

# **GRAF** *Tech* *International*

**GrafTech International Ltd. (NYSE: EAF)**

**Buy Recommendation**

November 29, 2020

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## Summary

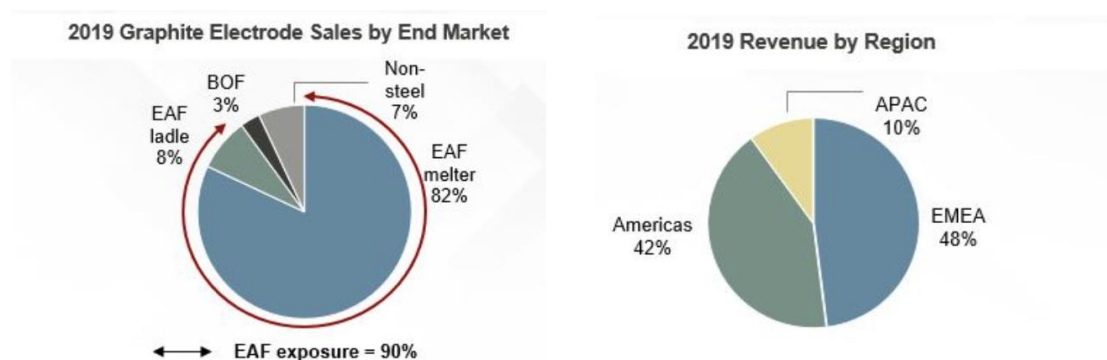
- GrafTech International Ltd. (“GrafTech” or the “Company”) is one of the world’s largest graphite electrode producers and the industry’s only vertically integrated manufacturer, through its production of petroleum needle coke.
- The Company completed its IPO in April 2018 and traded as high as \$22.37/share in August 2018 but has traded at a substantial discount to itself and to peers since then as a result of steel market headwinds and market misperceptions.
- The efficiency and safety of GrafTech's business post-restructuring and IPO are fundamentally misunderstood by the market.
- The market is pricing in GrafTech’s debt levels at face value while ignoring the Company’s substantial free cash flow generation, robust liquidity and interest coverage positions, and significant debt paydowns this year.
- GrafTech is well-positioned to take advantage of rising steel demand and favorable supply conditions in 2021 and 2022.
- **We rate GrafTech a Buy based on a \$13 price target vs. a November 27, 2020 closing price of \$7.87 (65% upside).**

## Company Overview

### Company History

Headquartered in Brooklyn Heights, OH, GrafTech International Ltd. is a leading manufacturer of graphite electrodes used in the production of electric arc furnace (EAF) steel. It operates three of the highest capacity graphite electrode facilities in the world and is the only producer vertically integrated into petroleum needle coke, the most important material in the graphite electrode production process.

In 2017, GrafTech entered into fixed-price take-or-pay contracts for about 60% of the Company’s production capacity from 2018 through 2022. GrafTech serves more than 100 customers, primarily steel mini-mills operating both domestically and internationally, with international customers accounting for 77% of net sales in 2019. Six of the Company’s ten largest customers are based in Europe.



GrafTech was founded in 1886 and had its first IPO in 1995. The Company was taken private by Brookfield Asset Management in August 2015, then returned to the public market in April 2018. Under Brookfield’s ownership, GrafTech has undergone a significant transformation from a

conglomerate to a pure-play graphite electrode producer after divesting its non-core Engineered Solutions businesses in 2016 and 2017. Furthermore, in 2017 GrafTech reoriented its commercial strategy from annual, uncontracted sales to three-to-five-year take-or-pay contracts. As of 3Q20, Brookfield owns 65% of the Company.

*Source: GrafTech SEC filings*

### Relevant KPIs

GrafTech's KPIs include sales volumes of graphite electrodes (in metric tons, or "MT"), weighted average realized price per MT, production volumes (MT), production capacity (MT) and capacity utilization. The Company's 3Q20 and YTD results are shown below.

(in thousands)	For the Three Months Ended September 30,		For the Nine Months Ended September 30,	
	2020	2019	2020	2019
Sales volume (MT) (1)	33	40	98	130
Production volume (MT) (2)	32	40	98	136
Production capacity excluding St. Marys (MT) (3)(4)	48	48	150	150
Capacity utilization excluding St. Marys (3)(5)	67%	83%	65%	91%
Total production capacity (MT) (4)(6)	55	55	171	171
Total capacity utilization (5)(6)	58%	73%	57%	80%

*Source: GrafTech 3Q20 Earnings Release*

### Valuable Assets

GrafTech's assets provide the Company with a strong moat in an industry with high barriers to entry. GrafTech has three of the five largest (by production capacity) graphite electrode manufacturing facilities in the world, whose scale reduces operating costs relative to competitors. Both greenfield and brownfield developments of graphite electrode manufacturing facilities require prohibitive capital costs and long lead times (three to five years for greenfield). Moreover, GrafTech has over 130 years of R&D experience in graphite and carbon-based solutions and has built an extensive intellectual property portfolio.

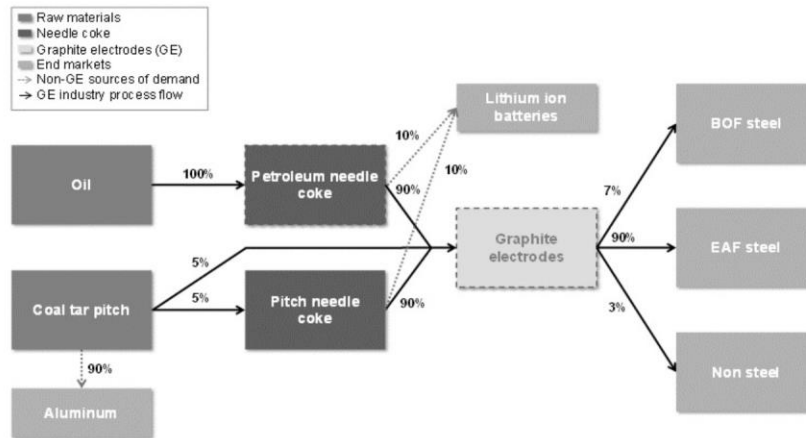
*Source: GrafTech SEC filings*

### Industry Overview

#### Electric Arc Furnace Steel Value Chain

Graphite electrode producers combine petroleum needle coke and pitch needle coke with binders and other ingredients to form graphite electrodes. Graphite electrodes are primarily used in EAF steel, acting as conductors of electricity in the furnace, generating sufficient heat to melt scrap metal. The product takes 3-6 months to produce and 8-10 hours for a steelmaker to consume. EAF currently represents 47% of all steel production excluding China and has historically been the fastest-growing segment of the global steel market. The other segment, basic oxygen furnace (BOF) steel, uses pitch needle coke and requires the burning of coal; as a result, the EAF method produces 25% of the carbon dioxide emissions of BOF.

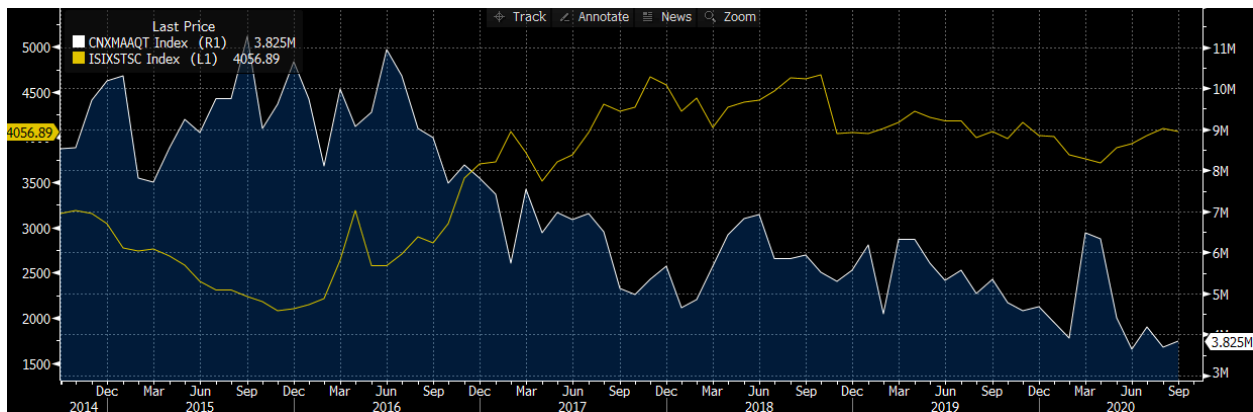
*Sources: GrafTech SEC filings, Investor Presentations*



Source: GrafTech SEC filings

### Macroeconomic Drivers

Graphite electrode spot prices tend to track with steel demand and supply conditions. From 2011 to 2015, the graphite electrode market was negatively impacted by China rapidly ramping up its steel production and creating a global steel supply glut. However, market conditions have changed: Chinese producers are increasingly geared toward domestic supply, and there has been a significant decrease in Chinese steel exports since 2017. The chart below shows the China Steel Exports Index and a Composite Steel Price Index from September 2014 to September 2020.



Source: Bloomberg

Global steel demand is recovering since 1Q20 and 2Q20. The World Steel Association forecasts 4.1% growth in 2021, with especially strong rebounds in the regions in which GrafTech’s customers operate (Europe, USMCA, Central and South America). Given GrafTech’s position in the steel supply chain, the Company’s market lags the steel market; ultra-high-power (UHP) graphite electrode prices remained weak in 3Q20. Still, as EAF demand has improved in 3Q20, steelmakers are drawing down inventory of graphite electrodes, creating a tighter market in 2021.

## GrafTech share price and North America Hot-Rolled Coil Steel Index 1/1/2018 – 11/20/2020



Sources: GrafTech SEC filings, World Steel Association, Credit Suisse, Bloomberg

### Competitive Landscape

The graphite electrode industry is fairly consolidated, particularly outside of China. The five largest global producers in the industry are Showa Denko K.K., GrafTech, Fangda Carbon New Material Technology Co. LTD, Tokai Carbon Co., Ltd. and Graphite India Limited. Most non-U.S. graphite electrode producers are based in Japan and India.

Players in the graphite electrode market compete primarily on price; however, GrafTech differentiates its product offering through its support and technical service platform, ArchiTech Furnace Productivity System. ArchiTech is installed in customers' furnaces and provides real-time diagnostics and troubleshooting from GrafTech's engineers.

