Steris/Synergy a Decade Out: Retrospectively Assessing this Century's First Litigated Potential Competition Matter

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Abstract. The 2015 Steris/Synergy merger was the first litigated matter involving potential competition issues in more than 30 years. The FTC's unsuccessful challenge alleged that Synergy's planned U.S. x-ray sterilization facilities would compete with Steris's gamma sterilization facilities to the benefit of consumers. Steris argued that its plans were half-baked and unlikely to come to fruition. A retrospective analysis of the merger finds support both in the trial record and in post-trial data for the FTC's challenge. In particular: (1) Steris itself appears to have used x-ray for virtually all of its incremental radiation sterilization capacity since the time of the merger; (2) Steris has become significantly more profitable since the merger consistent with (if not a dispositive indicator of) increased market power; and (3) a replication of the Synergy financial model that underpinned so much of the trial is not consistent with testimony that x-ray's financials were "woeful" and hence unlikely to support entry. More generally, I argue for an expected value approach to potential competition matters that jointly considers probability of entry and effects of entry, and that is more likely to enforce mergers with greater expected harm. Relative to an expected value approach, the current enforcement regime, which appears to assign greater weight to the probability of entry than to the effects of entry, is likely to overenforce mergers in which entry is likely but harms conditional on entry are small, and to underenforce mergers with a lower probability of entry but significant harms conditional on entry.

I. Introduction and Executive Summary

The 2015 merger of Steris and Synergy combined two of the world's three large providers of sterilization services. At the time the merger was announced in late 2014, the U.K.-based Synergy was in the advanced stages of planning a U.S. expansion that would have put it into more direct competition with the U.S.-based Steris, as well as the U.S.-based Sterigenics (the only other large provider of sterilization services in the world). Synergy had publicly announced the expansion to investors shortly after the announcement of Steris's plan to acquire Synergy. Documentary evidence indicated that the merger itself and the subsequent FTC investigation contributed to Synergy's discontinuation of its expansion plans. In May 2015, the FTC challenged the transaction on the theory that, but for the merger, Synergy would have expanded its U.S. presence and competed with Steris to the benefit of consumers. A district court ruled against the FTC, largely on the basis of testimony from Synergy executives that its expansion plans were doomed by poor financial prospects. The matter was the first litigated challenge to a merger involving *potential* competition—i.e., competition between a current market participant and a potential entrant—since 1984.

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The time is ripe to look back at Steris/Synergy. The 2023 Merger Guidelines, the FTC's unsuccessful 2022 challenge of the Meta/Within merger, and recent agency challenges to the Sanofi/Maze,[2] Adobe/Figma,[3] and Visa/Plaid[4] transactions have given greater prominence to potential competition theories of harm, and indicate that such theories may play a greater role in future agency enforcement. Moreover, a decade of post-merger history is now available, and (as I will explain) Steris's own post-acquisition expansion resolves at least some of the uncertainty that existed surrounding Synergy's plans at the time it was acquired, and, in my view, is consistent with the FTC's theory of harm.

The Steris court focused entirely on whether Synergy "probably" would have entered the U.S. but for the acquisition, to the exclusion of the competitive effects of such entry. While such a framework may well be consistent with applicable case law, in my view, economics strongly favors an *expected value approach* to assessing matters involving potential competition, in which both the likelihood of entry and the magnitude of competitive effects are jointly considered in an assessment of expected harm. An expected value approach may be equally likely to condemn mergers with a high probability of forestalling moderately beneficial entry, and those with a low probability of preventing very beneficial entry, but may be more forgiving than existing approaches towards mergers that are very likely to forestall entry of minor competitive significance.

Synergy's U.S. expansion plans centered on a then-novel sterilization technology, x-ray, which works similarly to the then-dominant gamma sterilization. Synergy considered x-ray because it offers technological advantages over gamma that it thought would attract customers and lower costs. X-ray also has disadvantages compared to gamma, including a high initial cost to build an x-ray facility and, at the time, uncertain customer acceptance. Synergy's executives testified that these disadvantages were prohibitive. In particular, they claimed that they resulted in an unacceptably low projected rate of return for Synergy's x-ray expansion, meaning that the project was unlikely to receive final sign-off and funding from Synergy's PLC board (its board of directors). The district court found that Synergy "probably" would not have built at least one U.S. facility within a reasonable period of time, and that the timing of Synergy's killing of its x-ray plans (following an FTC meeting in which staff outlined their concerns about the merger's effect on Synergy's entry plans, rather than following the merger announcement) was evidence that Synergy discontinued its entry plans for legitimate business reasons. (See Section II for a more detailed discussion of the factual record).

The past ten years overwhelmingly indicate that x-ray is a viable and profitable technology. In that time, Steris has built or announced 10 new x-ray facilities, for a total of 11 open or announced x-ray facilities when counting the single facility Synergy owned at the time of the merger. Steris has built just one new gamma facility since its acquisition of Synergy, bringing its total to 29 gamma facilities. The x-ray plants Steris has opened as of July 2025 thus account for the vast majority of the new radiation sterilization capacity added to Steris's network since it acquired Synergy. Moreover, since at least March 2019 (40 months following Steris's acquisition of Synergy), Steris has marketed itself as a "technology-neutral

[2] The FTC's challenge to the merger of Sanofi and Maze caused the parties to abandon the proposed transaction; see the FTC's majority statement at https://www.ftc.gov/system/files/ftc_gov/pdf/statement_of_chair_khan_joined_by_commr_slaughter_re_sanofi-maze_abandonment.pdf.

[3] Adobe and Figma abandoned their proposed merger while DOJ's investigation into the merger was ongoing, stating that "we no longer see a path toward regulatory approval of the deal." See https://www.figma.com/blog/figma-adobe-abandon-proposed-merger/.

[4] Visa and Plaid abandoned their proposed acquisition following the DOJ's filing of a complaint seeking to block the transaction. See https://www.justice.gov/archives/opa/pr/visa-and-plaid-abandon-merger-after-antitrust-division-s-suit-block.

service offering," and has promoted the technical advantages of x-ray. This track record strongly indicates that x-ray is now Steris's *preferred* solution for adding new sterilization capacity, and is consistent with the FTC's allegations that an independent Synergy was likely to expand into the U.S. market with x-ray. (See Section III.A).

In the five years following the merger (which largely preceded Steris's own x-ray expansion), Steris became dramatically more profitable, consistent with—if not a dispositive indication of—a merger-specific increase in market power. Steris's financial filings indicate that its operating margin increased by 28.4% since its 2015 acquisition of Synergy, from 32.4% in the first full year following the merger (FY 2017) to 41.6% in FY 2025. Evidence indicates that it is unlikely that any significant part of the increase in Steris's margin is due to cost-saving efficiencies resulting from the transaction, as Steris itself projected only $2.5 million in savings to its sterilization business prior to the merger, and, as I will explain, the nature of the sterilization business makes significant merger synergies unlikely. (See Section III.B).

Testimony of Synergy executives—cited as probative by the district court—that x-ray's poor financials doomed the project is not supported by evidence. This testimony largely hinged on a financial model prepared by Synergy's management that was discussed at length at trial and prominently cited in the court's opinion. Synergy executives testified that Synergy's modelled returns were "woeful," and in particular that the project's internal rate of return (IRR, a measure of the project's profitability) was well below a lightly-documented but allegedly widely-accepted Synergy corporate threshold of 15%. The trial record contains sufficient information for me to replicate Synergy's financial model. As I will demonstrate, Synergy's model predicted an IRR of approximately 15%, and was highly conservative in important ways (in particular, in assuming the price of x-ray would permanently remain 20-40% below the price of gamma). While the financial model does not demonstrate that Synergy would *certainly* have pursued the expansion, it is consistent with Synergy seeing the project as at least at the threshold of viability, and with trial evidence that Synergy sought only incremental improvements to the project's finances before moving forward. As I will explain, testimony to the contrary appears to rely upon a selective view of evidence that is inconsistent with economics, in particular ignoring profits that would be generated by Synergy x-ray facilities beyond the first ten years of the facilities. Steris's own success with x-ray and its reliance on the technology when building new facilities, along with its increasing margin, strongly suggest that Steris views the finances associated with its new x-ray facilities as being highly favorable. (See Section IV.A).

Steris's own post-acquisition x-ray expansion has been subject to delays, with years passing between the announcement of new facilities and their openings. The cause of the delays is difficult to determine. While permitting difficulties appear to be at least partly responsible, it is possible that Steris's lack of a close competitor in bringing x-ray to market reduced the urgency of the project. Had Synergy experienced delays in bringing x-ray to market, this would have attenuated any competitive benefits from Synergy's expansion. (See Section IV.B).

Both recent evidence and trial evidence indicate that Synergy's x-ray expansion would have increased competition between Synergy, Steris, and Sterigenics to the benefit of consumers. (See Section IV.C).

The factual record in this matter illustrates the importance of an expected value approach to analyzing matters involving potential competition. Through a series of hypothetical examples, I explain the economics of an expected value approach and the benefits of using such a framework to analyze potential competition matters. (See Section V.A).

I find that significant evidence indicates that Synergy "probably" would have expanded with x-ray but for the merger, though the delays experienced by Steris in opening its own x-ray facilities coupled with

Synergy's slow forecast ramp-up of x-ray volumes suggest that the competitive benefits provided by an independent Synergy may have been modest. This evidence, coupled with the lack of significant efficiencies likely to have been generated by the merger indicate that the FTC's decision to challenge the merger is supported by an expected value approach. (See Section V.B).

II. What happened before the merger: Radiation sterilization and Synergy's U.S. x-ray plan

This section provides an overview of the matter's factual record, including the advantages and disadvantages of x-ray over other methods of sterilization (Section II.A); the competitive landscape for sterilization services as of 2015 (Section II.B); and Synergy's x-ray expansion plan (Section II.C).

A. Methods of sterilization

Sterilization is the final step in the manufacturing of medical devices, labware, and various other products whose usefulness depends on sterility, i.e., the device being devoid of bacteria and other lifeforms. While some large manufacturers have their own sterilization facilities, most outsource sterilization to contract sterilizers like Steris and Sterigenics.

Products can be sterilized by exposing them to poisonous ethylene oxide (EO) gas (roughly half of U.S. sterilization) or to ionizing radiation (roughly the other half). EO sterilization requires gas permeable packaging and products and can leave a harmful residue on products, which makes it unsuitable for many healthcare applications, for which radiation sterilization is typically required.[5] Steris's own view is that most products (85-90%) are suitable for either radiation sterilization or EO sterilization, but not both, and that using an inappropriate sterilization method would "ruin the product."[6] Steris has also stated that "if it could be irradiated, it would be," because of benefits of irradiation over EO (e.g., faster turnaround time), and that EO is used only for products whose materials are incompatible with radiation.[7]

There are three methods of radiation sterilization:

- **E-beam**: An electrically-powered accelerator shoots electrons at products with sufficient energy to disrupt the DNA and proteins of any organisms attached to the products. Electrons have mass and charge, and thus cannot significantly penetrate matter, making e-beam unsuitable for dense products or for sterilizing large batches (e.g., pallets) of products at the same time. E-beam irradiators generally sterilize products one box at a time.
- **Gamma**: Cobalt-60, an isotope manufactured in nuclear generators, emits gamma rays, which are high-energy photons that disrupt the DNA and proteins of organisms. Products are placed in a room with Cobalt-60 for sufficient time to achieve sterility. Gamma rays lack mass or charge and so can significantly penetrate matter, making gamma more suitable for dense products or larger batches of products. Gamma irradiators generally sterilize totes containing multiple boxes of products.

[5] Silor (Zimmer Biomed) transcript, 111:24-112:1; 112:3-4.
[6] Steris 2020 Q2 earnings call ("There is a small percentage of product that can be done with either [EO or radiation]. [] Having said that, the preponderance of products are one or the other. [] [T]hey could sterilize, but you ruin the product with the sterilization methodology.[] So at a high level, [] maybe 10% or 15% of either one could go either way.").
[7] Steris, "Introduction to Industrial Sterilization for Medical Devices," at 14:30, available at https://www.youtube.com/watch?v=-ledNIWTjx0&.

- **X-ray:** An electrically-powered accelerator fires electrons at a tantalum plate, releasing high-energy photons (x-rays), which then incapacitate organisms in the same manner as do gamma rays. X-rays have even greater penetrative ability than gamma, making x-ray a superior choice for dense products or large batches of products. X-ray irradiators generally can sterilize whole pallets of products, without requiring the pallet to be broken down and reassembled following processing.

At the time of the Steris/Synergy transaction in 2015, e-beam accounted for approximately 15% of radiation sterilization in the U.S., with gamma accounting for the remaining 85%.[8] Evidence indicates that the use of e-beam has not meaningfully increased since then.[9] In 2015, x-ray sterilization worldwide was limited to a single Synergy plant in Däniken, Switzerland, which was constructed in 2010.[10]

Evidence indicates that e-beam can be cost-effective for non-dense products that can be efficiently sterilized box-by-box,[11] while Gamma or x-ray sterilization is required for denser products. The advantages to x-ray over gamma are:

- **Greater penetration:** X-ray is better able to sterilize whole pallets as shipped by the manufacturer, whereas gamma irradiators typically require more handling with concomitant greater processing time[12] and risk of product damage.[13]
- **Tighter dose uniformity:** Because x-rays can be directed and gamma rays cannot, x-ray offers tighter dose uniformity (the ratio of maximum dose to minimum dose),[14] meaning the dose a product receives is more predictable.
- **Less heat:** X-ray produces less heat than gamma, avoiding damage to some products.[15]
- **Can be turned off:** Cobalt-60 simply decays until it is no longer usable, continuously emitting gamma rays, and varying the dose given by an irradiator over time. Gamma requires the disposal of radioactive waste when no longer usable. An x-ray machine can be turned on and off.
- **Greater certainty of supply:** One of two large suppliers of Cobalt-60 (Nordion) is owned by Steris's chief rival Sterigenics; the other is Russian, and subject to U.S. sanctions.[16] Nordion itself depends on Russian reactors to manufacture Cobalt-60.[17] Synergy documents indicate that moving away from Cobalt-60 was attractive to both Synergy and its customers.[18]

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[8] Decision, at 2.
[9] https://www.iba-industrial.com/iba-signs-contract-to-install-a-fully-integrated-x-ray-irradiation-solution-in-france/ (saying gamma and EO are 90% of sterilization).
[10] Decision, at 3.
[11] See E-BEAM Services, "Who Is E-Beam Sterilization For?" (stating that "Processing at E-BEAM is the most cost-effective method for low to medium density products, but not a good fit for extremely dense materials."); available at https://ebeamservices.com/e-beam-sterilization/.
[12] Hansen (Johnson & Johnson) transcript, 46:14-17 ("It might take us up to seven days to get our product through a gamma site []; going through an x-ray radiator will be a short period of time, typically one to two days.")
[13] Tyranski (Synergy) transcript, 514:16-22
[14] McLean (Synergy) transcript, 369:2-3.
[15] Tyranski (Synergy) transcript, 515:17-22
[16] Sotera (Nordion) 2024 Annual Report, at 11 ("Nordion's two main competitors in the industrial LSA Co-60 sources supply market are a Russian Co-60 sources producer, which historically has supplied certain regions in Europe and Asia, and a China-based producer, which supplies the domestic Chinese market.")
[17] Ibid.
[18] McLean (Synergy transcript, 305:19-306:4 (stating that concerns about Cobalt-60 availability had led to a "market environment [that is] starting to move very slowly towards recognition that x-ray and e-beam will be the key sterilization technologies of choice into the long-term future).

The two main disadvantages of X-ray relative to gamma are:

- **Fixed cost of x-ray facilities**: In 2015, Synergy modelled the cost of an accelerator to be approximately 25% of the total cost of an x-ray facility,[19] or about $5 million. A gamma facility requires the same ancillary systems but does not require an accelerator (it instead requires a supply of Cobalt-60 and equipment to handle the Cobalt-60, which has lower upfront costs but higher recurring costs than x-ray).
- **Costs to customers of changing facilities:** Medical device manufacturers must test and validate any change in sterilization,[20] including switching from gamma to x-ray, which is costly.[21]

Given these advantages and disadvantages, the case for x-ray comes down to whether or not the ongoing benefits from its use are sufficient to overcome the hurdle of the fixed costs associated with a provider building an x-ray plant and customers shifting products to the plant.

B. The competitive landscape in 2015

At the time of the merger, Steris operated eleven U.S. gamma facilities, nine U.S. EO facilities, and one gamma facility in Canada; Steris did not operate outside of the U.S. and Canada.[22] Synergy operated five U.S. e-beam facilities, one U.S. EO facility,[23] seventeen gamma facilities in Europe, Africa, and Asia, and one x-ray facility in Däniken, Switzerland. Sterigenics operated fourteen U.S. gamma facilities, ten U.S. EO facilities, one U.S. e-beam facility, and 22 gamma, EO, and e-beam facilities in Europe and Asia.[24] A few additional providers offered U.S. e-beam services, though they did not account for a meaningful share of U.S. sterilization, and the FTC stated that these providers lacked the expertise of Steris, Synergy, and Sterigenics.[25]

The FTC alleged two product markets: 1) contract radiation sterilization services, consisting of gamma, x-ray, and e-beam sterilization;[26] and 2) contract gamma and x-ray sterilization services sold to targeted customers that would not switch to e-beam.[27] These product markets do not appear to have been disputed at trial, and are consistent with post-trial statements by Steris indicating little substitution between radiation and EO,[28] and with the continued low share of e-beam.[29] The record indicates that Steris, Synergy, and Sterigenics controlled substantially all of market #1, while Steris and Sterigenics controlled substantially all of market #2.[30] Though the market shares alleged by the FTC are redacted from the public record, the fact that in 2015 Market #2 consisted solely of Steris and Sterigenics gamma plants implies that its HHI was at least 5,000.[31] Synergy documents contemplated its new x-ray facilities taking

[19] As described in Section A, Synergy modelled the cost of an x-ray facility to be $20.2 million and the cost of the accelerator to be EUR 5.2-5.3 million. See Tyranski (Synergy) transcript, at 615:22-616:5 and 616:22-617:5.
[20] McLean (Synergy) transcript, 363:11-24.
[21] Hansen (Johnson & Johnson) transcript 73:20-22, 74:22-75:4. 197:5-8.
[22] Steris home page, archived as of May 2, 2015, available at https://web.archive.org/web/20150502215058/http://www.isomedix.com/.
[23] Tyranski (Synergy) transcript, 586:20-22
[24] FTC complaint, at 2.
[25] The FTC stated that smaller providers disproportionately sterilized non-medical items, such as spices or soil. See https://www.ftc.gov/system/files/documents/cases/150529sterissynergytro.pdf at 69.
[26] Complaint, at 5.
[27] Complaint, at 8.
[28] See note 6, supra.
[29] See note 9, supra.
[30] A contemporaneous Synergy document stated that the combined U.S. share of Steris and Sterigenics was 83% for radiation sterilization (i.e., including e-beam) and 90% for EO. See Steeves (Synergy) transcript, 152:16-19.
[31] The minimum HHI that can be associated with only two competitors is 5,000, i.e., $50^2+50^2 = 5{,}000$.

