

## Basic Materials

### Initiating on Titanium Industry; Investors, Prepare for Take-Off

#### Key Takeaway

**In our view, the cycle is turning for titanium, with multi-year inventory adjustments concluding, and secular growth from the aerospace industry raising ASP. Operational leverage is huge and the potential upside could be +3-4x above current share prices. We initiate with a Buy rating on Osaka Titanium (5726 JP, ¥3,400 PT), and Toho Titanium (5727 JP, ¥1,700 PT).**

**+3-420% upside potential vs. limited downside.** Supply/demand for sponge titanium has been weak in the last seven years. We think that this is currently priced in the shares. However, when the cycle is right, and titanium prices recover, we believe the stocks have significant upside. Under our bull-case scenario, the upside for Osaka Titanium is +420% and Toho Titanium +300% vs. current share prices. Our base case scenario has +40% upside, assuming modest ASP/volume recovery. Our estimates are +25-45% above company guidance for FY3/18, and we expect earnings to triple by FY3/21.

**Inventory adjustments concluded, titanium sponge prices/volumes to rise.** We think that sponge titanium inventories have adjusted, and that strict environmental regulations and solid demand for airplanes should boost ASP. We expect sales volumes to increase by +5.0%, and sponge titanium prices to rise +7.5% CAGR in the next four years.

**Manufacturers cut costs, large operational leverage.** Facing losses/mediocre margins, Japanese titanium companies have relentlessly cut costs; outside contractors' fees have been lowered, and depreciation costs are now normalized. At the same time, if/when production increases, the potential operational leverage is huge, as the high fixed-cost ratio results in lowering production cost per ton.

**Cross shareholdings, no other listed pure-plays.** Due to legacy issues and business tie-ups, the majority shareholders of titanium companies are corporates; 50% of Toho Titanium is held by JXTG Holdings (5020 JP, NC), and 48% of Osaka Titanium by NSSMC (5401 JP, UNFP), and Kobe Steel (5406 JP, Buy). Thus, the ratio of floating stock is relatively low. Also, there are no other pure-play titanium sponge manufacturers except the Japanese and VSMPO-AVISMA (NC, Russia). We think that if/when investors focus on positive industry dynamics, the Japanese titanium names could rally.

**Osaka Titanium Technologies (5726 JP).** We initiate with a Buy rating and ¥3,400 PT based on 20x FY3/20 EPS. Osaka Titanium is one of the largest sponge titanium producers in the world with 40kt/annum capacity - similar to VSMPO-AVISMA, but with 1/5th the market cap vs. its Russian peer.

**Toho Titanium (5727 JP).** We initiate with a Buy rating and ¥1,700 PT based on 20x FY3/20 EPS. Toho's non-titanium businesses are also solid; the company is producing materials for multilayer ceramic capacitors, which are necessary for electronic devices.

**Valuation/Risks.** Historically, stocks price in two-year forward earnings, thus we use FY3/20 as our base year. Our 20x P/E multiple is in-line with historical/sector averages. Risks include worsening general macroeconomics impacting demand for titanium products, sudden rise in energy and raw material prices.

**Thanh Ha Pham \***

Equity Analyst

+81 3 5251 6160 tpham@jefferies.com

**Sangin Yun \***

Equity Associate

+81 35251 6140 syun@jefferies.com

\* Jefferies (Japan) Limited

^Prior trading day's closing price unless otherwise noted.

Company Name	Ticker	Mkt. Cap (MM)	Rating	Price <sup>^</sup>	Price Target	Cons. Next FY	Current EPS Estimates			Valuation (P/E)	
							2017	2018	2019	2018	2019
OSAKA Titanium Technologies	5726 JP	¥89.2BN	BUY	¥2,424	¥3,400	--	¥50.07	¥134.61	¥177.93	18.0x	13.6x
Toho Titanium	5727 JP	¥95.8BN	BUY	¥1,345	¥1,700	--	¥36.06	¥62.97	¥83.23	21.4x	16.2x

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## Executive Summary

**We initiate on Osaka Titanium Technologies (5726 JP) and Toho Titanium (5727 JP) with Buy ratings, and price targets of ¥3,400 and ¥1,700, respectively. We think inventory adjustments in the last five years have concluded. At the same time, record high orders for aircrafts could drive volume growth. Operational leverage via lower unit costs on higher utilization rates, combined with higher ASP, will likely boost earnings.**

**Modern aircrafts use carbon fibers, that need titanium.** In order to reduce weight and increase fuel efficiency, modern aircraft increasingly use more Carbon Fibre Reinforced Plastics (CFRP). Aluminium rusts when in contact with CFRP, due to its galvanic corrosion behaviour. On the other hand, titanium is placed among the noble materials and commercially pure titanium alloys are completely resistant to galvanic corrosion when coupled with carbon composites.

