



Steel Founders' Society of America

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2023 Industry Market Forecast

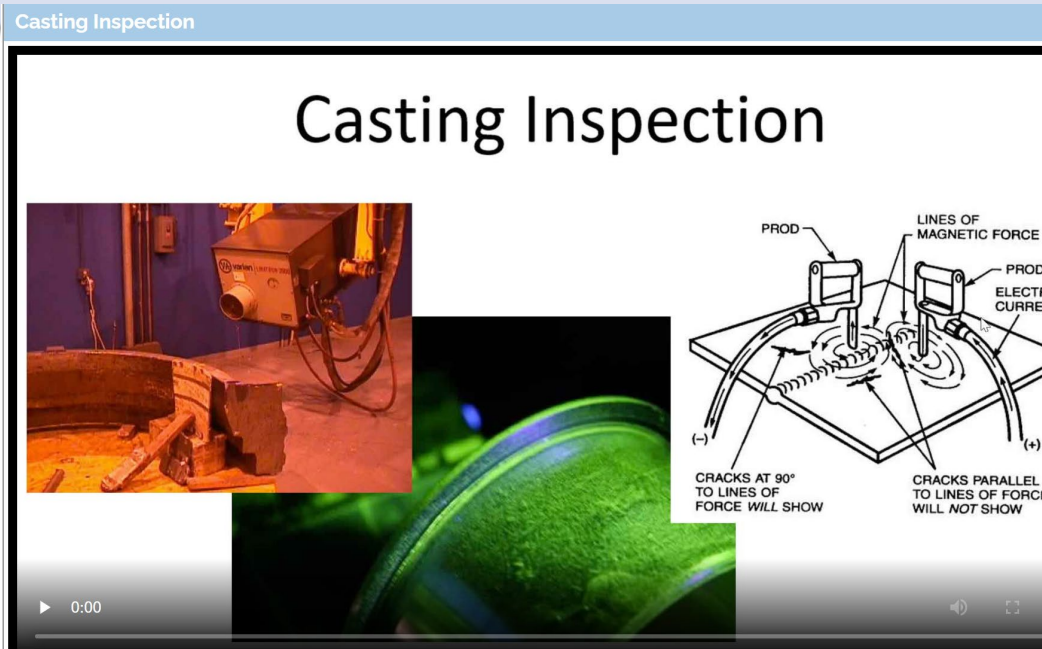
Marketing Committee Role

The function of the Marketing Committee is to **broaden the market for and promote the use of steel castings** by investigating and developing new markets, developing and implementing an effective marketing program, and communicating the advantages of steel castings to present and prospective consumers in an effective manner.

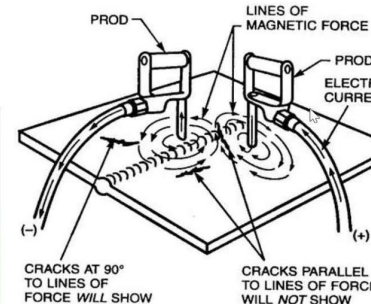
To carry out its mission, the committee maintains liaison with other committees of the Society through the staff, identifies technical, business and market topics of interest to customers and SFSA members, directs development of the material and delivery of the information. The committee develops the deliverables for the marketing program such as messaging, competitive input, target market, and specific planning, The committee also performs related market research to help guide the work of the Society and **prepares each year for the Society an annual forecast of steel casting demand.....**

- Member Directory
- Free SFSA Publications
- Online Specs./Std. Tool
- Customer Webinars
- White Papers
- Foundry Glossary
- **New Steel Casting Design Videos**

Casting Inspection



Casting Inspection



CRACKS AT 90° TO LINES OF FORCE WILL SHOW

CRACKS PARALLEL TO LINES OF FORCE WILL NOT SHOW

Free publications

Casteel Reporter - SFSA's newsletter

Other free SFSA publications:

- Supplements to the Steel Castings Handbook
- Research Reports 94 A&B on Fatigue and Fracture Toughness of Five Carbon or Low Alloy Cast Steels at Room or Low Climate Temperature
- SFSA Project A95 on Corrosion, Toughness, Weldability and Metallurgical Evaluation of Cast Duplex Stainless Steels
- Test Coupons and Casting Properties - Information gathered from several publications on the relationship between the properties of test coupons and the properties of castings
- Fracture Toughness in Relation to Steel Castings Design and Application
- Ultrasonic Testing of Steel Castings
- Cast to Shape. A history of the steel castings industry in the United States
- Raw Materials Specifications
- Sub-size Charpy specimens

Standards and Specifications for Steel Castings

Choose one of the search tabs below, enter the desired search criteria and click "Search" to find matching alloy grades in our database.

Notice: This facility is in its beta test stage, and is provided for convenience. Search results provided are subject to both human and machine errors and you should not rely on the information provided here without confirming it against the applicable standards and specifications.

Properties/Chemistry

Mechanical

- Standards specify either a minimum or a range of mechanical properties. Your entered value(s) must be equal to or higher than the minimum or within the range of mechanical properties specified for a grade in a standard to have a match result.
- You can search tensile strength (UTS), yield strength (YS), impact toughness, and rupture strength in Metric (SI) or Imperial System. You only need to input value using one unit and your entered value will automatically be converted to the other unit.

Hardness BHN HBW HRC

Tensile strength ksi or MPa

Yield strength ksi or MPa

Elongation%

Reduction in area%

Impact Foot-pounds or Joules

Impact test temperature in °F or °C

Stress rupture test ksi or MPa

100 hour rupture test MPa at temperature in °C

Chemistry

- All values are in weight percent (wt%)
- Standards specify either a maximum or a range of wt% for various elements. Your entered value(s) must be equal to or lower than the maximum or within the range of wt% of elements specified for a grade in a standard to have a match result.
- Elements that are specified as "Others" in a standard are not included in the search algorithm. To see these "Other" elements of a certain grade, click the page for that specific grade (either shown in the search results or by going to the other tabs e.g. By Standard)

Al% As% Ba% Bi% B% C% Co% Cr% Cu% Mn% Mo%

N% Nb% Ni% P%

V% W% Zr%

STEEL FOUNDERS' SOCIETY OF AMERICA

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www.sfsa.org
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Understanding Steel Casting Failures

All parts, regardless of their product form, be they castings, forgings or fabrications will fail if the service load exceeds the design limits. The load bearing capacity of a casting depends on the geometry, material properties (strength) and quality. Selecting these requirements is the responsibility of the design engineer. The casting producer must meet the requirements specified.

Routine part failures generally indicates either one or a combination of an inadequate geometric design, incorrect material selection or failure to select the quality requirements which might include NDE requirements, the net result is that a redesign is required. A sporadic part failure indicates the part was not capable of meeting the load required; which may be due to an unplanned use or a quality issue that may or may not have been identified as a requirement for the part.

It is common for a failed part to be sent to a laboratory for inspection and analysis. The fracture surface is examined and the initiation feature and crack path are determined. Pictures are taken and a report is written. Unfortunately, this does not address the main issues: did the casting meet the specification requirements, did it meet or exceed the design loads, was the design adequate for the service conditions, or did the part experience abuse with loads that exceeded the design?

Steel casting are used to make complex shapes. As the design becomes more complex in shape, the load is highest at and is constrained to the smallest cross section subjected to that load. When a part is loaded in excess of its capacity, it can fail in a brittle manner in the heavily loaded section without obvious deformation as the failure path is determined by the complex part shape and the load, Figure 1. Often the fracture surface at the microscopic level shows ductility but the crack path will be flat without any macro deformation due to the geometric constraint. The initiation of failure will be at the weakest, most heavily loaded feature and will propagate through the weakest material Figure 2. A test laboratory that examines the failure path is expected to find an initiation point and areas of weakness that limited the capacity of the part, Figure 3.

All parts can be loaded beyond capacity and fail. The failure will occur at the weakest area of the heavily loaded section of the part. The weakest area will have a feature that initiates the failure. Common practice is to identify this initiation feature as a defect and attribute the failure to its existence. This is often incorrect since the part load may have exceeded the design intent due to an inadequate design or product abuse. Labeling the initiation of failure to a defect incorrectly and prematurely assigns responsibility of failure to part quality and fails to correctly identify the root cause or commercial responsibility.

All real materials have features that limit the capability of the part. In the ASTM nondestructive testing standard E1316, the definition of a defect is, "one or more flaws whose aggregate size, shape, orientation, location, or properties do not meet the specified acceptance criteria and are rejectable." In this definition the correct commercial and technical use of the term, defect, is a condition that violates the purchase requirement at the transfer of ownership from the producer to purchaser. A flaw in the part that

Steel Casting Design Videos

- Enable dramatically better steel casting designs for lower mass, assured design life, easier producibility, and lower final assembled total cost.