15% of the gamma share over time,[32] which, if the plans had come to fruition, would have considerably lowered the HHI in any geographic market (the FTC alleged geographic markets around each planned Synergy facility).[33]

C. Synergy's U.S. x-ray strategy

1. From 2012-2014, Synergy planned a U.S. expansion using x-ray

Synergy documents indicate Synergy had begun looking to x-ray to expand its network by March 2012, when it acquired the Däniken, Switzerland facility, which housed both gamma and x-ray irradiators.[34] An October 2012 presentation made by Synergy's founder and CEO (Richard Steeves) stated that Synergy could not gain a competitive advantage over Steris and Sterigenics only by offering EO, gamma, or e-beam,[35] but noted that "we do, however, currently hold a competitive advantage over competitors with the knowledge and experience in x-ray technology" and contemplated an "x-ray expansion in the U.S. to target over $120 million in Steris and Sterigenics revenue."[36] In April of 2013, Steeves presented to a Synergy planning group, describing a "bold plan, x-ray expansion in the U.S," stating that x-ray could be "faster, better cheaper" than gamma.[37] In June 2013, Steeves hired a U.S. CEO for Synergy's sterilization business (Andrew McLean), telling him "I'm keen to develop the x-ray service as a potential game changer" and "this is one of the key projects I would like you to lead."[38] Steeves went on to tell McLean that "We haven't run the numbers, but intuitively, I think it could be lower cost than gamma and it would beat the gamma service on every other operating metric."[39] In July 2014, Steeves told Synergy's PLC board that Sterigenics' acquisition of Cobalt-60 supplier Nordion "could create a new opportunity for Synergy given the concern around [Nordion's] dominance."[40]

McLean tasked a deputy, Gaet Tyranski, to obtain customer letters of interest, with Tyranski telling one Synergy customer, Covidien, that "Synergy is in the final stages of gaining board approval for wholesale investments in x-ray capacity in the Americas as an alternative to gamma in the U.S., at comparable pricing."[41] Synergy obtained letters of interest from at least five large customers, including Johnson & Johnson, Community Tissue, Becton Dickinson, Stryker, and Bayer.[42] Tyranski sought and obtained tax incentives from state and local governments in Indiana and Texas, the planned sites for Synergy's first two x-ray facilities.[43] McLean and his team made presentations to Synergy's Senior Executive Board (SEB, Synergy's management board) in July and September 2014. The team's September deck stated that

[32] McLean (Synergy) transcript, 316:6-22.
[33] The FTC then alleged five geographic markets, in areas roughly 500 miles from each of five planned Synergy U.S. x-ray facilities. See Complaint, at 3. For example, the minimum amount by which a new company with 15% share can lower the HHI occurring under symmetric duopoly is if the two incumbents each have shares of 50% before entry, and 42.5% shares following entry, which results in a pre-entry HHI of 5,000 and a post-entry HHI of 3,837.5. 1,162.5 = 5,000 – 3,837.5.
[34] https://www.auntminnieeurope.com/industry-news/article/15644519/synergy-health-expands-x-ray-business.
[35] Steeves (Synergy) transcript: 152:23-153:1.
[36] Steeves (Synergy) transcript, 153:10-155:1.
[37] Steeves (Synergy) transcript, 155:18-22.
[38] Steeves (Synergy) transcript, 157:10-18.
[39] McLean (Synergy transcript, 273:4-8.
[40] Steeves (Synergy) transcript, 159:24-160:2.
[41] Tyranski (Synergy) transcript, 506:3-7.
[42] McLean (Synergy) transcript, 307:23-308:6.
[43] Tyranski (Synergy) transcript, 508:20-509:2; 542:3-544:16.

x-ray had already attracted "Significant customer engagement. Very high interest"[44] and that Synergy anticipated beginning to operate at least two x-ray facilities in 2016.[45]

At its September 17, 2014 meeting, the SEB approved the U.S. x-ray strategy; McLean reacted by writing "clearly this is a major achievement and marks the true beginning of what I believe will be a fundamental change to the way in which products are sterilized in the long-term future in the U.S."[46] McLean summarized the SEB's decision by saying "We are going to completely transform how irradiation sterilization is done in the U.S. and we have a compelling value proposition to support that, hence our board having the confidence to make a very large capital investment to underpin a new nation-wide network."[47] McLean cautioned his team to "please keep this confidential for now as we want to announce this to the market and our customers at a later date with maximum impact."[48] McLean anticipated that Synergy's soon-to-be-announced x-ray plans would be "a big disruption to the U.S. irradiation market" and told Synergy's anticipated x-ray supplier, IBA, that "we need to have a carefully orchestrated communications program and timing."[49] Adrian Cowherd, Synergy's COO, wrote to Tyranksi following the presentation, saying "you did a very good job today with your presentation, both in terms of content and in the way you delivered it. [] So this goes to show how well you did in helping us to get to the right outcome."[50] Steeves wrote to Tyranski saying "your presentation was very good [] Let's fine tune the CAPEX for the expansion plans and regroup at the end of the month."[51]

The next day, on September 18, 2014, Steeves presented the x-ray strategy to Synergy's PLC board, telling them that McLean was negotiating exclusivity with IBA, a supplier of x-ray accelerators, in exchange for Synergy's making down payments on two machines of EUR 300 thousand each,[52] but did not request "formal approval of the [] plan of four x-ray facilities costing 40 to 50 million pounds;"[53] Steeves understood that the deposits could also be used for e-beam machines if Synergy elected not to go forward with x-ray.[54] The PLC board was told that McLean would "present on [] strategy for U.S. in November strategy session." While Synergy CFO Gavin Hill "advised that as mentioned in the July meeting, the requests for CAPEX continued to be high,"[55] Synergy COO Adrian Cowherd stated that if the negotiations with Steris did not lead to a definitive agreement, he thought it "unlikely" that "there would be a decision to back away from x-ray for North American, given that it would be very difficult to provide gamma sterilization in North America."[56] At the meeting, Steeves told the PLC board that he would not be keen to install more gamma capacity in the U.S.[57] and that "with the cobalt costs likely to increase while electricity costs were falling, it was likely that x-ray would be preferred to cobalt sterilization in any event."[58]

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[44] McLean (Synergy) transcript, 291:19-292:10.
[45] McLean (Synergy) transcript, 313:2-6.
[46] McLean (Synergy) transcript, 321:12-21.
[47] FTC post-hearing brief, at 4.
[48] McLean (Synergy) transcript, 322:18-22.
[49] McLean (Synergy) transcript, 324:10-25.
[50] Tyranski (Synergy) transcript, 521:10-23.
[51] Tyranski (Synergy) transcript, 522:17-24.
[52] Steeves (Synergy) transcript, 162:8-21; McLean (Synergy) transcript, 320:19-24.
[53] Baroudel (Synergy) transcript, 470:2-21.
[54] Steeves (Synergy) transcript, 223:1-18.
[55] Baroudel (Synergy) transcript, 467:15-468:6
[56] Baroudel (Synergy) transcript, 491:5-23.
[57] Steeves (Synergy) transcript, 163:7-164:1.
[58] Baroudel (Synergy) transcript, 492:6-18.

The week of October 7, 2014, McLean staged a three-day x-ray kickoff meeting for Synergy employees in Tampa, FL, which was attended by not only McLean's x-ray team but by Synergy employees new to the effort from both the U.S. and Europe.[59] At the meeting, Tyranski and McLean presented slides stating "the U.S. x-ray strategy was approved by the SEB in September. Following this approval, Phases 1 and 2 for the strategy will be rolled out immediately. [] This will be the largest organic growth project in terms of both capital expenditure and reach ever undertaken by Synergy," with ""Phase 2" referring to "complete building and start operation of at least two commercial scale x-ray facilities."[60] The slides stated that McLean and Tyranski had received the following "feedback" from the SEB: "further reduce CAPEX by at least $1.5 million, further validate the locations, finalize the exclusivity provisions with IBA, and go for it!"[61] The slides did not mention gating hurdles to the project beyond reducing capex.[62]

On November 4, 2014, Synergy publicly announced its x-ray rollout, saying "we are pleased to announce that we have signed an agreement with IBA for x-ray technology to be deployed in the United States, supplemented by our in-house knowledge and expertise."[63] The same disclosure stated, referring to the Däniken x-ray facility, that "our x-ray services are now the fastest growing of our […] technologies, driven by the higher levels of quality, favorable economics, and faster processing speed."[64] Finally, the disclosure stated that a "major global customer" of Synergy's [Johnson & Johnson] had obtained the first FDA approval of x-ray sterilization for a Class 3 medical device "paving the way for further conversion."[65] On November 5, 2014, Steeves stated on an public earnings call that "We've also reached an agreement with IBA that will allow us to get started with x-ray in the U.S."[66]

2. Synergy killed its U.S. x-ray expansion in February 2015, following a meeting with FTC staff about Steris's planned acquisition

Steris announced its planned acquisition of Synergy on October 13, 2014. At that point, Synergy had contemplated a U.S. x-ray expansion for more than two years, had expended resources in pursuing the plan, and had committed to making down payments on x-ray machines. On October 21, 2014, Tyranski sent an email to his team stating "we've made a difficult but sensible decision to stop any market development expense on x-ray outside the already budgeted and ongoing activity in Däniken/Europe while we wait for the Steris transition."[67] In the same email, Tyranski assured his team the x-ray strategy was still proceeding otherwise as planned and stated "I [] imagine we will have to re-present the business case to the new Steris board."[68] In November, 2014, McLean sent a management report to Synergy's PLC, stating "The U.S. x-ray strategy is now approved. [] However, final selection of the first two sites is on hold, pending network study of the combined STE/SYR network."[69]

Following the merger's announcement and into 2015, McLean and Tyranski continued to work on implementing the approved x-ray strategy, including seeking letters of interest from customers, locating sites for potential plants, and telling customers that Synergy x-ray capacity would be available in late

[59] McLean (Synergy) transcript, 327:10-23; Tyranski (Synergy) transcript, 525:18-20.
[60] Tyranski (Synergy) transcript, 526:17-527:7.
[61] Tyranski (Synergy) transcript, 527:13-17.
[62] Tyranski (Synergy) transcript, 527:24-528:4.
[63] Steeves (Synergy) transcript, 166:25-167:3.
[64] Steeves (Synergy) transcript, 167:13-19.
[65] McLean (Synergy) transcript, 355:24-6.
[66] Hill (Synergy) transcript, 766:21-25.
[67] Tyranski (Synergy) transcript, 532:1-6.
[68] Tyranski (Synergy) transcript, 532:16-23.
[69] McLean (Synergy) transcript, 356:19-357-4.

2016.[70] During this time, Synergy customers including Haemonetics, Thermo Fisher, and Zimmer Orthopedic sent products to Däniken for testing on Däniken's x-ray line.[71] Synergy told IBA, its would-be supplier of x-ray accelerators, that the x-ray plan was "business as usual, but purchase agreement deadline pushed back to 31 March 2015," pending the anticipated closing of the Steris acquisition, at which point Synergy told IBA it expected to fulfil its purchase agreement with IBA."[72]

On January 9, 2015, the FTC sent Steris and Synergy second requests and on February 19, 2015, McLean met with FTC staff, who explained they had concerns that the transaction would eliminate Synergy's planned x-ray rollout.[73] On February 24, 2015—five days after McLean's meeting with FTC staff—Tyranski reported to his staff "This whole FTC inquiry is going down a rat hole and I'm going to have to communicate to IBA soon that we cannot proceed for the Americas."[74] In response, a Synergy employee wrote "definitely a switch but not surprised based on Andrew's approach with the FTC."[75] Tyranski testified that while the FTC investigation was one reason for killing x-ray, there were other reasons, namely the lack of customer interest and Synergy's inability to lower the CAPEX needed for the x-ray expansion, testifying that Synergy's decision to kill its planned x-ray expansion "wasn't solely because the FTC investigation was going down a rat hole."[76]

On February 25, 2015—six days after McLean's meeting with FTC staff—McLean sent a declaration to FTC staff stating that Synergy was ending the x-ray program.[77] McLean attached to his declaration four emails from Synergy customers expressing skepticism regarding the future of x-ray.[78] The circumstances under which at least one of those emails was produced appear most consistent with the emails being generated out of the ordinary course for the purpose of generating favorable documents to rebut the FTC's concerns.[79] McLean testified that he solicited the customer emails because FTC staff had told him on February 19 that they had not seen Synergy documents indicating that any customers had rejected x-ray.[80]

3. Why did Synergy decide to kill its x-ray expansion?

The FTC and Synergy took very different views of the reason for Synergy's killing of its x-ray expansion. At trial, Synergy executives testified that the financial case for x-ray fell far short of the company's financial thresholds for new projects, and in particular a 15% internal rate of return (IRR) when

[70] Tyranski (Synergy) transcript, 550:21-552:16.
[71] Haemonetics: Tyranski (Synergy) transcript, 553:4-8. Thermo Fisher: Tyranski transcript, 553:23-25. Zimmer: Tyranski (Synergy) transcript, 554:1-5. Tyranski (Synergy) transcript, 553:23-25.
[72] Tyranski (Synergy) transcript, 557:3-10 and 559:6-13.
[73] McLean (Synergy) transcript, 358:4-15.
[74] McLean (Synergy) transcript, 358:22-359:5.
[75] McLean (Synergy) transcript, 360:5-10.
[76] Tyranski (Synergy) transcript 570:16-21.
[77] McLean (Synergy) transcript, 340:24-341:2.
[78] McLean (Synergy) transcript, 341:3-6.
[79] One email was from a Johnsons & Johnson employee, Vic Baran, who testified that McLean requested he send the email and also requested that Baran double the cost of Johnson & Johnson converting a product group to x-ray sterilization. See McLean (Synergy) transcript, 342:15-343:1. McLean testified that the reason he encouraged Baran to increase J&J's costs associated with switching products to x-ray was because he needed to give his internal stakeholders a reason why Synergy couldn't turn "interest" in x-ray into "commitment." See McLean (Synergy) transcript, 347:24-348:7. Another Johnson & Johnson employee, Joyce Hansen, testified that she, and not Baran, made decisions about whether or not Johnson & Johnson would use x-ray or gamma, and re-affirmed that Johnson & Johnson remained interested in x-ray sterilization and intended to use it to sterilize its products. See Hansen (Johnson & Johnson) transcript, 49:24-50:4:7.
[80] McLean (Synergy) transcript, 399:24-400:1.

considering the first ten years of the project.[81] IRR measures the capital expenditures required to start a project against future profit flows generated by the project; a higher IRR means a project is more likely to be profitable.[82] Synergy executives further testified that Synergy's PLC board would have only funded the x-ray expansion if Synergy had attracted "take-or-pay" contracts from x-ray customers, meaning contracts that obligated customers to a certain spend on x-ray.[83] The executives testified that the September 17, 2014 approval of Synergy's U.S. x-ray strategy amounted to a mere approval of the general strategy and a directive to continue working on improving the financial model, to lower the upfront cost of x-ray facilities ("capex"), and to obtain binding customer commitments, but that the PLC board's final approval was neither expressed nor implied by the SEB's approval.[84]

The FTC appeared to question the relevance of the financial thresholds put forward by Synergy, including a 15% IRR threshold when considering the first ten years of the project, with lines of questions evincing a view that the thresholds were not supported by company documents.[85] The FTC further questioned whether Synergy had seriously attempted to obtain "take-or-pay" contracts from customers[86] and its questions noted the lack of support for the necessity of contracts in company documents.[87] In the FTC's view, Synergy documents consistently pointed towards Synergy continuing its x-ray expansion until the Steris transaction, which appeared to pause certain aspects of the development pending the closing of the acquisition, and until Andrew McLean's February 19, 2015 meeting with FTC staff, which preceded Synergy's decision to kill x-ray by less than a week.[88] This section briefly expands on three main areas of factual dispute.

The x-ray financial model. Synergy executives testified that Synergy's financial model contained "arbitrary" assumptions and was "far from locked down."[89] Hill testified the first time he had seen any financial case for a potential U.S. x-ray expansion was at the September 17, 2014 SEB meeting;[90] his impression at that time was that the financial case was "woeful," lacked "detail behind where the revenue was coming from," and thus was "highly speculative."[91] McLean testified that Synergy had no reliable methodology for forecasting x-ray volumes in future years, and "just plugged in some numbers to show that we would be approaching a decent level of capacity utilization in year seven or so."[92] Tyranski and McLean both testified that Synergy management were instructed by the SEB to lower CAPEX by $1.5 million per plant, but were unable to do so.[93] In particular, Synergy executives testified that all Synergy projects must have a "minimum 15 percent IRR [internal rate of return]" when considering only the first

[81] Hill (Synergy) transcript, 661:14-18.
[82] A project's IRR is the annual discount rate which, if applied to future profit flows, causes the project to break even. For instance, a project which required an expenditure of $100 in year 1 and generated $110 in profit in year 2 (but no additional profits) would have an IRR of 10%, because discounting year 2 profits by 10% would result in profits that exactly offset the initial outlay, i.e., at a 10% discount rate the project's discounted profit would be $-\$100 + \frac{\$110}{1+10\%} = 0$. The IRR of a project that generated profits over multiple years is calculated in an analogous way.
[83] Steeves (Synergy) transcript, 204:1-9; McLean (Synergy) transcript, 379:3-10
[84] McLean (Synergy) transcript, 419:8-420:14.
[85] Hill (Synergy) transcript, 735:15-736:4; 738:4-15.
[86] McLean (Synergy) transcript, 3344-25; 441:22-442:15; Tyranski (Synergy) transcript, 507:21-508:2; 551:11-13
[87] Tyranski (Synergy) 641:11-13.
[88] FTC opening arguments, transcript. 12:17-13:5.
[89] McLean (Synergy) transcript, 407:15-16; 408:23-24.
[90] Hill (Synergy) transcript, 682:14-17.
[91] Hill (Synergy) transcript, 683:4-14
[92] McLean (Synergy) transcript, 411:10-12.
[93] McLean (Synergy) transcript, 422:16-423:1; Tyranski (Synergy) transcript, 636:25-637:4.

ten years of a project to be approved,[94] but that as of September 2014 the x-ray financial plan showed a (ten-year) IRR of only 6.51 percent.[95] Hill also testified that all major capital expenditures need[ed] to be put through a thorough "black hat" review process before they received final approval,[96] and that the x-ray expansion had not even begun the review.[97] In fact, Hill testified that the financial model double counted revenue from Synergy's to-be-closed Lima, OH facility, and that removing the Lima volume would reduce the 10-year IRR to three percent.[98]

The FTC's lines of questions implied that its view was that: 1) Synergy's financial threshold was unsupported by Synergy documents and that it made no sense to ignore profits beyond year 10 of an asset when calculating the asset's profitability;[99] 2) No Synergy document produced at trial referenced a "black hat" review;[100] 3) Synergy documents did not support claims that Synergy only considered the first ten-years of profits when measuring the profitability of an investment;[101] and in fact Synergy's planning documents assumed an x-ray accelerator would last for 20+ years;[102] and 4) four of ten sterilization projects approved between 2011 and 2014 had projected (ten-year) IRRs of less than 15% at the time those projects were approved.[103]

In Section A I replicate Synergy's financial model using the trial record and find that it predicted an IRR of approximately 15%, when appropriately considering the full lifespan of an x-ray facility. I also find that the model was conservative in key respects, and that it did not support the testimony offered by Synergy executives that Synergy's x-ray expansion would have low financial returns.