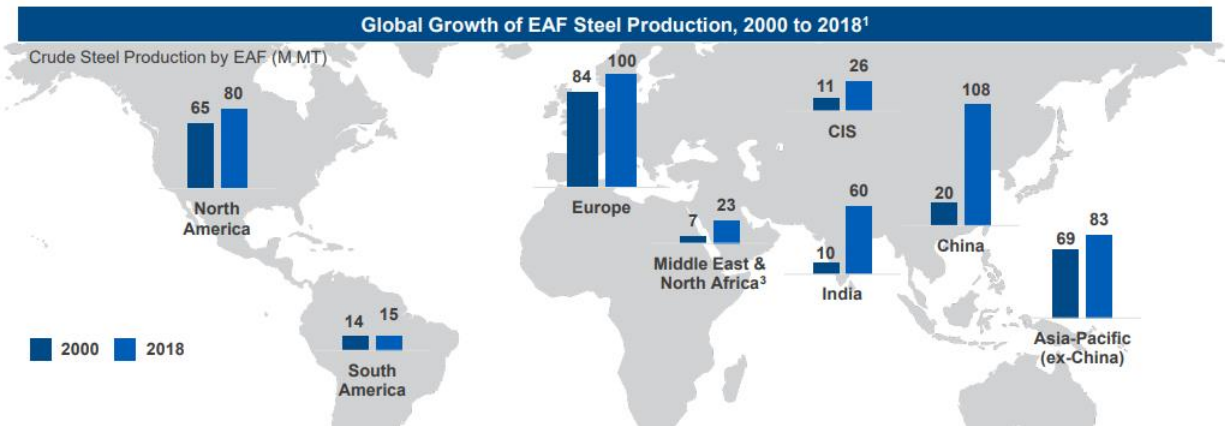
As previously discussed, the graphite electrode industry has large barriers to entry due to the costs and specialized knowledge required to develop graphite electrode manufacturing facilities. Further, amid lower steel prices over the past several years, graphite electrode producers have been reluctant to build new capacity, supporting spot prices in the near term.

Sources: GrafTech SEC filings, RBC Capital Markets

### Thesis Point #1: EAF Dependency on Graphite Electrodes

Offsetting its position in a cyclical industry, GrafTech benefits from EAF steel manufacturers' dependency on graphite electrodes, as there is no other commercially available substitute with the proper electrical and heat sustainability properties. As a result, EAF steel manufacturers are willing to pay a premium for high quality graphite electrodes. Furthermore, on average, the cost of graphite electrodes represents only 1-5% of the total production cost of EAF steel. GrafTech competes in the ultra-high power (UHP) electrode space, which yields higher margins and requires an extensive manufacturing process and material science knowledge.

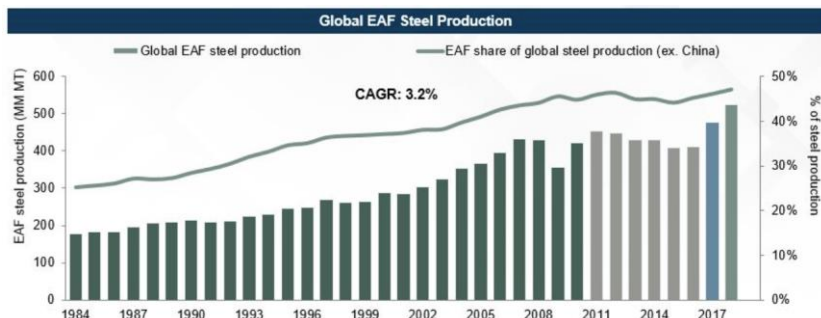
Compared to BOF steel, EAF steel production is more environmentally friendly and produces higher quality steel grades as steelmakers increasingly use higher quality scrap; as a result, EAF steel producers continue to capture market share from BOF producers.



Source: World Steel Association Steel Statistical Yearbook 2019

As the producer of 25% of the world’s (ex-China) UHP graphite electrodes, GrafTech’s positioning will enable the Company to take advantage of steel demand’s upswing in 2021 and 2022.

Sources: GrafTech SEC filings, JPMorgan



Source: GrafTech SEC filings

**Thesis Point #2: Market Insufficiently Rewards GrafTech’s Vertical Integration**

GrafTech is the only company in the industry vertically integrated into petroleum needle coke, which represents a significant percentage of the raw material cost of graphite electrodes. In 2010, GrafTech acquired Seadrift Coke LP, one of the largest producers of petroleum needle coke. This reduced GrafTech’s reliance on other suppliers, while competitors have to buy needle coke at market prices, which are vulnerable to market supply and demand trends. In addition, GrafTech’s vertical integration results in cost advantages of ~\$3,000/MT compared to non-integrated producers. The benefits of vertical integration and overall expense management led to an EBITDA margin of 54.80% in 2019 vs. a peer median of 9.96%. In addition, GrafTech reported ROA of 56.7% and 48.8% in 2018 and 2019, respectively, vs. a peer median of 6.90% in 2019.

However, the market has failed to recognize GrafTech’s unique positioning and efficiency relative to peers, as the Company’s stock trades at a P/E of 3.5x vs. a peer median of 20.1x. Instead, the market prices in a large amount of risk on the basis of the Company’s debt load, while ignoring the Company’s track record of free cash flow generation and debt paydown, especially in 2020. Overall, we believe that GrafTech’s superior efficiency will be appreciated as market conditions in the broader graphite electrode and steel industries improve.

*Sources: GrafTech SEC filings, RBC Capital Markets, Bloomberg*

**Thesis Point #3: Spot Pricing Set to See Upward Pressure from Electric Vehicles; Contract Structure Protects GrafTech from Market Volatility**

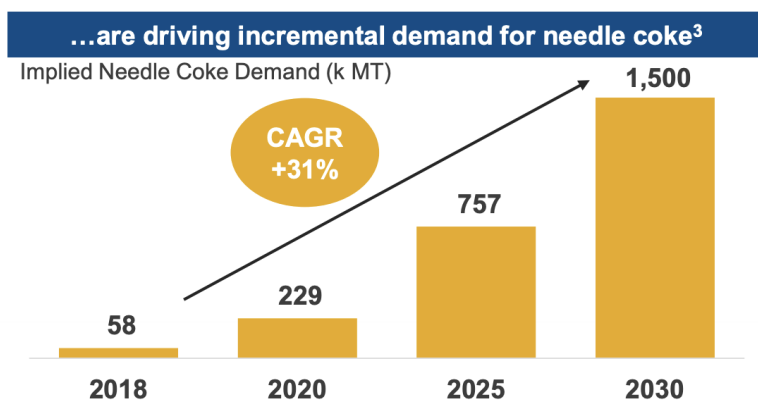
Spot Pricing

In 2019, GrafTech generated 80% of its revenue from Long-Term Agreements (LTAs). This structure is appealing to customers trying to secure supply given the long lead time necessary in producing graphite electrodes. It also allows GrafTech to essentially set a floor on revenue, which competitors are not able to do given their lack of reliable petroleum needle coke supply.

Graphite electrodes are priced at a spread over petroleum needle coke spot prices, with the average spread being \$3,000/MT. This spread could benefit from increased petroleum needle coke demand from electric vehicle manufacturers, yielding higher margins, especially in the UHP segment.

As petroleum needle coke prices rise, competitors in the graphite electrode industry face cost pressures that GrafTech can avoid due to its vertical integration.

*Sources: GrafTech SEC filings and Investor Presentations*



*Source: BMO Capital Markets Global Metals & Mining Conference*

Long-Term Agreements Structure

In 3Q20, GrafTech’s average price from LTAs was ~\$9,300/MT. The average price for non-LTA business increased slightly to ~\$5,700/MT (vs. ~\$5,500 in 2Q20). Due to the nature of LTAs, GrafTech is largely insulated from spot prices trending lower, as customers are locked in to paying around \$9,000/MT to \$10,000/MT.

GrafTech has maintained its contract book through 2020. The Company has developed mutually beneficial solutions with customers struggling to take committed volumes and made substantial progress in completing several “blend and extend” contract modifications, which provide customers with near-term relief in exchange for additional volume commitments in future years. 2020/2021 commitments have been pushed into 2023/2024, while prices remain largely intact.

We believe that the market has punished GrafTech this year for delivering LTA volumes slightly below previous guidance, without recognizing the benefits of LTAs, including customers’ obligation to pay prices above those found in the spot market.

*Source: GrafTech SEC filings, BMO Capital Markets*

## **Risks**

### **Steel Cyclicalities**

Cyclicalities is inherent in graphite electrode spot prices. Spot prices tend to track with steel demand, which has declined in the past year-and-a-half to two years. Accordingly, GrafTech’s share price has declined over the past two years. The spread pricing for graphite electrodes is highly beneficial when demand is robust, but as spots have declined, so too have margins. However, favorable supply and demand conditions for EAF steel in 2021 and 2022 mitigate this risk.

### **Leverage**

The market views GrafTech’s debt levels as a major risk, overlooking the Company’s substantial free cash flow generation, liquidity, and significant debt paydowns this year. GrafTech’s FCF in 2018, 2019 and LTM (9/30/20) was \$768.4M, \$741.2M and \$586.5M, respectively. As of 9/30/2020, GrafTech’s LTM cash flow to debt ratio was 41% vs. a peer median of 48%. As of 3Q20, the Company’s liquidity position was strong at \$406M, with \$159M in cash and \$247M in RCF availability. Further, the Company’s interest expenses are manageable (\$127M against \$970M in operating income in 2019), with an interest coverage ratio of 7.6x.

GrafTech is committed to using its FCF to pay down its debt load, which currently totals \$1,564M vs \$2,156.6M at YE2018. The Company lowered its debt by \$150M in 3Q20 and \$313M YTD. It has no significant debt maturities until February 2025, when the outstanding \$1,564M of debt is due. Sell-side analysts forecast GrafTech generating robust free cash flow while barely paying down debt over the next several years – a viewpoint we strongly disagree with.

S&P’s credit rating of GrafTech reflects improvement over the past several years, from B in December 2017, to B+ in January 2018 and most recently, BB- in April 2019.

### **Disruptions to LTAs**

Disruptions to GrafTech’s LTAs, including customer bankruptcies and contract renegotiations, would reduce the Company’s revenue; however, the nature of LTAs – contractual obligations – and GrafTech’s continual efforts to preserve its LTAs reduce the likelihood of disruptions



## Valuation

### Valuation Relative to Self Historically

Metric	Current vs 2Yr Average Historical Multiple					2Yr Historical Multiple Range			Implied @ Hist Avg	
	Current	Hist Avg	Diff	# SD	3M Trend	Low	Range	High	Hist Avg	Price (USD)
<b>Current Price</b>										<b>7.87</b>
BF P/E	4.6x	4.3x	7%	0.4		2.8x		6.5x	4.3x	7.36
BF EV/EBITDA	4.9x	4.7x	4%	0.4		3.7x		6.1x	4.7x	7.28
BF EV/EBIT	5.3x	5.0x	8%	0.8		3.9x		6.4x	5.0x	6.89
BF EV/Rev	2.8x	2.8x	1%	0.1		2.1x		3.5x	2.8x	7.75
LF P/BV	--	--	--	--		--		--	--	--

### GrafTech share price 1/1/2018 – 11/20/2020



Source: Bloomberg

### Valuation Relative to Industry

We used two separate comp sets for GrafTech: first, the standard Bloomberg comps to display how GrafTech is undervalued compared to the Electrical Equipment Manufacturing industry, and second, a custom set of comps pulled from GrafTech's SEC filings to display the firm's superior efficiency compared to other graphite electrode producers around the world.