- Disseminate via the Wiki and SFSA Website to casting buyers and industry - steel casting producers' foundry engineering teams, and OEM concept-to-production teams.



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SFSA Steel Casting Design & Manufacturing Engineering

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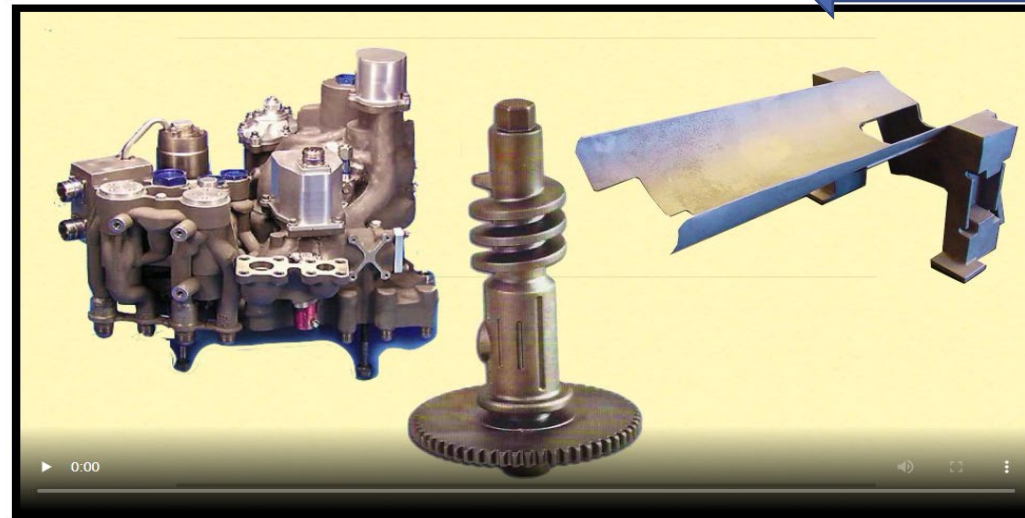
- 1 Videos you can share with your customers
 - 1.1 Story of the Steel Casting Design Pathway
 - 1.2 Steel Casting Geometry: Freeway to Producer Response
 - 1.3 Castability Geometry
 - 1.4 Castability Geometry Differs by Steel Alloy Type - Parallel Pathways
- 2 In development for future release:
 - 2.1 Interior Mold Cavity Geometry Junctions
 - 2.2 Process Dominated Castability Geometry
 - 2.3 Welded Steel Fabrications
 - 2.4 Net Shape Machined from Wrought Steel Blocks
 - 2.5 Basic Steel Casting Gating Principles
 - 2.6 Basic Steel Casting Riser Principles
 - 2.7 Prototyping New Steel Casting Designs: What to Accomplish and Why?
 - 2.8 Power of Additive Manufacturing to Enable Rapid Prototyping
 - 2.9 Is Cast Steel Really Steel?
 - 2.10 Add Strength without Upsetting Castability Geometry and Low Mass.

Videos you can share with your customers [edit]

Provide your customers with the shareable link for each video that you'd like them to view.

Story of the Steel Casting Design Pathway [edit]

Shareable link: <https://www.sfsa.org/design-manufacturing-engineering/story-of-the-casting-design-pathway/>



Mike Gwyn

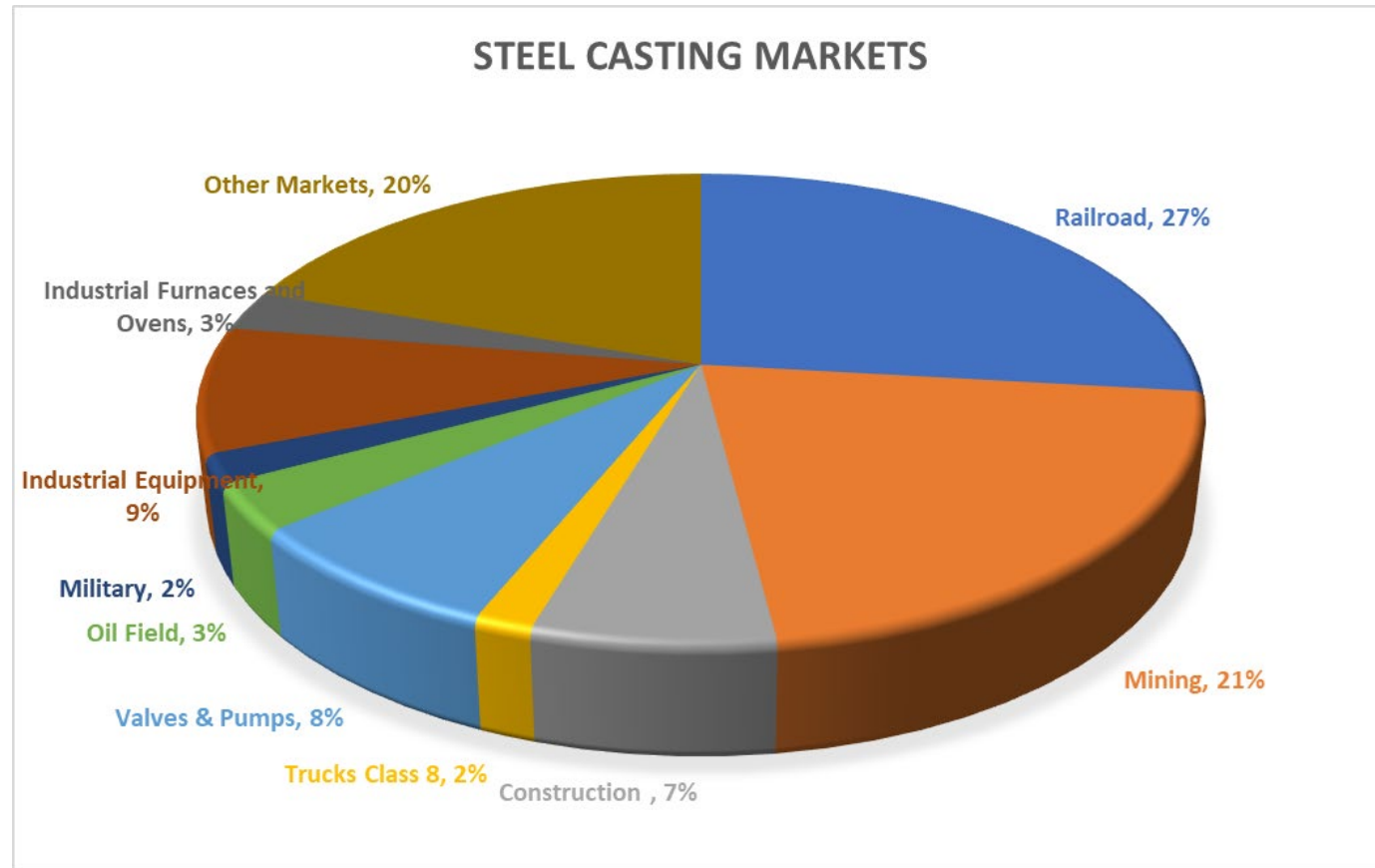
Provide your customers with shareable link

Design Videos Schedule

Topic	Scheduled Completion
1. Story of the Steel Casting Design Pathway	Complete
2. Steel Casting Geometry: Freeway to Producer Response	Complete
3. Castability Geometry	Complete
4. Castability Geometry Differs by Steel Alloy Type	Complete
5. Interior Mold Cavity Geometry Junctions	September 2022
6. Process Dominated Castability Geometry	October 2022
7. Welded Steel Fabrications	October 2022
8. Net Shape Machined from Wrought Steel Blocks	November 2022
9. Basic Steel Casting Gating Principles	December 2022
10. Basic Steel Casting Riser Principles	January 2023
11. Prototyping New Steel Casting Designs: What to Accomplish and Why?	February 2023
12. Power of Additive Manufacturing to Enable Rapid Prototyping	February 2023
13. Is Cast Steel Really Steel?	March 2023
14. Add Strength without Upsetting Castability Geometry and Low Mass.	March 2023

Forecast Process

- Segmented primary markets
- Identified key customers and users in each market
- Analyze customer top line sales
- Market survey to members
- Leverage customer associations
 - Pumps, Valves, Rail, Equip. Mfg.
- Review analyst reports