**Record high aircraft orders, end of inventory adjustments.** During the Dubai AirShow in Nov '17, both Boeing and Airbus landed record high orders. Currently there is an eight-year order backlog for airplanes, and demand is expected to grow with customers from emerging countries traveling more. At the same time, inventories of titanium metal and scrap titanium have adjusted, allowing for both price and production/sales to rise. We expect operational leverage to boost earnings through lower unit costs (on economies of scale) and higher margins combined with higher sales volumes.

**Japanese titanium names are the only pure plays.** Except for VSMPO-AVISMA (Russia), and the two Japanese titanium names, there are no other listed pure-play titanium sponge producers. Weak margins and high inventories forced Western rivals to consolidate or de-list. We think that investors are looking for a way to benefit from strong aerospace dynamics, and Japanese titanium companies are the best opportunity. At the same time, tensions between the US and Russia could draw attention to Japanese producers, with end-users of titanium products looking to diversify their procurements.

**Low float ratio to raise share price volatility.** Historically, titanium stocks have priced in two-year forward earnings. At the same time, the majority stakes of both Osaka Titanium and Toho Titanium are held by corporates that have business tie-ups and are unlikely to trade the stocks. As the float ratio of these stocks are relatively low, share prices tend to be quite volatile at the inflection point of margin improvement, and stocks could trend up for a very long time, in our view.

**Osaka Titanium: Initiate with Buy and ¥3,400 PT.** Not only we are expecting titanium prices to increase +7.5% CAGR in the next four years, but sales volumes should increase by +5% CAGR backed by strong demand. On top of that, inventory adjustments should lower costs, further boosting FY3/19 earnings.

**Toho Titanium: Initiate with Buy and ¥1,700 PT.** Toho's titanium businesses should benefit from favourable industry dynamics and earnings boosted by operational leverage. At the same time, Toho's non-titanium businesses are in high demand; catalysts for MLCCs are steadily growing, further accelerating earnings growth.

**Valuation.** As stocks have been pricing two-year forward earnings, we use FY3/20 EPS as our base year. We use a 20x P/E ratio, which is consistent with historical multiples for both companies.

**Risks.** Main risks are macroeconomics related – geopolitical concerns raise uncertainty and could delay aircraft deliveries. Also, raw materials such as ilmenite and rutile, and energy costs such as electricity, could rise rapidly, weighing on margins.

## Large Upside vs. Limited Downside

**Chart 1: Large upside for share price: Bull-Case scenario — upside for Osaka Titanium is ¥10,000 (+420%), Toho Titanium is ¥4,000 (+300%)**

Sponge Titanium Price (¥ Thousand/ton)				Price Target			
	FY3/17 A	FY3/20 Est.	FY3/21 Est.		FY3/17 A	FY3/20 Est.	FY3/21 Est.
<b>Base case</b>				<b>Osaka Titanium</b>		<b>3,700</b>	5,100
	974	1,250	1,300	<b>Toho Titanium</b>		<b>1,700</b>	2,300
YoY (%)	-18%	+9%	+4%				
<b>Bull case</b>				<b>Osaka Titanium</b>		6,500	<b>10,000</b>
	974	1,412	1,598	<b>Toho Titanium</b>		2,700	<b>4,000</b>
YoY (%)		+13%	+13%				
<b>Bear case</b>				<b>Osaka Titanium</b>		1,400	1,300
	974	1,005	1,005	<b>Toho Titanium</b>		900	900
YoY (%)		+0%	+0%				

Source: Jefferies estimates

**Sponge titanium prices.** Our *base-case scenario* assumes sponge titanium prices increasing by +7.5% CAGR to ¥1.3m/ton by FY3/21. Under our *bull-case scenario*, we assume prices reaching FY3/08 highs (¥1.6m/ton, +13% CAGR). Under our *bear-case scenario* we assume prices remain flat at current levels. Our price targets are based on FY3/20 EPS. If sponge prices rally, the theoretical share price could reach ¥10,000/share for Osaka Titanium, and ¥4,000/share for Toho Titanium.