We believe that GrafTech is lumped in with its Electrical Equipment Manufacturing sub-industry classification, despite being the only pure-play graphite electrode manufacturer in that group. The other firms in this group are generally very diversified in their product offerings, which creates more revenue streams but exposes the companies to additional risks - a situation GrafTech avoids as a pure-play producer. On a price-to-earnings basis, GrafTech trades at a 3.5x multiple, compared to an industry median multiple of 22.7x. GrafTech is undervalued on an EV/EBITDA basis as well, trading at 5.5x compared to an industry median of 11.7x.

Looking at the custom comps to get a better sense of GrafTech's efficiency compared to more similar companies, GrafTech's EBITDA margin of 54.8% is multiples higher than the comp set median of 9.96%. GrafTech's ROA of 38.55% is similarly higher than the comp set median of 0.72%. We believe this reflects the effectiveness of GrafTech's restructuring and subsequent refocusing on graphite electrodes, as well as the increased margin arising from the Company's long-term agreements.

Overall, we think that GrafTech is being lumped in with more diversified manufacturers, leading to a mispricing as seen in its sub-industry. Despite trading at a discount to comps in both sets, GrafTech has seen a general price decline since its peak in 2018. We attribute this decline to industry cyclicality rather than material flaws in GrafTech's business model. Given our positive demand outlook heading into 2021, this presents an attractive buying opportunity for a high-quality company with superior margins from its unique contract model.

### Relative Valuation - Sub Industry

Company Information		Valuation Metrics			
Ticker	Firm	EV/EBITDA	P/FCF	P/E	Div Yield
AMOT US	Allied Motion Technology	12.5x	19.6x	26.9x	0.28%
AMSC US	American Semiconductor	-	-	-	-
ATKR US	Atkore International	5.1x	8.8x	12.2x	-
BEEM US	Beam Global	-	-	-	-
3665 TT	Bizlink Holding	9.1x	33.3x	18.4x	3.60%
WIRE US	Encore Wire Corp	7.5x	33.7x	17.5x	0.15%
ENS US	Enersys	10.1x	13.2x	22.7x	0.84%
FCEL US	Fuelcell Energy	-	-	-	-
LYTS US	LSI Industries	10.4x	7.7x	48.4x	2.44%
OESX US	Orion Energy Systems	51.5x	-	263.0x	-
POWL US	Powell Industries	4.5x	3.9x	15.1x	3.78%
PLPC US	Preformed Line Products	4.5x	35.3x	9.7x	1.31%
THR US	Thermon Group	11.22	11.4x	193.1x	-
VICR US	Vicor Corp	178.0x	-	468.6x	-
XLWH US	Xinliwang Interntional	-	-	-	-
EAF	GrafTech	4.5x	3.7x	3.4x	1.46%
Top Quartile		11.9x	33.3x	120.7x	3.02%
Mean		27.7x	18.5x	99.6x	1.77%
Median		10.1x	13.2x	22.7x	1.31%
Bottom Quartile		6.3x	8.8x	16.3x	0.56%

### Relative Valuation - Graphite Electrode Manufacturers

Company Information		Margins		
Ticker	Country	EBITDA Margin	Op Income Margin	Net Profit Margin
GRIL IN	Graphite India Ltd	(2.56%)	(4.22%)	1.45%
5302 JP	Nippon Carbon Co Ltd	9.96%	1.28%	(1.66%)
SGL GR	SGL Carbon SE	20.00%	11.16%	8.10%
4004 JP	Showa Denko KK	6.07%	(0.46%)	(5.83%)
5310 JP	Toyo Tanso Co Ltd	24.19%	17.15%	12.32%
EAF	GrafTech International	54.80%	50.02%	48.79%
Top Quartile		20.00%	11.16%	8.10%
Mean		11.53%	4.98%	2.88%
Median		9.96%	1.28%	1.45%
Bottom Quartile		6.07%	(0.46%)	(1.66%)

## DCF Valuation and Model Explanation

### Revenue Drivers

GrafTech's revenue is mainly driven by LTAs (Long Term Agreements) with steel manufacturers to receive graphite electrodes on demand over a certain period, but GrafTech also sells graphite

electrodes to the market at the spot price (spot contracts). Electric arc furnace (EAF) steel manufacturers go through one graphite electrode in about 8-10 hours, making easy access to a graphite electrode supply a necessary part of EAF steel production. GrafTech's production volume for graphite electrodes for each year is based on a percentage of production capacity (the total amount of capacity that GrafTech has), which has grown at an average rate of 7.75% in the past two years. Production volume is driven by GrafTech's operating rate percentage, which has been approximately 83.63% of production capacity the past three years and is equal to GrafTech's total amount of contracts (LTAs + Spot Contracts). Revenue from LTAs and spot contracts is driven by GrafTech's LTA contract price (per MT), which is set at a premium over non-LTA market spot prices (per MT). With this premium on LTA prices, a revenue mix with a higher proportion of LTA contracts is much more attractive for the company as it brings in a significantly larger amount of revenue than non-LTA spot contracts do. LTAs are priced at a premium over spot contracts because of the top quality (tier 1) graphite electrodes that GrafTech supplies to steel manufacturers, as well as the on-demand service that GrafTech offers to customers.

#### Base Case Revenue Growth Assumptions

Changes in revenue are driven by changes in the growth rate of production capacity, GrafTech's operating rate, and more importantly, the percentage of LTAs out of GrafTech's total contracts. In the Base Case, conservative assumptions for the capacity growth rate starts at 1.5% in 2020 and fluctuates in the following years before leveling off at 1.5% in 2023 and 2024 (from a previous two-year average of 7.7%). With the uncertainty of LTA contracts in the near term, we expect management to focus cash flows on paying down debt rather than investing in new plants to increase operating capacity, especially since operating rates are expected to be around 70-80% for the next five years. This assumption leads to our conservative growth rate of 1.0-1.5% growth in total production capacity, mainly driven by slow technological innovation and workers becoming more efficient at producing graphite electrodes. Percent operating rate assumptions experience a similar 2020 drop to 56.5% from 79.7% in 2019, and slowly rise close to pre-COVID-19 levels at 76.0% of operating capacity in 2024. COVID-19 has created considerable uncertainty for steel producers, GrafTech's customer base, which leads to the lower expected operating rate in 2020, and then a slow 3-5% rise back to almost pre-COVID-19 operating rate levels by 2024.

Percent of LTAs out of GrafTech's total contracts rise in 2020 to 87% and slowly drop off to 35% by 2024 as management has stated that they expect to lose a considerable amount of LTA contracts with COVID-19. Management has guided that they expect to maintain 100,000-120,000 total LTA contracts into 2022, with that number dropping to 63,000 by 2024. This assumes that GrafTech will continue to lose LTA contracts into 2022, and GrafTech will be unable to receive new LTA contracts from other different EAF steel manufacturers, which we believe is highly unlikely given the benefit they bring to the customer and to GrafTech. Most of these LTA contracts that GrafTech is expected to lose, are replaced by spot contracts, in which the Company sells graphite electrodes at the market price.

As stated before, LTA contracts trade at a premium to normal spot contracts, so assumptions for the pricing of these contracts are important to keep in mind. For our base case, LTA contract prices (per MT) drop to \$9,450 per MT in 2020, slowly improve to \$10,000 per MT by 2022 and then stay at this level. Before COVID-19, LTAs for GrafTech were priced at around \$10,300, so this assumption shows prices returning to almost pre-COVID-19 levels by 2024. Non-LTA spot price

contracts are expected to drop to \$5,600 in 2020 from pre-COVID-19 levels of \$8,700 per MT and then slowly rise back to \$7,000 per MT by 2023 as demand starts to increase from EAF steel manufacturers. The change in spot prices as well as a decrease in the percentage of LTAs subsequently cause a rise in non-LTA spot revenue to \$830,973 from \$94,520 in 2020. These estimates and assumptions are consistent with equity research reports from Morgan Stanley, Credit Suisse, BMO and RBC, and lead to revenue growth of -33.1% in 2020 (due to missed contract payments and bankrupt manufacturers from COVID-19), 2.3% in 2021, 12.5% in 2022, 4.5% in 2023, and 4.6% in 2024.

### Base Case Valuation

Using levered free cash flow to calculate an equity price for the perpetuity method in the base case provides a **price target of \$14.20** for GrafTech. The main drivers of this method were an aggressive paydown schedule as we expect GrafTech to be paying down its debt very heavily as the Company approaches a debt wall of \$1.44 billion in 2025, as well as a 2.0% perpetuity growth rate. Using the calculated equity discount rate for GrafTech of 9.8% results in a present value of levered FCF of \$1,223,087 and a present value of the terminal value of \$2,608,018. The **equity discount rate of 9.8%** used a more normalized risk-free rate historical figure of 2.5% with an equity risk premium from Damodaran of 6.0%, and a 1-year beta for GrafTech of 1.21 (all conservative estimates given the 10-year yield trades at 0.8% currently, and GrafTech's historical beta is 0.9).

Like the perpetuity method, the P/E exit method also used levered cash flows and the equity discount rate of 9.8% to arrive at the same present value of years 1-5 LFCF of \$1,223,087. Using a **P/E multiple of 5.0x** to compute the terminal value, which is then discounted at the cost of equity, yields \$2,129,379 as the present value of the terminal value. The **price target for GrafTech using this method is \$12.40**.

The next method uses an EV/EBITDA exit multiple to arrive at an equity price for GrafTech used unlevered free cash flows, a WACC of 7.5% to discount future cash flows to a present value UFCF of the projection period of \$2,663,669, an **EBITDA multiple of 4.5x**, and a present value of terminal value of \$2,807,907. This method produced an **equity price of \$13.80** for GrafTech. WACC of 7.5% was calculated using GrafTech's cost of equity of 9.8% used in the perpetuity method, and a cost of debt of 5.0% with weights for debt and equity at 46.4% and 53.6% respectively.

The EV/Sales exit method also used unlevered free cash flows and a **sales multiple of 2.5x** to arrive at a terminal value, which was then discounted at a WACC of 7.5%, to get a present value of the terminal value of \$2,754,470, with a present value of UFCF for the projection period at \$2,663,669, the same as in the EV/EBITDA method. **The EV/Sales exit method produced a base case price target of \$13.60**.

A football field analysis used a P/E multiple range from 3.0x-7.0x, an EV/Sales multiple range from 1.5x-3.5x, ER report valuation ranges, 52-week H/L ranges, an EV/EBITDA multiple range from 3.5x-5.5x, and a perpetuity growth range from 1-3%, indicating a **general price target for our base case of around \$13 (65% upside)**.

