Mr. Wayne Hinman, a member of the Tronox board of directors advised Mr. Casey in an email: "[W]e will be better off in the long run, by trying to maintain pricing and where possible pass on higher raw material costs and give up sales volume in the short term, and take the short term margin/cost hit, rather than try and keep our plants loaded." (PX1075 at 001 (Hinman email to Casey)).

234. An October 2011 presentation by Cristal's Mr. Stoll to Cristal's Steering Body stated: "The *'Evil Sin'* would be to attempt to lower prices to take market share as markets weaken. *We Must Hold Price!*" (PX2242 at 017 (Cristal Steering Body Meeting Commercial Update) (italics in original); Stoll, Tr. 2086; PX7009 (Stoll, Dep. at 146-47)).

235. In December 2011, Mr. Stoll of Cristal sent an email to Mr. Nahas, Cristal's then-president, informing him that despite lower customer demand, prices had remained

steady because "[a]ll of the large global TiO2 suppliers are still acting in a disciplined manner, respecting each other's market positions and share and holding on to price. No volume stalking of any great consequence is taking place yet, which is very good news." (PX6000 at 003 (Stoll email to Nahas)).

236. Mr. Stoll of Cristal explained the meaning of the email referenced in F. 235: "[E]ven though the market demand was slowing, we weren't out starting to be the initiator to drop price to get more share because we realized that hanging on to price had a lot more impact on our profitability than to try and gain more share. Once you lower price to get more share, you might gain a couple thousand tons of volume, but you can bring down the price on all of the other tons that you're selling all over the world and the financial consequence of that is extremely significant. It's more significant than trying to get a larger share position." (PX2247 (Stoll, Dep. at 154-56)).

237. In a July 2011 email, responding to a sales manager's request for a price to quote for a prospective customer [redacted], Mr. Mouland of Tronox referenced the pricing of DuPont (now Chemours (F. 195)), stating: "At this point, we certainly don't want to undercut DuPont & send the wrong message." (PX1291 at 001, *in camera* (Mouland email to Larson)).

238. In an August 2011 email, a Tronox sales manager reported to Mr. Mouland on his discussions at a paint company, [redacted]: "Personally, I would like to have a small portion of their business but we certainly cannot undercut DuPont [Chemours] to get it." Mr. Mouland responded: "Just to close out on this officially. We are not interested in undercutting DuPont [Chemours] and bidding on business." (PX1292 at 001-02, *in camera* (email exchange between Mouland and Larson)).

239. In May 2011, Cristal had a potential business opportunity at [redacted], which had been a "100% Tronox account for over 10 years." A senior manager at Cristal wrote that he was "not sure [he] believe[s] this is a good time to take on new business at a 10 year 100% account like this. I believe that Tronox would find out about it . . . ." Another manager agreed: "[I]t would be very visible to Tronox and would send a conflicting signal to price ourselves aggressive[ly], there is little to gain and quite a bit to loose [sic]." Cristal decided to forgo the opportunity and told the potential customer that it was "very tight on supply." (PX2021 at 001-02, *in camera* (email exchange between Herrmann, Jaquet, and others)).

240. In a 2014 presentation regarding Tronox's sales and marketing strategy, when considering a strategy to increase sales in higher priced regions such as North America and Europe, Tronox identified "[c]ompetitive response" as a risk. (PX1016 at 062 (Tronox presentation)).

241. In November 2014, an internal Tronox email discussed an opportunity to secure new business at [redacted], a siding and window profile manufacturer, replacing then-incumbent supplier DuPont (now Chemours). Mr. Romano stated that the price offer being contemplated by Tronox was "very low" and cautioned that Tronox should

not be "undercutting significantly." (PX1086 at 002-03, *in camera* (Romano email to Duvekot, Mouland, and Doherty)).

242. In May 2014, in an internal Tronox email regarding a sales and marketing presentation, Mr. Duvekot recommended the presentation include as an "action" item "[k]eep[ing] pigment price as high as possible for the time being – don't use discounts in high priced regions to attract additional sales, this will lead to market price destruction." (PX1360 at 001 (Duvekot email to Romano); PX7026 (Duvekot, Dep. at 111-12) ("[B]ack in those days, in those circumstances, in 2014, if we were to start using discounts in those high priced regions to attract additional sales, all it would do is lead to market price destruction."); *see also* PX1030 at 013 (Tronox presentation)).

243. In April 2015, responding to an email seeking approval to reduce price to secure business at a prospective customer, Tronox's Mr. Duvekot suggested a higher price offer and wrote: "Being aggressive leads to disaster unless we know where the competition is and know what aggressiveness means." (PX1453 at 001 (Duvekot email to Mouland); *see also* PX1429 at 001, *in camera* (Duvekot email to Bruno) ("It doesn't make sense to undercut the competition, [redacted] [a customer] will use it to put pressure on the others.")).

244. In a July 2015 email discussing pricing for a customer, [redacted], Mr. Duvekot stated: "Especially on a highly visible account like [redacted] any price move will be seen by the competitors, even more so if we use it to take a piece of the pie. That will cause a reaction from the competition, at this account or elsewhere in the market, which will just lead to more price erosion in the market. Tronox does not want to play this game (anymore)." (PX1432 at 001, *in camera* (Duvekot email to Hofman); PX7026 (Duvekot, Dep. at 125-27), *in camera*).

245. In an August 2015 email approving a pricing request, Mr. Romano, Tronox's chief commercial officer, directed: "[B]e sure we are not undercutting the Chemour[s] price. There is some other activity going on over in North America with Valspar and I want to be sure we are not not [sic] seen as facilitating further price erosion." (PX1133 at 001 (Romano email to Bradley)).

246. In a March 2016 email, Tronox's Mr. Mouland wrote to two salespeople: "We will have to pass on this opportunity as I do not want to undercut a competitor. The price increase is taking hold and any attempt to get volume at the expense of price could undermine our progress." (PX1305 at 001 (Mouland email); PX7022 (Mouland, Dep. at 70-71)).

**b. Product homogeneity**

247. Tronox documents and testimony describe chloride TiO2 as a commodity product. (PX1004 at 015 (Tronox presentation) (TiO2 industry characterized by "commodity products"); PX0016 at 026 (Tronox White Paper); PX7014 (Quinn, Dep. at 38)).

248. Customers can switch between the chloride TiO2 produced by the five North American chloride TiO2 producers. (Young, Tr. 659-60; PX7030 (Arrowood, Dep. at 8-9); Vanderpool, Tr. 198; PX8000 (Malichky, Decl. at 002 ¶ 8)).

249. Customers believe that the sale of chloride TiO2 is a commodity business. (PX7033 (Post (AkzoNobel), Dep. at 79); *see also id.* at 97 (stating that "the behaviors of the industry [are] driven as a commodity"); Pschaidt, Tr. 1033; Arrowood, Tr. 1113-14).

250. Markets for homogenous products are more susceptible to coordination. One reason for this is that reactions by rivals to attempts to steal their business are likely to be strong, given that each firm's product is largely interchangeable with its rivals' products. (PX5000 (Hill Expert Report at 096 ¶ 220)).

### c. Ability to learn competitors' actions

251. Tronox, Chemours, Kronos, and Venator are publicly traded companies. (Arndt, Tr. 1354-55; PX7035 (Christian Dep. at 15); PX7052 (O'Sullivan, Dep. at 13); PX8005 (Maiter, Decl. at 001 ¶ 1)).

252. Cristal is a privately held company. (PX7006 (Stoll, IHT at 121).

#### i. Public statements

253. Prior to the spinoffs of Chemours from DuPont in 2015 (F. 195) and Venator from Huntsman in 2017 (F. 198), disaggregated information on TiO2 was typically not available in the financial reports of DuPont and Huntsman. (PX7006 (Stoll, IHT at 119-21) ("[T]hey [DuPont] didn't break out in detail their titanium dioxide business. . . . [Y]ou could really gain no insight into their financial performance or other metrics in the way that they released earnings. After Chemours spun off . . . [t]hey became that business. They spun it off as TiO2. So in public information that's released, it's much more transparent the financials associated with TiO2 directly. . . . And as [for] Venator, same thing.")).