Steel Markets Survey

SFSA Markets	Steel Casting Examples
Rail/Transit	frames, couplings, bolsters, track components
Mining - Equipment	axle housing, frame components, suspension, gear case
Mining - Consumables	G.E.T., liners, hammers, grate plates, cement and aggregate components
Construction Equipment	axle components, sprocket, end caps, transmission housing
Truck - Class 8	suspension brackets, brake components, axle spindles, fifth wheels
Pump	housing, impeller, covers, bowls
Valve	strainer bodies, bonnets, butterfly valves
Oil & Gas	port adapters, brackets, levers, slip linkages
Military	ground vehicle and maritime components
Industrial Furnace and Oven Mfg.	Furnace, heat treat, steel mill components - rollers, links, baskets
Industrial Machinery	Industrial equipment parts - pulp & paper, food, shotblast - plates, wheels, sprockets, flanges
OTHER MARKETS	
Agricultural Implement Manufacturing	Agricultural Products - Hitch Links, Sprockets
Electric Power Generation	Power Generation - Coreforms, deflector blocks
Aerospace Product and Parts Manufacturing	Aerospace bearing supports, combustor cases, compressor cases, exhaust diffusers, stationary inlet guides, swirlers
Engine, Turbine, and Power Transmission Equipment	Turbine engine - compressor cases, combustor basket
Special Die and Tool Manufacturing	Dies, Tooling, fixtures

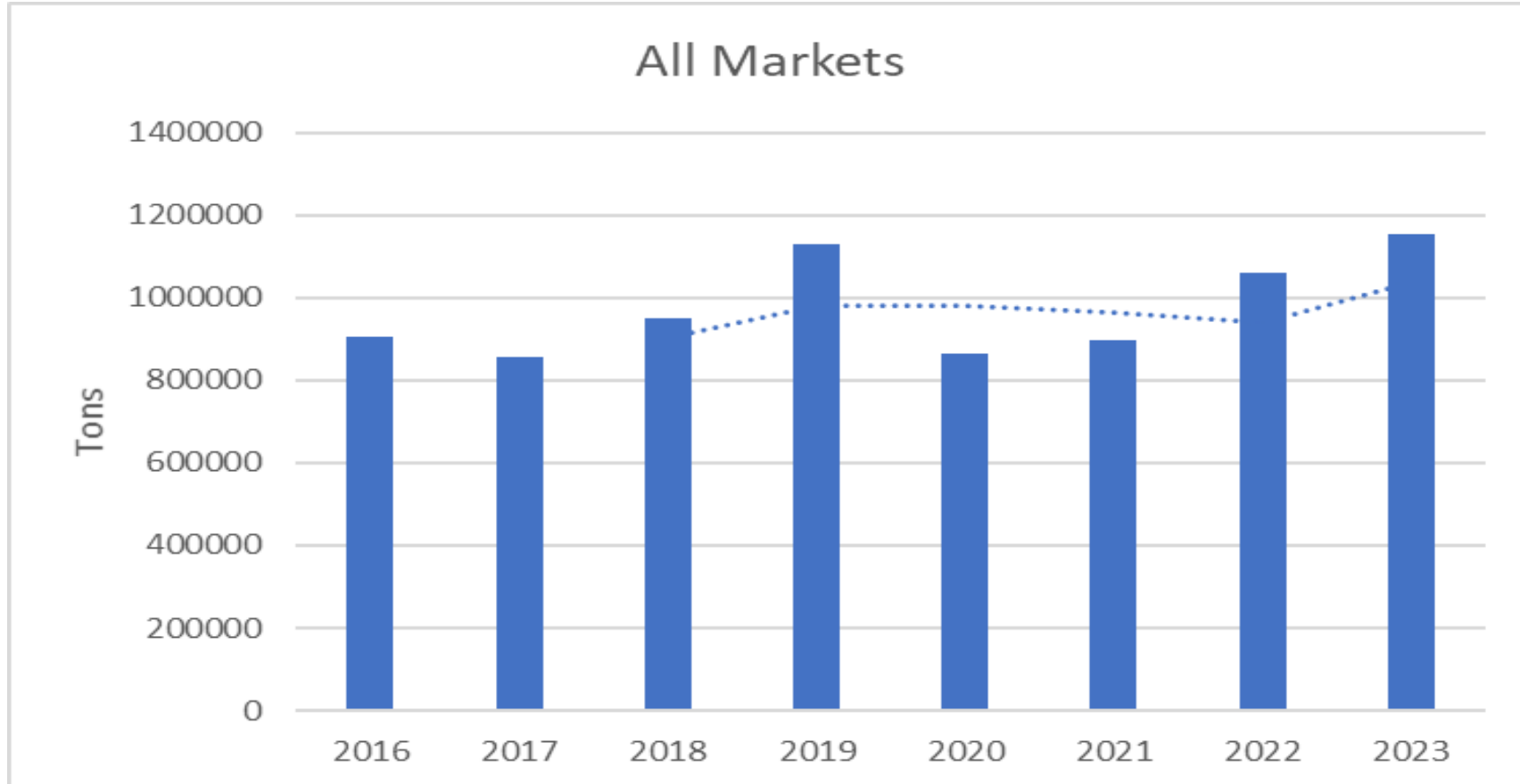


Steel Founders' Society of America

Market Segments – Annual Production

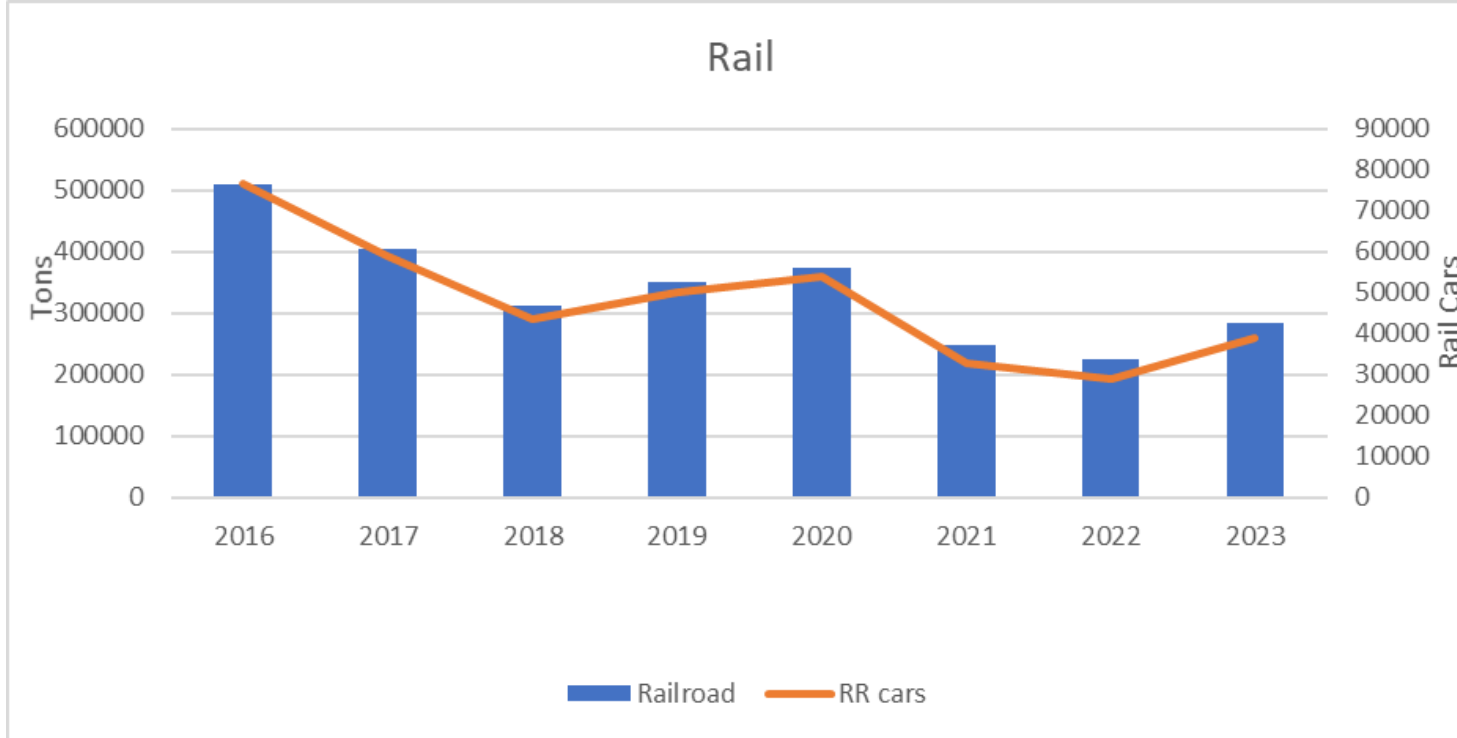
Market	Industry	% of total market prod.	SFSA Members	% of Industry Production
Railroad	267,000	27%	53,400	20%
Mining	243,900	24%	147,000	60%
Valve and Pump	82,700	8%	45,700	55%
Oil & Gas	31,700	3%	18,800	59%
Construction	69,600	7%	14,500	21%
Trucks	16,000	2%	3,700	23%
Military	21,900	2%	15,000	68%
Industrial Equip.	95,200	9%	35,600	37%
Industrial Furn.	23,400	2%	14,000	59%
Other Industrial	152,000	15%	79,700	52%
Total	1,003,400		427,400	43%