Customer commitments. McLean testified that the reason Synergy killed x-ray was that "we believed in the technology… but our customers fundamentally did not share that enthusiasm."[104] Because of the lack of customer interest, McLean testified, the PLC board was unlikely to approve the capital expenditures needed to open x-ray plants.[105] As McLean testified, "what we were being told by our customers, again and again the more they looked at this project, was the costs to convert [from gamma to x-ray] were going to far exceed any economic benefits in terms of reduced pricing. And [] in general, the cost of sterilization makes up less than three percent of the product cost, so when you weigh up these regulatory and contingency barriers, there is no value proposition that would incentivize us to bear these costs and bear that regulatory risk to make the conversion. It just wouldn't make sense."[106] The FTC questions implied that Synergy documents did not support testimony that "take-or-pay" contracts were required for Synergy expansions,[107] and that Synergy had not seriously attempted to obtain such contracts.[108] Testimony also indicated that Synergy had understood that "take or pay" contracts were unlikely for some

[94] McLean (Synergy) transcript, 416:12-15.
[95] McLean (Synergy) transcript, 417:17-19.
[96] Hill (Synergy) transcript, 678:15-17.
[97] Hill (Synergy) transcript, 707:4-13.
[98] Hill (Synergy) transcript, 694:3-18.
[99] Hill (Synergy) transcript, 734:12-735:7.
[100] Hill (Synergy) transcript, 759:3-6.
[101] Hill (Synergy) transcript, 735:15-736:4; 737:15-738:15; 739:5-15.
[102] Hill (Synergy) transcript, 741:1-10.
[103] Baroudel (Synergy) transcript, 476:12-477:10; Hill (Synergy) transcript, 752:7-10
[104] McLean (Synergy) transcript, 360:23-361:5
[105] McLean (Synergy) transcript, 361:16-21.
[106] McLean (Synergy) transcript, 381:8-22.
[107] Tyranski (Synergy) transcript, 641:11-14.
[108] McLean (Synergy) transcript, 404:12-19 (stating that Synergy was "far from" the point at which it would look for binding "take-or-pay" contracts from customers); Tyranski (Synergy) transcript, 591:13-15.

time, but continued moving forward with its x-ray expansion regardless.[109] In Section III.A, I explain that the post-trial record, and in particular, Steris's successful wide-scale deployment of x-ray sterilization and its nearly complete reliance on x-ray to build new irradiation capacity, indicates broad customer acceptance of x-ray, contrary to testimony of Synergy executives.

No PLC approval. An outside member of Synergy's PLC board, Constance Baroudel, testified that the SEB's approval of Synergy's x-ray strategy did not imply the project would receive funding, as SEB meetings "were only for the management of Synergy," whereas the PLC board "decides on the strategy for the group [Synergy]," and any project with a capex of more than GPB 10 million required PLC approval.[110] Baroudel testified that different Synergy businesses developed "wish list[s] of projects they would like funding for," while the PLC would prioritize, funding only "the best, the most appropriate."[111] She testified that a business team may do "a first run" at a financial analysis, that would then be "validated, torn apart" by Synergy's finance team, led by Hill,[112] and that this had not happened yet. The FTC questioned whether the PLC actually voted to approve projects[113] and why Synergy announced its x-ray expansion to investors if the PLC board had no intention of moving forward.[114]

III. What happened after the merger: X-ray entry and Steris pricing since Steris's Synergy acquisition

This section describes aspects of the post-trial record, including Steris's successful at-scale deployment of x-ray sterilization, both in the U.S. and abroad (Section III.A), and Steris's rapidly increasing revenue and margins which are consistent with—even if not a dispositive indicator of—increased market power (Section III.B).

A. Steris's x-ray expansion, 2019-present

Steris has opened or announced 11 x-ray facilities. Beginning in October, 2019—less than four years after the closing of Steris's acquisition of Synergy—Steris announced that it would build three new x-ray facilities in the U.S—in Libertyville, IL;[115] Ontario, CA;[116] and Northborough, MA[117] (the Northborough

[109] McLean (Synergy) transcript, 381:23-24 (stating that McLean told other Synergy executives in March 2014 that "take-or-pay" contracts were unlikely to be obtained).
[110] Baroudel (Synergy) transcript, 445:15-17; 446:3-6; 446:15-23.
[111] Baroudel (Synergy) transcript, 448:14-23.
[112] Baroudel (Synergy) transcript, 450:11-14.
[113] Baroudel (Synergy) transcript, 473:22-475:5.
[114] Baroudel (Synergy) transcript, 495:9-499:19.
[115] Libertyville (announced November 7, 2019): https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-libertyville-south-illinois-facility-to-include-x-ray-processing.
[116] Ontario (announced January 7, 2020): https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-ontario-california-facility-to-include-x-ray-processing.
[117] Northborough (announced October 9, 2019): https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-northborough-massachusetts-facility-to-include-x-ray-processing.

facility appears to have since been relocated to Chester, NY)[118]—and a fourth in Venlo, Netherlands.[119] Two of those x-ray facilities—in Libertyville and Venlo—have since opened, Libertyville in July 2024[120] and Venlo in March 2022.[121] Steris has stated on earnings calls that its other two announced U.S. x-ray facilities—in Ontario, CA and Chester, NY, are slated to open soon.[122] In addition, Steris has opened three additional x-ray facilities, in Chonburi, Thailand (2024);[123] Kuala Ketil, Malaysia (2023);[124] and Suzhou, China (2024).[125] Further, in addition to the two upcoming U.S. sites, Steris has announced three additional x-ray facilities outside of the U.S., including a second x-ray facility in Venlo;[126] and new x-ray facilities in Tullamore, Ireland[127] and Hochstadt, Germany.[128] Altogether, as of July 2025, Steris has six operating x-ray facilities[129] and five additional announced but not-yet-opened facilities,[130] for a total of eleven open or announced x-ray facilities, including three in the U.S.

As points of comparison, at the time of the merger, Steris operated twelve gamma facilities (eleven in the U.S. and one in Canada) and Synergy sixteen (all in Europe, Africa, and Asia). Since Steris's November 2015 acquisition of Synergy, Steris has opened just one new gamma facility, in Chonburi, Thailand,[131] meaning that Steris's x-ray facilities have accounted for virtually all of its incremental radiation

[118] Steris originally announced an x-ray facility in Northborough, MA, and purchased a warehouse adjacent to its Northborough gamma facility to house the new x-ray facility. However, Steris did not receive a necessary permit from the Northborough Planning Board, and sold the warehouse it had purchased. On Steris's 2022 Q4 Earnings Call, Steris announced that it planned to open an x-ray facility in Ontario, NY, which I assume to have replaced the Northborough facility in Steris's network (See Steris 2022 Q4 earnings call transcript, "In particular, in the U.S., there's three facilities that will come online over the next couple of years. The earliest will be late -- very late this fiscal year, most likely in Illinois. And then followed by either California or Chester, New York.") Northborough permit: https://www.communityadvocate.com/2022/10/26/steris-northborough-planning-board-case-dismissed/; sale of Northborough warehouse: https://www.wbjournal.com/article/framingham-investment-firm-buys-northborough-manufacturers-property-for-67m.

[119] Venlo (announced October 21, 2019): https://www.steris-ast.com/news-and-events/news/steris-announces-expansion-of-venlo-the-netherlands-facility-to-include-x-ray-processing.

[120] Steris, June 24, 2024, "STERIS ANNOUNCES COMPLETION OF LIBERTYVILLE, ILLINOIS EXPANSION TO INCLUDE X-RAY PROCESSING," available at https://www.steris-ast.com/steris-announces-completion-of-libertyville-illinois-expansion-to-include-x-ray-processing/.

[121] Steris, "X-ray Sterilization Facility in Venlo, The Netherlands," March 17, 2022, available at https://www.youtube.com/watch?v=rdR71u6wTYA&t (stating the facility was open).

[122] Steris 2021 Q1 earnings call ("The next operation to come online at least domestically here will be in Libertyville, Chicago suburbs and that's likely to be Q4 timeframe for us. So no material impact on the current fiscal year. And then we have other builds going on the West Coast and the East Coast that will follow after the Libertyville operation comes online.").

[123] https://www.steris-ast.com/steris-announces-completed-expansion-of-chonburi-thailand-facility-now-includes-x-ray-processing/.

[124] https://www.steris-ast.com/steris-kuala-ketil-malaysia-x-ray-operations-recieve-iso-13485-accreditations/.

[125] https://www-dev-sc.steris-ast.com/news-and-events/news/steris-announces-expansion-of-suzhou-china-facility-to-include-x-ray-processing.

[126] https://www.steris-ast.com/steris-announces-new-x-ray-processing-facility-in-the-netherlands/.

[127] https://www.steris-ast.com/steris-announces-new-x-ray-processing-facility-in-ireland/.

[128] https://www.steris-ast.com/steris-announces-new-x-ray-facility-in-germany/.

[129] Däniken, Libertyville, Venlo, Suzhou, Chonburi, and Kuala Ketil.

[130] Ontario, Chester, Tullamore, Venlo, and Hochstadt.

[131] Steris now operates two gamma facilities in Chonburi.

sterilization capacity added since its acquisition of Synergy. Steris has not closed any gamma facilities since its acquisition of Synergy.[132]

X-ray now accounts for a significant share of Steris's capacity. Steris's x-ray facilities have greater capacity than a typical gamma facility, since each of Steris's x-ray plants sterilize entire pallets, whereas most of their gamma facilities require boxes to be de-palletized and individually placed in containers. This means that Steris's x-ray facilities now account for a significant portion of its U.S. and worldwide sterilization networks. In particular, I calculate the share of gamma and x-ray sterilization capacity accounted for by Steris's (opened and accounted) x-ray facilities under three related metrics.

- **Share of facilities**. Steris's x-ray facilities (including both opened and announced facilities) account for 3 out of 28 U.S. x-ray or gamma facilities, or 10.7%.[133] Worldwide, Steris's x-ray facilities account for 11 out of 61 total gamma or x-ray facilities, or 18.0% of the total.
- **Share of facility bandwidth within Steris's network, based on carrier size**. Information on the bandwidth of different Steris facilities indicates that Steris's x-ray facilities account for a higher share of gamma/x-ray capacity than is indicated by counts of facilities. For each of its gamma facilities, Steris's website lists the carrier size (i.e., the size of the tote into which boxes are loaded for passage through a gamma irradiation chamber). For x-ray facilities, Steris's website lists the maximum pallet size that can fit through the irradiator. Assuming that capacity for both types of irradiators is proportional to bandwidth—i.e., that one carrier or pallet passes through an irradiator at a constant rate of speed[134]—and assuming that Steris's five announced but not-yet opened facilities are comparable in capacity to its six existing x-ray facilities, Steris's three U.S. x-ray facilities have 70.1% as much capacity as its 11 gamma facilities, and its 11 worldwide x-ray facilities have 71.2% as much capacity as its 29 worldwide gamma facilities.
- **Share of total facility bandwidth, including competitors**. Further assuming that Sterigenics's gamma facilities have the same average capacity as Steris's gamma facilities, Steris's opened or announced x-ray plants would constitute 23.7% of total U.S. x-ray/gamma capacity and 30.4% of worldwide x-ray/gamma capacity.
- **Share of facility bandwidth based on direct measurement of capacity**. In the alternative, I estimate the capacity of Steris's x-ray facilities by extrapolating from the announced capacity of 50,000 pallets per year of Sterigenics's gamma pallet irradiator in Fort Worth, TX.[135] Assuming Steris's x-ray facilities can sterilize the same number of pallets as Sterigenics's Fort Worth

[132] To determine this fact, I compared the current list of Steris facilities, available at https://www.steris-ast.com/our-locations, to the list of Synergy and Steris locations at the time of the merger, available through archived copies of the Steris and Synergy web sites.

[133] A smaller provider, SteriTek, has opened two U.S. x-ray facilities, in Fremont, CA (opened in 2016) and Lewisville TX (opened 2022). I lack information about the volume or complexity of products sterilized in these locations. If, as was true in 2015, the facilities of small providers primarily sterilize industrial materials and provide cross-linking services, SteriTek's facilities are unlikely to closely compete with those of Steris and Sterigenics. If SteriTek commonly sterilizes medical devices, then Steris's x-ray facilities would comprise 3 of thirty U.S. gamma/x-ray sterilization facilities, or 10%, and x-ray facilities (Steris's and SteriTek's) would comprise 5 of thirty U.S. gamma/x-ray facilities, or 16.7%.

[134] This assumption is wrong to the extent that different facilities, whether due to power differences or differences in product mix, take more or time to sterilize comparable packages. The share percentages presented assume that any such differences are averaged out when consider all U.S. or worldwide facilities.

[135] Sterigenics, August 2, 2017, "$17.5 Million Investment makes Fort Worth the Largest Sterilization Facility in Sterigenics' Global Network," ("The expansion increases the facility's total sterilization throughput by 60%, adding 50,000 pallets per year in capacity"), available at https://sterigenics.com/sterigenics-completes-expansion-of-ft-worth-facility/.

facility, I calculate their capacity in cubic feet by multiplying 50,000 pallets by the maximum pallet size of each Steris facility as stated on Steris's website. Then, I leverage estimates of the total volume of products sterilized (including by manufacturers with in-house sterilization facilities) to calculate the share of Steris's x-ray facilities. Specifically, evidence indicates that approximately 400 million cubic feet of products are sterilized in worldwide gamma facilities each year,[136] and 150 million cubic feet in the U.S.[137] Using this metric, Steris's opened and announced x-ray facilities would amount to approximately 13.1% of U.S. x-ray/gamma capacity (including that of in-house sterilizers), and 13.0% of worldwide capacity, global gamma capacity.

Table 1 presents these results.

Table 1: Estimated shares of Steris (open and announced) x-ray facilities, using three different methodologies

U.S. gamma/x-ray sterilization

	Facilities (#)	Share of facilities	Total carrier/pallet size (cu. ft.)[1]	Share of carrier size	Estimated capacity (cu. ft)[2]	Share of capacity
Steris gamma	11	39.3%	639.3	33.6%	62,700,000	36.3%
Steris x-ray[4]	3	10.7%	451.3	23.7%	22,564,339	13.1%
Sterigenics gamma	14	50.0%	813.7	42.7%	79,800,000	46.2%
Total U.S. gamma/x-ray	**28**		**1,904.2**		**172,564,339**	

Worldwide gamma/x-ray sterilization

	Facilities (#)	Share of facilities	Total carrier/pallet size (cu. ft.)[1]	Share of carrier size	Estimated capacity (cu. ft)[3]	Share of capacity
Steris gamma	29	47.5%	1,584.4	40.3%	208,800,000	45.4%
Steris x-ray[5]	11	18.0%	1,195.8	30.4%	59,788,858	13.0%
Sterigenics gamma	21	34.4%	1,147.3	29.2%	151,200,000	32.9%
Total WW gamma/x-ray	**61**		**3,927.5**		**459,788,858**	

Sources: https://www.steris-ast.com/locations/; https://sterigenics.com/locations/.

Notes: **1**- Sterigenics's capacity is estimated to be proportional to Steris's based on number of facilities. **2**- U.S. gamma capacity of 150 million cu. ft. is allocated to Steris and Sterigenics in proportion to number of facilities. I assume other firms have 5% of capacity. **3**- Worldwide gamma capacity of 400 million cu. ft. is allocated to Steris and Sterigenics in proportion to number of facilities. I assume other firms have 10% of capacity. **4**- Includes one open (Libertyville) and two announced x-ray facilities. Capacity of two annoucned facilities is assumed to be the same as Libertyville. **5**- Includes six open and five announced facilities. Capacity of announced U.S. facilities is assumed to be the same as Libertyville. Capacity of 3 announced facilities in Europe assumed to be equal to the average capacity of Steris's five ex-US x-ray facilities.

Steris's x-ray facilities are successful. Available data indicate that, as of July 2025, Steris's already-opened x-ray facilities are successful. Its Venlo x-ray facility—Steris's first since Däniken—was "very well-received from a customer perspective"[138] and had "significant positive margins within the first year of operation, which is not necessarily the norm."[139] Indeed, within three years of the opening of the Venlo

[136] A Comparison of Gamma, E-beam, X-ray and Ethylene Oxide Technologies for the Industrial Sterilization of Medical Devices and Healthcare Products, International Irradiation Association, August 2017, at 10 ("In excess of 200 large-scale commercial gamma irradiators are in operation in about 50 countries, utilizing some 400 million curies (Ci) of Cobalt-60 to irradiate more than 400 million cubic feet of product annually.)

[137] McLean (Synergy) transcript, 408:9-10 ("the irradiation market in the United States is roughly 150 million cubic foot.")