254. In 2015, Huntsman told investors during an investor conference that having more publically traded TiO2 companies will "[a]bsolutely" change the dynamics of the market. (PX9041 at 004 (Basic Materials Conference Transcript)).

255. In a June 2017 investor presentation, Venator explained that it anticipated a "[s]ignificant recovery in TiO2 prices" because, in part, there would be "[g]reater accountability for TiO2 stewardship by newly independent companies (Venator and Chemours)." (PX3000 at 004 (Venator presentation)).

256. In a 2017 Venator analyst day presentation, Venator referred to "Improved Fundamentals," including "[s]ignificant and ongoing consolidation. . . ." and "[g]reater industry transparency as companies become independently managed and accountable to shareholders." (PX3054 at 094 (Venator presentation)).

257. Tronox discusses its quarterly results in earnings calls. When discussing its quarterly results, Tronox discusses changes in sales volume, changes in the selling prices by region, margin information, and operation related information such as relative plant utilization rate and inventory levels. (Arndt, Tr. 1360-61).

258. Tronox's public statements to investors, including earnings calls, are made on behalf of Tronox as a whole. Tronox uses its best efforts to ensure that its statements to investors are accurate, complete, and not misleading. (Arndt, Tr. 1359).

259. Tronox and Cristal monitor and analyze public statements by competitors such as quarterly earnings updates, presentations at industry conferences, and ratings agency meetings. (PX7002 (Mouland, IHT at 33-34) (stating that market intelligence comes "primarily from the customers and then earnings calls" from competitors); PX1039 at 004 (Merturi email to Staton and Arndt) ("Moody's has put all rated TiO2 companies on review and at this stage Chemours and Huntsman have already discussed their price increase with them. Moody's has a perspective on price from our peers[.] It will look suspect at best if we continue to say we don't know yet."); PX1052 at 001-02 (McGuire email to Tronox sales executives circulating notes from a November 2016 Chemours earnings call, including Chemours' outlook of reduced inventories and stronger price environment); PX1053 at 001-03 (Arndt email to Tronox senior executives attaching an August 2016 Chemours earnings call transcript, which projected continuing price increases through 2016 and discussed Chemours inventory situation); Romano, Tr. 2142-44; PX1054 at 001-04 (Engle email to Romano, Duvekot, Mouland describing "tidbits" from Huntsman transcript relating to inventories and utilization); PX2051 at 001 (Stoll email to Nahas stating: "It is interesting being here at the TZMI Conference this week in Hong Kong. There is much concern by all of the TiO2 producers about the price collapse and how much lower pricing will go.")).

260. Tronox's Mr. Engle, vice president of marketing, listens to competitors' earnings calls to learn about their production plans and other announcements and obtain competitive intelligence. (Engle, Tr. 2540-41; Engle, Tr. 2482 ("So the biggest source [of competitive intelligence] would be trade data and public filings or public announcements, investor presentations, things like that.")).

261. In a 2016 earnings call regarding Chemours' fourth quarter 2015, Chemours CEO, Mark Vergnano, stated that the industry was "at a place that we really need to drive this price increase" and that "what our driver is right now [is] to be able to get behind this price increase and move it through the industry." (PX9048 at 008).

262. In a 2016 earnings call regarding Chemours' second quarter 2016, Mr. Vergnano of Chemours stated his prediction that for "the rest of the year, you will see a cadence up in our price as you look at third quarter . . . . [S]o we feel good about where we are on the price side, and I think you will see continued movement because of the execution of these price increases for the rest of the year." (PX9056 at 009).

263. At a basic materials conference sponsored by Goldman Sachs, Huntsman's (now Venator) executive vice president stated: "Well, there's the April 1 effective price increase. It was roughly $235 a ton, nominated. And we have communicated and signaled that we would expect the realization on that price would be on the upper end of what we've been realizing over the last 3 or 4 quarters. That is closer to 2/3, 70% realization." (PX9060 at 003 (Huntsman Corp. at Goldman Sachs Basic Materials Conference Transcript)).

264. Mr. Arndt, Tronox's head of investor relations, pointed out in a written summary circulated to Tronox executives regarding Huntsman's second quarter 2016 earnings call that Huntsman stated it "continue[s] to be disciplined with [its] sales volumes in an effort to maximize the effective capture of the announced TiO2 price increase." (PX1055 at 001).

265. Cristal monitors and analyzes public statements by competing firms, such as quarterly earnings updates, and regularly prepares detailed analyses. (PX2059 at 002-10 (Cristal competitor earnings call analysis, November 2016); PX2060 at 002-13 (Cristal competitor earnings call analysis, August 2016); PX2061 at 001-16 (Cristal competitor earnings call analysis, March 2017); PX2062 at 001-15 (Cristal competitor earnings call analysis, May 2017); PX2278 at 004-14 (Cristal competitor profitability analysis, March 2013)).

266. Cristal monitors TiO2 competitors' public calls and circulates summaries among executives. (PX2049 at 001-04 (Cristal email providing "takeaways" from Tronox's and Chemours' conference calls, including information on production curtailments, capacity utilization, and planned price increases); PX2268 at 001 (Cristal email attaching Tronox's and Chemours' 2016 earnings calls presentations and setting forth "Key Messages" relating to projected pricing, low inventories, and motivation for price increases during 2017); PX2269 at 001 (Cristal email relating to competitor earnings reports describing, among other things, lower capacity utilization rates); PX2361 at 002-04 (Cristal email summarizing key comments from competitors' earnings calls on price increase announcements and implementation, inventory levels, plant utilization rates, and expectations for future pricing)).

267. Tronox's public disclosures include production-related information, such as information pertaining to plant utilization and inventories. (Arndt, Tr. 1361, 1369-70).

268. Tronox publicly announced its decision to reduce production at two of its TiO2 pigment plants, Hamilton and Kwinana, in a second quarter 2015 earnings call. (PX9006 at 003 (Tronox Q2 2015 earnings call) ("Production has been suspended at one of our six processing lines in Hamilton and one of our four processing lines at Kwinana . . . . Together, these processing line curtailments represent approximately 15% of total pigment production.")).

269. In its first quarter 2016 earnings call, Mr. Casey of Tronox was asked whether, "given that volume has picked up quite a bit and prices are moving up," Tronox planned to bring

curtailed plants back to production. He answered: "We believe that a very disciplined approach to production, to managing supply relative to demand, is what has facilitated the recovery in our markets, and we intend to continue to be disciplined about that. So, we don't intend to bring back the full production instantaneously simply because we see the very first signs of price recovery." (PX9003 at 010 (Tronox Q1 2016 earnings call)).

### ii. Customer-provided information

270. Tronox obtains intelligence regarding competitor actions from its customers. (PX7002 (Mouland, IHT at 13-14) ("[M]arket intelligence comes from [Tronox's] customer base, . . . the customers that [Tronox] ha[s], and then the prospective accounts that we're always looking at."); PX7002 (Mouland, IHT at 84) ("[A]ll of it pretty much comes from the customer."); PX7022 (Mouland, Dep. at 58) ("[I]t's my job to know what's going on out there, so what I expect from my [sales people] . . . is to make sure they have very good relationships with their accounts and we can solicit customer feedback across multiple data points.")).

271. Customer-provided competitive pricing information is used to obtain pricing approvals from management, and such information is included in reports provided to senior management. (F. 272-288; Mouland, Tr. 1145-46; PX7001 (Romano, IHT at 155-56); *see, e.g.*, PX2368 at 001-05 (Cristal North America weekly report)).

272. Tronox learns from its customers whether its competitors have announced price increases. (Mouland, Tr. 1155-56).

273. Tronox tries to "discern if [the customers are] telling the truth or if they're giving [Tronox] accurate information." (Romano, Tr. 2154).

274. Tronox does a "reasonably good" job of developing competitive intelligence. (PX7001 (Romano, IHT at 171); PX7046 (Romano, Dep at 89-90)).