**Perpetuity Growth Rate Sensitivity Analysis**

		Long-term Growth Rate				
		1.00%	1.50%	2.00%	2.50%	3.00%
Equity Discount Rate	\$14.2					
	13.8%	9.1	9.4	9.6	9.9	10.2
	12.8%	9.8	10.1	10.4	10.7	11.1
	11.8%	10.7	11.0	11.4	11.8	12.3
	10.8%	11.7	12.1	12.6	13.1	13.7
	9.8%	12.9	13.5	14.1	14.8	15.6
	8.8%	14.5	15.2	16.0	17.0	18.1
	7.8%	16.5	17.5	18.7	20.0	21.7
	6.8%	19.2	20.6	22.3	24.5	27.2

**Exit EBITDA Multiple Sensitivity Analysis**

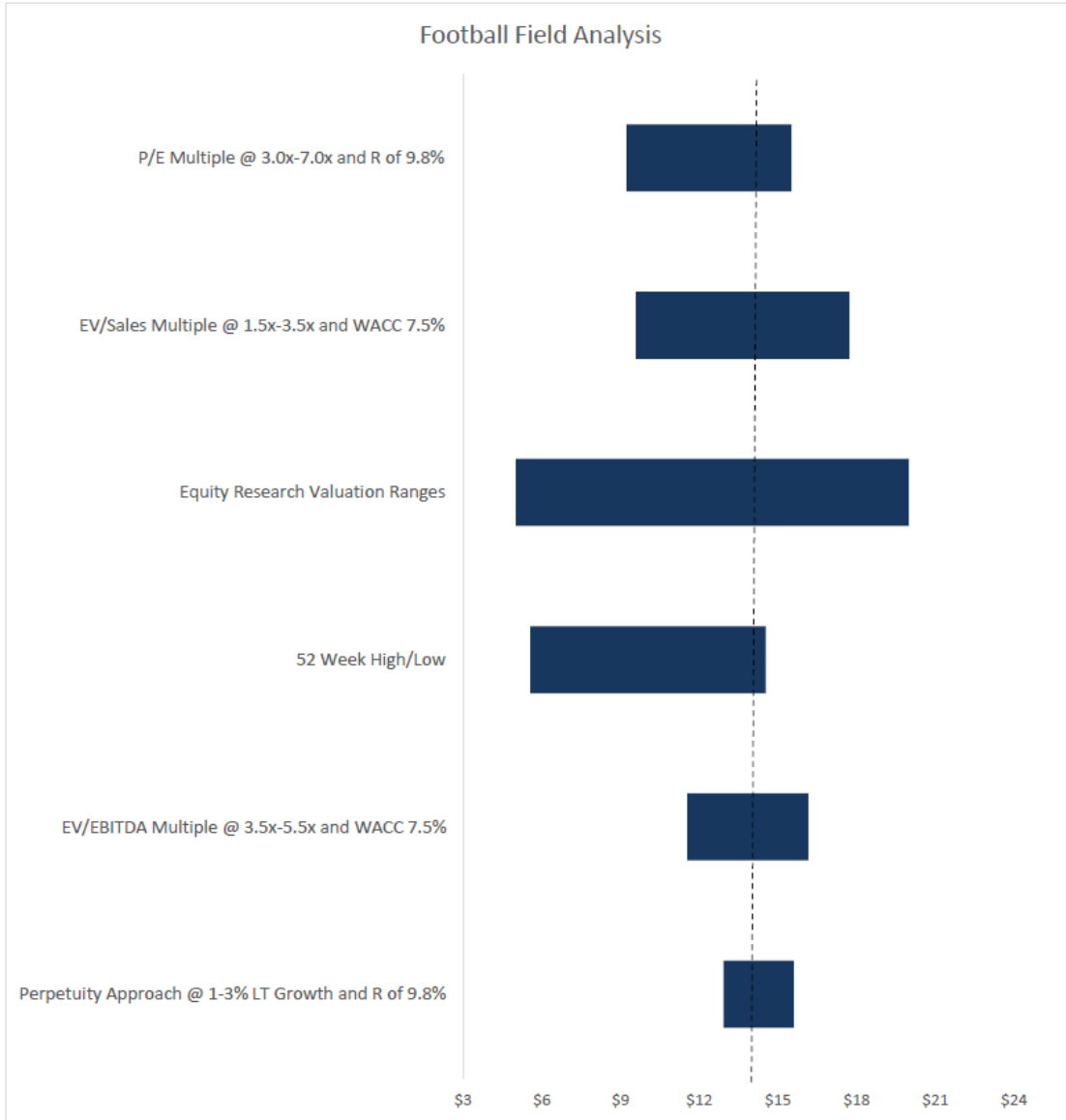
		EBITDA Multiple				
		3.5x	4.0x	4.5x	5.0x	5.5x
WACC	\$13.8					
	11.5%	9.6	10.6	11.6	12.6	13.6
	10.5%	10.1	11.1	12.1	13.2	14.2
	9.5%	10.5	11.6	12.7	13.7	14.8
	8.5%	11.0	12.1	13.3	14.4	15.5
	7.5%	11.5	12.7	13.9	15.0	16.2
	6.5%	12.1	13.3	14.5	15.7	16.9
	5.5%	12.6	13.9	15.1	16.4	17.6
	4.5%	13.2	14.5	15.8	17.1	18.4

**Exit EV/Sales Multiple Sensitivity Analysis**

		EV/Sales Multiple				
		1.5x	2.0x	2.5x	3.0x	3.5x
WACC	\$13.6					
	11.5%	8.0	9.7	11.4	13.2	14.9
	10.5%	8.3	10.1	12.0	13.8	15.6
	9.5%	8.7	10.6	12.5	14.4	16.3
	8.5%	9.1	11.1	13.1	15.0	17.0
	7.5%	9.6	11.6	13.7	15.7	17.7
	6.5%	10.0	12.2	14.3	16.4	18.5
	5.5%	10.5	12.7	14.9	17.1	19.3
	4.5%	11.0	13.3	15.6	17.9	20.2

**P/E Multiple Sensitivity Analysis**

		P/E Multiple				
		3.0x	4.0x	5.0x	6.0x	7.0x
Equity Discount Rate	\$12.4					
	13.8%	8.2	9.6	10.9	12.3	13.6
	12.8%	8.5	9.9	11.3	12.7	14.1
	11.8%	8.7	10.2	11.6	13.1	14.5
	10.8%	9.0	10.5	12.0	13.5	15.0
	9.8%	9.2	10.8	12.4	14.0	15.5
	8.8%	9.5	11.2	12.8	14.4	16.1
	7.8%	9.8	11.5	13.2	14.9	16.6
	6.8%	10.1	11.9	13.7	15.4	17.2



**Conclusion**

GrafTech offers an opportunity to invest in one of the world’s largest producers of a key input in electric arc furnace steel, combining vertical integration and favorable contract structures to achieve industry-leading margins – yet remaining significantly undervalued compared to peers and the Company’s 2018 share prices. As steel market conditions improve in 2021 and 2022 and steel manufacturers continue to move into the EAF production of steel and away from BOF, and as the Company continues to pay down debt, we believe GrafTech’s shares will trade closer to those of graphite electrode peers.

## Appendix

Figure 1. Income Statement & Balance Sheet

GrafTech Financial Model								
Income Statement (\$ in Thousands)								
	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Income Statement</b>								
Revenue	\$550,771	\$1,895,910	\$1,790,793	\$1,197,956	\$1,228,395	\$1,377,190	\$1,439,710	\$1,506,183
% Growth Rate		244.2%	(5.5%)	-33.1%	2.5%	12.1%	4.5%	4.6%
Operating Expenses	\$519,016	\$769,859	\$816,748	\$591,790	\$579,802	\$639,016	\$686,262	\$717,947
Operating Income	31,755	1,126,051	974,045	606,166	648,593	738,174	753,448	788,236
% Operating Margin	5.8%	59.4%	54.4%	50.60%	52.80%	53.60%	52.3%	52.3%
Interest Expense	\$30,823	\$135,061	\$127,331	\$98,974	\$73,953	\$60,753	\$49,753	\$34,628
Interest Income	(395)	(1,657)	(4,709)	(1,732)	(4,406)	(10,611)	(16,135)	(21,127)
Other Expense (Income)	(2,104)	89,839	8,596	8,000	8,000	8,000	8,000	8,000
Total Other Expenses	\$28,324	\$223,243	\$131,218	\$105,242.6	\$77,547.2	\$58,142.2	\$41,617.8	\$21,501.1
Earnings Before Taxes	\$3,431	\$902,808	\$842,827	\$500,923	\$571,045	\$680,031	\$711,830	\$766,735
Corporate Taxes	(\$4,552)	\$48,589	\$98,225	\$82,151	\$97,649	\$116,285	\$121,723	\$131,112
Net Earnings	7,983	854,219	744,602	418,772	473,397	563,746	590,107	635,623
% Net Margin	1.4%	45.1%	41.6%	35.0%	38.5%	40.9%	41.0%	42.2%
<b>Metrics &amp; Drivers</b>								
Corporate Tax Rate	(132.7%)	5.4%	11.7%	16.4%	17.1%	17.1%	17.1%	17.1%
<b>GrafTech Financial Model</b>								
Balance Sheet (\$ in Thousands)								
	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Balance Sheet</b>								
Cash and Cash Equivalents	\$13,365	\$49,880	\$80,935	\$351,945	\$529,210	\$885,557	\$1,265,802	\$1,551,113
Accounts Receivable	116,841	248,286	247,051	161,289	167,426	186,054	195,630	204,350
Other Current Assets	224,336	339,885	354,594	225,984	237,480	263,020	276,646	288,538
Total Current Assets	\$354,542	\$638,051	\$682,580	\$739,218	\$934,116	\$1,334,631	\$1,738,079	\$2,044,001
Net Property, Plant & Equipment	\$512,841	\$513,705	\$513,020	\$490,032	\$466,984	\$448,072	\$428,301	\$408,721
Other Long-Term Assets	331,720	353,735	330,564	333,582	333,582	333,582	333,582	333,582
Total Assets	\$1,199,103	\$1,505,491	\$1,526,164	\$1,562,832	\$1,734,682	\$2,116,285	\$2,499,962	\$2,786,304
Accounts Payable	\$69,110	\$88,097	\$78,697	\$54,155	\$54,757	\$61,823	\$64,403	\$67,495
Accrued Liabilities	9,737	82,255	65,176	47,787	46,854	53,733	55,543	58,437
Other Current Liabilities	73,112	156,775	76,333	75,062	64,665	79,395	79,394	84,946
Total Current Liabilities	\$151,959	\$327,127	\$220,206	\$177,003	\$166,276	\$194,951	\$199,340	\$210,878
Total Debt	\$322,900	\$2,050,311	\$1,812,682	\$1,484,600	\$1,204,600	\$1,004,600	\$804,600	\$454,600
Other Long-Term Liabilities	111,029	204,822	184,349	184,349	184,349	184,349	184,349	184,349
Total Liabilities	\$585,888	\$2,582,260	\$2,217,237	\$1,845,952	\$1,555,225	\$1,383,900	\$1,188,289	\$849,827
Shareholders' Equity	\$613,215	(\$1,076,769)	(\$691,073)	(\$283,120)	\$179,457	\$732,384	\$1,311,673	\$1,936,477
Total Liabilities and Equity	\$1,199,103	\$1,505,491	\$1,526,164	\$1,562,832	\$1,734,682	\$2,116,285	\$2,499,962	\$2,786,304
Check	--	--	--	--	--	--	--	--
<b>Metrics &amp; Drivers</b>								
Net Earnings	\$7,983	\$854,219	\$744,602	\$418,772	\$473,397	\$563,746	\$590,107	\$635,623
Cash Ratio	8.5%	15.2%	36.8%	198.8%	318.3%	454.2%	635.0%	735.6%
Debt to Equity	13%	13%	(107.7%)	(147.9%)	263.8%	77.0%	45.0%	32.8%
Net Debt	309,535	2,000,431	1,731,747	1,132,655	675,390	119,043	(461,202)	(1,096,513)