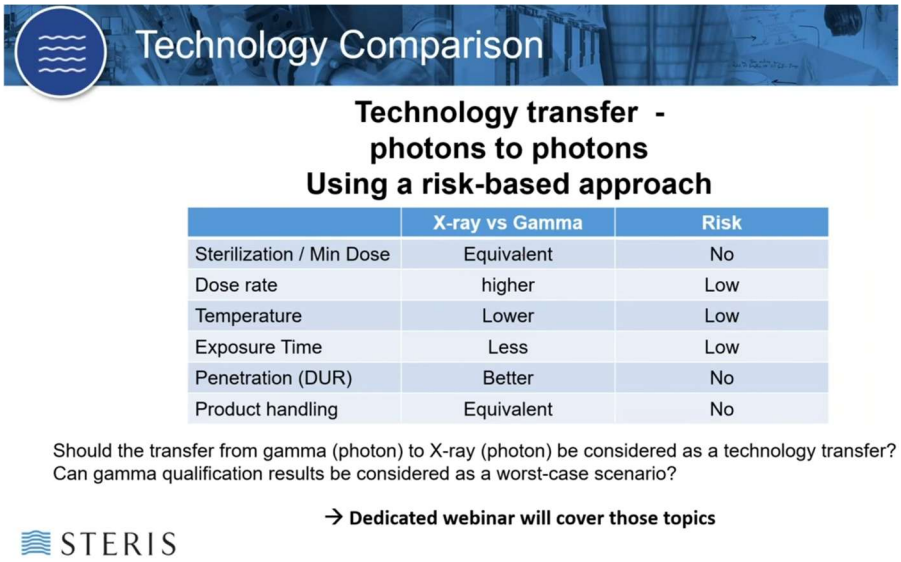
[138] Steris 2023 Q1 earnings call.

[139] Id.

x-ray facility, Steris announced plans to add a second x-ray processing line to the Venlo facility,[140] doubling its capacity. Steris would not have been incentivized to add a second processing line to Venlo unless the first x-ray line was likely to reach capacity soon after its opening, indicating significant customer interest in Steris's Venlo x-ray facility.

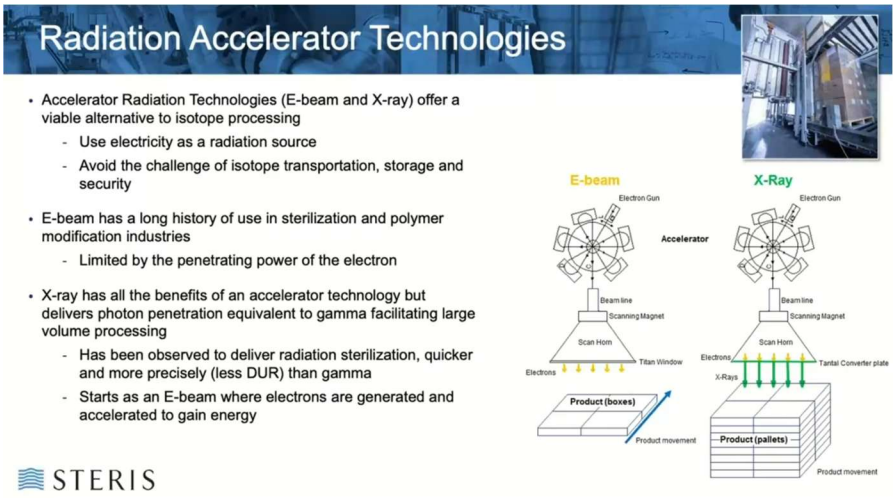
Steris promotes x-ray. Steris has actively promoted the benefits of x-ray sterilization over gamma and e-beam sterilization. In September 2020, a Steris presentation stated that "within Steris, we believe, and are confident that x-ray offers the most successful capacity on a like-for-like alternative scale."[141] Steris began marketing and describing its sterilization business as being "technology neutral" no later than March 2018.[142] In September 2020, Steris explained to customers that they faced "no" or "low" risk in each of six categories from switching products from gamma to x-ray (see Figure 1 for a slide from a Steris presentation encouraging customers to switch from gamma to x-ray).[143] As Steris put it, "photons are photons. You'll find either no risk of a change between x-ray and gamma, or it's very little."[144] Figure 2 depicts a Steris slide from the same presentation, explaining the benefits to customers of x-ray processing over gamma, including a lower dose uniformity ratio and quicker processing.

Figure 1: September 2020 Steris slide on transferring products from gamma to x-ray[145]



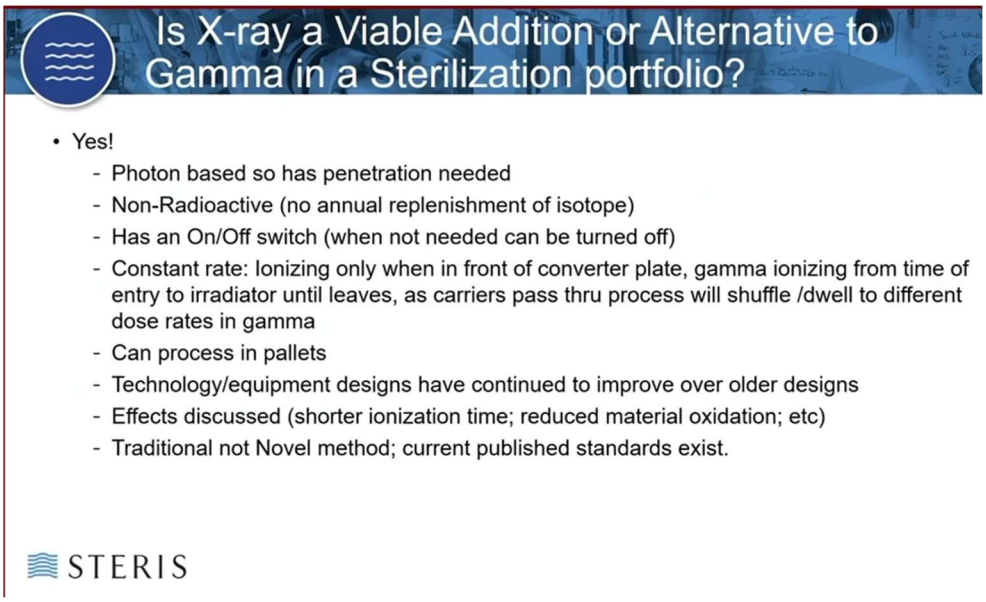
[140] https://www.steris-ast.com/steris-announces-new-x-ray-processing-facility-in-the-netherlands/
[141] https://www.youtube.com/watch?v=-ledNIWTjx0&ab_channel=STERISAppliedSterilizationTechnologies, around 26:10.
[142] Steris 2018 Annual report (reporting results through March 31, 2018), at 5 ("As a technology neutral service provider, we offer unbiased
technology assessments dependent on the individual requirements of each product."). The language does not appear in Steris's 2017 Annual Report.
[143] Steris, "Fundamentals of X-ray Irradiation Processing | Steris AST TechTalk," September 14, 2020, available at https://www.youtube.com/watch?v=os-gvk5qiYc&ab_channel=STERISAppliedSterilizationTechnologies.
[144] https://www.youtube.com/watch?v=cUEIrYPdvNc&ab_channel=STERISAppliedSterilizationTechnologies, around 32:20.
[145] https://www.youtube.com/watch?v=os-gvk5qiYc, at 20:30.

Figure 2: September 2020 Steris slide explaining the benefits of x-ray over gamma[146]



A May 2023 Steris presentation elaborated on the advantages of x-ray over gamma, explaining that (unlike e-beam) x-ray was photon-based and so had the same penetration as gamma, that x-ray is more controllable than gamma (because x-rays can be directed at a product whereas gamma rays are isotropic, or always on), that x-ray can process entire pallets (reducing turnaround time), and that x-ray can have fewer adverse effects on products.[147] Steris's 2023 slide is consistent with Synergy documents contemporaneous with the Steris/Synergy merger.[148] Figure 3 displays a slide from this presentation.

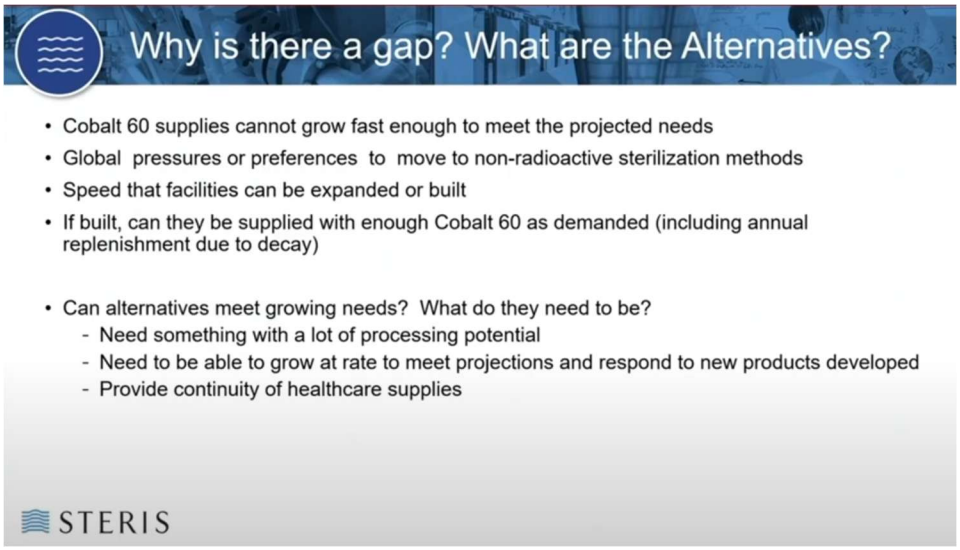
Figure 3: May 2023 Steris slide describing benefits of x-ray over gamma[149]



[146] https://www.youtube.com/watch?v=-ledNIWTjx0&, around 29:00.
[147] Steris, "X-ray Sterilization Processing for Bioprocessing Products," available at https://www.youtube.com/watch?v=DpDi9eKRUu8&.
[148] See notes 13-18 and 37, and surrounding text, *supra*.
[149] Steris, "X-ray Sterilization Processing for Bioprocessing Products," available at https://www.youtube.com/watch?v=DpDi9eKRUu8&, at 28:30.

Steris's May 2023 presentation also described a widening gap between the demand for irradiation processing and the capacity of gamma sterilization, with the latter limited by the global supply of Cobalt-60. As the presentation put it, "they can't make enough cobalt fast enough, and it decays."[150] A Steris representative stated that x-ray is needed due to the ongoing growth in health care.[151] Figure 4 depicts a slide from Steris's presentation describing the reasons for a shortage in cobalt.

Figure 4: May 2023 Steris slide describing pressures on gamma sterilization



B. Steris's revenue and margins have significantly increased since its 2015 Synergy acquisition

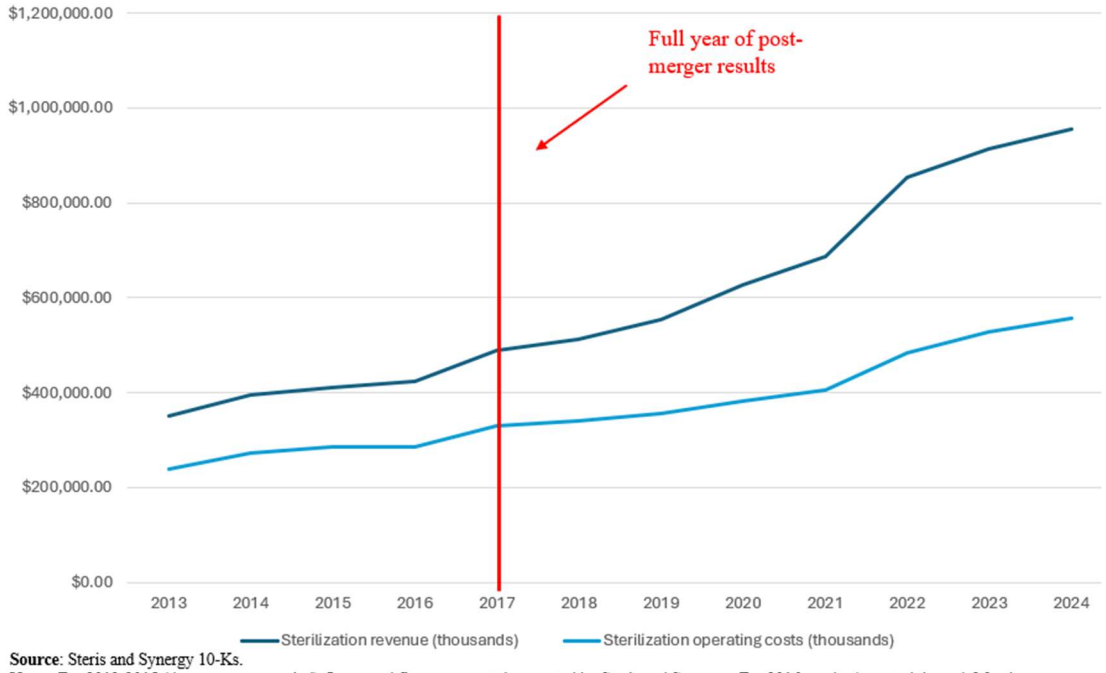
The combined firm's revenue expanded more quickly than its costs. Financial filings from both before and after Steris's November 2015 acquisition of Synergy indicate that the combined firm's revenue increased following the merger at a faster rate than revenues were increasing pre-merger, with substantially all of the increase occurring from 2018-2022, before Steris's own x-ray expansion came online. Specifically, the parties' combined pre-merger sterilization revenue grew at a compound annual growth rate (CAGR) of 8.2% during the pre-merger period, FY 2013-2015.[152] During the post-merger period, FY 2017-2024, Steris's revenue from its sterilization business increased at a CAGR of 10.0%.[153] On the other hand, the growth of the combined firm's operating costs *slowed* following the merger,

[150] https://www.youtube.com/watch?v=DpDi9eKRUu8&ab_channel=STERISAppliedSterilizationTechnologies, around 27:00.
[151] https://www.youtube.com/watch?v=DpDi9eKRUu8&ab_channel=STERISAppliedSterilizationTechnologies, around 25:50.
[152] 2013 was the first year reported revenues for both Steris and Synergy are available. 2015 was the final year for which the firms reported revenue separately. To track combined revenues, I obtained reported revenues from sterilization for both Steris and Synergy Health. For the pre-merger years, I sum Steris's reported revenue and Synergy's reported revenue, and for Steris FY 2016, ending 5 months after the closing of the acquisition, I imputed standalone Synergy's revenue for the first 7 months of the fiscal year as equal to 7/12 of its FY 2015. The CAGR is the rate of growth satisfying $(1 + CAGR)^N = \frac{Nth\ periuod\ value}{1st\ period\ value}$, where N is number of years. The fiscal years of both Steris and Synergy end in late March, e.g. FY 2024 ended March 31, 2024.
[153] 2017 was the first year in which Steris's financial filings fully reflected Synergy revenues. I tracked Steris's revenues from its AST (Applied Sterilization Technologies) division.

growing at a pre-merger CAGR of 9.0% and a post-merger CAGR of 7.8%.[154] The combined firm's revenue and operating costs from 2013-2024 is plotted below in Figure 5.

The combined firm's margin increased. The combined firm's operating profit from sterilization—i.e., operating income as a fraction of revenue—markedly increased following Steris's acquisition of Synergy, from an average of 31.2% in the pre-merger years (FY 2013-2015), to an average of 39.5% in the post-merger years (2017-2024). The increase in Steris's margin appears to have begun in its FY 2018, i.e., the year beginning seventeen months following Steris's acquisition of Synergy. Figure 6 depicts the combined firm's operating margin from FY 2013-2024.

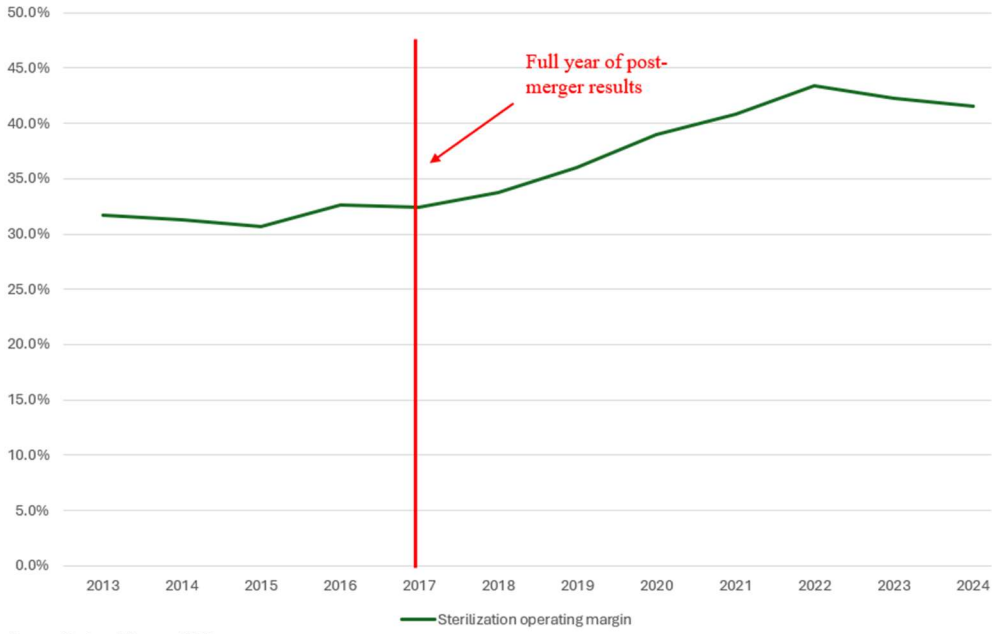
Figure 5: Combined firm's pre- and post-merger revenue and operating costs



Source: Steris and Synergy 10-Ks.
Notes: For 2013-2015 (the pre-merger period), I summed figures separately reported by Steris and Synergy. For 2016 results (reported through March 2016, 5 months following merger), I estimated the combined firm's full-year revenue by allocating 7/12 of Synergy's reported revenue and operating income for FY 2015, the last year for which Synergy reported results. From 2017-2024, results reflect the combined entity's results.

[154] From 2013-2018, Steris allocated certain corporate costs to its AST segment when reporting the segment's operating income. From 2019-2024, Steris removed these costs from reported operating income. To ensure comparability across the period 2013-2024, I have adjusted Steris's reported operating income from 2019 to 2024 downward by 9.8%, or Steris's 2018 allocated corporate costs as a percentage of Steris's 2018 operating income. Steris reported its 2018 operating income inclusive of these corporate costs in its 2018 Annual Report, and reported 2018 operating income *exclusive* of these costs in its 2019 Annual Report, which allows for the adjustment.

Figure 6: Combined firm's pre- and post-merger operating margin



Source: Steris and Synergy 10-Ks.
Notes: For 2013-2015 (the pre-merger period), I summed figures separately reported by Steris and Synergy. For 2016 results (reported through March 2016, 5 months following merger), I estimated the combined firm's full-year revenue by allocating 7/12 of Synergy's reported revenue and operating income for FY 2015, the last year for which Synergy reported results. From 2017-2024, results reflect the combined entity's results.

Public information does not dispositively identify the causes of the increase in Steris's margin, or whether Steris's acquisition of Synergy contributed to the increase to any significant extent. However, as I will explain, evidence indicates that Steris's increased margin is consistent with greater market power resulting from the removal of a potential competitor following its acquisition of Synergy.