275. Customer-provided competitive intelligence is used by Cristal and Tronox to make pricing decisions in customer negotiations. (PX2068 at 001 (Cristal email regarding approval for price response based on competitor pricing); PX2069 at 003 (Cristal Price Decision Form); PX1050 at 001 (Mouland email to Romano) (discussing Tronox's response to pricing from Cristal and Huntsman to Benjamin Moore); PX2070 at 001-03, *in camera* (recommending response based on customer-provided competitor pricing, stating "[w]e are very confident of his communication that they are [redacted] below us . . . ."); PX7046 (Romano, Dep. at 89-90) (stating that during negotiations "we obtain information from customers on whether or not we're competitive.").

276. In many instances, customers share specific competitor pricing information with Tronox sales representatives. (PX1048 at 001-02 (Duvekot email to Romano) (noting that a customer was "very open and showed many offers in writing"); Duvekot, Tr. 1311-13; PX1089, *in camera* (Doherty email to Mouland) ("Per [redacted], Purchasing Mgr, Kronos and DuPont have moved their price by [redacted]."); PX1088 at 001, *in*

*camera* (Mouland email to Romano) (stating that a customer "is a straight shooter. When we do increase, she is requesting we get competitive with Chemours who are [redacted] below us"); PX1211 at 003, *in camera* (price approval request stating that a "[c]ustomer confirmed Kronos is taking them up [redacted]); PX1741 at 001, *in camera* (Mouland email to Romano) (price approval request citing Cristal's pricing of [redacted] per pound, and further noting that "[w]e also get a lot of useful market intel from [the customer]."); PX1157 at 001 (Mouland email to Duvekot) (describing specific prices offered to a customer by Huntsman (now Venator) and DuPont (now Chemours)); PX1735 at 002, *in camera* (Tronox Americas Weekly Report) (describing that Cristal is offering [redacted] per pound lower than Tronox at [redacted])).

277. When implementing a price increase in the market, part of Tronox's process is for the sales force to collect "competitive intelligence on [its] competitors' actions so [Tronox] can better evaluate the success rate of implementation. With that information," management will determine if any adjustment is needed. (PX1021 at 002 ("Price Increase Implementation Process"); PX7046 (Romano, Dep. at 89-90, 102); *see also* F. 210 (As part of Tronox's price increase implementation efforts, Tronox collects "competitive intelligence on [Tronox's] competitors' actions" to assess whether the other TiO2 producers are "maintain[ing] a disciplined approach.").

278. An internal Tronox email from 2016 stated that: "put[ting Tronox's] price in writing to the customer" serves as "a signal to competition." (PX1434 at 001-02 (Bondt email)).

279. Cristal obtains competitor pricing information from its customers. (PX2065 at 001, *in camera* (Florville email to Parks) ("I had a conversation with [a customer] this morning to talk about his meeting with Huntsman last night. [He] indicated that Huntsman offered [redacted] [per pound] for volume and that they would like him to respond to the offer ASAP."); PX2068 at 001, *in camera* (Weeks email to Snider and Gigou) ("Our refusal to . . . meet [redacted] [per pound] price resulted in [a customer] moving 5 trucks per month away from us and over to [redacted] (these were the five trucks we took from them last year).")).

280. Cristal is aware that price offers are communicated by customers to other competitors. In Mr. Stoll's experience, "information goes from competitor to customer to other supplier." (PX7006 (Stoll, IHT at 188)).

281. As an example of the communication referenced in F. 279, customers tell Cristal whether its price is higher than those from other suppliers and what the other suppliers' prices are. This information in turn is included in Cristal's weekly reports for North America. (PX7037 (Pickett, Dep. at 50, 93); PX7043 (Gigou, Dep. at 75-77)).

282. Cristal's redbook is a compilation of Cristal's market intelligence that summarizes everything that Cristal knows about its customers, such as what it knows "about how much they use, what products they use, and what applications they use it in. Cristal's redbook also includes Cristal's "best assessment of . . . demand [in] particular regions around the world." (PX7009 (Stoll, Dep. at 164)).

283. The data in Cristal's redbook is assembled by the Cristal sales and marketing teams. Cristal's redbook data tracks all major suppliers' sales volumes by customer and product. (PX7010 (Snider, Dep. at 33-34, 61-62, 66)).

284. Much of the market intelligence included in Cristal's redbook is derived from "conversations with [Cristal's] customers." (PX7009 (Stoll, Dep. at 165)).

285. Dr. Hill compared the data in Cristal's redbook with the actual data derived from producers' invoices. Dr. Hill found that market shares calculated from the redbook data were a "close match" to the actual market shares calculated from the invoice data. Dr. Hill concluded that the redbook data was "remarkably accurate . . . ." (Hill, Tr. 1833-35; PX5000 (Hill Expert Report at 098-99 ¶ 228 & Fig 36)).

286. Kronos obtains competitive intelligence from customers and the information is a data point that Kronos considers when making business decisions. (Christian, Tr. 756-57).

287. Kronos relies on its sales force to determine what customer-provided competitor information is legitimate information and what might be posturing for purposes of negotiation. (Christian, Tr. 928-29).

288. Chemours gets information about its competitors as a "direct result of [Chemours'] interaction with [its] customers." (PX7052 (O'Sullivan, Dep. at 31-32)).

#### d. Price elasticity

289. Price elasticity of demand is how responsive demand is to changes in price. Inelastic demand makes a market more susceptible to coordination because if prices of all firms were to rise, few sales would be lost, which makes the reward of coordinating greater. (Hill, Tr. 1803-04).

### 3. Views of industry participants and customers

290. On February 21, 2017, the chairman of Huntsman sent an email to Tronox's then-CEO Mr. Casey congratulating him on the agreement to acquire Cristal, which was announced that day (F. 24). Mr. Casey replied that the acquisition would be good for the merged firm and for its competitors as well. (PX1045 at 001 (stating, "I think it will be very good for our shareholders - and if today's market reaction is an indication, for yours, and Chemours' and Kronos' too.")).

291. Kronos, in a September 2017 public investor presentation, described higher concentration as part of the "[s]tructural improvements" in the industry that would lead to increased earnings. (PX3011 at 38 (Kronos presentation).

292. A July 2017 presentation to analysts by Venator's chairman, Peter Huntsman, and president, Simon Turner, described consolidation as a "key driver" of a "[m]ore

sustainable cycle." (PX3054 at 14 (Venator presentation); *see also id.* at 19 (noting that consolidation of TiO2 producers, including Tronox/Cristal, will result in "[f]ewer, larger, more rational producers")).

293. True Value believes that the merger "does not bode well for True Value manufacturing." Mr. Vanderpool, division vice president of True Value, explained: "If you take capacity out of the marketplace, it's going to affect pricing in the marketplace. . . . [We're] going from five major suppliers down to four major suppliers, and we have a tough time figuring out how that benefits True Value manufacturing. . . . [redacted]. So we see raw material prices continue to go up and tightening in the market from allocation, and that's a very big concern of ours." (Vanderpool, Tr. 213-14).

294. "The acquisition of Cristal by Tronox is cause for concern for Ampacet." The merger causes "a 20% reduction in [its] supply base." (PX4130 (Santoro email); PX7040 (Santoro, Dep. at 122-23, 125-26)).

295. RPM, the producer of Rust-Oleum coatings, is concerned about the merger because "when you have less producers, it's not good for buyers." (PX7016 (DeCastro, Dep. at 127)).

### D. Rebuttal

#### 1. Entry

296. Based on producer invoice data and a 2016 TZMI study analyzed by Dr. Hill, chloride TiO2 sales by suppliers other than Tronox, Cristal, Kronos, Chemours, and Venator, account for a 0.5% share of the total North American chloride TiO2 market sales volume of 831,182 metric tons. (PX5000 (Hill Expert Report at 067-68 ¶ 152 & Fig. 25)).

297. The vast majority of TiO2 manufactured in China is sulfate TiO2. "[A]lmost no commercial grade chloride pigment is produced today" in China. (PX1036 at 006 (Tronox presentation); PX1091 at 011 (Tronox presentation) (identifying expected Chinese sulfate TiO2 capacity in 2020 as roughly 10 times greater than China's chloride TiO2 capacity); PX1033 at 002, *in camera* (Tan email to Engle) (actual chloride TiO2 production in China estimated to be [redacted] as compared to nameplate capacity[32] of [redacted])).