**Chart 2: Osaka Titanium - Base, Bull, Bear Case Scenario Analysis**

Osaka Titanium OP/Ton (¥ Thousand/ton)				Total OP			
	FY3/17 A	FY3/20 Est.	FY3/21 Est.		FY3/17 A	FY3/20 Est.	FY3/21 Est.
<b>Base Case</b>				<b>OP</b>	2.1	10.2	14.2
	63	227	295	<b>NP</b>	0.6	6.5	9.3
YoY (%)	-18%	+26%	+30%	<b>EPS</b>	15.8	177.9	253.8
<b>Bull Case</b>				<b>OP</b>		16.8	26.5
	63	389	594	<b>NP</b>		11.6	18.3
YoY (%)		+40%	+53%	<b>EPS</b>		315.7	496.8
<b>Bear Case</b>				<b>OP</b>		3.4	3.4
	63	86	86	<b>NP</b>		2.3	2.3
YoY (%)		+0%	+0%	<b>EPS</b>		63.1	63.1

Source: Jefferies estimates

**Operational leverage.** We forecast OP increasing by 6.9x for Osaka Titanium, and 3.3x for Toho Titanium in FY3/21 vs. FY3/17. This comes from high operational leverage: 1) production costs per unit declines rapidly due to high fixed cost ratio; 2) cost cutting in the past; and 3) ASPs increase and demand/supply for aerospace grade titanium sponge remains tight.

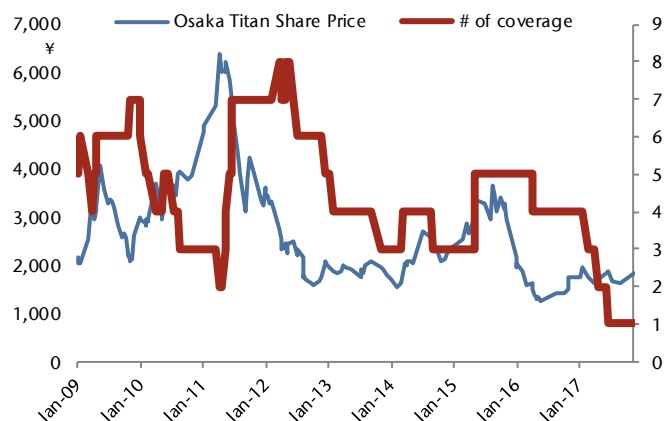
**Chart 3: Toho Titanium - Base, Bull, Bear Case Scenario Analysis**

Toho Titanium OP/Ton (¥ Thousand/ton)				Total OP			
	FY3/17 A	FY3/20 Est.	FY3/21 Est.		FY3/17 A	FY3/20 Est.	FY3/21 Est.
<b>Base case</b>				<b>OP</b>	3.7	9.3	12.3
	102	241	326	<b>NP</b>	3.4	5.9	8.0
YoY (%)	-18%	+33%	+35%	<b>EPS</b>	47.3	83.2	112.6
<b>Bull case</b>				<b>OP</b>		13.1	19.6
	102	403	624	<b>NP</b>		9.3	14.0
YoY (%)		+45%	+55%	<b>EPS</b>		130.6	196.0
<b>Bear case</b>				<b>OP</b>		4.4	4.4
	102	85	85	<b>NP</b>		3.1	3.1
YoY (%)		+0%	+0%	<b>EPS</b>		44.1	44.1