As a matter of accounting, an increase in margin must be driven by either a decrease in costs or an increase in prices.[155] Either factor could, in theory, relate to the merger or it could be independent of the merger. I consider each factor separately, below.

Merger efficiencies are unlikely to explain Steris's increased margin. It is unlikely that the merger itself led to a reduction in Steris's costs (relative to what costs would have been absent the merger) that was anywhere close to large enough to account for the observed increase in Steris's operating margin. Steris projected only $2.5 million in synergies as a result of the transaction,[156] roughly 0.9% of the combined firm's pre-merger sterilization operating costs, or enough to increase the combined firm's pre-merger margin from 30.7% (in 2015) to 31.3%.[157] The lack of attention paid to synergies during the trial—they were discussed only during the brief testimony of one witness, Steris CEO Walt

[155] One way that costs can decrease is if the mix of products sold shifts to lower cost, higher margin products. Synergy documents contemporaneous with the trial indicated that x-ray was likely to be lower cost than gamma, and thus is it possible that some of Steris's increase in margin resulted from a shift in mix towards x-ray. However, this is unlikely to account for the majority of the increase in Steris's margin, given that Steris's first x-ray facility following the Synergy acquisition (in Venlo, Netherlands) was not opened until 2022, well after the increase in Steris's margin.
[156] Roseborough (Steris) transcript, 786:17-787:10
[157] Steris and Synergy reported a combined $284.3 million in operating costs in FY 2015, or 69.3% of combined revenue (implying an operating margin of 30.7%). Reducing these costs by $2.5 million would have decreased costs to 68.7% of revenue, increasing the combined operating margin by 0.9%, to 31.3%.

Roseborough[158]—suggests that synergies significantly in excess of projections were unlikely, since the parties had every incentive to describe synergies as thoroughly as possible during the trial.

It is possible that Steris realized merger cost savings beginning around 2017 that were unanticipated at the time of the merger. In my view, however, it is unlikely that savings of sufficient magnitude to explain Steris's increase in margin are possible. Both Steris and Synergy operated a large number of geographically-distributed sterilization facilities, making freight savings unlikely. Nor is a rationalization of facilities likely to have resulted in significant cost savings, given that Steris has not closed a significant number of facilities—for instance, it has not closed any gamma facilities since the merger.[159] Thus, the costs of a single sterilization facility—e.g., the Cobalt-60 or electricity and x-ray accelerator needed to generate photons and conveyor, warehousing, and shielding systems—are unlikely to be affected by the presence or absence of other facilities in a sterilizer's network.

Steris's increased margin is consistent with price increases. Steris does not publicly report pricing for its sterilization services. The one industry estimate of the price of gamma sterilization I am aware of comes from a small e-beam provider, E-BEAM Services, which has periodically updated a blog post describing its price for sterilizing boxes 6 inches in height as "competitive with gamma," and which listed this price as $1.60 per cubic foot on October 29, 2015[160] (four days before Steris closed its acquisition of Synergy) and as $4.20 per cubic foot beginning on October 21, 2021 (the last time the price was updated).[161] Thus, the ordinary course estimates provided by E-BEAM Services imply a compound annual growth rate in the price of gamma sterilization of 17.5%,[162] well in excess of the growth rate of Steris's costs, as reported in its financial filings.[163]

Steris has cited "favorable pricing" as a reason for increasing sterilization operating income in a recent financial filings (in 2024).[164] In past years, Steris has described other causes of its increasing margin, including "organic growth and favorable fluctuations" (2022); "increased volume" offset by "higher labor

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[158] Roseborough (Steris) transcript, 786:17-787:10

[159] To determine that Steris has not closed any gamma facilities, I compared the list of current Steris gamma facilities, available on Steris's website, to the list of Steris and Synergy gamma facilities at the time of the merger. They are identical.

[160] E-BEAM Services, "What is the price of electron beam radiation sterilization, and how does that compare to gamma?," October 21, 2015, available at https://web.archive.org/web/20201021100214/https://ebeamservices.com/blog/price-electron-beam-radiation-sterilziation-compare-gamma/.

[161] E-BEAM Services, "What is the price of electron beam radiation sterilization, and how does that compare to gamma?," October 21, 2021, available at https://web.archive.org/web/20151029004747/https://ebeamservices.com/blog/price-electron-beam-radiation-sterilziation-compare-gamma/. The blog had a price of $3.20 per cubic foot as recently as April 2021, see https://web.archive.org/web/20210410212735/https://ebeamservices.com/blog/price-electron-beam-radiation-sterilziation-compare-gamma/.

[162] The CAGR is the rate of growth which, if applied to a 2015 gamma price of $1.60 would result in a 2021 price of $4.20. $4.20 = $1.60 * CAGR^6.

[163] Some caution is needed in interpreting the estimates of E-BEAM Services, as only a relatively small fraction (10-15%) of products that can be sterilized using gamma or x-ray are capable of being sterilized by e-beam, because, as described above, the electrons emitted by an e-beam have mass and charge and thus cannot penetrate nearly as well as the photons emitted by gamma and x-ray sterilization, and are thus unsuitable for most products. It is possible that the estimates provided by E-BEAM services relate only to the minority of products that *could* be sterilized using e-beam, and that such products are not representative of the larger set of products which need to be sterilized using gamma or x-ray, and thus price increases associated with products not suitable for e-beam could be higher or lower than those measured by E-BEAM Services.

[164] Steris 2024 Annual Report, at 38.

and energy costs (2023); "higher volumes and reduced expenditures" (2021); "increased volumes" (2020); "increased volume" (2019 and 2018); and "the result of the combination [with Synergy], increased demand from core medical device Customers and operational efficiencies, including cost synergies" (2017).[165] As an additional point of reference, Steris's chief competitor, Sterigenics reported operating margins from sterilization of between 52% and 54% in each year from 2019-2024. Sterigenics was privately held prior to its fiscal year 2020, and did not publicly report financial results.

While the evidence as to causes of the increase in Steris's margin is not dispositive, my view is that Steris price increases in excess of any cost increases are likely to be responsible for at least some material portion of the increase in Steris's margin.

IV. Retrospectively assessing the FTC's case

This section reconsiders, with the benefit of hindsight, claims made by both the FTC and the merging parties at trial. I find that testimony of Synergy executives that the financial case for x-ray was "woeful" was inconsistent with evidence (Section IV.A); that both evidence presented at trial and Steris's own post-merger x-ray expansion strongly suggest Synergy was likely to expand with x-ray but for the merger (Section IV.B); and that Synergy's x-ray expansion was very likely to benefit consumers by increasing competition for sterilization services (Section IV.C).

A. Synergy's x-ray financial model strongly indicated that the x-ray project was projected to be profitable

Much was made at trial of Synergy's financial model for x-ray. The term "IRR," referring to Synergy's projected internal rate of return on its planned x-ray expansion, was used 86 times at trial.[166] Synergy executives contended that the IRR of the x-ray project was only 6.51%, which was below its internal threshold of 15% required for all capital projects, a threshold which Synergy testimony indicated was lightly documented[167] but which Synergy management and executives testified was understood throughout Synergy.[168]

Relying on this testimony, the district court cited the project's IRR as evidence that the x-ray business model "failed every one of the metrics Synergy uses to rank capital investments"[169] and noted that "the PLC board generally will not approve funding a discretionary capital investment without an IRR of 15%."[170] In the district court's view, the financial model approved by the SEB in September 2014 required "an effort to develop a financial model that more accurately represented the economic realities," and in the course of this effort, "the numbers got worse instead of better."[171]

[165] Steris 2017 Annual Report, at 32; Steris 2019 annual report, at 32; Steris 2018 Annual Report, at 33; Steris 2020 Annual Report, at 30; Steris 2021 Annual Report, at 34; Steris 2022 Annual Report, at 36; Steris 2023 Annual Report, at 35.
[166] The term "IRR" appears 86 times in the transcripts 796 pages.
[167] Hill (Synergy) transcript, 735:25-739:12.
[168] Tyranski (Synergy) transcript, 600:2-10.
[169] Opinion, at 35.
[170] Decision, 35-36.
[171] Opinion, at 35.

1. Replication of Synergy's financial model

The trial record allows me to replicate Synergy's financial model to a reasonable approximation. I do so by matching available model inputs and outputs— including the model's IRR[172]—to those discussed in testimony. In doing so, I find:

- **Synergy projected x-ray to be profitable**. Evidence strongly indicates that the IRR of Synergy's own model was approximately 15%, and thus at or near the level Synergy required for the approval of a project, even before accounting for improvements to the finances sought by management, and even under the conservative assumption that x-ray would be priced 20-40% lower than gamma. Testimony that the project had a low IRR depended on a selective view of evidence (in particular, a claim that Synergy ignored profits generated by a facility beyond year 10 when assessing profitability) that is not consistent with economics or with Synergy's ordinary course practices.
- **Capex decreased through exchange rate fluctuations**. The USD/EUR exchange rate became more favorable to Synergy between September 2014 and the project's death in March 2015, lowering the project's capex by $1 million per facility even without Synergy taking any action, and increasing the project's IRR above 15%.
- **Additional capex reduction would not have meaningfully affected profitability**. The additional capex reduction sought by Synergy, beyond that achieved through favorable exchange rate fluctuations, (i.e., an additional $500 thousand reduction per facility, for a total capex reduction of $1.5 million once the reductions from favorable exchange rate fluctuations were accounted for) would have resulted in only a minor improvement to the project's IRR. This capex improvement was the only concrete feedback from Synergy executives following the model's presentation at the September 17, 2014 SEB meeting, a fact that is most consistent with the project being close to (if not already over) the threshold for approval.
- **Synergy's x-ray model was conservative**. Synergy's x-ray model likely understated x-ray's profitability, in that it projected a price for x-ray that was a 20-40% discount off of the price of gamma, and further projected that this price would not increase over at least the first ten years of the lifespan of the new facilities. Allowing for even modest growth in the price of x-ray sterilization—e.g., allowing the price of x-ray to approach the then-prevailing price of gamma over a period of ten years—would have increased IRR significantly.
- **The model's treatment of transferred revenue was likely correct**. Synergy executives testified that Synergy's financial model contained a double-counting error resulting from shifting revenues from Synergy's derelict Lima, OH e-beam facility to its new x-ray facility, which artificially inflated the project's IRR. In fact, Synergy documents indicate Synergy may not have retained the revenue but for x-ray, meaning the revenues were appropriately included in the model.

My replication of Synergy's financial model is described in detail in the Appendix (Section VII.A). In broad strokes, it takes information on model inputs (prices, margins, capacities, costs, and expected capacity utilization) and model outputs (IRR, years to profitability) from the trial record and Synergy's annual reports and calibrates remaining unknown inputs (e.g., the annual fixed cost of an x-ray facility) to match the outputs of the actual model that are described in the trial record. Table 2 presents my replication of Synergy's financial model for its planned x-ray facilities in Texas and Indiana.

[172] Synergy's financial model indicated an IRR when considering only the first ten years of 6.51%, and an IRR when including a "terminal value" term accounting for the value of the plant after year 10 to be 15.85%.

Table 2: Replication of Synergy's financial model for TX and IN x-ray facilities (combined)

	Capital costs	Profit[1]	Price/cu. ft.[2]	Margin[3]	Capacity utilization (TX)[4]
2016	-$40,400,000	$343,000	$2.50	34.4%	0%
2017		$922,500	$2.50	34.4%	17%
2018		$2,535,000	$2.50	34.4%	33%
2019		$4,147,500	$2.50	34.4%	50%
2020		$5,760,000	$2.50	34.4%	67%
2021		$6,802,750	$2.50	34.4%	83%
2022		$7,609,000	$2.50	34.4%	100%
2023		$7,609,000	$2.50	34.4%	100%
2024		$7,609,000	$2.50	34.4%	100%
2025		$7,609,000	$2.50	34.4%	100%
2026		$7,609,000	$2.50	34.4%	100%
2027-2041		>$7,609,000	>$2.50[5]	34.4%	100%
IRR, 2016-2041		**14.50%**	(2016-2041 was approximate facility lifespan)		
IRR, 2016-2025 only		**6.51%**	(matches Synergy calculation)		
IRR, 2016-2025 + TV[6]		**15.85%**	(matches Synergy calculation)		

Notes: 1- Profit is Price/cu. ft. * Margin * Capacity utilization * Capacity - Fixed costs. I assume each facility has a capacity of 5,625,000 cu. ft., based on Synergy's statements at trial that four facilities could capture 15% of 150 million cu. ft. U.S. gamma sterilization. I calibrate fixed costs to be $1.033M, so that the 2016-2025 IRR equals 6.51%, consistent with Synergy's model. 2- Synergy assumed a price of $2.50/cu. ft. through year 10. 3- Synergy's 2015 operating margin was 34.4%. 4- Synergy assumed that capacity utilization of its TX facility would increase to 100% over six years. Synergy's IN facilitiy was assumed to begin with a base of e-beam revenue, which I approximate as $4 million in revenue beginning in 2016, with IN adding volume at the same rate as TX. 5- Synergy assumed that revenue grew at 2% per annum beginning in 2027. 6- Synergy calculated a terminal value assuming profits would grow at 2% per annum in perpetuity. I calibrate the discount factor to match Synergy's calculation of a 15.85% IRR. This discount value is 11.9%.

Using Synergy's framework, the IRR when accounting for the first 25 years of the facilities (the approximate expected lifespan of an x-ray facility) is 14.5%, meaning that the flow of projected profits from 2017-2041 would, if discounted at 14.5%, exactly cancel out the initial expenditure on the constructing the new facilities. Synergy, using a different (but related) methodology for calculating IRR (specifically, calculating an approximate a "terminal value" of each facility beginning in year 11) determined that the project's IRR was 15.85%.[173] Thus, per both Synergy's and my calculation, the project's IRR was close to 15% at the time of the September 2014 SEB meeting.

The replication of Synergy's model presented in Table 2 allows me to assess Synergy testimony regarding key model inputs that were at issue at trial.

[173] The terminal value calculation used by synergy appears to set the terminal value of each x-ray facility to its year-10 profit flow, divided by a discount rate minus a rate of growth, or $TV = \frac{year\ 10\ profit}{discount\ rate - growth\ rate}$. The trial record indicates that the calculation used a 2% growth rate, consistent with Synergy's publicly-disclosed "perpetuity growth rate" of 2%. The discount rate that results in an IRR (including terminal value) of 15.85% is 11.9%. This discount rate is well above Synergy's publicly-announced pre-tax discount rate of 7.9%, possibly reflecting perceived additional risk associated with x-ray. See Synergy 2015 Annual report, at 81 for the pre-tax discount rate and the perpetuity growth rate of Synergy's AST segment.

2. Favorable exchange rate fluctuations achieved two-thirds of Synergy's stated Capex reduction goal

Synergy management testified that they were asked to reduce Capex by $1.5 million per facility following the September 2014 SEB meeting, and did not identify other specific feedback regarding the project's finances.[174] Synergy achieved approximately two thirds of its capex reduction goal solely through favorable exchange rate fluctuations between the September 17, 2014 SEB meeting and Synergy's February 24, 2015 decision to kill its planned x-ray expansion. The x-ray accelerators Synergy planned to purchase were priced in Euros while Synergy, a U.S. company, would have paid for them in dollars. The dollar strengthened by approximately 18.4% between the September 2014 SEB meeting and Synergy's termination of its x-ray plans in late February, 2015, resulting in the dollar cost of the accelerators decreasing from $6.6 million in September 2014 to $5.6 million in early March 2015 (the date closest to the death of Synergy's x-ray expansion for which data are available).[175] The reduction in capex due to the more favorable exchange rate increased the x-ray project's IRR to 15.2% (when assuming no other changes).

Decreasing the capex by an additional $500 thousand per facility (to bring the total capex reduction to $1.5 million per facility) would have further increased IRR to 15.5%. This modest return from the additional capex reduction requested by Synergy executives—and the lack of other feedback regarding Synergy's financial model—is consistent with the project *already* having an IRR at or near the level required for viability. The modest increase in IRR from fully achieving Synergy's stated goal of reducing capex by $1.5 million per facility is not consistent with testimony by Synergy executives that the financial model was "woeful"[176] and showed returns far below what would be needed for approval.[177] If executives saw the model as "woeful," they would have been incentivized to either kill the project outright without delay, or to ask for more dramatic improvements.

3. The model conservatively assumed x-ray would be significantly discounted relative to gamma

Synergy's financial model assumed a price of $2.50 per cu. ft. for the life of the x-ray facilities.[178] In 2015, gamma sterilization was priced between $3 and $4 per cu. ft.[179] This means that Synergy's model assumed that Synergy x-ray would offer between a 20% and a 40% discount off of then-prevailing gamma rates. Evidence indicates that the price of gamma has increased, potentially dramatically, since 2015.[180] Synergy's model did not account for any growth in the price of x-ray sterilization, at least until 2027, when Synergy assumed that x-ray revenue would grow by 2% per year in calculating the terminal value of the x-ray facilities.[181] Synergy's model is *extremely* conservative in this regard; merely projecting the price of x-ray to grow to $4 over ten years—i.e., so that the price of x-ray in 2026 would be equal to the

[174] Tyranski (Synergy) transcript, 610:5-12.
[175] The exchange USD:EUR exchange rate was 1.2829 on 9/20/2014 and 1.0844 on 3/7/2015. Synergy projected each x-ray accelerator to cost EUR 5.174 million.
[176] On September 20, 2014, the USD:EUR exchange rate was 1.2829. On March 7, 2015, it was 1.0844. Synergy projected the cost of an x-ray accelerator to be EUR 5.174 million, which was equal to $6.6 million in September 2014 and $5.6 million in March 2015. See Tyranski (Synergy) transcript, 633:13-15 (stating that Synergy modelled the x-ray accelerators to cost EUR 5.174 million).
[177] Hill (Synergy) transcript, 683:4-6.
[178] Mclean (Synergy) transcript, 414:23-415:1.
[179] McLean (Synergy) transcript, 415:7-14.
[180] See note 162, supra. See also evidence on the increasing profit margin of Steris, Section B, supra, which is most consistent with Steris being able to increase its prices for sterilization services.
[181] Hill (Synergy) transcript, 687:10-11.

high-end estimate of the price of gamma in 2016, but making no other changes—would increase the IRR associated with the x-ray project to 19.7%.[182] Allowing the price of x-ray to grow at 5% per year over the life of the facilities (while maintaining the model's initial 20-40% discount off of gamma prices) would increase the project's IRR to 20.7%.