298. Chinese "exports have largely stayed within Asia-Pacific to serve low-grade sulfate pigment applications . . . ." (PX1395 at 008 (February 2017 Tronox "Q&A" for investors)).

[32] "Nameplate capacity" refers to the amount of product that a plant is theoretically capable of producing, based on its design, as opposed to the amount that is actually produced. (Christian, Tr. 827-28, 831; Stoll, Tr. 2112; Malichky, Tr. 416).

299. The chloride process for TiO2 is environmentally cleaner than the sulfate process but technically more difficult to master and operate. (PX9020 at 027-30 (Chemical Economics Handbook)).

300. Lomon Billions is a TiO2 producer in China and is the fourth largest TiO2 producer globally by capacity. (Young, Tr. 680; Stoll, Tr. 2106; Romano, Tr. 2243).

301. Lomon Billions produces chloride TiO2 at a plant in Jiaozuo, China. The plant is designed for a nameplate capacity of 100,000 tonnes. (PX7054 (O'Malley Noe, Dep. at 48-49, 51); Christian, Tr. 828-30).

302. Lomon Billions' chloride TiO2 plant has been producing below its nameplate capacity of 100,000 tonnes. Lomon Billions produced a total of 60,000 tonnes of chloride TiO2 in 2017. (Engle, Tr. 2492; RX1642 at 005; PX7054 (O'Malley Noe, Dep. at 124); Quinn, Tr. 2412 ("I know that Lomon has been running their plants below nameplate capacity."); Turgeon, Tr. 2716 ("[T]hey are running below their nameplate capacity as of today.")).

303. Lomon Billions' sales of chloride TiO2 in the United States in 2017 was approximately 3,000 to 4,000 tonnes. (PX7054 (O'Malley Noe, Dep. at 102)).

304. Lomon Billions has a very limited presence in North America, with only a few employees located within North America, and access to a single, third-party operated warehouse for inventory. (PX7054 (O'Malley Noe, Dep. at 101, 112, 127-128)).

305. Lomon Billions does not offer technical service from North America. (PX7054 (O'Malley Noe, Dep. at 65)).

306. In February 2018, Lomon Billions announced in a press release that it had approved an investment of approximately $285 million to construct two new chloride TiO2 manufacturing lines at its existing chloride production plant in Jiaozuo, China, to provide an additional annual chloride pigment capacity of around 200,000 metric tons. The press release further stated that Lomon Billions expected commercial production from the new lines "during 2019." Lomon Billions also plans "[f]uture additional 300,000 tonne[s of] chloride capacity . . . most likely at a new coastal location in China." (RX0195; PX7054 (O'Malley Noe, Dep. at 48-51); RX1642 at 016).

307. Construction of a new TiO2 plant from scratch ("greenfield") takes at least four and a half years, which is an aggressive timeline that assumes everything proceeds according to plan. Chemours announced an expansion into Mexico in 2011, but the plant did not begin production until 2018. (Romano, Tr. 2139-41; PX1636; Christian, Tr. 793 ("[I]f you stumbled across a CP [chloride process] plant in the middle of a field and the owner's manual was laying there and the keys were there, it would still take you five to seven years to figure out how to make a quality CP grade on that plant.")).

308. Chemours does not view Chinese TiO2 production as directly competitive to its business in North America. "Most production in China is of low quality sulfate titanium dioxide,

which serves less demanding applications than the [chloride] product Chemours produces." (PX8004 (O'Sullivan, Decl. at 002-03 ¶ 9)).

309. Lomon Billions' chloride TiO2 was unable to pass [redacted] qualification testing. [redacted] (Chinese manufactured chloride TiO2 "doesn't meet the performance [requirement] that we need for our finished product.")).

310. [redacted] conducted laboratory testing of Lomon Billions' chloride process TiO2 [redacted] and the product "did not pass, did not meet any of" [redacted] standards. [redacted].

311. [redacted] qualification process for chloride TiO2 products takes [redacted] [redacted].

312. [redacted] has been evaluating chloride TiO2 products from Chinese producers. It has found that the quality is not yet satisfactory for its needs. [redacted] has further found that there is "no product availability. . . ." [redacted].

313. Kronos does not see chloride TiO2 from China in the markets in which it competes, and has observed that such products are used for "lower quality products." (Christian, Tr. 797-98).

314. In a strategy presentation prepared in November 2016, Tronox questioned [redacted] that Chinese capacity utilization will reach 87% by 2019, which is almost 20% better than historical performance, stating: "This seems technically impossible, as the Chinese generally overstate their plant capacity. . . . [redacted] also assumes chloride capacity in China will expand by [redacted] which also seems aggressive since almost no commercial grade pigment is produced today." (PX1036 at 006, *in camera*).

315. In a September 2017 investor presentation, Kronos noted the manageability of the threat of Chinese chloride TiO2 production, including as reasons: "[s]uperior chloride [process] technology [is] closely guarded by Western producers" and "[q]uality and reliability concerns." Kronos further explained: "Benefits of production in China such as low labor and environmental costs [are] not applicable to chloride technology" which "[r]equires uninterrupted power supply" and a "highly skilled labor force." (PX3011 at 019 (Kronos presentation)).

316. [redacted] Kronos came to the "very strong conclusion" that Lomon Billions is "struggling with their technology. They have safety concerns with their technology, and they are looking to acquire technology." (Christian, Tr. 805-06, *in camera*).

317. Based on published numbers showing utilization rates in Lomon Billions' chloride plant in the 30 to 40% range, Kronos believes that Lomon Billions is not successfully utilizing the chloride technology. Kronos doubts Lomon Billions will achieve its announced plan to bring a new plant online "inside a year or two, for 200, 250 million dollars, and [to produce] 200,000" tonnes. As Mr. Christian explained, "I think those numbers are . . . difficult to achieve. I think that that is an extremely low cost per metric ton. . . . [B]ased upon what we know, they're struggling with the technology they have now. So I don't know why, if you have additional capacity in the [chloride TiO2] plant that you own today, why you would build another one, and I don't think that that time frame is achievable or at that cost." (Christian, Tr. 808-10).

318. Kronos does "not foresee Lomon Billions being able to utilize the technology they have licensed to make a chloride process TiO2 that can compete in the U.S. market in the next five years." (PX8002 (Christian, Decl. at 006 ¶ 24)).

319. Kronos believes it is "highly unlikely" that Chinese chloride process TiO2 will constitute any threat to its business within the next two or three years. (Christian, Tr. 814-15).

320. Chemours does not project that Chinese chloride TiO2 producers, to the extent they further develop their process and quality, will affect the North American market anytime within the next three to five years. (PX7052 (O'Sullivan, Dep. at 043) ("[W]e do our most rigorous planning in a three to five-year time horizon. Certainly outside of that horizon our anticipation would be the Chinese will be increasingly relevant in North America."); PX8004 (O'Sullivan, Decl. at 002-03 ¶ 9) (Chemours anticipates that Chinese chloride process titanium dioxide "will not affect its business plans in North America for at least 3 years.")).

321. In a 2015 email, then-Tronox CEO Mr. Casey wrote, "I think it is a very remote prospect that China will be producing chloride capacity of any magnitude in the next 3-5 years." (PX1065 at 001).

322. A 2016 Tronox strategy presentation, addressing the "China chloride outlook," noted that it is "[s]till expected to take a while for appreciable profitable tonnes to start flowing," and questioned why "[n]ewly installed" Chinese chloride plants had less than 10% utilization. The reasons Tronox identified included: "Legitimacy of base technology [is] questionable," "Chinese made adjustment to base technology," "Recommendation on equipment specs/sourcing ignored," "Limited commissioning support," and lack of "know-how/experience of running CP [chloride process] plant." (PX1000 at 018).

323. A Tronox TiO2 strategic plan presentation prepared in June 2016 observed that "China has built multiple chloride plants but struggles to commission them, suffering from poor profitability, uptime, and quality," although it expects China to "master the technology eventually." (PX1062 at 009 (Tronox 2017 TiO2 Strategic Plan)).