Total Steel Castings Market



2022		2023	
Total Market	Excluding Rail	Total Market	Excluding Rail
18.5%	16%	9%	7%

Rail Forecast



Projected Car Deliveries

2022 – 39,000

2023 – 46,000

2024 – 39,000

2022	2023
27%	15%

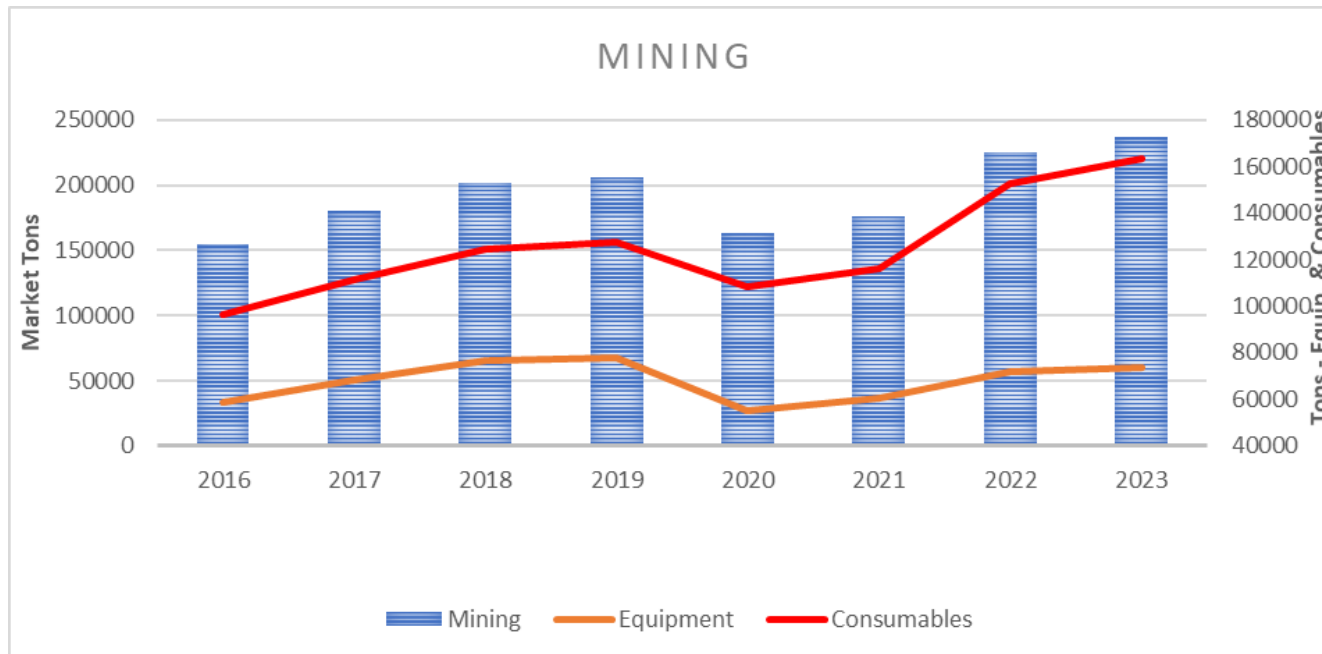
Customer Market Sales Forecast

% change from prior year

Railroad	2020	2021	2022	2023
Railroads (sales)	-9.2%	11.9%	13.7%	3.9%
Equipment (sales)	-21.5%	-2.8%	55.4%	11.5%
SFSA Forecast (tonnage)	-41%	15%	27%	15%

Note: Customer market data is percentage change in sales, SFSA forecast is percentage change in tonnage.

Mining Forecast



2022	2023
27%	5%

Equipment

- 2022 Projection – up 19%

Consumables

- 2022 Projection – up 32%

- Continued strong aggregate and mining environment

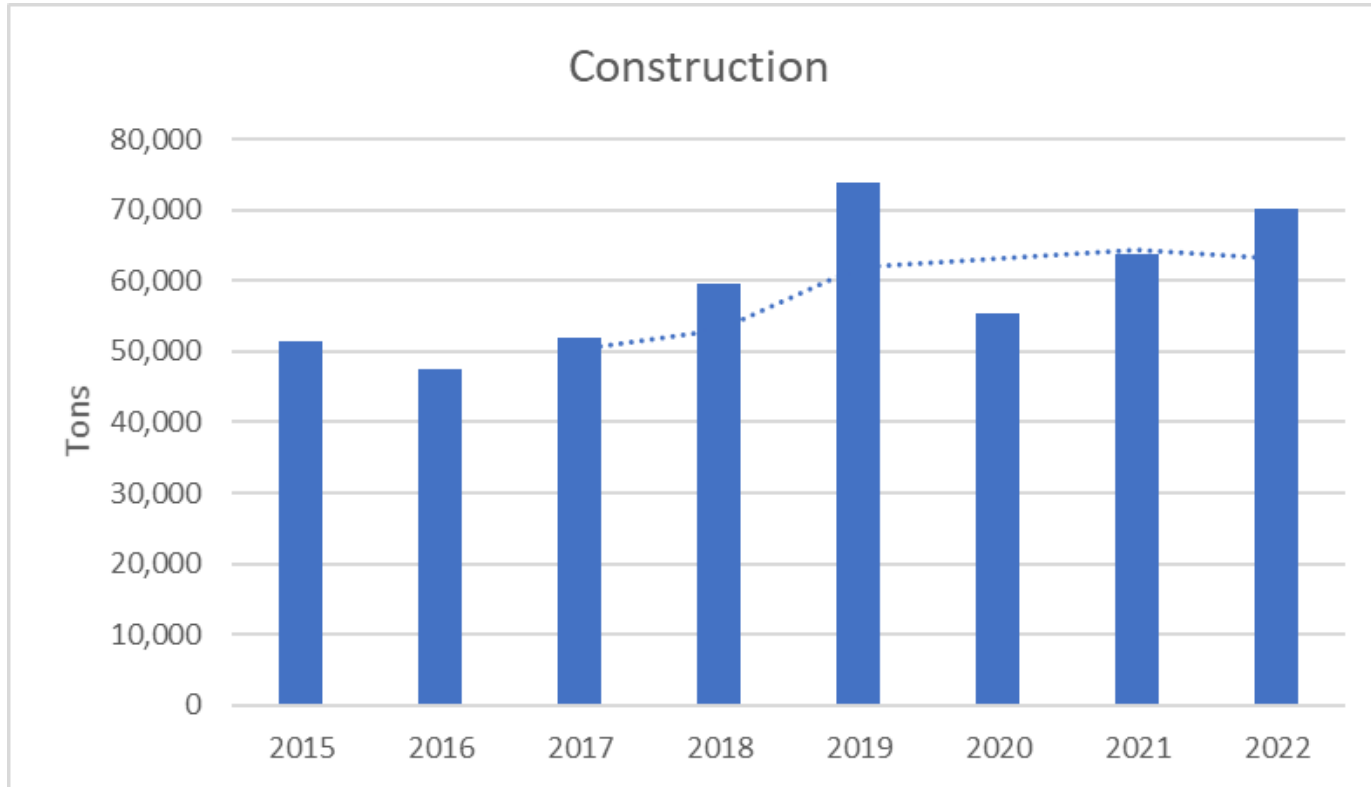
- Elevated commodity prices

Customer Market Sales Forecast

% change from prior year

Mining	2020	2021	2022	2023
Mines (sales)	3.4%	38%	-1.3%	-3.4%
Equipment (sales)	-13.1%	9.9%	16.4%	7.5%
SFSA Consumables (tonnage)	-15%	6%	32%	7%
SFSA Equipment (tonnage)	-30%	10%	19%	2%