Synergy executives testified that the financial model was conservative in its assumptions on the price of x-ray. McLean testified that Synergy intentionally modelled the price of x-ray to be below that of gamma "to be a little bit conservative."[183] McLean also told Steeves that the number in the projections were "bolted down" but that "there were elements in the model that were highly conservative [and] I am hoping we do not misinterpret a conservative business case with not being on top of the numbers."[184] Synergy documents indicated that, if anything, x-ray might be able to sustain a price *premium* over gamma; for instance, a July 2014 presentation prepared by McLean's stated "Experience from Däniken demonstrates that customers are willing to pay a premium for x-ray if they have unique DUR, temperature, turnaround time, or other specific requirements."[185]

Synergy may well have had good business reasons to model the price of x-ray to be well below the gamma price, i.e., to reflect the risk inherent in a new technology. However, the model's IRR of approximately 15% even under its highly conservative pricing assumptions contradicts Synergy testimony that the model projected "woeful" financial returns.

4. The model's treatment of Lima e-beam revenues is consistent with economics

Synergy's x-ray model included revenues intended to be transferred from its soon-to-be-closed e-beam facility in Lima, OH to its x-ray facility in Decatur, IN. The trial record indicates that Synergy projected these revenues to begin immediately.[186] Synergy executives testified that the inclusion of these revenues was a double counting error, since Synergy already had the revenues, and thus they would not be incremental to new x-ray facilities.[187]

As a matter of economics, it would be appropriate to count the Lima revenues in the x-ray model if (and only if) Synergy had no good alternative means to keep the revenue. Synergy's lease at its Lima facility had expired and Synergy documents indicated plans to shutter the facility and to move the volume to its new Decatur facility.[188] Decatur is located 53 miles from Lima. Synergy's next closest plant, in Saxonburg, PA, was located 264 miles from Lima, and was co-located with a Bayer facility,[189] meaning that a portion of Saxonburg's volume was likely dedicated to Bayer.[190]

Saxonburg came online in March 2015. In January 2015, Synergy sought to extend the end date of its Lima lease from October 2016 to October 2017 to "buy us time for the Steris transaction and x-ray

[182] This calculation assumes that the price of x-ray would grow by 2% per year thereafter, consistent with Synergy's financial model.
[183] Mclean (Synergy) transcript, at 415:7-14.
[184] McLean (Synergy) transcript, 326:19-3274:3.
[185] McLean (Synergy) transcript, 289:17-23.
[186] Tyranski (Synergy) transcript, 540:19-23.
[187] Hill (Synergy) transcript, 694:7-14.
[188] Tyranski (Synergy) transcript, 540:19-22.
[189] The Google Maps street view shows a Bayer facility connected to the Steris facility in Saxonburg; see https://tinyurl.com/4ja7j2rj.
[190] For instance, Synergy's Petaluma, CA e-beam facility was co-located with Labcon, who committed to providing volumes to the facility. Tyranski (Synergy) transcript, 636:8-18.

strategy,"[191] which suggests that Synergy did not see transferring the Lima volumes to Saxonburg as a viable strategy. Synergy's next closest facility, in Chester, NY, was 587 miles away from Lima. Per the FTC's complaint, sterilizers generally serve customers located within 500 miles of facilities,[192] indicating that Synergy's Lima customers may have been unwilling to have product sterilized at Chester. If the planned Decatur x-ray facility represented Synergy's best chance to retain the Lima customers after the Lima facility was closed, as a matter of economics if would be appropriate to count the Lima revenue towards the profitability of the x-ray plan, contrary to the testimony of Synergy executives.[193]

Even when considering, for the sake of argument, the executives' testimony that including Lima revenues was an "error," removing the estimated Lima revenues (but making no other change) lowers x-ray's IRR from 14.5% to 12.8%.[194] Removing Lima revenue from a more aggressive version of the financial model, under which the price of x-ray grows at 5% per year and Synergy's margin grows at 2% per year, reduces the IRR from 23.0% to 21.2%. In short, while the inclusion of the Lima revenues was likely appropriate, their exclusion would not have materially worsened x-ray's profitability.

5. Testimony that Synergy ignored profits beyond year ten of a project is not consistent with economics or Synergy documents

Synergy executives testified that Synergy customarily considered only the first ten years in evaluating the profitability of a project, and ignored any profits that accrued in year 11 or beyond.[195] Synergy claimed that it did so because "in the long run, we are all dead. And anything over ten years is very much in the long run."[196] My replication of Synergy's financial model indicates that considering only the first ten years of profits lowers x-ray's IRR from 14.5% to a 6.51%,[197] and thus caused the profitability of the project to be significantly understated relative to an accurate and appropriate accounting that considered profits generated over the full lifespan of new x-ray facilities.

Synergy's claimed irrelevance of profits from year 11 on does not withstand scrutiny. Synergy forecast the lifespan of an x-ray facility to be between 20 and 30 years,[198] and the Däniken x-ray facility, constructed in 2010, remains open in July 2025. Synergy forecast a six year "ramp-up" to a new x-ray plant reaching capacity, meaning that limiting a financial model to consider only the first ten years would account for only four years of operation at capacity.

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[191] Tyranski (Synergy) transcript, 540:13-541:5.
[192] FTC complaint, at ¶47.
[193] It is possible the next best alternative to transferring the volume to a new x-ray facility in Indiana was extending the Lima lease and keeping the volumes in Lima.. See Hill (Synergy) transcript, 747:24-748:1. Had Synergy pursued this option, it would have incurred additional costs from keeping Lima open, costs which Synergy executives had evidently decided were prohibitive, given their realized decision to close Lima and move volumes elsewhere.
[194] At trial, Synergy executives testified that removing Lima revenue halved the IRR, on the basis of taking the ten-year IRR, which ignores revenues from 2027 onwards, from "6 percent to 3 percent" (Hill (Synergy) transcript, 694:17-18). In my replication of Synergy's model, removing Lima revenues takes the ten-year IRR from 6.51% to 3.7%, which validates my replication being a reasonable approximation of Synergy's financial model.
[195] Hill (Synergy) transcript, 772: 2-7.
[196] Hill (Synergy) transcript, 660:4-7.
[197] In fact, Synergy's model calculated the IRR when ignoring years profits beyond year 10 to be exactly 6.51%. I exactly match Synergy's number because I calibrated a model input—the amount of fixed costs per period—to equate the 10-year IRR implied by my replication of the Synergy model to 6.51%. Different assumptions regarding fixed costs or other model inputs would not change any of my conclusions.
[198] Synergy itself modelled the x-ray accelerator as having a 20-year lifespan and the building and conveyor system associated with an x-ray plant as having a 30-year lifespan. See Hill (Synergy) transcript, 741:20-742:4.

Ignoring profits beyond year ten is inconsistent with profit maximization or economics.[199] As an example, consider a project requiring a $20 million upfront payment that would produce a profit of $100 million in year 11 (and no other profits). The project would be a clear money loser when considering only the first ten years (i.e., it would lose $20 million over the first ten years), but a clear winner over an 11 year horizon (with an IRR of 15.8%, i.e., similar to the IRR associated with Synergy's x-ray project).[200] Economics teaches that a profit-motivated firm, like Synergy, would have every incentive to consider all profits that would accrue from a project, including those beyond year 10.[201]

The practice of ignoring profits beyond year 10 was not memorialized in Synergy documents.[202] Indeed, the standard financial template designed by Synergy executives included both a ten-year IRR and a long-run IRR (with a terminal value).[203] Synergy's past actions also were not consistent with considering only the return in the first ten years of an investment. Synergy documents indicated that four of ten recently-approved Synergy projects had projected (ten-year) IRRs of less than 15 percent at the time they were approved.[204] If Synergy had considered only the first ten years of those projects, and had required an IRR of 15%, it would not have approved funding for those projects.

6. Testimony that the model's "Terminal Value" was incorrectly applied is unavailing

Synergy executives testified that the x-ray financial model was unreliable because it included a terminal value term—meaning a proxy for profits in year 11 and beyond—that assumed x-ray would deliver revenues "into perpetuity, so that means forever and ever and ever, and that clearly is not realistic."[205] My replication of Synergy's financial model allows me to estimate Synergy's IRR without relying on any terminal value calculation, and thus to assess Synergy's methodology.

The executives are correct in that economics does not support modelling the profitability of an asset with a 20-30 year life as though it would produce returns forever. However, the practical effect of this modelling choice was vastly overstated at trial, as when a Synergy executive testified that "a terminal value goes out thousands and thousands of years into the future."[206] Synergy's terminal value calculation discounted future profits,[207] and it appears that Synergy management applied a high annual discount rate of approximately 11.9%—about 50% higher than Synergy's contemporaneous corporate discount rate of 7.9%[208]—to future profits, which had the effect of assigning almost no value to revenues that were projected to be realized more than a few years into the future. For instance, at an annual discount rate of 11.9%, profits to be realized 6 years into the future would be discounted by half, and profits to be realized

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[199] See, for example, Brealey, Richard A., Stewart C. Myers, Franklin Allen, and Alex Edmans. Fundamentals of Corporate Finance. 9th ed. New York: McGraw-Hill Education, 2018, (at 241-242 (stating that the "net present value rule states that managers increase shareholders' wealth by accepting projects that are worth more than they cost" and that "the net present value rule works for projects of any length.").

[200] That is, $-20M + \frac{100M}{(1+1\ .8\%)^{11}} = 0$.

[201] See, for example, Robert S. Pindyck & Daniel L. Rubinfeld, Microeconomics, 8th ed. (Pearson, 2013), chap. 8 "Profit Maximization and Competitive Supply," §8.2 Do Firms Maximize Profit?, p. 272 ("The assumption of profit maximization is frequently used in microeconomics because it predicts business behavior reasonably accurately and avoids unnecessary analytical complications.")

[202] Hill (Synergy) transcript, 735:25-738-10

[203] Hill (Synergy) transcript, 660:21-661:9.

[204] Baroudel (Synergy) transcript, 476:12-477:3.

[205] Hill (Synergy) transcript,

[206] Hill (Synergy) transcript, 738:7-10

[207] Hill (Synergy) transcript, 738: 18-21.

[208] Synergy 2015 Annual Report, at 81.

15 years into the future would be discounted by more than 80%. Profits "thousands and thousands of years into the future" would be discounted to literally zero.[209]

Synergy additionally assumed that each facility's x-ray revenues would grow in perpetuity at 2% per year, which Synergy executives testified was "clearly not realistic."[210] In fact, a 2% growth rate was Synergy's stated standard modelling assumption in 2015, as described in its Annual Report (describing a 2% "perpetuity growth rate" for Synergy AST).[211] Synergy appears to have applied a common methodology to calculate the project's terminal value, under which the terminal value equals the annual profit flow divided by the discount factor minus the projected growth rate.[212] As mentioned, my replication of Synergy's financial model implies that Synergy applied a discount rate of 11.9%,[213] which is well *above* its stated corporate-wide discount rate of 7.9%.[214] The higher discount rate assumed by Synergy *lowers* the terminal value and thus has the effect of compensating for Synergy's assumed perpetual revenue from x-ray facilities.

Based on my replication of Synergy's model, which calculates out-year profits directly rather than through the use of a terminal value, Synergy's terminal methodology appears to reasonably approximate the correct value of IRR over the life of the project, in that Synergy's IRR (including terminal value) was 15.85% whereas in my replication the IRR over an estimated 25-year life of the facilities was 14.50%. Thus, the use of a perpetual value IRR no more than modestly overstated the project's IRR, contrary to testimony of Synergy executives.

7. The model conservatively projected slow volume growth

Synergy executives testified, and the court cited as persuasive, that Synergy's x-ray model was "the product of guesswork and assumptions."[215] In this, they appear to refer to the rate at which x-ray plants would attract new business. Synergy's financial model assumed that its Texas x-ray plant would reach capacity in year seven, and its Indiana plant earlier (owing to the Lima volumes that would shift to Indiana). The realized experience of Steris's x-ray plants suggests Synergy's modelling assumptions were, if anything, conservative. In particular, Steris's Venlo x-ray plant opened in 2022, and in 2023—about one year later—Steris announced it would build a second x-ray facility on the same site and stated in an earnings call that Venlo was "very well-received" with "significant positive margins,"[216] which strongly suggests that Venlo was on track to reach capacity well before its seventh year. Likewise, the proliferation of x-ray facilities throughout Steris's network, as described in Section III.A, indicates broad customer acceptance of x-ray sterilization.[217] Moreover, Synergy had continued to move forward with its x-ray plans over the course of two years, suggesting that it saw significant demand for x-ray sterilization. Nonetheless, Synergy is correct that a lag in the time it would take for an x-ray plant to reach capacity

[209] For instance, at an 11.9% annual discount rate, profits 2,000 years into the future would be discounted by a factor of 2.2 * 10^-98. As a point of reference, there are approximately 10^80 atoms in the universe, meaning that the proportion of profits "thousands of years into the future" that would contribute to IRR is less than the ratio of one atom to all of the atoms in the universe.
[210] Hill (Synergy) transcript, 687: 10-14.
[211] Hill (Synergy) transcript, 658:3-6.
[212] See, for instance, Brealey, Richard A., Stewart C. Myers, Franklin Allen, and Alex Edmans. Fundamentals of Corporate Finance. 9th ed. New York: McGraw-Hill Education, 2018, at 215-216.
[213] 11.9% is the discount rate that produces an IRR (inclusive of terminal value) of 15.85%, consistent with Synergy's financial model. See Hill (Synergy) transcript, 740:8-11.
[214] Synergy 2015 Annual report, at 79.
[215] Decision, at 17.
[216] Steris 2023 Q1 earnings call.
[217] See Section A, supra

would have worsened the financial returns of the x-ray project. For instance, if it took 10 years instead of 6 for the facilities to reach capacity, with no other changes, the IRR of Synergy's x-ray expansion would decrease from 14.5% to 12.2%.

Evidence indicates that Synergy was well aware that converting customers to x-ray could be a gradual process, and moved forward with its x-ray expansion nonetheless. For instance, Tyranski testified that Synergy's SEB was aware that it would take time for medical device manufacturers to convert products to x-ray sterilization,[218] with the plan being to initially fill volume at Synergy's new facility by sterilizing non-medical products and less-regulated Class 1 medical devices.[219] While there surely was uncertainty as to the speed with which customers would adopt x-ray sterilization, the record indicates that this uncertainty was appropriately accounted for in Synergy's financial model through the gradual ramp-up of x-ray revenue at Synergy facilities.

8. The model conservatively assumed no growth in Synergy's margin on x-ray sales

Synergy's financial model appears to assume that Synergy would earn a constant margin on x-ray sales over the life of the facility, and in replicating their model I assumed a margin of 34.4%, taken from Synergy's 2015 Annual Report. The combined firm's margin increased dramatically following the merger, from 32.4% in 2017 (the first full post-merger year) to 41.6% in 2025.[220] Holding Synergy's margin fixed while allowing the price of x-ray to increase implicitly assumes that its costs would increase in lockstep with its revenues.[221] A more likely scenario is that Synergy's costs would stay roughly constant as its prices increased to match those of gamma, which would cause its profit margin to increase. Allowing for 5% annual growth in the price of x-ray and also allowing Synergy's profit margin to increase steadily to 41.6% by FY 2025—i.e., to match Steris's operating profit margin in 2025—increases the project's IRR to 23.1%.[222]

9. Summary

Table 3 summarizes the various potential changes to Synergy's financial model discussed above. The results in the table indicate that Synergy's baseline financial model was at or near the 15% IRR threshold stated to be required of all Synergy capital projects even with conservative assumptions and that even marginal changes to those assumptions would have increased the IRR to be materially above 15%. Indeed, in one key way—a more favorable exchange rate lowering the cost of the x-ray accelerators by $1 million apiece—the x-ray project already had a notably improved IRR in late February 2015, when it was killed, than it did when it was approved by the SEB in September 2014.

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[218] Tyranski (Synergy) transcript, 51625-517:12.
[219] Tyranski (Synergy) transcript, 518:22-519:5.
[220] See Section B, supra.
[221] A firm's variable cost margin is $\frac{p-c}{c}$, where c is the firm's marginal cost. In this equation, if p increases, the margin increases as well, unless c also increases in proportion to p. However, if the price of x-ray increased simply because it was moving towards parity with gamma, the cost c would be unlikely to increase and thus the margin $\frac{p-c}{c}$ would increase.
[222] In 2015, Synergy likely had no reason to expect its margin to increase dramatically in the next ten years, but an increase in price would typically also result in an increased margin, thus making a price increase even more profitable than it would be with a constant margin. Thus, an assumption of a constant margin exacerbates the extent to which the price assumptions embedded in Synergy's model are conservative.

Table 3: Internal rate of return of Synergy financial model under various scenarios

Capex	IRR	Price of x-ray	IRR
Baseline: $20.2 million per facility	14.5%	Baseline: $2.50 per cu. Ft.	14.5%
↓ $1 million from stronger dollar	15.2%	↑ 2%/yr, to $3/cu. ft. in 2026	16.7%
↓ $1.5 million (Synergy's goal)	15.5%	↑ 5%/yr, to $4/cu. Ft. in 2026	17.6%
Synergy margin		**Lima revenues**	
Baseline: 34.4% margin	14.5%	Baseline: Lima revenues to IN	14.5%
↑ 2%/yr (match Steris 2025 margin)	16.7%	↓ Remove Lima revenues	12.8%
Terminal value		**Rate of volume growth**	
Baseline: 25-year facility life, no TV	14.5%	Baseline: 6 yrs to fill capacity	14.5%
Synergy TV calculation	15.9%	↓ 10 yrs to fill capacity	12.2%
Medium upside scenario		**High upside scenario**	
Capex ↓ $1M, 6 yrs to fill capacity, price ↑ 2%/yr, Lima revenues to IN	17.4%	Capex ↓ $1M, 6 yrs to fill capacity, price ↑ 5%/yr, margin ↑ 2%/yr	21.4%
Downside scenario			
Baseline capex, price, and margin, no Lima, 10 yrs to fill capacity	10.2%		

B. Was Synergy likely to enter but for the merger?

Synergy documents, as summarized in Section C, strongly indicate that Synergy was, at the least, seriously considering, and in the advanced stages of planning for, U.S. x-ray entry. At trial, Steris and Synergy dismissed these documents as "aspirations"[223] that never got past the "'wouldn't it be great' phase."[224] Steris's post-trial brief stated that "no rational public company would have [built one or more x-ray facilities in the U.S. in a reasonable period] when confronted with the challenges, uncertainties, and feeble financial returns faced by Synergy."[225]

The parties' arguments centered on the following points:

- The project's SEB approval endorsed only the general strategy, and did not promise the funds needed to build two or more U.S. x-ray facilities.[226]
- Synergy's financial model relied on "utterly speculative assumptions" and "fell far short of the standard benchmarks for Synergy approval."[227]
- Approval would have required "a rigorous 'black hat' financial review by the finance department,"[228] which was never done because "the financials failed on their face and such a review would have been pointless."[229]

[223] Baroudel (Synergy) transcript, 495:13-21.
[224] Steris opening argument, transcript 16:12-15.
[225] Steris post-trial brief, at 1.
[226] McLean (Synergy) transcript, 419:8-23.
[227] Steris post-trial brief, at 1.
[228] Steris post-trial brief, at 1.
[229] Steris post-trial brief at 14.