324. In a January 2017 update for the sales force regarding TiO2 market demand and supply developments, Tronox stated that "[i]t could take years before the Chinese chloride based

TiO2 industry is mature and stable enough to bring the same quality and consistency as their international competitors." (PX1401 at 002).

325. In response to a German government request for information, Cristal stated: "It's been exceedingly difficult for the Chinese to acquire and successfully employ the proprietary chloride technology. Over time, the Chinese are expected to gradually progress with this transformation, but it's difficult to predict when, to what extent, and how fast this will occur. Very small inroads have been made to date." (PX2073 at 012 (Cristal's October 2016 response to Germany's competition authority questionnaire)).

326. In July 2017, Venator, which has worked with Lomon Billions in connection with a licensing arrangement for a single grade of TiO2, stated in an investor presentation that the "Chinese struggle with quality control, consistency of production, no automation and too much manual interruption - ultimately the know-how of how to run plants." Venator noted that it could work with a Chinese supplier for "2 years" and leave the plant with [the product] "being produced effectively," but then "3 months later," find the "process breaking down" and the product "more variable." (PX3027 at 024 (Venator presentation)).

327. Venator's July 2017 analyst day presentation described an array of "headwinds" facing Chinese TiO2 producers, including feedstock cost and availability and technology issues. (PX3035 at 020, 025 (Venator presentation)).

328. Low labor costs and relaxed environmental standards are not advantages that are applicable to chloride TiO2 production. (PX3011 at 019 (Kronos presentation); Christian, Tr. 796 ("[C]heap labor and relaxed environmental standards" are not applicable to chloride TiO2 as opposed to sulfate TiO2 "because [the latter is] much more labor-intensive and it generates a significant amount of waste or byproducts per ton of TiO2 . . . . So when you think about China as a potential competitor, a lot of their historic, perceived advantages over the western world just don't exist or at least aren't overly material in comparison to western producers.")).

329. A July 2017 Venator presentation noted: "Current prices for Chinese chloride slag feedstock have increased by 40% since Chinese New Year 2017." (PX3027 at 009).

330. The majority of the high-grade feedstock[33] that is used to run a chloride process TiO2 plant successfully is sourced from Australia and Africa. To the extent China masters chloride process technology in the future, it will still have to import feedstock, which is a large part of the cost structure of producing chloride process TiO2. (Christian, Tr. 793-94; PX3011 at 019).

331. Based on TZMI's 2016 producer cost study, Lomon Billions' Jinzhou plant in China has higher variable manufacturing costs than any plant in North America and is the highest

[33] High-grade feedstock is explained in more detail in F. 339.

cost chloride TiO2 plant in the world. (PX1663 at 133-53 (TZMI presentation) (detailing costs for North American chloride TiO2 plants and for the Jinzhou plant).

332. In a presentation to its lenders in September 2017, Tronox highlighted with regard to Chinese market dynamics several "Inflationary Pressures" including "Increasing feedstock cost"; "Wage growth"; and "Higher energy prices." (PX1438 at 019 (Tronox presentation)).

333. In November 2016, Tronox predicted that Chinese producers would be limited in their ability to grow exports of TiO2 because Chinese demand growth is expected to exceed Chinese production growth. (PX1006 at 015 (Tronox presentation) ("Chinese demand growth (5.3%) is expected to exceed Chinese production growth (4.2%)[,] which will limit their ability to grow exports.")).

334. In a 2016 third quarter earnings call, Mr. Casey of Tronox stated: "As demand grows domestically [in China], more and more supply will go into the domestic market, which means less will be available for the export market [and the] Chinese share in the global market we think is going to decline over the next several years." (PX9001 at 009 (Tronox Q3 2016 earnings call)).

335. In a 2017 fourth quarter earnings call, Mr. Romano of Tronox described Lomon Billions' plan to expand production by 200,000 tonnes in 2019 as "a bit aggressive on timeline." Mr. Romano further stated that supply and demand were "in balance" and Tronox did not "see that turning in 2019." Mr. Quinn added that "all the incremental expansion over the next 18 to 24 months, will really kind of just be soaked up by the incremental global growth. So we don't see that, that incremental expansion will significantly change the current dynamics." (PX9101 at 008 (Q4 2017 Tronox earnings call)).

336. North American customers do not view Chinese chloride producers as a reliable supply source for chloride TiO2 in the foreseeable future. [redacted], *in camera* ([redacted] cannot "count on [Lomon Billions] for incremental quantities of chloride TiO2" and "do[es] not see . . . other Chinese producers as realistic supply options for [redacted] U.S. plants"); [redacted], *in camera* ([redacted] has "no expectation that TiO2 from China will provide [it] with an economical competitive alternative to our domestic sources in the foreseeable future."); [redacted], *in camera* (Given the lower quality of Chinese chloride TiO2, the one to three years needed to qualify a grade of TiO2, [redacted] requirements for slurry TiO2, and the decreasing TiO2 capacity in China, "[redacted] does not expect Chinese TiO2 to be a viable alternative to North American supply for the foreseeable future"); [redacted], *in camera*.

### 2. Efficiencies

#### a. Feedstock

337. TiO2 "feedstock" refers to the raw material that gets transformed into TiO2 pigment. (Turgeon, Tr. 2580-81).

338. TiO2 feedstock includes TiO2-containing mineral sands products, the most common of which are ilmenite and rutile. (Turgeon, Tr. 2585-86; RX1014-005; RX1196-108; *see also* RX0171 (Stern Expert Report at 0018-19)).

339. Natural rutile is about 92 to 96% TiO2. Natural rutile is a high-value feedstock that can be directly converted into TiO2 pigment. (Turgeon, Tr. 2589-90, 2595).

340. Ilmenite is titanium oxide and iron oxide combined together. (Turgeon, Tr. 2589-90). Ilmenite contains about 35 to 65% TiO2 and is lower in TiO2 than natural rutile. (Turgeon, Tr. 2589-90).

341. Some ilmenite can be directly converted into TiO2 pigment. Other ilmenite must go through an intermediate step called an "upgraded process." This intermediate step creates a TiO2 pigment plant "feedstock." (Turgeon, Tr. 2596-97).

342. One way to convert ilmenite into feedstock is through smelting. (Turgeon, Tr. 2596-97). Smelting is a process where ilmenite is melted at high-temperatures in a furnace with anthracite, and the iron in the material is separated from the titanium. (Turgeon, Tr. 2596). The titanium product that results from smelting is referred to as "slag." Slag is a feedstock that can be used in a TiO2 pigment plant. (Turgeon, Tr. 2596-97).

343. Without further processing, ilmenite cannot be used to produce chloride TiO2. (Van Niekerk, Tr. 3913-14) ("[W]e need high-grade feedstock . . . , typically close to 90 percent TiO2 is required for our chlorinators and downstream processing in the pigment plant to work well.").

344. For a manufacturer to produce chloride TiO2, it needs to have access to high-grade feedstock. (Christian, Tr. 791).

345. Cristal does not presently produce enough feedstock to supply its TiO2 plants and purchases the additional feedstock its plants require. (Stoll, Tr. 2111).

346. Tronox is slightly "long" on high-grade feedstock. By Tronox's estimates, its supply of high-grade feedstock in 2018, as a "standalone" company, would exceed its demand by approximately [redacted].[34] (PX0010 at 219 (Tronox February 2017 board of directors presentation draft 2.9.2017) (estimating 2018 demand for "CP slag/NR/ SR"

[34] The abbreviation "kMT" is an acronym that "stands for kilo metric ton." https://www.acronymfinder.com/Kilo-Metric-Ton-(measurement)-(KMT) html.

listed as [redacted] and supply listed as [redacted] resulting in [redacted] excess high-grade feedstock in 2018).

347. By Tronox's estimates, a combined Tronox and Cristal entity would be "significantly short on high grade feedstock," with an estimated deficit in 2018 of [redacted]. (PX0010 at 219, *in camera*) (Tronox February 2017 board of directors presentation draft 2.9.2017)).

348. "[E]ven with [the] Jazan [slagger] [F. 349] operating at nameplate capacity, [the combined Tronox and Cristal entity] would still be short of feedstock." (PX7038 (Van Niekerk. Dep. at 27-29)).