Figure 2. Cash Flow Statement and P/E Schedule

<b>GrafTech Financial Model</b>								
<b>Cash Flow Statement (\$ in Thousands)</b>								
	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Cash Flow Statement</b>								
Net Earnings				\$394,989	\$438,038	\$453,376	\$383,319	\$395,370
Depreciation				57,159	57,138	49,057	42,031	41,467
Change in Working Capital				181,017	(22,628)	14,306	25,001	3,181
Cash From Operating Activities				\$633,166	\$472,548	\$516,739	\$450,351	\$440,019
Capital Expenditures				(\$35,248)	(\$35,594)	(\$33,523)	(\$28,721)	(\$28,931)
Cash From Investing Activities				(35,248)	(35,594)	(33,523)	(28,721)	(28,931)
Dividends				(\$10,819)	(\$10,819)	(\$10,819)	(\$10,819)	(\$10,819)
Share Repurchases				--	--	--	--	--
Change in Revolver				(3,100)	--	--	--	--
Change in Long-Term Debt				(328,000)	(280,000)	(200,000)	(200,000)	(350,000)
Cash From Financing Activities				(\$341,919)	(\$290,819)	(\$210,819)	(\$210,819)	(\$360,819)
Change in Cash				\$255,998	\$146,135	\$272,398	\$210,811	\$50,269
Beginning Cash				\$80,935	\$336,933	\$483,068	\$755,466	\$966,277
Ending Cash			\$80,935	\$336,933	\$483,068	\$755,466	\$966,277	\$1,016,546
<b>Metrics &amp; Drivers</b>								
Operating Income				\$577,778	\$606,247	\$606,358	\$507,227	\$504,681
EBITDA				634,937	663,385	655,416	549,258	546,149
<b>GrafTech Financial Model</b>								
<b>PP&amp;E Schedule (\$ in Thousands)</b>								
	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>PP&amp;E Schedule</b>								
Beginning Balance of PP&E				\$513,020	\$491,109	\$469,565	\$454,030	\$440,721
Plus: Capital Expenditures				35,248	35,594	33,523	28,721	28,931
Less: Depreciation				(57,159)	(57,138)	(49,057)	(42,031)	(41,467)
Ending Balance of PP&E			\$513,020	\$491,109	\$469,565	\$454,030	\$440,721	\$428,184
<b>Metrics &amp; Drivers</b>								
Revenue	\$550,771	\$1,895,910	\$1,790,793	\$1,141,853	\$1,148,194	\$1,131,266	\$969,224	\$964,359
Capital Expenditures as a % Revenue				3.1%	3.1%	3.0%	3.0%	3.0%
Depreciation as a % Revenue				5.0%	5.0%	4.3%	4.3%	4.3%

Figure 3. Working Capital Schedule



**GrafTech Financial Model**  
**Working Capital Schedule (\$ in Thousands)**

	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Working Capital Schedule</b>								
Accounts Receivable	\$116,841	\$248,286	\$247,051	\$153,736	\$156,495	\$152,830	\$131,700	\$130,839
Other Current Assets	224,336	339,885	354,594	215,401	221,975	216,053	186,240	184,741
Non-Cash Current Assets	\$341,177	\$588,171	\$601,645	\$369,136	\$378,470	\$368,883	\$317,940	\$315,580
Accounts Payable	\$69,110	\$88,097	\$78,697	\$51,619	\$51,182	\$50,784	\$43,357	\$43,215
Accrued Liabilities	9,737	82,255	65,176	45,549	43,795	44,138	37,392	37,415
Other Current Liabilities	73,112	156,775	76,333	71,546	60,443	65,217	53,449	54,388
Non-Debt Current Liabilities	\$151,959	\$327,127	\$220,206	\$168,714	\$155,420	\$160,139	\$134,197	\$135,018
Working Capital	\$189,218	\$261,044	\$381,439	\$200,422	\$223,050	\$208,744	\$183,743	\$180,562
Change in Working Capital		71,826	120,395	(181,017)	22,628	(14,306)	(25,001)	(3,181)
<b>Metrics &amp; Drivers</b>								
Revenue	\$550,771	\$1,895,910	\$1,790,793	\$1,141,853	\$1,148,194	\$1,131,266	\$969,224	\$964,359
Days Receivable	77.4	47.9	50.4	49.1	49.7	49.4	49.6	49.5
Other Current Assets as a % Revenue	40.7%	17.9%	19.8%	18.9%	19.3%	19.1%	19.2%	19.2%
Accounts Payable as a % of Revenue	12.5%	4.6%	4.4%	4.5%	4.5%	4.5%	4.5%	4.5%
Accrued Liabilities as a % of Revenue	1.8%	4.3%	3.6%	4.0%	3.8%	3.9%	3.9%	3.9%
Other Current Liabilities as a % Revenue	13.3%	8.3%	4.3%	6.3%	5.3%	5.8%	5.5%	5.6%
Days	365	366	365	365	365	366	365	365

Figure 4. Equity Schedule

**GrafTech Financial Model**  
**Equity Schedule (\$ in Thousands)**

	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Equity Schedule</b>								
Beginning Balance of Equity				(\$691,073)	(\$306,903)	\$120,317	\$562,873	\$935,373
Plus: Net Earnings				394,989	438,038	453,376	383,319	395,370
Less: Dividends				(10,819)	(10,819)	(10,819)	(10,819)	(10,819)
Less: Share Repurchases				--	--	--	--	--
Ending Balance of Equity			(\$691,073)	(\$306,903)	\$120,317	\$562,873	\$935,373	\$1,319,924
<b>Common Stock Schedule</b>								
Beginning Balance of Shares Outstanding	302,225	302,225	290,525	270,475	270,475	270,475	270,475	270,475
No. of Shares Repurchased	--	(11,700)	(20,050)	--	--	--	--	--
No. of Shares Issued	--	--	--	--	--	--	--	--
Ending Balance of Shares Outstanding	302,225	290,525	270,475	270,475	270,475	270,475	270,475	270,475
<b>Metrics &amp; Drivers</b>								
Average Common Shares Outstanding	302,225	296,375	280,500	270,475	270,475	270,475	270,475	270,475
Net Earnings	\$7,983	\$854,219	\$744,602	\$394,989	\$438,038	\$453,376	\$383,319	\$395,370
Basic Earnings per Share	\$0.03	\$2.88	\$2.65	\$1.46	\$1.62	\$1.68	\$1.42	\$1.46
<b>Share Repurchases Schedule</b>								
No. of Shares Repurchased			20,050	--	--	--	--	--
x Average Price Paid per Share			\$23.7	\$5.70	\$6.32	\$6.70	\$5.67	\$5.85
Share Repurchases (\$)		\$524,130	\$474,410	--	--	--	--	--
<b>Metrics &amp; Drivers</b>								
P/E Multiple				3.9x	3.9x	4.0x	4.0x	4.0x
<b>Dividends Schedule</b>								
Average Common Shares Outstanding	302,225	296,375	280,500	270,475	270,475	270,475	270,475	270,475
x Dividends per Share		\$5.14	\$0.34	\$0.04	\$0.04	\$0.04	\$0.04	\$0.04
Dividends (\$)	--	\$1,523,368	\$95,370	\$10,819	\$10,819	\$10,819	\$10,819	\$10,819
<b>Metrics &amp; Drivers</b>								
Dividend Yield				0.7%	0.6%	0.6%	0.7%	0.7%

Figure 5. Debt Schedule

**GrafTech Financial Model**  
**Debt Schedule (\$ in Thousands)**

	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Beginning Debt</b>								
Revolver Beginning Balance				\$3,100	--	--	--	--
Long-Term Debt Beginning Balance				1,812,600	1,484,600	1,204,600	1,004,600	804,600
Total Beginning Debt Balance				\$1,815,700	\$1,484,600	\$1,204,600	\$1,004,600	\$804,600
<b>Debt Pay Down and Issuance</b>								
Beginning Cash Balance		\$13,365	\$49,880	\$80,935	\$336,933	\$483,068	\$755,466	\$966,277
Cash From Operating Activities				633,166	472,548	516,739	450,351	440,019
Cash From Investing Activities				(35,248)	(35,594)	(33,523)	(28,721)	(28,931)
Dividends				(10,819)	(10,819)	(10,819)	(10,819)	(10,819)
Share Repurchases				--	--	--	--	--
Long-Term Debt Paydown (Scheduled)				(328,000)	(280,000)	(200,000)	(200,000)	(350,000)
Less: Minimum Cash Balance				(80,000)	(80,000)	(80,000)	(80,000)	(80,000)
Total Cash Available (Required)				\$260,033	\$403,068	\$675,466	\$886,277	\$936,546
Revolver Issued				--	--	--	--	--
Long-Term Debt Issued				--	--	--	--	--
Total Cash Available				\$260,033	\$403,068	\$675,466	\$886,277	\$936,546
Revolver Paydown				(\$3,100)	--	--	--	--
Long-Term Debt Paydown				(328,000)	(280,000)	(200,000)	(200,000)	(350,000)
Total Debt Paydown				(\$331,100)	(\$280,000)	(\$200,000)	(\$200,000)	(\$350,000)
<b>Ending Debt</b>								
Revolver Ending Balance			\$3,100	--	--	--	--	--
Long-Term Debt Ending Balance			1,812,600	\$1,484,600	\$1,204,600	\$1,004,600	\$804,600	\$454,600
Total Ending Debt Balance			\$1,815,700	\$1,484,600	\$1,204,600	\$1,004,600	\$804,600	\$454,600
<b>Metrics &amp; Drivers</b>								
Change in Revolver				(\$3,100)	--	--	--	--
Change in Long-Term Debt				(\$328,000)	(\$280,000)	(\$200,000)	(\$200,000)	(\$350,000)
EBITDA				634,937	663,385	655,416	549,258	546,149
Shareholders' Equity				(306,903)	120,317	562,873	935,373	1,319,924
Debt / EBITDA				2.3x	1.8x	1.5x	1.5x	0.8x
Debt-to-Equity Ratio				(483.7%)	1,001.2%	178.5%	86.0%	34.4%