Construction Forecast



2022	2023
10%	7%

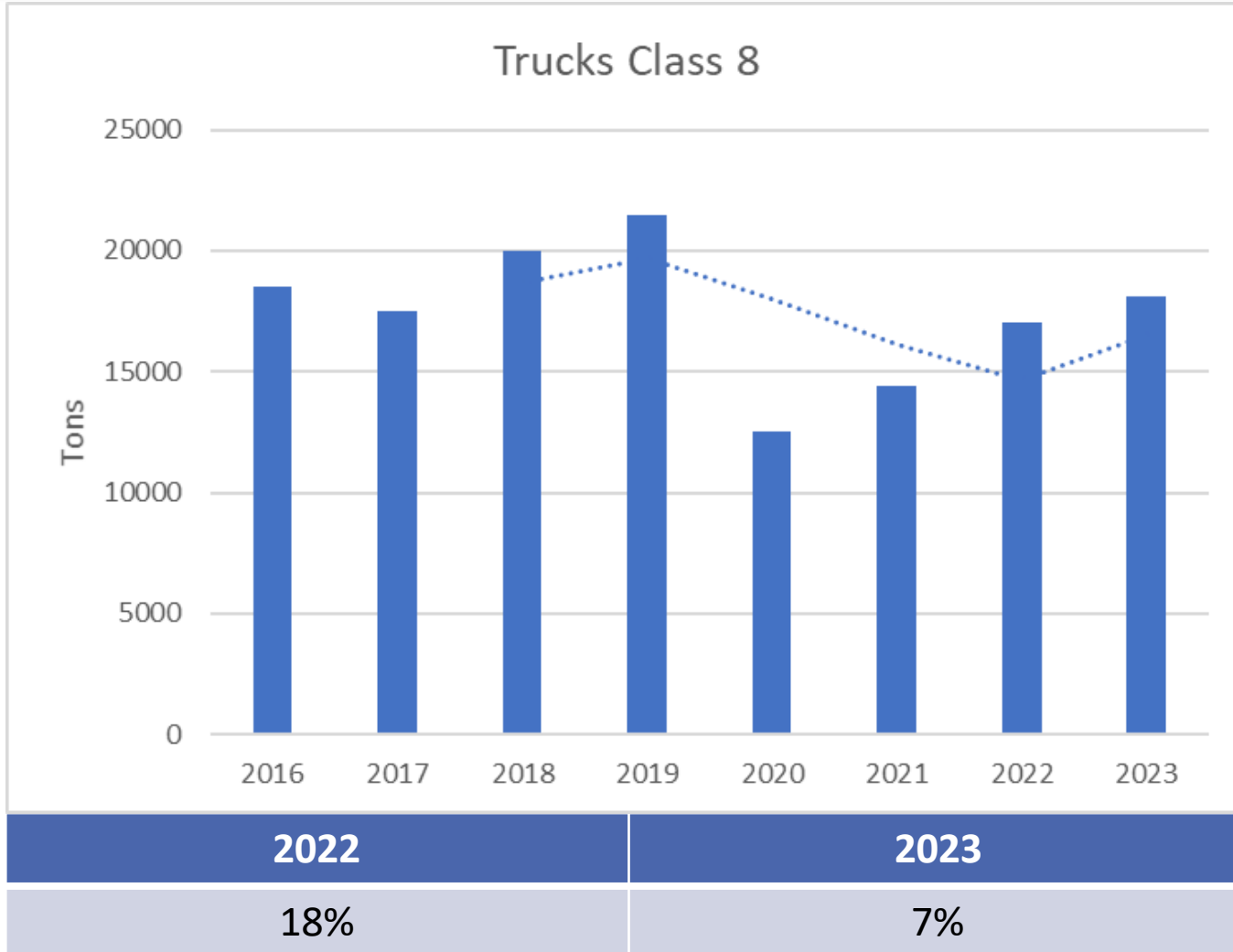
- OEM Forecasts
- Infrastructure Spending
- New orders anticipated to accelerate in late 2023 through 2024.

Customer Market Sales Forecast

% change from prior year

Construction	2020	2021	2022	2023
Equipment (sales)	-13.1%	16.9%	17.1%	4.7%
SFSA Forecast (tonnage)	-25%	15%	10%	7%

Truck Forecast



Class 8 Production Forecast

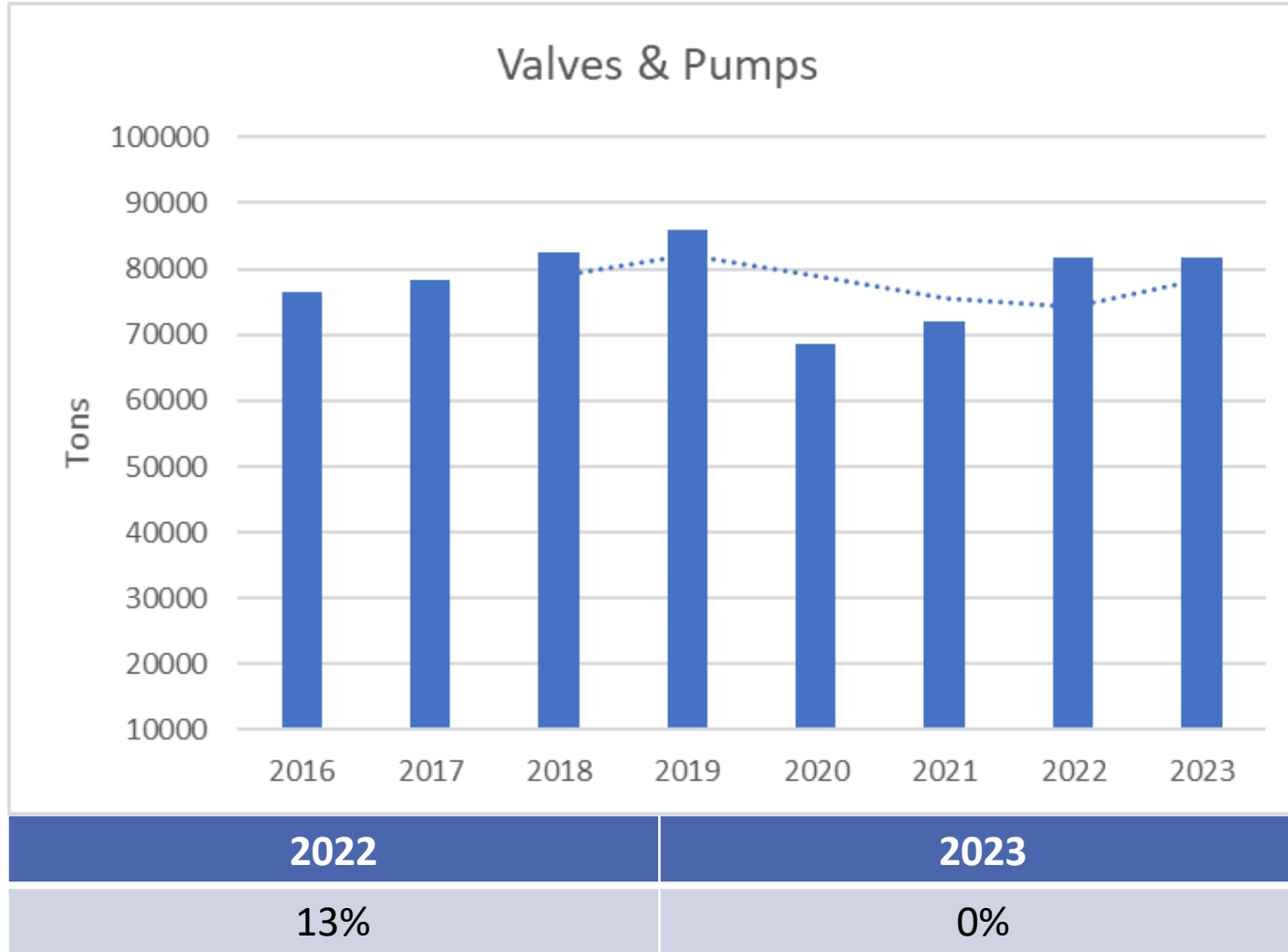
- '21 – 260,500
 - '22 – 296,000
 - '23 – 320,000
-
- Pent-up demand due to OEM supply issues

Customer Market Sales Forecast

% change from prior year

Trucks	2020	2021	2022	2023
Manufacturers (sales)	-22%	21.6%	19.8%	1.8%
SFSA Forecast (tonnage)	-42%	30%	18%	7%