**b. Jazan slagger**

349. The Jazan slagger is an ilmenite smelting facility located in Jazan, Saudi Arabia. (Hewson, Tr. 1636; Van Niekerk, Tr. 3946-47).

350. The Jazan slagger is owned by Advanced Metal Industries Cluster Company Limited ("AMIC"). AMIC is a joint venture that is owned 50% by Cristal and 50% by Cristal's owner, TASNEE. (Hewson, Tr. 1636-37; Van Niekerk, Tr. 3899-3900).

351. AMIC built the Jazan slagger in order to supply Cristal with a source of high-grade feedstock for Cristal's chloride TiO2 production. (Hewson, Tr. 1637).

352. The Jazan slagger is not operational today. (Hewson, Tr. 1637).

353. Cristal encountered significant problems with the furnaces when they attempted to commission the Jazan slagger in 2015. (Van Niekerk, Tr. 3900).

354. [redacted].

355. [redacted].

356. Respondents' Synergies White Paper, submitted on August 15, 2017 in connection with the FTC's investigation into the Acquisition, notes, [redacted].

357. Mr. Van Niekerk, senior vice president of strategy at Tronox, acknowledged that Tronox "cannot fully determine the impact of [the] design issues" with the Jazan slagger until it has "started up the furnace and experience[d] those limitations." (PX7038 (Van Niekerk, Dep. at 220-22)). *See also* PX1280 at 003 (Van Niekerk June 2, 2017 email attaching integration slides) [redacted].

358. Tronox may face challenges in activating the Jazan slagger because of its proximity to the Yemen border, where there is ongoing armed conflict. The United States Department of State has issued warnings against United States citizens traveling within certain miles of the Yemen border. (PX7012 (Mancini, Dep. at 120-23); PX7008 (Hewson, IHT at 87-88)).

359. In September 2016, a Cristal presentation to the TASNEE board's executive committee (including the chairman of TASNEE, the vice-chairman, and the CEO of TASNEE) outlined [redacted].

360. [redacted].

361. Tronox's Mr. Van Niekerk acknowledged in an email that the [redacted].

362. [redacted].

363. [redacted].

364. [redacted].

365. [redacted].

366. [redacted].

367. [redacted].

368. In February 2017, AMIC held a workshop regarding the Jazan slagger. (PX2295 (AMIC Workshop, February 2017)).

369. [redacted].

370. By February 2017, Cristal had completed several modifications to the Jazan slagger. (PX2295 at 068 (AMIC Workshop, February 2017)).

371. [redacted].

372. In June 2017, a TASNEE press release stated that "work is still ongoing to solve the technical problems" at the Jazan slagger, and projected a trial operation during the first half of 2018. (PX9029 (TASNEE Press Release on Jazan Slagger); PX7008 (Hewson, IHT at 101); PX7005 (Keegel, Dep. at 71)).

373. Tronox's February 21, 2017 agreement for the acquisition of Cristal (F. 24) does not include any provisions regarding a purchase of the Jazan slagger. Tronox has acknowledged that "[t]he Tronox-Cristal transaction does not include the Jazan Slagger." (PX0005 at 027 (Synergies White Paper); PX0009).

374. Tronox entered into an option agreement with AMIC with regard to the Jazan slagger on May 20, 2018. On March 15, 2018, while still negotiating the option agreement, Tronox entered into a technical services agreement ("TSA") with AMIC with respect to the Jazan slagger in order to help Cristal commission the slagger. (Van Niekerk, Tr. 3900-01, 3951; RX1603; PX1745).

375. Under the option agreement for the Jazan slagger (F. 374), Tronox has a five-year option to acquire the Jazan slagger. (Van Niekerk, Tr. 3901; RX1603 at 0052).

376. Pursuant to the terms of the option agreement for the Jazan slagger (F. 374), Tronox has agreed to loan AMIC approximately $125 million toward the efforts to make the Jazan smelter facility operational. If the slagger achieves certain levels of operational performance in the future, then Tronox is obligated to purchase the slagger and the $125 million would become part of the consideration paid by Tronox for Jazan. If the required performance levels are not met, then Cristal would pay back the loan to Tronox. (RX1603 at 0027-33, Section 5.14 (Option Agreement); PX7009 (Stoll, Dep. at 25-26); Van Niekerk, Tr. 4002; Quinn, Tr. 2374-75).

377. Tronox chose to pursue an option agreement for the potential purchase of the Jazan slagger because the slagger's current inoperable state makes its value uncertain, and Tronox did not want to acquire an asset that has not been proven to work. Also, Tronox's valuation of the facility was significantly less than Cristal's valuation. The Tronox board would "never allow" the purchase of a "$500 million plant" that is "not working" and has no track record," because "the risk would just be too high." (PX7014 (Quinn, Dep. at 075-76); PX7008 (Hewson, IHT at 75); PX7038 (Van Niekerk, Dep. at 74-75); Quinn, Tr. 2381).

378. A Tronox August 2017 Update on the negotiations over the Jazan slagger identified as part of the supporting rationale for acquiring the Jazan slagger the fact that the "Call Option removes risk to Tronox if Jazan demonstrates unsurmountable weaknesses." (PX1281 at 010).

379. There is no certainty that a purchase of the Jazan slagger will take place. (Quinn, Tr. 2375; PX1220 (option agreement)).

380. [redacted].

381. The KPMG Report (F. 427) identifies Tronox's anticipated improvements to Jazan as an assumption underpinning the synergy estimate: "[Jazan-related synergies] assume that the Jazan Slagger will reach the production levels projected by [Tronox]." (PX0006 at 005 (KPMG Report)).

### c. Yanbu plant

382. Cristal's Yanbu plant is a chloride TiO2 plant in Saudi Arabia. (PX0005-015).

383. Tronox does not operate any TiO2 plants, or plants of any kind, in Saudi Arabia. (PX7012 (Mancini, Dep. at 71)).

384. The customers served by Cristal's chloride TiO2 plant in Yanbu are predominantly located in Saudi Arabia. None of the TiO2 grades produced at Yanbu are sold in North America. (PX7000 (Snider, IHT at 69-70); Hewson, Tr. 1608).

385. Respondents' Synergies White Paper (F. 356) states that Tronox expects to leverage "greater know-how" to "quickly repair the [Yanbu] facility and increase production at least to the plant's nameplate capacity of [redacted] metric tons," yielding an incremental [redacted] metric tons of additional chloride TiO2 production by Year 3 following the proposed acquisition. (PX0005 at 015, 018-19, *in camera* (Synergies White Paper)).

386. Mr. Mancini, Tronox chief integration officer, and Dick Dean, Tronox vice president of operations integration, created a 2-page document in February 2017, titled "Tronox Analysis of its Preliminary Yanbu Improvement Plan" (hereinafter, "Preliminary Yanbu Improvement Plan"). (PX1425 at 001-02)).

387. The Preliminary Yanbu Improvement Plan references implementing "best practices," and "operational excellence" principles, such as "The Tronox Way" (F. 388), to increase production, and contains estimates on the improvements Tronox expects in terms of output, quality, and costs. (PX1425 at 001-02 (Yanbu Improvement Plan)).

388. The Tronox Way refers to a standard of best practices developed by Tronox and used across its facilities that is intended to maximize output and lower the company's cost position. (Turgeon, Tr. 2648; Dean, Tr. 2998).

389. Although Mr. Mancini prepared the Yanbu Improvement Plan, Mr. Dean provided the estimates it contains. (PX7023 (Dean, Dep. at 18)).

390. The Preliminary Yanbu Improvement Plan states in part:

> Tronox plans to drive improvements at Yanbu by applying lessons learned at its nearly identical plant in Hamilton, Mississippi, USA. Incremental EBITDA will be generated as production increases (resulting in not only more tons to sell but a lower fixed cost per ton), quality improves (resulting in fewer low quality tons sold at a discount) and manufacturing efficiency improves, lowering variable cost per ton as less ore, process chemicals and energy is required in each ton of production.
>
> Production increases will be realized by (1) increasing line rates (the amount in metric tons of TiO2 that can be produced per line per hour) and

(2) improving on stream time (the time that a line is operational and productive over the course of a year).