Figure 6. Interest Schedule

**GrafTech Financial Model**  
**Interest Schedule (\$ in Thousands)**

	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Interest Expense Schedule</b>								
Revolver Average Balance				\$1,550	--	--	--	--
Long-Term Debt Average Balance				\$1,648,600	\$1,344,600	\$1,104,600	\$904,600	\$629,600
Average Debt Balance				\$1,650,150	\$1,344,600	\$1,104,600	\$904,600	\$629,600
Revolver Interest Rate				3.8%	3.8%	3.8%	3.8%	3.8%
Long-Term Debt Interest Rate				6.0%	5.5%	5.5%	5.5%	5.5%
Average Interest Rate				6.0%	5.5%	5.5%	5.5%	5.5%
Revolver Interest Expense				\$58	--	--	--	--
Long-Term Debt Interest Expense				98,916	73,953	60,753	49,753	34,628
Total Interest Expense				\$98,974	\$73,953	\$60,753	\$49,753	\$34,628
<b>Metrics &amp; Drivers</b>								
Revolver Beginning Balance				\$3,100	--	--	--	--
Long-Term Debt Beginning Balance				1,812,600	1,484,600	1,204,600	1,004,600	804,600
Revolver Ending Balance			3,100	--	--	--	--	--
Long-Term Debt Ending Balance			1,812,600	1,484,600	1,204,600	1,004,600	804,600	454,600
<b>Interest Income Schedule</b>								
Average Cash Balance				\$208,934	\$410,001	\$619,267	\$860,871	\$991,411
Interest Rate on Cash				0.8%	1.0%	1.5%	1.5%	1.5%
Total Interest Income				\$1,671	\$4,100	\$9,289	\$12,913	\$14,871
<b>Metrics &amp; Drivers</b>								
Cash Beginning Balance				\$80,935	\$336,933	\$483,068	\$755,466	\$966,277
Cash Ending Balance				336,933	483,068	755,466	966,277	1,016,546

Figure 7. WACC Calculation

**GrafTech Valuation**  
**WACC Analysis (\$ in Thousands)**

Inputs		Cost of Debt Calculation	
Risk Free Rate	2.50%	Pre-Tax Cost of Debt	6.0%
Yield-to-Maturity of Debt	6.00%	Corporate Tax Rate	17.1%
Equity Risk Premium	6.00%	After-Tax Cost of Debt	5.0%
Beta	1.21	<b>Cost of Equity Calculation</b>	
Corporate Tax Rate	17.1%	Risk Free Rate	2.5%
Common Shares	270,475	Equity Risk Premium	6.0%
Share Price	\$7.77	Beta	1.21
Market Value of Debt	\$1,815,700	Cost of Equity	9.8%
<b>WACC Calculation</b>			
	Amount	% Total	Cost of Capital
Market Value of Debt	\$1,815,700	46.4%	5.0%
Market Value of Equity	2,101,591	53.6%	9.8%
Enterprise Value	\$3,917,291	100.0%	7.5%

Figure 8. Case & Revenue Assumptions

<b>GrafTech Financial Model</b>								
<b>Cases (\$ in Thousands)</b>								
	Fiscal Year Ended December 31,							
	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
<b>Revenue Drivers &amp; Cases</b>								
<b>Bull Case</b>								
Production Capacity (MT)	195,000	214,000	226,400	229,796	232,094	236,736	241,471	246,300
% Capacity Growth Rate		9.7%	5.8%	1.5%	1.0%	2.0%	2.0%	2.0%
Production Volume (MT)	166,347	183,800	180,427	133,282	146,219	160,980	181,103	201,966
% Operating Rate	85.3%	85.9%	79.7%	58.0%	63.0%	68.0%	75.0%	82.0%
Long-term Contracts (LTAs)	118,000	132,500	148,000	115,955	116,975	117,516	117,717	121,180
Spot Contracts	48,347	51,300	32,427	17,327	29,244	43,465	63,386	80,786
Total Contracts	166,347	183,800	180,427	133,282	146,219	160,980	181,103	201,966
% of LTAs	70.9%	72.1%	82.0%	87.0%	80.0%	73.0%	65.0%	60.0%
LTA Contract Price (per MT)		\$10,304	\$9,835	\$9,500	\$10,000	\$10,300	\$10,600	\$10,800
Non-LTA Market Spot Price (per MT)		\$7,888	\$8,688	\$5,700	\$6,500	\$6,900	\$7,500	\$7,900
LTA Revenues (\$ in millions)		\$1,365,280	\$1,455,580	\$1,101,573	\$1,169,754	\$1,210,411	\$1,247,799	\$1,308,740
Non-LTA Spot Revenues		404,654	281,726	98,762	190,085	299,906	475,395	638,212
Other Revenues		125,976	53,487	36,000	36,000	36,000	36,000	36,000
Implied Total Revenue		\$1,895,910	\$1,790,793	\$1,236,335	\$1,395,839	\$1,546,318	\$1,759,194	\$1,982,952
% Implied Growth Rate				(31.0%)	12.9%	10.8%	13.8%	12.7%
<b>Base Case</b>								
Production Capacity (MT)	195,000	214,000	226,400	229,796	230,945	233,254	236,753	240,305
% Capacity Growth Rate		9.7%	5.8%	1.5%	0.5%	1.0%	1.5%	1.5%
Production Volume (MT)	166,347	183,800	180,427	129,835	137,412	151,615	165,727	182,631
% Operating Rate	85.3%	85.9%	79.7%	56.5%	59.5%	65.0%	70.0%	76.0%
Long-term Contracts (LTAs)	118,000	132,500	148,000	112,956	105,120	104,615	81,206	63,921
Spot Contracts	48,347	51,300	32,427	16,879	32,292	47,001	84,521	118,710
Total Contracts	166,347	183,800	180,427	129,835	137,412	151,615	165,727	182,631
% of LTAs	70.9%	72.1%	82.0%	87.0%	76.5%	69.0%	49.0%	35.0%
LTA Contract Price (per MT)		\$10,304	\$9,835	\$9,450	\$9,500	\$9,900	\$10,000	\$10,000
Non-LTA Market Spot Price (per MT)		\$7,888	\$8,688	\$5,600	\$6,000	\$6,500	\$7,000	\$7,000
LTA Revenues (\$ in thousands)		\$1,365,280	\$1,455,580	\$1,067,436	\$998,644	\$1,035,685	\$812,064	\$639,210
Non-LTA Spot Revenues		404,654	281,726	94,520	193,751	305,505	591,646	830,973
Other Revenues		125,976	53,487	36,000	36,000	36,000	36,000	36,000
Implied Total Revenue		\$1,895,910	\$1,790,793	\$1,197,956	\$1,228,395	\$1,377,190	\$1,439,710	\$1,506,183
% Implied Growth Rate				(33.1%)	2.5%	12.1%	4.5%	4.6%

Bear Case	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
Production Capacity (MT)	195,000	214,000	226,400	228,664	228,664	224,091	219,609	215,217
% Capacity Growth Rate		9.7%	5.8%	1.0%	--	(2.0%)	(2.0%)	(2.0%)
Production Volume (MT)	166,347	183,800	180,427	125,765	132,625	134,454	136,158	137,739
% Operating Rate	85.3%	85.9%	79.7%	55.0%	58.0%	60.0%	62.0%	64.0%
Long-term Contracts (LTAs)	118,000	132,500	148,000	109,416	98,143	90,084	44,932	41,322
Spot Contracts	48,347	51,300	32,427	16,349	34,483	44,370	91,226	96,417
Total Contracts	166,347	183,800	180,427	125,765	132,625	134,454	136,158	137,739
% of LTAs	70.9%	72.1%	82.0%	87.0%	74.0%	67.0%	33.0%	30.0%
LTA Contract Price (per MT)		\$10,304	\$9,835	\$9,300	\$9,400	\$9,400	\$9,400	\$9,400
Non-LTA Market Spot Price (per MT)		\$7,888	\$8,688	\$5,400	\$5,500	\$5,600	\$5,600	\$5,600
LTA Revenues (\$ in millions)		\$1,365,280	\$1,455,580	\$1,017,566	\$922,540	\$846,794	\$422,361	\$388,423
Non-LTA Spot Revenues		404,654	281,726	88,287	189,654	248,472	510,863	539,936
Other Revenues		125,976	53,487	36,000	36,000	36,000	36,000	36,000
Implied Total Revenue		\$1,895,910	\$1,790,793	\$1,141,853	\$1,148,194	\$1,131,266	\$969,224	\$964,359
% Implied Growth Rate				(36.2%)	0.6%	(1.5%)	(14.3%)	(0.5%)

Figure 9. Bull Case DCF and Price Target Calculations

### GrafTech Valuation

#### Discounted Cash Flow Analysis (\$ in Thousands)

	Fiscal Year Ended December 31,				
	2020E	2021E	2022E	2023E	2024E
<b>Discounted Cash Flow Analysis</b>					
Years	0.3	1.3	2.3	3.3	4.3
Net Earnings	\$435,041	\$546,985	\$640,156	\$731,192	\$846,840
Plus: Depreciation	\$61,889	\$69,462	\$67,056	\$76,288	\$85,267
Change in Working Capital	164,433	(54,152)	(14,172)	(48,173)	(37,775)
Less: Capital Expenditures	(38,165)	(43,271)	(45,822)	(52,130)	(59,489)
Less: Mandatory Debt Repayments	(331,100)	(280,000)	(200,000)	(200,000)	(350,000)
Levered Free Cash Flow	\$292,098	\$239,023	\$447,218	\$507,177	\$484,843
Revenue	\$1,236,335	\$1,395,839	\$1,546,318	\$1,759,194	\$1,982,952
Operating Expenses	610,749	658,836	717,491	838,549	945,207
Operating Income	\$625,585	\$737,003	\$828,826	\$920,645	\$1,037,745
Taxes @ 17.10%	106,975	126,027	141,729	157,430	177,454
Tax-Effectuated EBIT	\$518,610	\$610,975	\$687,097	\$763,215	\$860,290
Plus: Depreciation	\$61,889	\$69,462	\$67,056	\$76,288	\$85,267
Change in Working Capital	164,433	(54,152)	(14,172)	(48,173)	(37,775)
Less: Capital Expenditures	(38,165)	(43,271)	(45,822)	(52,130)	(59,489)
Unlevered Free Cash Flow	\$706,768	\$583,013	\$694,159	\$739,200	\$848,294
Present Value UFCF @ a WACC of: 7.5%	\$691,518	\$530,431	\$587,263	\$581,512	\$620,536
Present Value LFCF @ Equity Discount Rate of: 9.8%	\$284,051	\$211,769	\$360,992	\$372,987	\$324,857
Present Value UFCF of Projection Period	\$3,011,260				
Present Value LFCF of Projection Period	\$1,554,656				
<b>Perpetuity Method</b>					
Present Value of Projection Period	\$1,554,656				
2024 Free Cash Flow	\$484,843				
Perpetuity Growth Rate	2.0%				
Terminal Value	\$6,372,943				
Years	4.3				
Present Value of Terminal Value	\$4,270,025				
Equity Value	\$5,824,681				
Shares Outstanding	270,475				
Equity Price	\$21.5				
<b>EV/EBITDA Exit Multiple Method</b>					
Present Value of Projection Period					\$3,011,260
2024 EBITDA					\$1,123,012
EBITDA Multiple					6.0x
Terminal Value					\$6,738,071
Years					4.3
Present Value of Terminal Value					\$4,928,966
Total Enterprise Value					\$7,940,227
- Net Debt					1,731,747
Equity Value					\$ 6,208,480
Shares Outstanding					270,475
Equity Price					\$23.0

#### P/E Exit Method

Present Value of Projection Period	\$1,554,656
2024 Net Earnings	\$846,840
P/E Multiple	7.0x
Terminal Value	\$5,927,879
Years	4.3
Present Value of Terminal Value	\$3,971,821
Equity Value	\$5,526,477
Shares Outstanding	270,475
Equity Price	\$20.4

#### EV/Sales Exit Multiple Method

Present Value of Projection Period	\$3,011,260
2024 Sales	\$1,982,952
Sales Multiple	3.0x
Terminal Value	\$5,948,856
Years	4.3
Present Value of Terminal Value	\$4,351,648
Total Enterprise Value	\$7,362,908
- Net Debt	1,731,747
Equity Value	\$ 5,631,161
Shares Outstanding	270,475
Equity Price	\$20.8

#### Bull Case Revenue Assumptions

Bull case revenue changes are driven by a slight increase in production capacity expectations to 2.0% growth by 2024, a % operating rate of 58.0% in 2020 which increases to 82.0% by 2024 (still under pre-COVID-19 levels of 85.6%), % of LTA assumptions that indicate management can resign and maintain many of their current contracts leaving GrafTech with a 60.0% LTA % in 2024, compared to the base case of 35% in 2024. With the increased LTA %, and a rising LTA contract price (per MT), revenues grow at a much higher rate than in the base case. LTA contract prices (per MT) rise to \$10,800 by 2024 (driven by more demand for EAF steel producers instead of BOF steel) and non-LTA market spot (per MT) prices rise to \$7,900 in 2024 (still under pre-COVID-19 average of around \$8200) both slightly higher than in the base case. Revenue subsequently grows at around 11.0-13.0% from 2021 to 2024 after dropping 31.0% in 2020.