Pump and Valve Forecast



Projected 2022 vs. 2021 Tonnage

- Pumps – 7.5%
- Valves – 21%

- Softening Demand
- Extended Lead Times

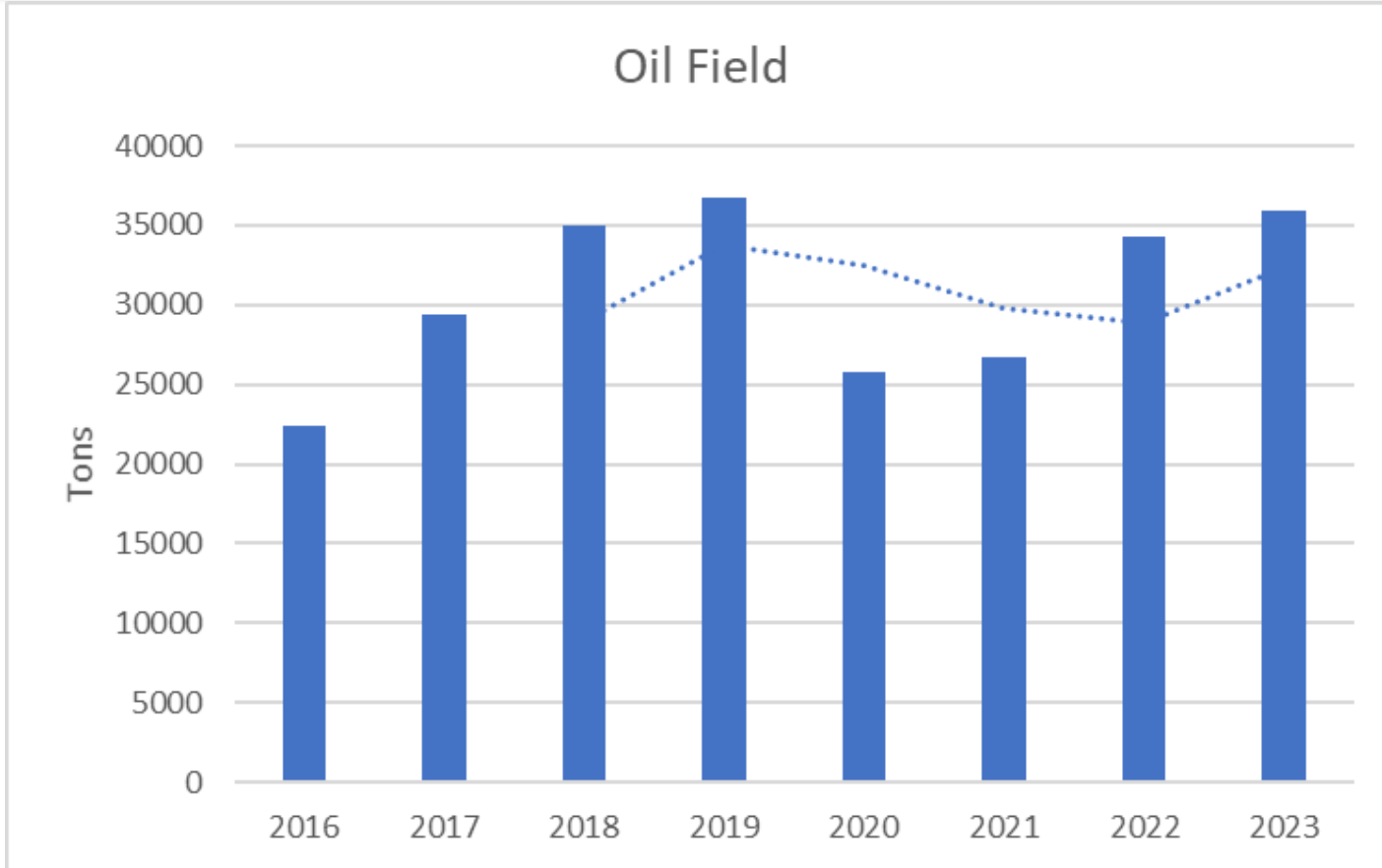
- Baird Process Control Survey
 - 0%-5% Growth in '23

Customer Market Sales Forecast

% change from prior year

Pumps and Valves	2020	2021	2022	2023
Manufacturers (sales)	-10.5%	8.3%	8.2%	6.9%
SFSA Forecast (tonnage)	-20%	5%	13%	0%

Oil Field Forecast



2022	2023
28%	5%

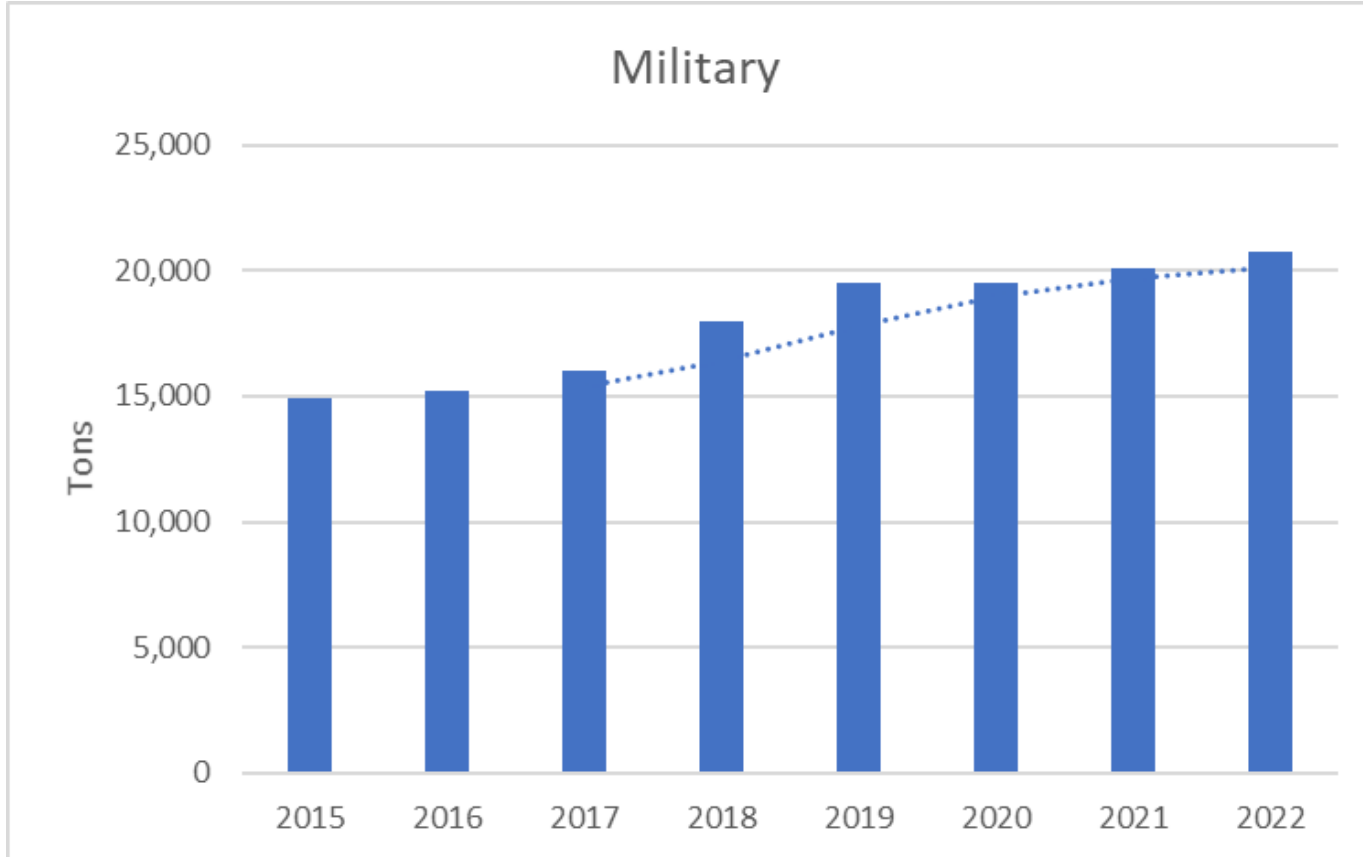
- Push for refining capacity increase
- Regulatory environment and price volatility are concerns for limiting investment

Customer Market Sales Forecast

% change from prior year

Oil Field	2020	2021	2022	2023
Manufacturers (sales)	-21%	-11%	18.7%	10.4%
SFSA Forecast (tonnage)	-30%	7%	28%	5%