Source: Jefferies estimates

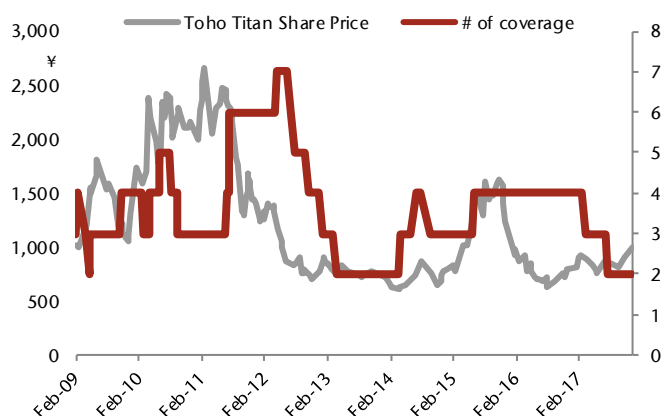
## Key Charts

**Chart 4: Eight Analyst Covered Osaka Titanium at its peak**



Source: Bloomberg, Jefferies

**Chart 5: Seven is the Lucky Number for Toho Titanium**



Source: Bloomberg, Jefferies

**Chart 6: Osaka Titanium Consensus vs. JEF Est.**

(unit: ¥bn)	FY3/17	FY3/18 E			FY3/21 E	
	Actual	CoE	Cons.	JEF E.	Cons.	JEF E.
OP	2.1	2.7	2.8	3.4	4.5	14.2
NP	0.6	1.5	1.5	1.8	3.0	9.3
EPS	15.8	40.8	41.5	50.1	82.1	253.8
DPS	5.0		10.0	13.0	20.0	64.0
FCF	-3.8		7.4	3.8		10.2

Source: Bloomberg, Jefferies Estimates

**Chart 7: Toho Titanium Consensus vs. JEF Est.**

(unit: ¥bn)	FY3/17	FY3/18 E			FY3/21 E	
	Actual	CoE	Cons.	JEF E.	Cons.	JEF E.
OP	3.7	3.0	2.9	4.4	3.9	12.3
NP	3.4	2.6	2.4	2.6	3.4	8.0
EPS	47.3	36.5	33.2	36.1	47.8	112.6
DPS	7.0	7.0	7.0	10.0	5.0	29.0
FCF	4.8	0.2		1.8		10.0

Source: Bloomberg, Jefferies Estimates

**Chart 8: Osaka Titanium Current/Peak/Low Multiples (FY3/02 – Present)**

(unit: ¥bn, ¥, x)	Current	Peak	Low
Share price	2,432	14,830	243
Sponge price	1,006	1,598	764
OP/Ton	62,857	711,336	-124,651
ROE	17	314	-22.9
PBR	2.6	16.7	0.9
PER	59.7	145.3	12.7
DPS	5.0	80.0	0.0

Source: Bloomberg, Company Data

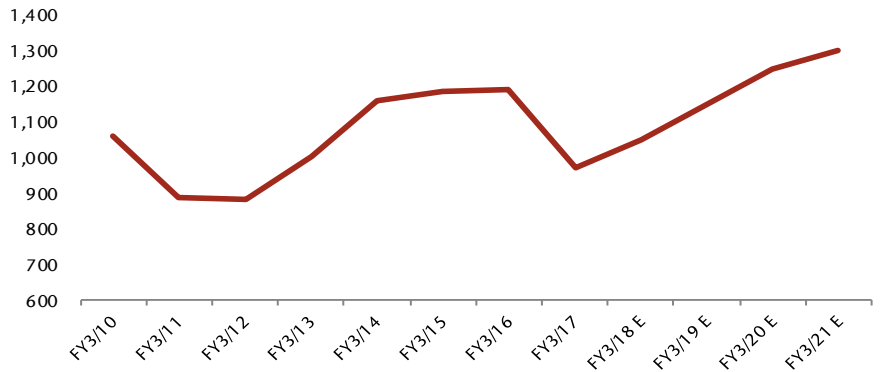
**Chart 9: Toho Titanium Current/Peak/Low Multiples (FY3/02 – Present)**

(unit: ¥bn, ¥, x)	Current	Peak	Low
Share price	1,354	9,600	193
Sponge price	1,006	1,598	764
OP/Ton	102,103	948,690	-269,033
ROE	9.0	23.9	-17.3
PBR	2.4	20.9	1.0
PER	37.0	152.3	13.6
DPS	7.0	28.0	0.0

Source: Bloomberg, Company Data

We think that record high demand for aircraft should support the price of aerospace-grade titanium

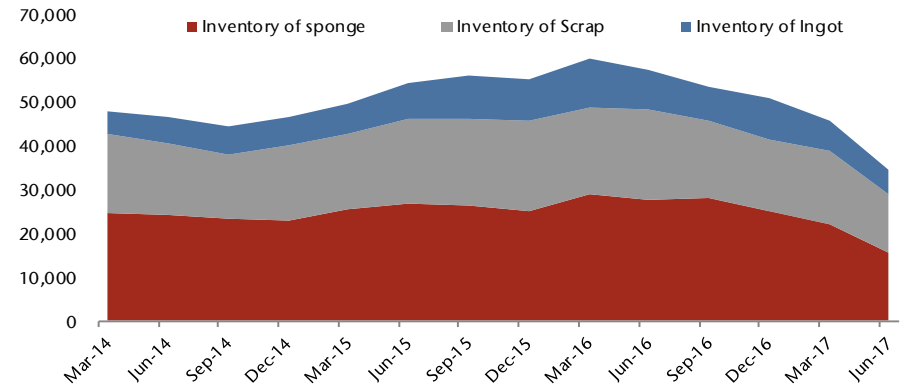
**Chart 10: Titanium price/ton - we expect prices rising at single-digit % per annum supported by record high demand from aerospace industry (¥ thousands/ton)**