#### Bull Case Valuation

Our bull case's higher revenue projections increase GrafTech's free cash flows and lead to higher price targets in each method. In the perpetuity method, the present value LFCF of the projection period increases to \$1,559,216 and the present value of the terminal value rises to \$4,223,060. Our bull cases price target using the perpetuity method is subsequently raised to \$21.4.

The P/E exit multiple method uses the same \$1,559,216 present value LFCF of the projection period, with a present value of the terminal value of \$2,802,128, and a **P/E multiple of 7.0x** symbolizing sell-side analysts finally starting to see the benefits of GrafTech's vertical integration and pricing it closer to other steel manufacturing peers, producing an **equity value per share of \$20.4**.

EV/EBITDA exit method using unlevered free cash flows in the bull case produces a present value UFCF of the projection period of \$3,015,851, a present value of the terminal value of \$3,651,543, **applying a 6x EV/EBITDA multiple** so it is better priced relative to peers **provides a price target of \$23.0**.

EV/Sales exit uses the same present value UFCF of the projection period of \$3,015,851 with a present value of the terminal value of \$3,582,051, and the same **EV/Sales multiple of 3x for a \$20.8 price target**.

Football field analysis used a P/E multiple range from 5.0x-9.0x, EV/Sales multiple range from 2x-4x, ER report valuation ranges, 52-week H/L ranges, EV/EBITDA multiple range from 5x-7x, and a perpetuity growth range from 1-3%, indicating a **general price target for our bull case of around \$20**.



**Perpetuity Growth Rate Sensitivity Analysis**

		Long-term Growth Rate				
		1.00%	1.50%	2.00%	2.50%	3.00%
Equity Discount Rate	\$21.5					
	13.8%	13.4	13.8	14.2	14.6	15.1
	12.8%	14.5	15.0	15.5	16.0	16.6
	11.8%	15.9	16.4	17.0	17.7	18.5
	10.8%	17.5	18.2	19.0	19.9	20.8
	9.8%	19.5	20.4	21.4	22.6	23.9
	8.8%	22.0	23.2	24.6	26.2	28.0
	7.8%	25.3	26.9	28.8	31.1	33.9
	6.8%	29.7	32.0	34.9	38.4	42.8

**Exit EBITDA Multiple Sensitivity Analysis**

		EBITDA Multiple				
		5.0x	5.5x	6.0x	6.5x	7.0x
WACC	\$23.0					
	11.5%	16.9	18.2	19.5	20.8	22.1
	10.5%	17.6	18.9	20.3	21.6	23.0
	9.5%	18.3	19.7	21.2	22.6	24.0
	8.5%	19.1	20.6	22.1	23.5	25.0
	7.5%	20.0	21.5	23.0	24.5	26.0
	6.5%	20.8	22.4	24.0	25.6	27.1
	5.5%	21.7	23.4	25.0	26.7	28.3
	4.5%	22.7	24.4	26.1	27.8	29.5

**Exit EV/Sales Multiple Sensitivity Analysis**

		EV/Sales Multiple				
		2.0x	2.5x	3.0x	3.5x	4.0x
WACC	\$20.8					
	11.5%	13.0	15.3	17.6	19.9	22.2
	10.5%	13.6	16.0	18.4	20.8	23.2
	9.5%	14.2	16.7	19.2	21.7	24.1
	8.5%	14.8	17.4	20.0	22.6	25.2
	7.5%	15.5	18.2	20.9	23.5	26.2
	6.5%	16.2	19.0	21.8	24.6	27.3
	5.5%	16.9	19.8	22.7	25.6	28.5
	4.5%	17.6	20.7	23.7	26.7	29.8

**P/E Multiple Sensitivity Analysis**

		P/E Multiple				
		5.0x	6.0x	7.0x	8.0x	9.0x
Equity Discount Rate	\$20.4					
	13.8%	14.2	16.0	17.8	19.6	21.4
	12.8%	14.7	16.6	18.4	20.3	22.2
	11.8%	15.2	17.1	19.1	21.0	22.9
	10.8%	15.7	17.7	19.7	21.7	23.7
	9.8%	16.2	18.3	20.4	22.5	24.6
	8.8%	16.8	18.9	21.1	23.3	25.5
	7.8%	17.3	19.6	21.9	24.1	26.4
	6.8%	17.9	20.3	22.7	25.0	27.4