- The approval of Synergy's PLC board was required for all investments greater than GBP 10 million, which would include the U.S. x-ray project's $40 million investment. The x-ray project had not advanced to the point where PLC approval had been sought.[230]
- The PLC board would not have granted its approval to the U.S. x-ray project, because the financials were poor and the project lacked "take-or-pay" customer commitments.[231]

The FTC did not dispute that Synergy's PLC board had not yet signed off on Synergy's x-ray expansion. However, the FTC contended that Synergy's ordinary course business documents indicated that the project had buy-in from the highest levels of the company and that Synergy "likely would have entered the United States with x-ray absent the proposed transaction."[232] The FTC further contended that the putatively gating obstacles the x-ray's approval—namely the lack of "take-or-pay" customer contracts and an IRR below 15%—were supported only by post-hoc testimony, and not by ordinary course documents.[233] In the FTC's view, Synergy documents indicated that the FTC investigation itself was the cause of the demise of Synergy's x-ray plans.[234]

The district court sided with the parties on this dispute, citing the project's financials, lack of customer commitments, and lack of PLC approval. The court cited the timing of the death of the x-ray plan as "the best evidence that it was done for legitimate business reasons, as opposed to anti-competitive ones" since "if the merger with Steris was going to prevent Synergy from entering the U.S. market, Synergy would have stopped working on the U.S. x-ray project as soon as the merger was announced in mid-October 2014." Thus "the fact that McLean and Tyranski decided to terminate the project in February 2015, four months after the merger was announced and in the midst of the FTC's investigation, supports the conclusion that this was a decision reached by the project managers after serious consideration of all the business factors involved."[235]

There is no point to my attempting to relitigate the dispute between the FTC and the parties regarding the proper interpretation of Synergy's business documents and testimony. However, ten years of hindsight permit me to offer the following observations on the economics of Synergy's entry plans:

- The FTC and one of its witnesses (Hansen of Johnson and Johnson)[236] cited fears of limited supply or harsher regulation of cobalt as a significant factor pushing the industry towards accelerator-based irradiation. While these fears remain, both Steris and Sterigenics appear to have sufficient supply of Cobalt, and Steris projected in 2020 that "we expect to see cobalt around for a long, long, long time."[237] Steris appears to continue to purchase cobalt from Nordion, despite its being owned by rival Sterigenics,[238] and evidence that Steris's sterilization margin has increased (see Section B, above) indicates that Nordion has not meaningfully worsened the terms on which it supplies cobalt to competitors of Sterigenics.
- Synergy's claims that customers were not interested in x-ray are in tension with Steris having opened or announced 10 additional x-ray facilities since closing the Synergy acquisition,

[230] Baroudel (Synergy) transcript, 450:19-24.
[231] Baroudel (Synergy) transcript, 500:17-19
[232] FTC post-trial brief, at 1.
[233] FTC post-trial brief, at 1.
[234] FTC opening statement, transcript, 12:17-13:5; Decision, at 39.
[235] Decision, at 39-40.
[236] Hansen (Johnson & Johnson) transcript, 45:19-46:5.
[237] Steris 202 Q2 earnings call.
[238] A current export license permitting Nordion to export (presumably spent) Cobalt-60 from 46 U.S. sites to Canada lists 46 every U.S. Steris site. See https://www.nrc.gov/docs/ML2308/ML23088A400.pdf.

accounting for substantially all of Steris's additional worldwide radiation capacity, since the time of the merger (see Section A). However, to date, Steris has opened only one x-ray facility in the U.S. (with two more planned), and the public record does not indicate how well Steris's U.S. location is doing.

- Synergy's claims that the financial case for x-ray was "woeful" is in tension not only with the actual results of the model (see Section A), but with Steris's reliance on x-ray for substantially all of its new facilities since the time of the merger. Steris's investment in x-ray came after it acquired Mevex, a supplier of x-ray accelerators, allowing it access to accelerators at cost, an advantage that Synergy did not have in 2015. At the same time, Synergy's proposed supplier, IBA, reported a loss in its accelerator segment, indicating that the market rate for an accelerator may not be far above the cost of manufacturing one internally.[239]
- There is clear evidence that the fact that the FTC inquiry was "going down a rat hole"[240] contributed to Synergy's decision to kill its x-ray expansion, and the court's inference that the timing of the project's demise indicated it was killed for business reasons is not consistent with the factual record. For instance, as recently as January 19, 2015—36 days before Tyranski's observation that the FTC investigation was "going down a rat hole"—Synergy was making significant business decisions contingent on its x-ray expansion (i.e., extending the lease of its Lima facility for one year so that Lima's volumes could be transferred to a new x-ray facility).[241] Nothing material changed as to the x-ray business case in those 36 days and the most logical explanation for Synergy's decision is that it learned that FTC staff was concerned about the overlap between Steris gamma and Synergy x-ray.[242] The more likely explanation is that the timing was determined by the need to produce evidence favorable to Synergy's position that it was unlikely to move forward with x-ray regardless of the fact of the Steris acquisition.

C. Would Synergy's x-ray expansion have increased competition?

The Synergy court focused exclusively on whether an independent Synergy was likely to enter with x-ray.[243] The court did *not* consider in its opinion or at trial whether Synergy's entry would have had meaningful competitive effects, despite the competitive effects of potential entry being a crucial component of any antitrust analysis. In this section I assess the implications of the record for the likely competitive effects of Synergy's entry. Broadly, I find support for x-ray in general and Synergy x-ray in particular competitively constraining gamma offerings from Steris and Sterigenics and giving customers leverage to obtain lower prices on gamma sterilization. However, the record indicates that it may have taken time for this competitive pressure to be meaningful.

Synergy documents contemporaneous with the merger predicted Synergy's x-ray facilities would have competed directly with Steris and Sterigenics gamma facilities[244] and incentivized gamma providers like

[239] IBA annual report 2023, at 127 (showing an EBIT for IBA's "Proton Therapy and Other Accelerators" segment of EUR -636,000). See https://www.iba-worldwide.com/sites/default/files/2024-04/iba_annual-report-2023_digital_en.pdf.
[240] McLean (Synergy) transcript, 359:14-21.
[241] Tyranski (Synergy) transcript, 540:5-18.
[242] McLean (Synergy) transcript, 358:7-10.
[243] Transcript, 791:10-16 (in which the court stated "So that's the question I have to decide. What is the evidence? Does it show a probability that Synergy would have entered the U.S. market by building one or more x-ray sterilization facilities within a reasonable period but-for the merger? If so, then I grant the injunction. If not, then I don't.")
[244] For instance, see McLean (Synergy) transcript, 302:10-15 ("Q: One of the things that Synergy had identified that might result if it entered with x-ray was that Steris and Sterigenics might drop prices for gamma. Correct? A: Yes.")

Steris and Sterigenics to lower prices.[245] A September 2014 presentation made by McLean and Tyranski to the SEB stated that one potential "competitive response" to Synergy's contemplated x-ray expansion was that rivals would "enter into pricing way, reducing prices to keep customers."[246] McLean testified at trial that increased price competition following Synergy's x-ray entry "was just going to be a reality" and that Synergy's entry would "inevitably lead to some form of pricing pressure."[247] Minutes from the November 2014 PLC Board meeting state that Steeves considered both Steris and Sterigenics to be concerned about Synergy's x-ray plans.[248] A Synergy document stated that any future x-ray plant should be built in the U.S. rather than the U.K. (where most Synergy gamma facilities were located), since "if an x-ray facility was built in the U.K., the probable effect would be to cannibalize the gamma business."[249] Tyranski testified that, prior to Steris's announced acquisition, the purpose of Synergy's x-ray plans was to take gamma business from Steris and Sterigenics.[250]

Synergy's actions following the approval of the x-ray plan by the SEB indicate that Synergy believed the x-ray plants would compete with Steris's gamma plants. Upon learning that the SEB had approved the x-ray strategy that McLean had been working to implement, he wrote "it's going to be a street fight," referring to anticipated competition between Synergy, Steris, and Sterigenics.[251] Tyranski stated shortly after the announcement of Steris's acquisition that an "obvious hold[] would be location, not putting a gamma beater next to a Steris facility and taking new Steris market share."[252] On October 21, 2014, one week after the announcement of Steris's acquisition, Tyranski wrote to the Synergy x-ray team saying "We've made a difficult, sensible decision to stop any market development expense on x-ray outside the already budgeted and ongoing activity in Däniken/Europe while we wait for the Steris transaction."[253]

The one Synergy customer to testify at trial, Joyce Hansen of Johnson & Johnson, testified that she viewed Synergy as more innovative than Steris or Sterigenics and was concerned that Synergy's drive towards bringing x-ray sterilization to market would be lost were it to be acquired by Steris.[254] She also testified that Johnson & Johnson would benefit from the availability of x-ray sterilization, given uncertainty about the supply of Cobalt-60 and given the advantages of x-ray over gamma, including lower processing time.[255] However, Hansen did not testify at trial as to whether the merger might prevent beneficial price competition between Steris and Synergy, or otherwise result in higher prices, and indeed did not commit to Johnson & Johnson using x-ray if deployed by Synergy.[256]

Steris's own experience with x-ray is potentially informative as to the potential for x-ray to compete with gamma.[257] Since Steris completed its acquisition of Synergy in 2015, it has opened or announced 10 x-

[245] Tyranski (Synergy) transcript, 302:10-15.
[246] McLean (Synergy) transcript, 320:10-12.
[247] McLean (Synergy) transcript, 371:2-7.
[248] Baroudel (Synergy) transcript, 489:14-17.
[249] McLean (Synergy) transcript, 431:11-20.
[250] Tyranski (Synergy) transcript, 534:2-6.
[251] McLean (Synergy) transcript, 323:4-10.
[252] Tyranski (Synergy) transcript, 8-12.
[253] Tyranski (Synergy) transcript, 532:1-6.
[254] Hansen (Johnson & Johnson) transcript, 50:12-51:11.
[255] Hansen (Johnson & Johnson) transcript, 45:14-46:17.
[256] Hansen (Johnson & Johnson) transcript, 57:12-20.
[257] The only testimony from Steris regarding Synergy's x-ray plans was Steris's CEO, Walt Roseborough, stating that he did not know much about Synergy's plans (see Roseborough (Steris) transcript, 782:14-16). Rosebrough also testified that x-ray played no role in Steris's decision to purchase Synergy, and that the Synergy team did not raise it despite being incentivized to do so in negotiations if x-ray were likely to be a source of value going forward (Rosebrough (Steris) transcript, 783:1-25). The FTC did not surface Steris documents in its briefs indicating that

ray facilities and only one gamma facility,[258] indicating that Steris itself sees advantages to x-ray over gamma, and presumably believes its customers share this view (as a profit-maximizing firm would not be incentivized to open or announce 10 x-ray facilities if customers did not want to use them). Steris began expanding its x-ray footprint no later than October 2019, less than 4 years after closing the Synergy acquisition,[259] indicating that Steris saw x-ray as a preferred technology at least shortly after the merger. One smaller U.S. competitor, SteriTek, has also opened two x-ray plants since the time of the Steris/Synergy merger,[260] and Ionosys, a provider of sterilization services in Europe, has plans to open an x-ray facility in Henriville, France.[261] However, Sterigenics, which is vertically integrated with Nordion, a significant supplier of Cobalt-60, has not opened or announced any x-ray facility, and has expanded gamma locations,[262] indicating that gamma likely remains a viable technology to this day.

In sum, I find that the evidence strongly indicates that Synergy expected its x-ray facilities to compete with Steris's gamma facilities and recognized that such competition could lower prices. Steris's own choices since the merger, and in particular its choice to focus almost exclusively on x-ray for new facilities, indicates that it sees material advantages to x-ray over gamma. However, it is notable that Steris intensified its focus on x-ray after acquiring Mevex, a maker of x-ray accelerators, and thus becoming vertically integrated into x-ray.[263] Economics teaches that vertical integration often lowers costs and thus provides an additional incentive to use the integrated technology. Synergy as an unintegrated provider of x-ray services would not have had such an incentive, and in fact Synergy seemed to be at odds with its contemplated supplier, IBA. [264] Further, if the delays experienced by Steris in opening new U.S. x-ray facilities were also encountered by Synergy, Synergy's U.S. x-ray entry may not have occurred as quickly as Synergy had planned.

V. Implications of Steris/Synergy for future potential competition cases

A. The expected value standard: an economic approach to mergers involving potential competition

The Steris court decided the matter on the relatively narrow issue of "whether, absent the acquisition, the evidence shows that Synergy probably would have entered the U.S. contract sterilization market by building one or more x-ray facilities within a reasonable period of time."[265] At trial, the judge stated that if he found this to be the case, he would find for the FTC, and, if not, he would find for the parties.[266] The judge also declined to hear economic testimony at trial, stating in an order that direct testimony of experts

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Steris was concerned about, or even aware of, potential competition from Synergy x-ray, and no one from Steris's sterilization business was called to testify at trial.

[258] See Section A, supra.

[259] See Section A, supra.

[260] See https://www.steri-tek.com/company/#facilities/.

[261] https://www.ionisos.com/en/our-sites/henriville/ (stating that "routine [x-ray] treatments are expected to start during the summer of 2025").

[262] Sterigenics has expanded or opened gamma facilities in Fort Worth, TX (2017); West Memphis, AR (2017); and Markham Vale North, UK. See, for example, https://sterigenics.com/sterigenics-completes-expansion-of-ft-worth-facility/.

[263] https://www.steris-ast.com/mevex-equipment/; McLean (Synergy) transcript, 425:1-12.

[264] Tyranski (Synergy) transcript, 623:8-627:17.

[265] Decision, at 7.

[266] Transcript, 791:11-16.

would be presented solely through expert reports.[267] The court's opinion did not cite any economic testimony.[268]

As I understand the court's decision, the court applied a binary test: was Synergy "probably" going to enter absent the merger or not. Such a test very well may be consistent with the law,[269] but, in my view, it is not well-supported by economics and thus is likely to lead to suboptimal outcomes.

To facilitate a discussion of the economics of potential competition matters, consider the following three hypotheticals. Suppose, *arguendo*, that none of the hypothetical mergers would result in efficiencies, and so are appropriately evaluated on the basis of their potential to give rise to anticompetitive effects alone.

Hypothetical # 1. An incumbent monopolist producer is protected by durable barriers to entry (say, the need for scale, regulatory requirements, or patents) and charges significant markups. There is some chance that a firm in an adjacent market will be able to overcome these barriers and enter (say, a foreign competitor who has gained scale abroad and is thinking of entering the U.S., or a rival with new IP that, if it can be commercially implemented, might allow the rival to lap the incumbent). Conditional on entry occurring, there is significant evidence that prices would decrease substantially. For the sake of having a concrete example, suppose that entry would result in a 25% reduction in price and, through lower prices and greater quality, $4 billion in benefits to U.S. consumers. There is a 25% chance that entry will be successful, and a 75% chance that the rival will be unable to enter. The incumbent proposes to acquire the rival, and intends to discontinue the rival's entry plans, thus lowering the probability of entry to 0.

Hypothetical #2. An incumbent producer of a differentiated good proposes to acquire a rival who has well-advanced plans to enter (say, an incumbent pharmaceutical manufacturer wishes to acquire a drug from another manufacturer that could compete with the incumbent's drug for some patients, and which has successfully demonstrated its safety and efficacy in trials). Entry is reasonably likely if the rival remains independent. The rival's entry may, or may not, happen if the acquisition goes through (e.g., the incumbent's documents suggest the incumbent may discontinue efforts to bring the rival's drug to market). Say there is a 65% chance of successful entry if the rival is independent, a 45% chance if the incumbent purchases the rival, and further suppose that successful entry would result in a 20% price decrease and $3 billion of consumer benefits (suppose for tractability that these benefits are the same regardless of who owns the entrant).

Hypothetical #3. An entrant is planning to enter an oligopoly market but will only do so if it prevails in patent litigation; the entrant will win the litigation and enter with 51% probability, and lose and not enter with 49% probability. One of the incumbents proposes to purchase the entrant and makes it clear that it intends to discontinue the patent litigation and to no longer pursue entry (thus lowering the probability of entry from 51% to 0%). Conditional on entry, prices would fall by 3%, resulting in $10 million in consumer benefits.

Table 4 summarizes the hypotheticals, and computes the *expected value* associated with each merger, computed as the change in the probability of entry produced by the merger multiplied by the consumer benefits that would be created should entry occur.

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[267] *Case Management Plan and Scheduling Order*, Fed. Trade Comm'n v. Steris Corp., No. 1:15-cv-01080-DAP (N.D. Ohio June 8, 2015) (ECF No. 24).

[268] A review of the court's opinion indicates that no expert witness was cited.

[269] Legal scholars have written much about the development of case law around potential competition. For a recent example, see Herbert Hovenkamp, "Potential Competition," Antitrust Law Journal, 2024.

Table 4: The expected value of three hypothetical mergers

Hypothetical	Probability of entry			Consumer benefits from entry ($M)	EV of merger ($M)
	Pre-merger	Post-merger	Delta		
#1	25%	0%	-25%	$4,000	-$1,000
#2	65%	45%	-20%	$3,000	-$600
#3	51%	0%	-51%	$10	-$5.1

Which of these hypotheticals gives rise to the strongest challenge against the acquisition of a potential competitor? As I understand the case law, at least as interpreted by the judge in *Steris*, only Hypothetical #3 could result in a viable challenge, as it is the only scenario in which entry is more likely than not absent the acquisition and in which the merger causes the likelihood of entry to substantially decreases.[270] In Hypothetical #1, the merger would decrease the chance of entry by only 25%, and in Hypothetical #2, by only 20%.[271]

Hypothetical #3 is also the *least bad* of the hypotheticals, in that its being blocked would have the smallest effect on expected price and on consumer welfare.[272] This perverse result—i.e., worse mergers being less likely to be actionable under the antitrust laws—in my view, indicates that the legal framework, at least as it was applied in *Steris*, is unmoored from economics, and likely to result in both under- and over-enforcement. And while I have interpreted the legal standard as requiring that entry be "more likely than not" without the merger (relative to what happens with the merger), the logic of the hypotheticals continues to be valid even under different legal standards (e.g., a standard that blocked mergers if they resulted in at least a 30% reduction in the probability of entry).[273] At bottom, Hypothetical #3 the merger has the greatest effect on the *probability* of entry, and thus will be favored under any standard based on the probability of entry, even as it has the least effect on the *anticompetitive effects* of forestalling entry.