Military Forecast



2022	2023
3%	12%

	Ground Systems	Maritime Systems
FY22	\$12.3B	\$34.6B
FY23	\$12.6B	\$40.8B

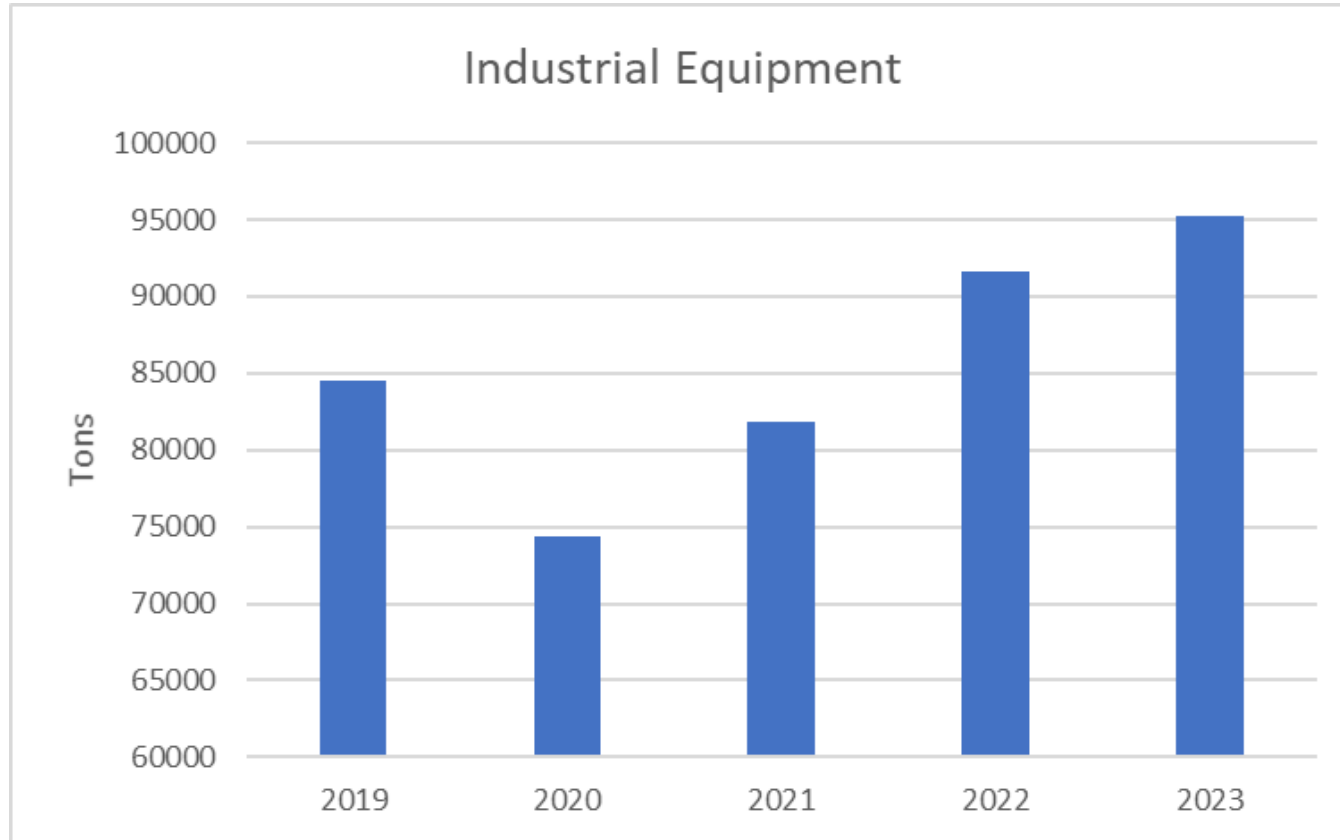
- Defense Spending Increase
- Navy Build Demand

Customer Market Sales Forecast

% change from prior year

Military	2020	2021	2022	2023
Ground Systems (sales)	-3.6%	2.1%	4%	5%
Naval Systems (sales)	1%	1.6%	7.6%	5.2%
SFSA Forecast (tonnage)	0%	10%	3%	12%

Industrial Equipment Forecast



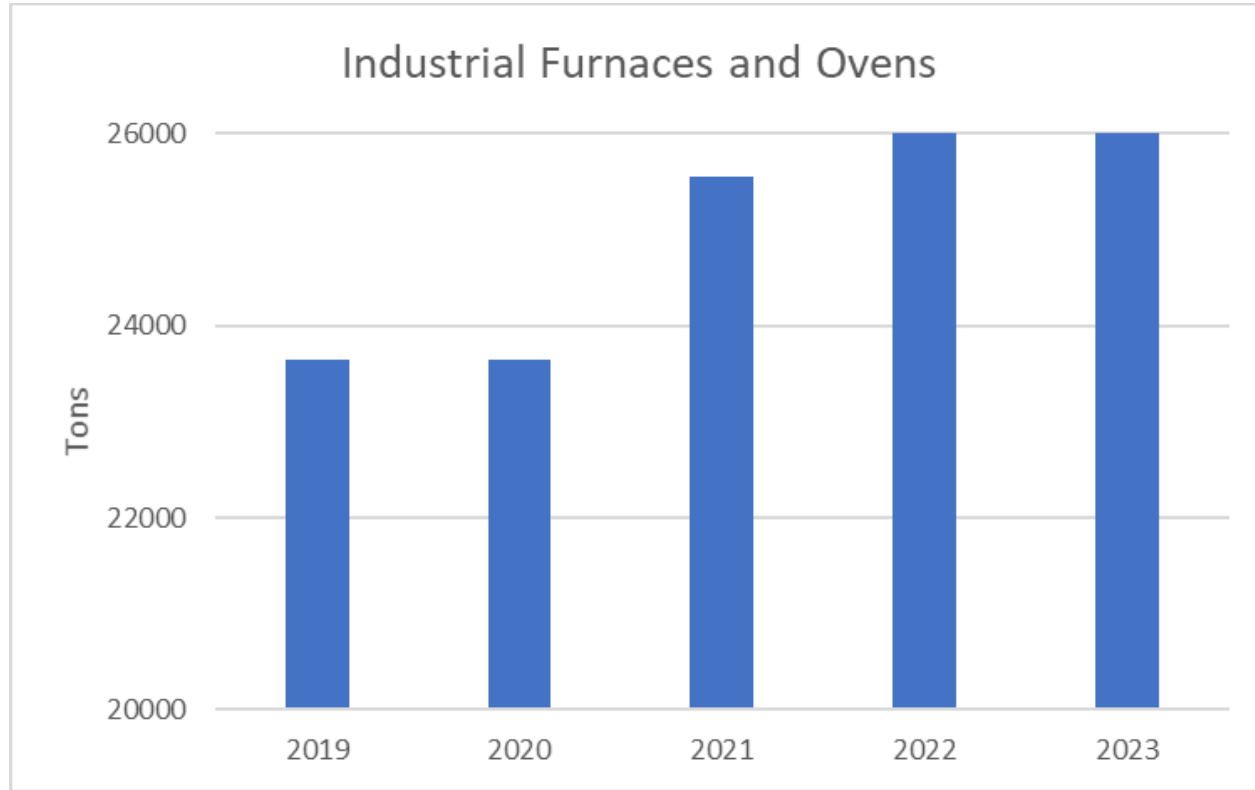
2022	2023
12%	4%

Industrial equipment parts - pulp & paper, food, shotblast - plates, wheels, sprockets, flanges

ITR Forecast – US Machinery New Orders

- '22 – 9%
- '23 – 3.5%
- Labor Shortage Driving Automation
- Softening Economy Tempers Demand