(PX1425 at 001).

391. When Mr. Dean took over managing Tronox's Hamilton, Mississippi plant in 2004, "it was not a plant that required turning around. It was a pretty good performing plant." (PX7023 (Dean, Dep. at 159-61)).

392. Mr. Dean's line rate projections in Tronox's Preliminary Yanbu Improvement Plan reflect what he believes Tronox will be capable of producing over a five year period, based on his technical knowledge and the projected improvements to be implemented at Yanbu. (PX7023 (Dean, Dep. at 22-23); Dean, Tr. 3109).

393. Mr. Dean's projected on-stream time improvements set forth in Tronox's Preliminary Yanbu Improvement Plan represent his judgment, based on his technical knowledge, of what Tronox will be able to achieve from one year to the next. (PX7023 (Dean, Dep. at 73-75); Dean, Tr. 3109).

394. Mr. Dean acknowledged there [redacted].

395. [redacted].

396. [redacted] described the culture at Tronox's plant in Hamilton as "one of a very engaged and interested workforce," adding "they're interested in the success of not only Hamilton but Tronox as a whole." [redacted].

397. A Tronox update on synergies, dated October 10, 2017, highlights [redacted].

398. [redacted].

399. Yanbu was built using Kerr-McGee's proprietary low pressure chloride TiO2 production technology.[35] (Dean, Tr. 2930, 2979; Hewson, Tr. 1609).

400. Tronox has experience with low-pressure chloride technology and employs low-pressure chloride technology at its plants in Mississippi and Australia. (Dean, Tr. 2930-31; Quinn, Tr. 2355).

401. [redacted].

402. Improving Yanbu is a priority for Cristal. (PX7042 (Gunther, Dep. at 30); PX7048 (Strayer, Dep. at 218)).

403. Cristal has the equipment it needs to run the Yanbu chloride TiO2 production plant at a capacity of [redacted] metric tons per year. (Hewson, Tr. 1633, *in camera*).

404. [redacted].

405. Cristal identifies Mr. van Beek as a "[l]ow pressure expert." (PX2379 at 005 (Strayer email attaching Yanbu organizational changes)).

406. [redacted].

407. Tony Blanchard, a Cristal employee, is working at Yanbu. Mr. Blanchard has operational experience from Cristal's Stallingborough, United Kingdom plant, as well a

[35] The difference between high-pressure and low-pressure technology is that "the mode of force that drives the process [with low pressure technology] is gravity. We have tanks at the beginning of the oxidation process where . . . the titanium tetrachloride is actually elevated up in the air, and as it's fed into the vaporization process, that height determines the maximum pressure that's going to be generated in the process. Other manufacturers actually pump the titanium tetrachloride in, and that can take it up to a much higher pressure." (Dean, Tr. 2929-30).

"[s]trong background on operational systems/processes." (PX2379 at 005 (Strayer email attaching Yanbu organizational changes)).

408. [redacted].

409. [redacted].

410. [redacted].

411. Cristal has been addressing issues at Yanbu and seeing improvement. The Yanbu TiO2 plant has improved its production performance in the past year. (Hewson, Tr. at 1626-28).

412. As of the first quarter of 2015, Yanbu was operating at a production rate of about [redacted] per year. (Hewson, Tr. 1620, *in camera*).

413. During 2017, Cristal has had [redacted] at Yanbu. Cristal's production at Yanbu during December 2017 reached [redacted]. (Hewson, Tr. 1627, 1636, *in camera*).

414. Cristal produced approximately 130,000 metric tons at Yanbu in 2017. (Dean, Tr. 2979-80).

415. In the second quarter of 2017, Cristal noted "[s]olid overall quality performance with improvement at Yanbu . . . ." (PX2493 at 005 (Morten email attaching Cristal manufacturing update); PX7048 (Strayer, Dep. at 100)).

416. A third quarter 2017 board update by Cristal noted "[i]mproving performance at Stall & Yanbu." (PX2471 at 004 (Gunther email attaching Cristal manufacturing update)).

417. Cristal acknowledges that Yanbu was on a positive trajectory in 2017. (PX7042 (Gunther, Dep. at 124-26); PX7048 (Strayer, Dep. at 218); *see also* PX2374 at 001 (Gunther email) ("the changes we have made in Yanbu are setting the plant on a positive trajectory already")).

418. Cristal's 2018 budget and strategic plan includes [redacted] at the Yanbu plant. (PX2373 at 018, *in camera* (Box email attaching 2018 Budget and Strategic Plan); PX7042 (Gunther, Dep. at 35-36), *in camera*).

419. Cristal's 2018 budget and strategic plan anticipates an increase of [redacted] in Yanbu's on-stream rate in 2018. (PX2373 at 006, *in camera* (Box email attaching 2018 Budget and Strategic Plan); PX7042 (Gunther, Dep. at 23-24), *in camera*).

420. Mr. Dean of Tronox acknowledged that Cristal probably does not need a merger to implement The Tronox Way practices such as shift handover protocols, workflow management protocols, meeting protocols, short interval control protocols, or operator checklists. Mr. Dean also acknowledged that loss accounting is a concept that is generally available and used by organizations other than Tronox. (Dean, Tr. 3102-06).

421. If the Acquisition did not occur, Cristal would "try to improve" the performance of the Yanbu plant, [redacted]. (PX7042 (Gunther, Dep. at 149-53), *in camera*).

422. If the Acquisition did not occur, Cristal would "still go down the track of the [redacted] [of output per year at Yanbu], and [redacted].

**d. Cost savings**

423. KPMG was hired to "provide consulting support" for the "sign-to-close period" of the Acquisition. (PX7045 (Nolan, Dep. at 43-44)).

424. The objective of KPMG's engagement was to assist Tronox with its assessment of the potential synergies Tronox anticipates in connection with the proposed acquisition of Cristal. (PX0006 at 003).

425. [redacted].

426. KPMG's conclusions were derived from "analysis of data room materials" provided by Tronox and Cristal, "as well as from [Tronox's] management team and their knowledge of [Cristal's] business from site visits." (PX0006 at 003).

427. KPMG prepared a report for Tronox (the "KPMG Report"). The report includes a letter to Tronox management stating that [redacted].

428. [redacted].

429. Respondents' proffered expert witnesses based their opinions as to likely output increases from improvements to Jazan and Yanbu upon the assertions, judgments, and/or expectations of Respondents, without any apparent independent verification. (*See, e.g.*, RX0170 (Shehadeh Expert Report at 0057-58); RX0171 (Stern Expert Report at 127-31); RX1258 (Imburgia Expert Report at 0016-17)).

430. Tronox has not evaluated how lowering its costs would affect TiO2 pricing, which is affected by many factors. Mr. Quinn, chief executive officer at Tronox, acknowledged that lowering Tronox's costs is unlikely to have an impact on TiO2 pricing. (Quinn, Tr. 2406).

431. "The synergies that are tied to a geographic location are the operational synergies . . . . [T]he overwhelming majority of those synergies are related to . . . non-U.S. assets." (Quinn, Tr. 2406-08).

## IV. SUMMARY OF CONCLUSIONS OF LAW

1. The Commission has jurisdiction over Respondents and the Acquisition pursuant to Section 5 of the FTC Act, 15 U.S.C. § 45, and Sections 7 and 11 of the Clayton Act. 15 U.S.C. §§ 18, 21(b).

2. Section 7 of the Clayton Act prohibits mergers or acquisitions "the effect of [which] may be substantially to lessen competition, or to tend to create a monopoly" in "any line of commerce or . . . activity affecting commerce in any section of the country." 15 U.S.C. § 18.

3. It is not necessary to demonstrate certainty that a proposed merger will produce anticompetitive effects, or even that such effects are highly probable, but only that the loss of competition is a sufficiently probable and imminent result of the merger or acquisition.

4. Section 7 of the Clayton Act requires a prediction as to the likelihood of anticompetitive effects, and doubts are to be resolved against the transaction.

5. Congress enacted Section 7 to curtail anticompetitive harm in its incipiency.

6. To establish a prima facie case of a violation of Section 7, the plaintiff may rely on a presumption of anticompetitive effects by defining a relevant market, and showing that the transaction will lead to undue concentration in that market.