Economic reasoning strongly favors an enforcement regime for potential competition cases that is structured around the *expected value* of harm from the merger, rather than the *probability* that entry occurs. In economic terms, I do not see any difference between a merger that forestalls highly uncertain

[270] I am interpreting the Steris court's "probably" standard to mean a probability of entry of at least 50%. The FTC, in its pre-trial brief, stated that courts had consistently applied a standard in potential competition cases requiring that entry have a "'probability,' 'reasonable probability,' or some close variant thereof" (*Reply Memorandum in Support of Plaintiff Federal Trade Commission's Motion for Preliminary Injunction*, Fed. Trade Comm'n v. Steris Corp., No. 1:15-cv-01080-DAP (N.D. Ohio Aug. 18, 2015), ECF No. 70, at 8-9), while noting that "courts have differed somewhat on the level of proof necessary to establish a probability of entry" (id., at 1).
However, the point illustrated by the hypotheticals continues to hold under other standards. For instance, if a different court interpreted "probably" to mean a 30% or greater chance, the hypotheticals can be adjusted to make the same point that if mergers involving potential competitors are evaluated solely on the basis of *probability* of entry, without regard to the magnitude of harm conditional on entry, perverse results are likely.

[271] There is a 65% chance of entry without the merger, and a 45% chance with the merger. 20% = 65% - 45%.

[272] Economists refer to *expected value* as the probability-weighted average outcome. The formula for the expected value of a variable (say, price) is simply the probability of each possible outcome (say, entry or no entry), multiplied by the price if that outcome occurs. For instance, Hypothetical #1 would result in $1 billion in expected consumer benefits (25% * $4 billion + 75% * $0). Hypothetical #2 would result in an expected value of $600 million in consumer benefits (65% * $3 billion + 35% * $0 – 45% * $3 billion – 55% * $0). Hypothetical #3 would result in $5.1 million in consumer benefits (51% * $10 million + 49% * $0).

[273] For instance, if, as a legal matter, mergers involving potential competition can be blocked only if there is at least a 30% chance of entry absent the merger, the logic of the hypotheticals holds without change. If the legal standard is that a challenge requires a X% chance of entry but for the merger, the hypotheticals can be adjusted to still make the same qualitative point. My overarching point is that basing a challenge solely on the relative probabilities of entry, and not on what happens conditional on entry, is not consistent with economics.

entry that would have had a significant procompetitive effect, and one that prevents near-certain entry that would have had a small procompetitive effect, if both mergers would result in the same expected harm.

An enforcement regime that assigns greater weight to *probability of entry* than to the *effects of entry* thus gets the economics wrong. Such a regime is likely to overenforce mergers in which entry is likely, by underweighting analysis of competitive effects and thus pursuing mergers likely to prevent entry that would result in only nominal benefits (like Hypothetical #3, above). Such a regime is also likely to underenforce harmful mergers that may not have as large of an effect on the probability of entry (like Hypotheticals #2 and #3 above), by focusing enforcement on probability of entry rather than expected value.

For their part, the 2023 Merger Guidelines nod towards an approach that considers both likelihood of entry and the effect of entry, stating that "the higher the market concentration, the lower the probability of entry that gives rise to concern."[274] However, the Guidelines's statement focuses entirely on the *concentration* of the pre-merger market, rather than the *effect* of entry, and thus does not usefully focus analysis on the expected value of a merger implicating potential competition. The Guidelines also seem to require a "reasonable" probability of entry; while the Guidelines do not attempt to define this term, they can be read as severing analysis of the probability of entry—which must be "reasonable," regardless of the competitive benefits that would result from said entry—from effects. For instance, if "reasonable" means 50%, then the Guidelines would fail to condemn the mergers in Hypotheticals #1 and #2, but would condemn the comparatively benign merger in Hypothetical #3. The same result would obtain if "reasonable" means 40% or 30%.

In horizontal mergers of current competitors (i.e., those not involving potential competition) enforcers commonly look to metrics like upward pricing pressure,[275] compensating marginal cost reduction,[276] Delta HHI,[277] and merger simulation.[278] When coupled with assessments of the volume of commerce likely to be affected by any loss in competition, such metrics allow for a prediction of the estimated consumer

[274] 2023 Merger Guidelines, at 10.

[275] Upward pricing pressure, or UPP, is a measure of the change in pricing incentive caused by the merger, reflecting each merging firm's internalization of the effect of a price change on the profits of its formerly-separate merging partner. UPP first appeared in the 2010 Horizontal Merger Guidelines, and has been used by the FTC and DOJ to predict likely merger effects. See, for example, Statement of Commissioner Joshua Wright In the Matter of Dollar Tree, Inc. and Family Dollar Stroes, Inc, July 13, 2015 (describing upward pricing pressure analysis relied upon by FTC staff in identifying needed divestitures); available at https://www.ftc.gov/system/files/documents/public_statements/681781/150713dollartree-jdwstmt.pdf.

[276] Compensating marginal cost reduction, or CMCR, measures the reduction in costs that would be needed to offset each merging firm's unilateral incentive to increase price. CMCR is closely related to UPP, and has also been used by the FTC and DOJ in assessing likely merger harms. See, for instance, *Opinion and Order*, Fed. Trade Comm'n v. Kroger Co., No. 3:24-cv-00347-AN (D. Or. Dec. 10, 2024), at 35-36 (describing the FTC expert economist's CMCR analysis); available at: https://www.doj.state.or.us/wp-content/uploads/2024/12/10T125935.982.pdf.

[277] Delta HHI refers to the change in the Herfindahl index that results from the merger, and is equal to the square of the sum of the merging firms' pre-merger market shares minus the square of each firm's pre-merger market share. Delta HHI first appeared in the 1982 Merger Guidelines, and has appeared in many if not most of the FTC and DOJ merger challenges since then.

[278] Merger simulation refers to inferring the parameters of a specified demand system based on observable information on margins and shares, and then using economic theory to compute the implied post-merger prices. For an example of a widely-deployed merger simulation model, see Gloria Sheu & Charles Taragin, *Simulating Mergers in a Vertical Supply Chain with Bargaining*, 52 RAND J. Econ. 596 (2021), https://doi.org/10.1111/1756-2171.12385.

harm resulting from a merger.[279] There is robust theoretical and empirical support for more extreme values of these metrics indicating that more significant anticompetitive effects are likely to occur.[280] In my experience, horizontal merger enforcement not involving potential competitors closely tracks estimates of consumer harm, in that enforcement is more likely the higher the forecast harm, and such enforcement does not depend on some binary threshold, such as whether some action is more likely than not. Mergers involving potential competitors should, in my view, follow an analogous framework, with mergers resulting in greater expected harms being more likely to be blocked, regardless of the probability of entry but for the merger.

B. Applying the expected value standard to Steris Synergy

As I explained above, evidence strongly indicates that Synergy was likely to have expanded with U.S. x-ray facilities. Evidence also indicates that *Steris's* realized x-ray entry faced significant delays of five or more years between the announcement of new facilities and their opening; to whatever extent this indicates that Synergy would have faced similar delays, it would suggest that the effects of Synergy's x-ray expansion may have been measured. Given this, an analysis of the merger under an expected value framework is trickier than assessing the mere likelihood of entry, and the answer is at least somewhat more ambiguous.

Steris faced delays in opening its own x-ray facilities. Steris's x-ray plant in Libertyville, IL was announced in November 2019, but was not opened until June 2024, despite the x-ray facility being an expansion of an existing Steris facility. Steris announced an x-ray facility to be built in Northborough, MA in October 2019, but appears to have scuttled that location in favor of an x-ray facility in Chester, NY after being denied a permit for its planned site.[281] While Steris's CEO stated on an earnings call that the facility would be moved to Chester, NY,[282] no facility has opened there as of July 2025. Similarly, in January 2020 Steris announced an expansion of its Ontario, CA plant to add an x-ray facility; as of July 2025, the facility has not been opened, though from earnings calls transcripts it seems likely on track to open soon.[283]

I am unable to determine the causes of Steris's delays from publicly-available information. It is possible that a lack of a close competitor with the potential to bring x-ray to market has disincentivized Steris from expediting the entry of its x-ray plants. It is also possible that Steris encountered regulatory delays that would have likely also affected Synergy; this seems especially likely to be the case as regards Steris's planned Northborough x-ray facility. Thus, it is possible that Synergy's planned facilities would have been delayed past their planned 2016 openings.[284]

Any delays faced by Synergy in expanding x-ray would lessen the merger's expected harm under an EV approach. If the delays experienced by Steris in opening its x-ray facilities were likely to have also plagued the entry of an independent Synergy, such delays would have lessened any procompetitive effect of Synergy's entry by pushing the effects farther into the future, and thus subject to greater discounting. Exacerbating potential construction delays is the fact that Synergy's plans were to gradually ramp up the

[279] For instance, an agency may reason that a merger thought expected to increase price by 5% over $1 billion in commerce would result in $50 million in consumer harms.
[280] See, e.g., Volker Nocke & Michael Whinston, 2022. "Concentration thresholds for horizontal mergers," *American Economic Review*, 112(6), pp. 1915-1948..
[281] See note 261, supra.
[282] See note 118, supra.
[283] See note 122, supra.
[284] Tyranski (Synergy) transcript, 513:21-25.

output of its x-ray plants over a period of 6 years,[285] and to initially focus on industrial customers and e-beam customers,[286] rather than the medical devices typically sterilized by gamma. To the extent Synergy's initial focus was on e-beam and industrial customers, Synergy x-ray may not have competed particularly closely for several years with Steris gamma, which disproportionately sterilizes high-value medical devices.[287] And to the extent that it took years to ramp up Synergy's capacity utilization—Synergy's financial model called for its x-ray plants to reach capacity in 2022, 8 years after the merger was announced—any procompetitive effects of Synergy's entry would have been delayed further still. For instance, if Synergy faced the same five-plus year delay experienced by Steris in opening its Ontario and Chester x-ray facilities, Synergy's x-ray facilities would not have been projected to reach capacity until 2027, 13 years following the merger.

The reason that potential procompetitive effects being pushed into the future matters is because it attenuates any expected harm that results from a merger. Just as Synergy discounted future profits in its financial model, courts and enforcers should properly discount future harms or benefits when weighing enforcement, and a procompetitive or anticompetitive effect projected to occur years into the future should properly receive much less weight in the decision of the court or enforcer (just as Synergy's projected profits 20 or more years into the future received almost no weight in its x-ray financial model).

Post-trial evidence sheds some light on the timeliness of the competition that would have been provided by Synergy's x-ray expansion. In particular, Steris's margin began to increase shortly after its purchase of Synergy, as described above in Section II.B. While there is ambiguity as to the cause of Steris's greater margins, the higher margins are consistent with actual or perceived competition from Synergy holding down Steris's prices prior to the merger.

Summary: Evidence supports blocking the merger under an EV approach. As described, evidence indicates that, absent the merger, Synergy was reasonably likely to expand its U.S. presence by opening x-ray facilities, but the expansion may have taken some time to begin to take customers in meaningful numbers from Steris or Sterigenics. An expected value approach to such a fact pattern would multiply a high probability of expansion by the more measured expected benefits that expansion by an independent Synergy would create. Because the merger was not expected to result in material efficiencies (as described above in Section III.B), the merger was likely to result in harm from the vantage point of 2015, and deserved to be challenged on expected value grounds.

VI. Conclusion

As described above, Synergy documents in the trial record overwhelmingly indicate that Synergy was seriously considering a U.S. x-ray expansion, and was in the late stages of planning for the expansion at the time the Steris acquisition was announced. The record further shows that the merger slowed the expansion, causing the Synergy team to wait for the acquisition to close both to get Steris's approval and to avoid cannibalizing Steris's gamma business. Furthermore, the record clearly indicates that the FTC investigation, and in particular the concerns of FTC staff about the overlap between Steris gamma and Synergy x-ray, contributed to Synergy's decision to kill x-ray five days after their meeting with staff.

The record, of course, is not dispositive (as no record ever is). It is possible that Synergy gave x-ray a serious look and decided that the time was not right for business reasons, and that the timing of x-ray's

[285] See Section A, supra.
[286] Tyranski (Synergy) transcript, 514:1-4.
[287] McLean (Synergy) transcript, 385:14-16.

demise concurrent with the FTC investigation was coincidental. Synergy indeed faced nontrivial hurdles in its x-ray expansion, including solid but unexceptional financial returns that were approximately equal to Synergy's stated minimum threshold for capital investments and uncertain customer interest in x-ray.

The post-merger history resolves at least *some* of the uncertainty faced by Synergy in 2015. It indicates that: 1) X-ray is now, in 2025, broadly accepted by customers (for instance, Steris's x-ray facility in Venlo, Netherlands was so popular that Steris decided to add a second x-ray facility at the same site less than one year after opening the Venlo facility); 2) In October, 2019, less than four years after it acquired Synergy, Steris found it profitable to announce three U.S. x-ray facilities (one of which is operating as of July 2025; 3) X-ray appears to be quite profitable for Steris, given that it has opened or announced ten new x-ray facilities (and only one new gamma facility) since acquiring Synergy and that Steris's margin has increased markedly, consistent with the combined firm enjoying greater market power than did Steris or Synergy as separate entities.

The post-merger decisions of Steris, along with a re-examination of the trial record, indicates that the shortcomings of x-ray appear to have been overstated at trial. The record indicates that Synergy's projected financial returns for x-ray were, at the least, near the threshold of viability, and the trial record is inconsistent with claims that the financial case for x-ray was "woeful." The post-acquisition record, which saw Steris begin to rely nearly exclusively on x-ray for new facilities beginning less than four years following the acquisition, also strongly supports the viability of Synergy's x-ray plans.

To be fair, Steris's experience does also offer reason for caution in assessing the business case for Synergy's x-ray expansion. Steris's x-ray facilities have taken many years to build. One planned site in Massachusetts was apparently relocated after a three-year permitting process resulted in Steris being denied a permit. One of Steris's remaining two U.S. x-ray facilities took 4.5 years from its announcement to open. The final U.S. location is still not open as of July 2025, more than five years following its announcement. If Synergy's planned U.S. x-ray facilities had run into similar delays, the procompetitive effect of Synergy's entry would have been pushed far into the future, and thus attenuated. The cause of these delays is not clear, and it is possible that they indicate that Synergy would have experienced similar delays; it is also possible that a lack of competitive pressure contributed to the delays.

The Steris court applied a simple standard in deciding the case: if it thought Synergy would "probably" have opened at least one x-ray facility, it would have ruled for the FTC. While presumably consistent with antitrust law, this standard is unmoored from economics. Mergers involving potential competitors can result in significant harm by marginally lowering the probability of entry that is very competitively significant, *or* by greatly lowering the probability of entry that is somewhat competitively significant. Economics strongly favors putting both types of mergers on equal footing if they result in equivalent expected harm. In other words, mergers involving potential competition should be assessed based on the *expected value* of harm that would result from the merger, and not solely on the basis of the probability the merger forestalls entry. Deciding cases primarily on the basis of the probability of entry is likely to overenforce mergers that are likely to prevent entry of little competitive consequence, and to underenforce mergers that have some small likelihood of preventing entry that would be highly procompetitive. An expected value approach to potential competition matters avoids this pitfall.

Applying an expected value approach to the Steris/Synergy merger with the benefit of hindsight indicates that while the merger may well have forestalled Synergy's entry as an independent competitor, it is possible that this entry would have taken some time to be fully up and running, and thus to exercise a constraint on Steris or its rival Sterigenics. However, the evident lack of merger efficiencies and likelihood that the merger prevented competitively beneficial entry, in my view, justify blocking the

transaction under an expected value standard. Moreover, in my view, the agency's challenge has to a significant extent been vindicated by the post-merger record. In particular, Steris's heavy reliance on x-ray for new capacity, evident customer acceptance of x-ray, and Steris's dramatically increased margins since the time of the merger all suggest that Synergy's planned x-ray entry was reasonably likely to materially benefit competition.

VII. Appendix

A. Replication of Synergy's financial model

My replication of Synergy's financial model relied on the following model inputs, taken from trial testimony:

- Synergy assumed an initial outlay of $40.4 million for two plants.[288] I allocate this expense to year 1 of each facility's life.
- Synergy assumed that volumes from its Lima, OH e-beam plant would transfer over to its Indiana x-ray facility.[289] I assume these revenues would have resulted in $4 million in revenue at the Indiana facility beginning in the first year of operation.[290]
- Synergy assumed that capacity utilization that would increase to 100% over the course of the first six years of a facility's life.[291] I model Synergy's Texas facility as operating at 0% of capacity in year 1, 1/6 of capacity in year 2, 2/6 of capacity in year 3, and so on. I model Synergy's Indiana facility as adding volume at the same rate as the Texas facility until its capacity is reached.
- Synergy assumed that it would capture a 15% share of U.S. gamma sales with four x-ray plants.[292] Synergy estimated that total gamma capacity in the U.S. was 150 million cubic feet.[293] Therefore, I model the capacity of each x-ray plant to be $150 \text{ million} * 15\% * \frac{1}{4} = 5.625 \text{ million cubic feet}$.
- Synergy assumed the price of x-ray would be $2.50/cu. ft.[294] I use this price to calculate the revenue associated with a given capacity utilization.
- Synergy's most recent publicly-announced profit margin was 34.4%.[295] I apply this margin in assuming that $1 in Synergy revenue would result in 34.4 cents of Synergy profit.
- I calibrate an annual fixed cost (which could include, e.g., an allocation of central management costs or property taxes), set to equate the project's 10-year IRR to that generated by Synergy's financial model in 2014.
- My conclusions are robust to different interpretations of the trial record, as my results do not significantly change under different assumptions.

[288] Hill (Synergy) transcript, 749:20-22.
[289] Tyranski (Synergy) transcript, 540:19-23.
[290] In 2015, Synergy North America operated 4 e-beam facilities and 2 EO facilities and had $30 million in revenues. I assume the Lima plant accounted for roughly 13% of revenues, or slightly less than 1/6 of total North American revenues, consistent with its age. Different assumptions on Lima's revenues do not change my conclusions.
[291] Tyranski (Synergy) transcript, 598:8-14.
[292] McLean (Synergy) transcript, 316:6-18.
[293] McLean (Synergy) transcript, 408:7-15.
[294] McLean (Synergy) transcript, 415:7-14.
[295] Synergy Annual report, 2015.