Industrial Furnace and Oven Mfg. Forecast

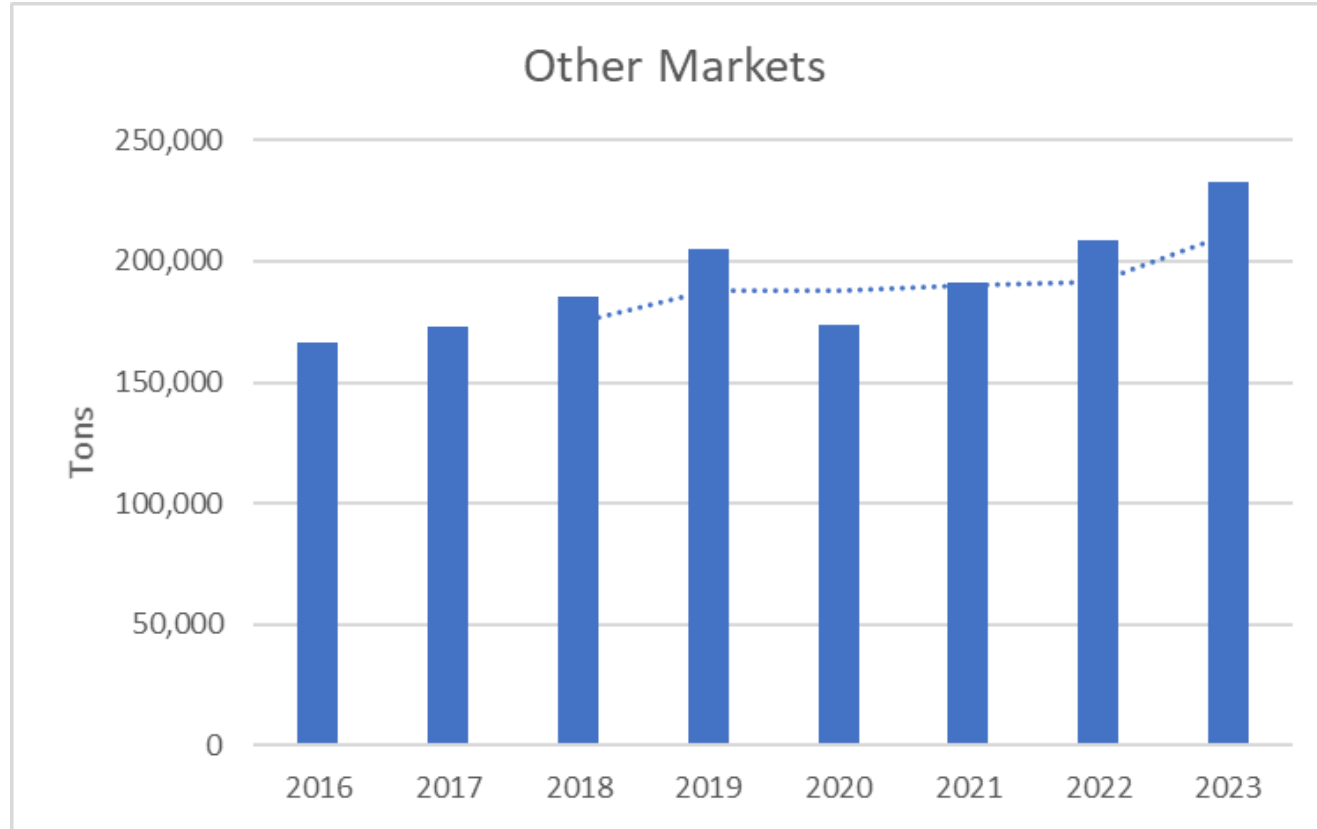


2022	2023
15%	5%

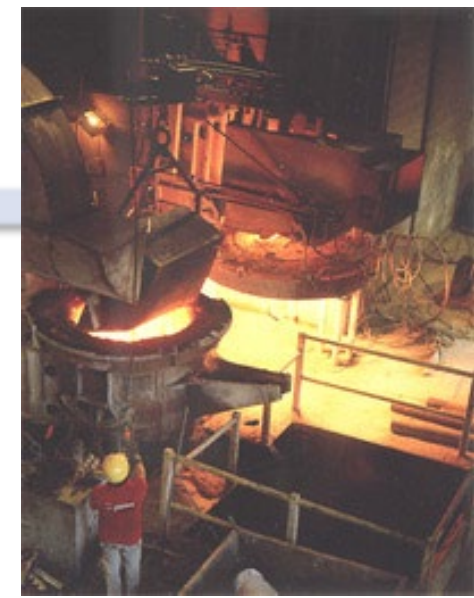
Industrial Process Ovens, Induction Heating, and Kilns - furnace, heat treat, steel mill components - rollers, links, baskets

- Steel Mill Expansion
- Reduced Foreign Competition

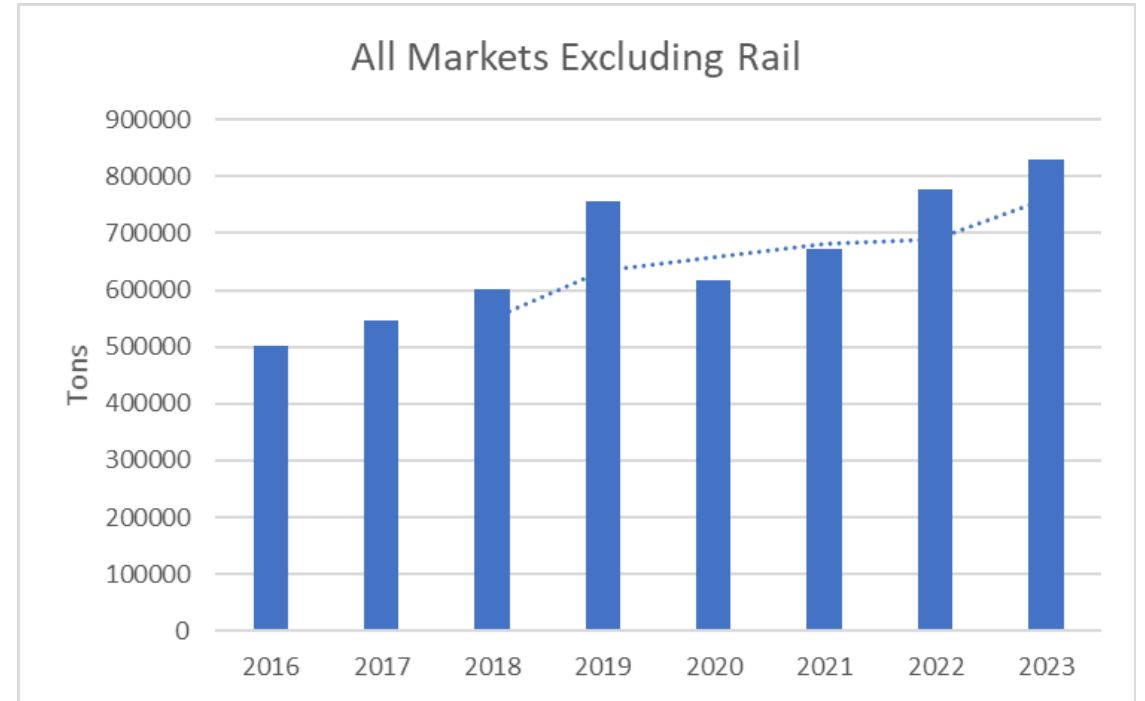
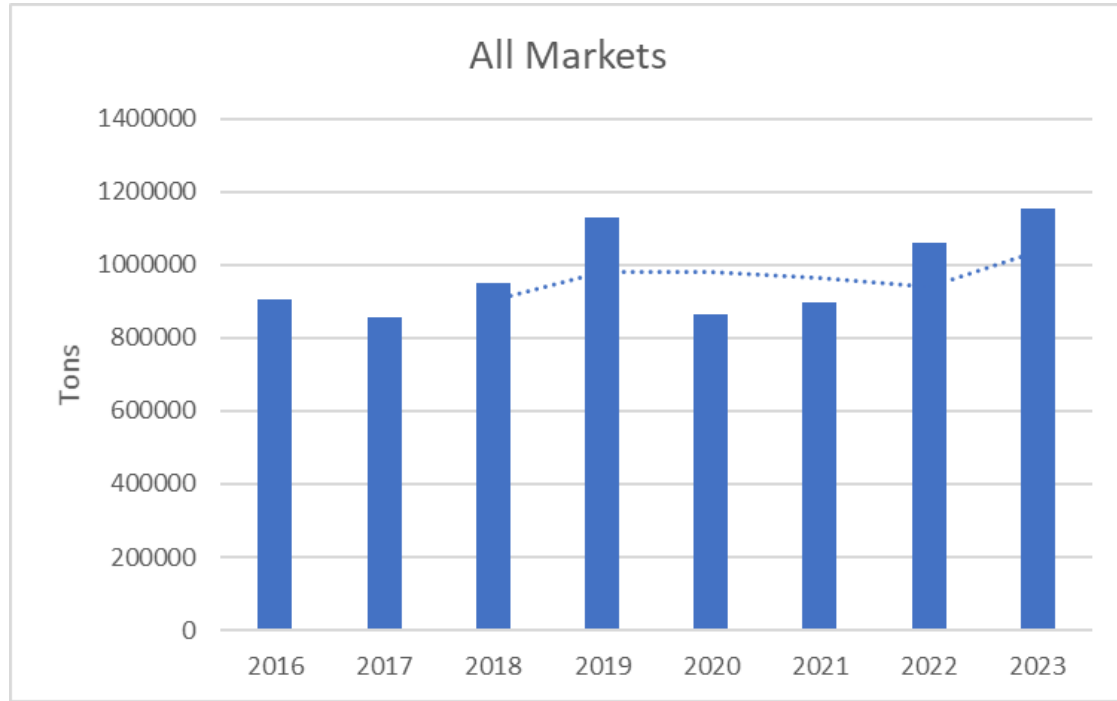
Other Markets Forecast



2022	2023
9%	12%



Forecast Summary



2022	2023
18.5%	9%

2022	2023
16%	7%