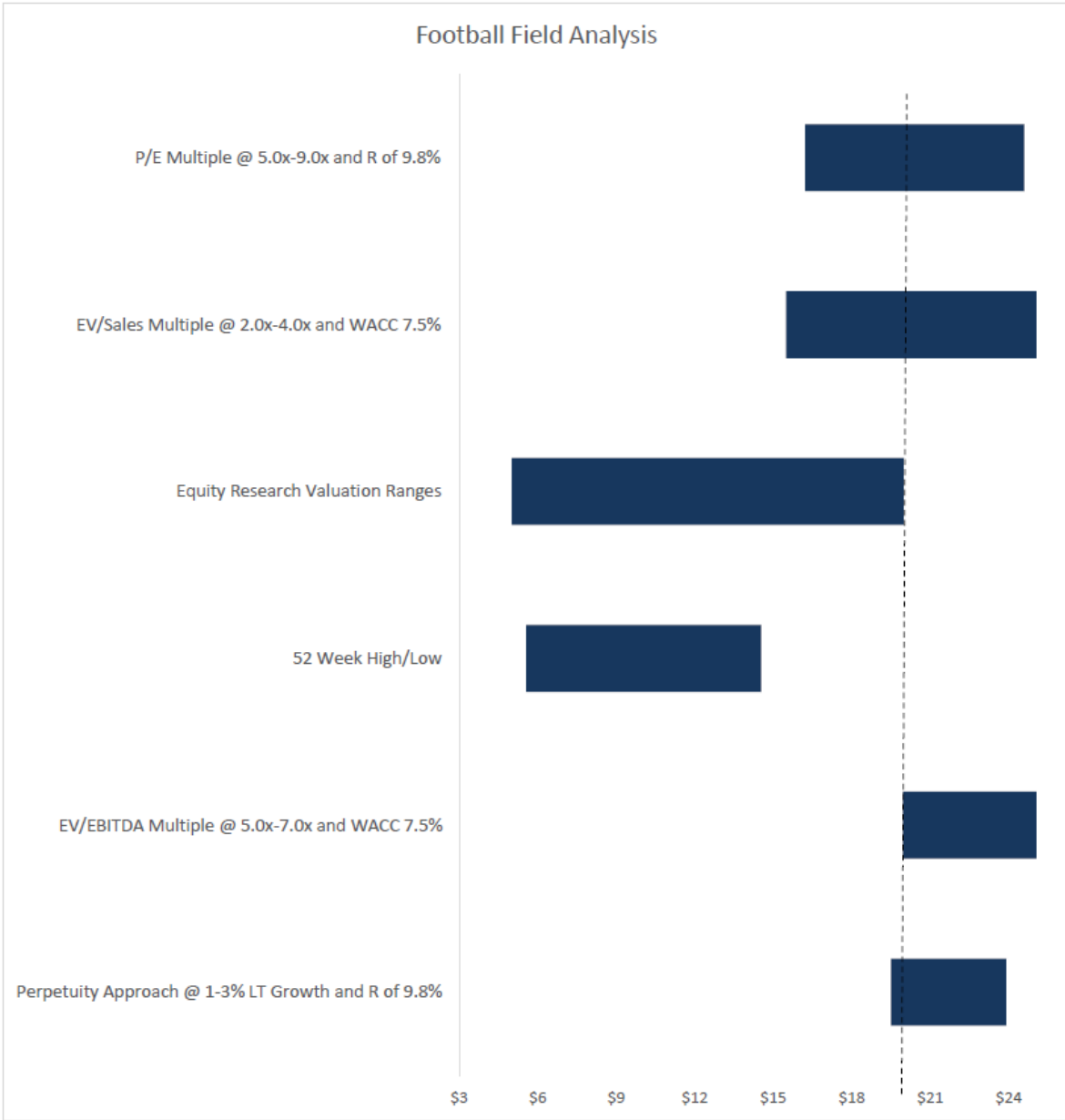


Figure 10. Base Case DCF and Price Targets

**GrafTech Valuation**  
**Discounted Cash Flow Analysis (\$ in Thousands)**

	Fiscal Year Ended December 31.				
	2020E	2021E	2022E	2023E	2024E
<b>Discounted Cash Flow Analysis</b>					
Years	0.3	1.3	2.3	3.3	4.3
Net Earnings	\$418,772	\$473,397	\$563,746	\$590,107	\$635,623
Plus: Depreciation	\$59,968	\$61,129	\$59,722	\$62,433	\$64,766
Change in Working Capital	171,170	(28,361)	(15,492)	(18,814)	(9,074)
Less: Capital Expenditures	(36,980)	(38,080)	(40,810)	(42,663)	(45,185)
Less: Mandatory Debt Repayments	(331,100)	(280,000)	(200,000)	(200,000)	(350,000)
Levered Free Cash Flow	\$281,829	\$188,084	\$367,166	\$391,064	\$296,130
Revenue	\$1,197,956	\$1,228,395	\$1,377,190	\$1,439,710	\$1,506,183
Operating Expenses	591,790	579,802	639,016	686,262	717,947
Operating Income	\$606,166	\$648,593	\$738,174	\$753,448	\$788,236
Taxes @ 17.10%	103,654	110,909	126,228	128,840	134,788
Tax-Effectuated EBIT	\$502,511	\$537,683	\$611,946	\$624,609	\$653,448
Plus: Depreciation	\$59,968	\$61,129	\$59,722	\$62,433	\$64,766
Change in Working Capital	171,170	-28,361	-15,492	-18,814	-9,074
Less: Capital Expenditures	-36,980	-38,080	-40,810	-42,663	-45,185
Unlevered Free Cash Flow	\$696,669	\$532,371	\$615,366	\$625,565	\$663,954
Present Value UFCF @ a WACC of: 7.5%	\$681,637	\$484,356	\$520,603	\$492,118	\$485,689
Present Value LFCF @ Equity Discount Rate of: 9.8%	\$274,064	\$166,639	\$296,374	\$287,596	\$198,414
Present Value UFCF of Projection Period			\$2,664,404		
Present Value LFCF of Projection Period			\$1,223,087		
<b>Perpetuity Method</b>					
Present Value of Projection Period			\$1,223,087		
2024 Free Cash Flow			\$296,130		
Perpetuity Growth Rate			2.0%		
Terminal Value			\$3,892,425		
Years			4.3		
Present Value of Terminal Value			\$2,608,018		
Equity Value			\$3,831,105		
Shares Outstanding			270,475		
Equity Price			\$14.2		
<b>P/E Exit Method</b>					
Present Value of Projection Period			\$1,223,087		
2024 Net Earnings			\$635,623		
P/E Multiple			5.0x		
Terminal Value			\$3,178,116		
Years			4.3		
Present Value of Terminal Value			\$2,129,414		
Equity Value			\$3,352,501		
Shares Outstanding			270,475		
Equity Price			\$12.4		
<b>EV/EBITDA Exit Multiple Method</b>					
Present Value of Projection Period			\$2,664,404		
2024 EBITDA			\$853,002		
EBITDA Multiple			4.5x		
Terminal Value			\$3,838,508		
Years			4.3		
Present Value of Terminal Value			\$2,807,907		
Total Enterprise Value			\$5,472,311		
- Net Debt			1,731,747		
Equity Value			\$ 3,740,564		
Shares Outstanding			270,475		
Equity Price			\$13.8		
<b>EV/Sales Exit Multiple Method</b>					
Present Value of Projection Period			\$2,664,404		
2024 Sales			\$1,506,183		
Sales Multiple			2.5x		
Terminal Value			\$3,765,458		
Years			4.3		
Present Value of Terminal Value			\$2,754,470		
Total Enterprise Value			\$5,418,874		
- Net Debt			1,731,747		
Equity Value			\$ 3,687,127		
Shares Outstanding			270,475		
Equity Price			\$13.6		

Figure 11: Bear Case DCF and Price Targets

**GrafTech Valuation**  
**Discounted Cash Flow Analysis (\$ in Thousands)**

	Fiscal Year Ended December 31,				
	2020E	2021E	2022E	2023E	2024E
<b>Discounted Cash Flow Analysis</b>					
Years	0.3	1.3	2.3	3.3	4.3
Net Earnings	\$394,989	\$438,038	\$453,376	\$383,319	\$395,370
Plus: Depreciation	\$57,159	\$57,138	\$49,057	\$42,031	\$41,467
Change in Working Capital	181,017	(22,628)	14,306	25,001	3,181
Less: Capital Expenditures	(35,248)	(35,594)	(33,523)	(28,721)	(28,931)
Less: Mandatory Debt Repayments	(331,100)	(280,000)	(200,000)	(200,000)	(350,000)
Levered Free Cash Flow	\$266,817	\$156,954	\$283,217	\$221,630	\$61,088
Revenue	\$1,141,853	\$1,148,194	\$1,131,266	\$969,224	\$964,359
Operating Expenses	564,076	541,948	524,907	461,997	459,678
Operating Income	\$577,778	\$606,247	\$606,358	\$507,227	\$504,681
Taxes @ 17.10%	98,800	103,668	103,687	86,736	86,300
Tax-Effectuated EBIT	\$478,978	\$502,578	\$502,671	\$420,491	\$418,381
Plus: Depreciation	\$57,159	\$57,138	\$49,057	\$42,031	\$41,467
Change in Working Capital	181,017	(22,628)	14,306	25,001	3,181
Less: Capital Expenditures	(35,248)	(35,594)	(33,523)	(28,721)	(28,931)
Unlevered Free Cash Flow	\$681,906	\$501,494	\$532,512	\$458,802	\$434,098
Present Value UFCF @ a WACC of: 7.5%	\$667,193	\$456,264	\$450,509	\$360,930	\$317,547
Present Value LFCF @ Equity Discount Rate of: 9.8%	\$259,466	\$139,058	\$228,611	\$162,991	\$40,930
Present Value UFCF of Projection Period			\$2,252,443		
Present Value LFCF of Projection Period			\$831,056		
<b>Perpetuity Method</b>					
Present Value of Projection Period			\$831,056		
2024 Free Cash Flow			\$61,088		
Perpetuity Growth Rate			2.0%		
Terminal Value			\$802,961		
Years			4.3		
Present Value of Terminal Value			\$538,003		
Equity Value			\$1,369,059		
Shares Outstanding			270,475		
Equity Price			\$5.1		

**EV/EBITDA Exit Multiple Method**

Present Value of Projection Period	\$2,252,443
2024 EBITDA	\$546,149
EBITDA Multiple	4.0x
Terminal Value	\$2,184,594
Years	4.3
Present Value of Terminal Value	\$1,598,053
Total Enterprise Value	\$3,850,495
- Net Debt	1,731,747
Equity Value	\$ 2,118,748
Shares Outstanding	270,475
Equity Price	\$7.8

**EV/Sales Exit Multiple Method**

Present Value of Projection Period	\$2,252,443
2024 Sales	\$964,359
Sales Multiple	2.0x
Terminal Value	\$1,928,718
Years	4.3
Present Value of Terminal Value	\$1,410,876
Total Enterprise Value	\$3,663,319
- Net Debt	1,731,747
Equity Value	\$ 1,931,572
Shares Outstanding	270,475
Equity Price	\$7.1

**P/E Exit Method**

Present Value of Projection Period	\$831,056
2024 Net Earnings	\$395,370
P/E Multiple	3.5x
Terminal Value	\$1,383,796
Years	4.3
Present Value of Terminal Value	\$927,177
Equity Value	\$1,758,233
Shares Outstanding	270,475
Equity Price	\$6.5

**Bear Case Revenue Assumptions**

Production capacity begins to decline in 2022 and continues to decrease by -2.0% in the following years. Operating rate % growth slows and does not return to pre-COVID-19 levels by 2024, reaching only 64% from around 80-85% pre COVID-19. The bear case's main driver is the assumption that management loses more LTA contracts than expected, dropping the % of LTAs by 2024 to 30% totaling only 41,000 LTAs while also forecasting for a drop in LTA contract prices (per MT) down to \$9,400 in 2024 compared to \$10,000 in the base. Current prices of LTAs are around \$9,450, so the bear case assumes that prices for all contracts remain at current COVID-19 levels which we believe is highly unlikely. With these assumptions, revenue drops by -36.2% in 2020, rises

.6% in 2021, and then in the following years decreases by -1.5%, -14.3%, and -5% in 2022, 2023, and 2024 respectively.

#### Bear Case Valuation

Our bear case's lower revenue projections decrease GrafTech's future cash flows and leads to lower price targets in each method. In the perpetuity method, the present value LFCF of the projection period decreases to \$831,056 and the present value of the terminal value decreases to \$538,003. Our bear cases price target using the perpetuity method is subsequently decreased to \$5.1.

The P/E exit multiple method uses the same \$831,056 present value LFCF of the projection period, with a present value of the terminal value of \$1,324,538, and a slightly lower **P/E multiple of 3.5x, producing an equity value per share of \$6.5.**

EV/EBITDA exit method using unlevered free cash flows in the bear case produces a present value UFCF of the projection period of \$2,252,443, a present value of the terminal value of \$1,797,809, with a slightly lower **4.0x EV/EBITDA multiple providing a price target of \$7.8.**

EV/Sales exit uses the same present value UFCF of the projection period of \$2,252,443 with a present value of the terminal value of \$1,763,595, and a slightly lower **EV/Sales multiple of 2.0x for a \$7.1 price target.**

Football field analysis used a P/E multiple range from 2.0x-6.0x, EV/Sales multiple range from 1x-3x, ER report valuation ranges, 52-week H/L ranges, EV/EBITDA multiple range from 3x-5x, and a perpetuity growth range from 1-3%, indicating a **general price target for our bear case of around \$6.5.**

**Perpetuity Growth Rate Sensitivity Analysis**

		Long-term Growth Rate					
		\$5.1	1.00%	1.50%	2.00%	2.50%	3.00%
Equity Discount Rate	13.8%		3.9	4.0	4.0	4.1	4.1
	12.8%		4.1	4.1	4.2	4.3	4.3
	11.8%		4.3	4.4	4.4	4.5	4.6
	10.8%		4.5	4.6	4.7	4.8	4.9
	9.8%		4.8	4.9	5.0	5.2	5.4
	8.8%		5.2	5.3	5.5	5.7	5.9
	7.8%		5.6	5.8	6.1	6.3	6.7
	6.8%		6.2	6.5	6.8	7.3	7.8

**Exit EBITDA Multiple Sensitivity Analysis**

		EBITDA Multiple					
		\$7.8	3.0x	3.5x	4.0x	4.5x	5.0x
WACC	11.5%		5.2	5.8	6.4	7.1	7.7
	10.5%		5.4	6.1	6.8	7.4	8.1
	9.5%		5.7	6.4	7.1	7.8	8.5
	8.5%		6.0	6.8	7.5	8.2	8.9
	7.5%		6.4	7.1	7.8	8.6	9.3
	6.5%		6.7	7.5	8.2	9.0	9.8
	5.5%		7.1	7.9	8.7	9.5	10.3
	4.5%		7.4	8.3	9.1	9.9	10.8

**Exit EV/Sales Multiple Sensitivity Analysis**

		EV/Sales Multiple					
		\$7.1	1.0x	1.5x	2.0x	2.5x	3.0x
WACC	11.5%		3.6	4.7	5.8	7.0	8.1
	10.5%		3.8	5.0	6.1	7.3	8.5
	9.5%		4.1	5.3	6.5	7.7	8.9
	8.5%		4.3	5.5	6.8	8.1	9.3
	7.5%		4.5	5.9	7.2	8.5	9.8
	6.5%		4.8	6.2	7.5	8.9	10.2
	5.5%		5.1	6.5	7.9	9.3	10.7
	4.5%		5.4	6.8	8.3	9.8	11.3

**P/E Multiple Sensitivity Analysis**

		P/E Multiple					
		\$6.5	1.5x	2.5x	3.5x	4.5x	5.5x
Equity Discount Rate	13.8%		4.1	5.0	5.8	6.7	7.5
	12.8%		4.2	5.1	6.0	6.8	7.7
	11.8%		4.3	5.2	6.1	7.0	7.9
	10.8%		4.4	5.4	6.3	7.3	8.2
	9.8%		4.5	5.5	6.5	7.5	8.4
	8.8%		4.6	5.7	6.7	7.7	8.7
	7.8%		4.8	5.8	6.9	7.9	9.0
	6.8%		4.9	6.0	7.1	8.2	9.3

### Football Field Analysis