Source: Japan Customs, Jefferies estimates

Adjustments of inventories for both titanium sponge and scrap materials have finished and are at six-year lows

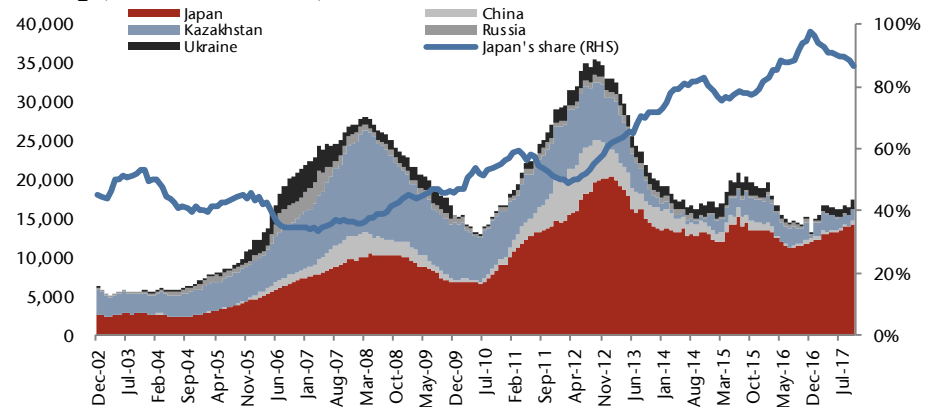
**Chart 11: Inventory of sponge titanium and scrap in US (Unit: tons)**



Source: U.S. Geological Survey, Jefferies

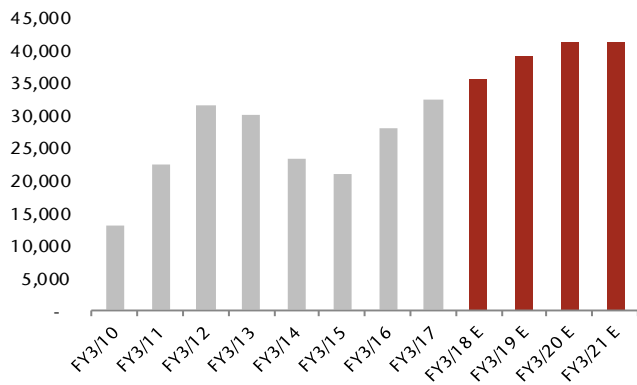
The US highly depends on titanium materials from Japan. Further tensions with Russia could further increase this ratio