7. The plaintiff may bolster a prima facie case based on a market concentration presumption by adducing evidence showing that anticompetitive unilateral or coordinated effects are likely.

8. If the plaintiff establishes a prima facie case, the burden shifts to the defendant to show that traditional economic theories of the competitive effects of market concentration are not an accurate indicator of the merger's probable effect on competition in the relevant market or that the procompetitive effects of the merger are likely to outweigh any potential anticompetitive effects.

9. Although the courts have not defined a precise standard that must be met to rebut a prima facie case, the courts advise that the more compelling the prima facie case, the more evidence the defendant must present to rebut the presumption successfully.

10. If the defendant successfully rebuts the presumption of a violation of Section 7, the burden of producing additional evidence of anticompetitive effect shifts to the plaintiff, and merges with the ultimate burden of persuasion, which remains with the plaintiff at all times.

11. The relevant market in which to assess the likely effects of the Acquisition is the sale of chloride TiO2 to North American customers.

12. Under the Merger Guidelines, a merger may substantially lessen competition if: (1) the merger would significantly increase concentration and lead to a moderately or highly concentrated market; (2) that market shows signs of vulnerability to coordinated conduct; and (3) the merger is likely to enhance that vulnerability.

13. Complaint Counsel met its prima facie case by establishing a presumption of liability, by showing that the Acquisition will lead to undue concentration in the relevant market.

14. Complaint Counsel bolstered the presumption of anticompetitive effects with substantial evidence demonstrating that the North American chloride TiO2 market is vulnerable to coordinated conduct and that this vulnerability will be enhanced by the Acquisition. Therefore, the evidence demonstrates a likelihood of anticompetitive coordinated effects.

15. It is a central object of merger policy to obstruct the creation or reinforcement by merger of market structures in which tacit coordination can occur.

16. Tacit coordination, sometimes called oligopolistic price coordination or conscious parallelism, describes the process, not in itself unlawful, by which firms in a concentrated market might in effect share monopoly power, setting their prices at a profit-maximizing, supracompetitive level by recognizing their shared economic interests and their interdependence with respect to price and output decisions.

17. Proof of prior tacit coordination is not necessary to demonstrate a reasonable probability of future coordination.

18. It is not necessary to demonstrate that market participants can form and enforce an agreement. Under the Merger Guidelines, coordinated interaction includes a range of conduct, and can involve parallel conduct in which each rival's response to competitive moves made by others is individually rational, and not motivated by retaliation or deterrence, but nevertheless emboldens price increases and weakens competitive incentives to reduce prices or offer customers better terms.

19. Issues of fact or law that do not affect the result in a case are not fairly deemed "material," for purposes of Section 557(c)(3)(A) of the Administrative Procedures Act, 5 U.S.C. § 557(c)(3)(A), or Rule 3.51(c)(1) of the Commission's Rules of Practice, 16 C.F.R. § 3.51(c)(1), notwithstanding that there may be allegations or evidence presented on such issues.

20. Even in highly concentrated markets, if there is sufficient ease of entry, enough firms can enter to compete with the merging firms, undercutting any of the likely anticompetitive effects of the proposed mergers.

21. Entry can be demonstrated either by new firms entering the relevant market or by expansion into the relevant market by existing firms.

22. Entry must also be proven to be likely, rapid enough, and sufficient in its magnitude, character and scope to deter or counteract the competitive effects of concern.

23. The burden of proving that entry will be timely, likely, and sufficient to deter or counteract anticompetitive effects is on the defendant.

24. The evidence fails to support Respondents' argument that entry or expansion by Chinese producers is likely, or that such entry will be timely or sufficient to counteract the likely anticompetitive effects of the Acquisition.

25. Cognizable efficiencies are defined as merger-specific efficiencies that have been verified and do not arise from anticompetitive reductions in output or service.

26. To be cognizable, an asserted efficiency must represent a type of cost saving that could not be achieved without the merger and the estimate of the predicted saving must be reasonably verifiable by an independent party.

27. The law requires a rigorous analysis of the kinds of efficiencies being urged by the parties in order to ensure that those efficiencies represent more than mere speculation and promises about post-merger behavior.

28. An anticompetitive merger cannot be justified on the basis of asserted efficiencies outside the relevant market.

29. It is incumbent upon the merging firms to substantiate efficiency claims, so that it is possible to verify by reasonable means the likelihood and magnitude of each asserted efficiency, how and when each would be achieved (and any costs of doing so), how each would enhance the merged firm's ability and incentive to compete, and why each would be merger-specific.

30. Because the Acquisition would create a highly concentrated market, the law requires proof of extraordinary efficiencies.

31. Claimed efficiencies must be reasonably verifiable by an independent party, and cannot be based solely on the judgment of business executives. Otherwise, the efficiencies defense might swallow the whole of Section 7 of the Clayton Act.

32. Respondents failed to meet their burden of demonstrating cognizable efficiencies.

33. The evidence proves that the planned Acquisition may substantially lessen competition in the relevant market for the sale of chloride TiO2 in North America in violation of Section 7 of the Clayton Act and Section 5 of the FTC Act.

34. Upon determining that a merger violates Section 7 of the Clayton Act, the appropriate remedy is to issue an order enjoining the merger. 15 U.S.C. § 21(b).

## ORDER

### I.

**IT IS ORDERED** that, as used in the Order, the following definitions shall apply:

A. "Tronox" means Tronox Limited, its directors, officers, employees, agents, representatives, successors, and assigns; the joint ventures, subsidiaries, partnerships, divisions, groups, and affiliates controlled by Tronox Limited, and the respective directors, officers, employees, agents, representatives, successors, and assigns of each.

B. "Cristal" means The National Titanium Dioxide Company Limited (Cristal), its directors, officers, employees, agents, representatives, successors, and assigns; the joint ventures, subsidiaries (including Cristal USA), partnerships, divisions, groups, and affiliates controlled by The National Titanium Dioxide Company Limited (Cristal), and the respective directors, officers, employees, agents, representatives, successors, and assigns of each.

C. "Cristal USA" means Cristal USA Incorporated, its directors, officers, employees, agents, representatives, successors, and assigns; the joint ventures, subsidiaries, partnerships, divisions, groups, and affiliates controlled by Cristal USA Incorporated, and the respective directors, officers, employees, agents, representatives, successors, and assigns of each.

D. "TASNEE" means The National Industrialization Company (TASNEE), its directors, officers, employees, agents, representatives, successors, and assigns; the joint ventures, subsidiaries (including Cristal), partnerships, divisions, groups, and affiliates controlled by The National Industrialization Company (TASNEE), and the respective directors, officers, employees, agents, representatives, successors, and assigns of each.

E. "Proposed Acquisition Agreement" means the "Transaction Agreement Dated as of February 21, 2017 between The National Titanium Dioxide Company Limited, Tronox Limited and, solely for the purposes of Articles I, II, VIII, IX and XIII, Cristal Inorganic Chemicals Netherlands Coöperatief W.A."

### II.

**IT IS FURTHER ORDERED** that:

A. Respondent Tronox and Respondents Cristal, TASNEE, and Cristal USA shall terminate the Proposed Acquisition Agreement, and cease and desist from taking any actions, directly or indirectly, to consummate the Proposed Acquisition Agreement.

B. Respondent Tronox shall cease and desist from acquiring Cristal, in whole or in part, including, but not limited to, any stock, assets, share capital, equity, or other interest in or related to Cristal, directly or indirectly, from Respondents Cristal, TASNEE, or Cristal USA.

C. Respondents Tronox, Cristal, TASNEE, and Cristal USA shall return all confidential information received, directly or indirectly, from one another and destroy all notes relating to such information.

D. Respondents shall submit a verified written statement within 15 days of the Order becoming final certifying compliance with the requirements of Paragraphs II.A. and II.C. relating to terminating the acquisition agreement and returning/destroying each other's confidential information, with sufficient detail and supporting documentation to allow the Commission to determine independently that Respondents are in compliance.

ORDERED:

D M Chappell

D. Michael Chappell
Chief Administrative Law Judge

Date: December 14, 2018