**Chart 12: US Imports of Titanium Sponge by Country (12-month moving average, thousand dollars)**



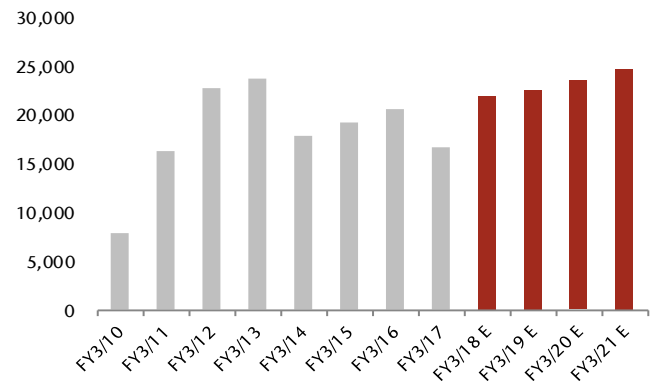
Source: U.S. Census Bureau, Jefferies

**Chart 13: Osaka Titanium sales (tons/annum)**



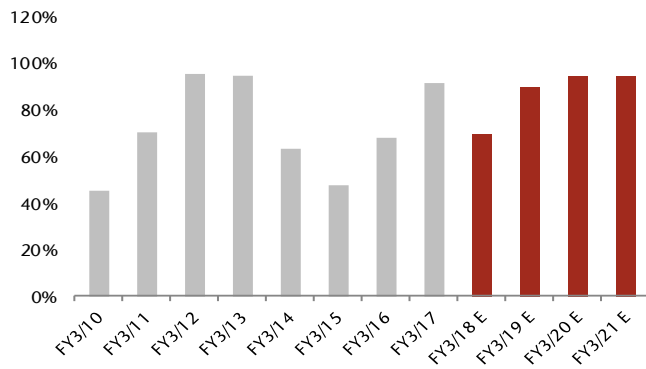
Source: Jefferies estimates

**Chart 15: Toho Titanium sales (tons/annum)**



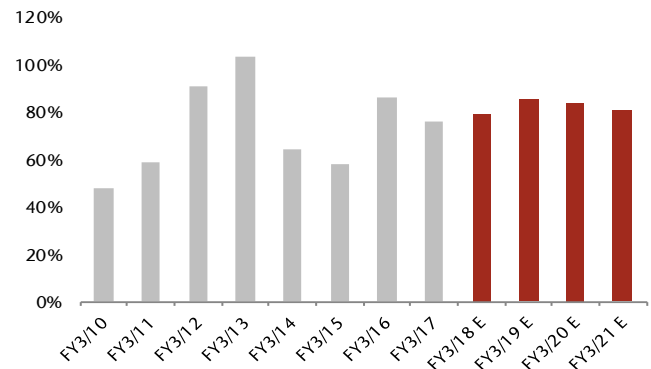
Source: Jefferies estimates

**Chart 14: Osaka Titanium utilization rate (%)**



Source: Jefferies estimates

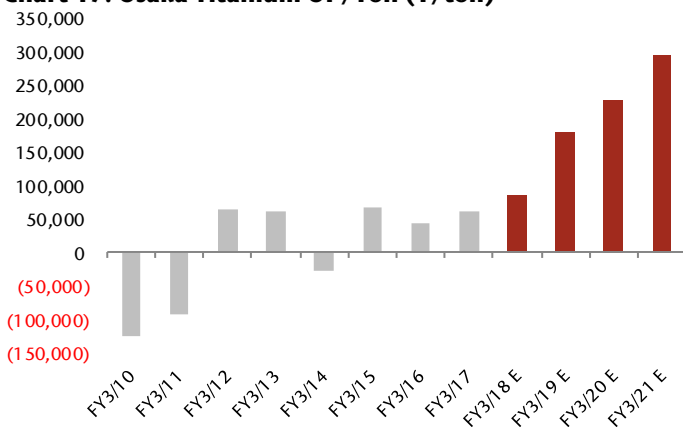
**Chart 16: Toho Titanium utilization rate (%)**



Source: Jefferies estimates

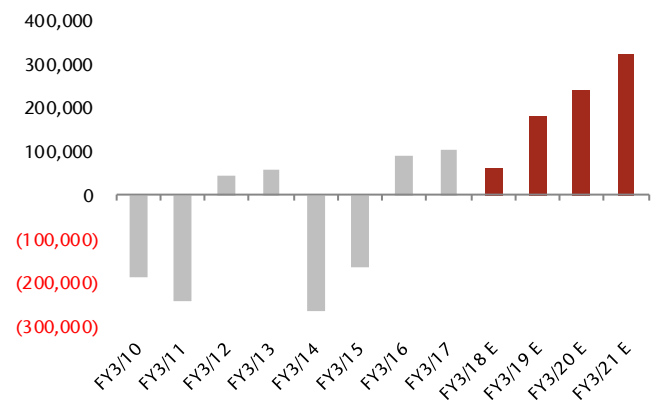
Note: new Saudi assets included in forecasts, where production ramp up takes time, without it we expect utilization rate of Japanese facilities to remain high

**Chart 17: Osaka Titanium OP/Ton (¥/ton)**



Source: Jefferies estimates

**Chart 18: Toho Titanium OP/Ton (¥/ton)**



Source: Jefferies estimates

# Titanium Industry

**Titanium has a relatively short history, but its excellent characteristics make it an indispensable material for aerospace and many industrial applications. In the long-term, demand growth appears solid, but the industry has faced inventory adjustments in the last 5-6 years. As this is mostly done, we think now is an excellent opportunity for investors to build up positions.**

## History of Titanium

For most of the earth’s 4.6-billion-year history, titanium slumbered deep in the earth’s crust. It was only 200 years ago that titanium was discovered in England and named after a Greek god. However, titanium metal was not commercially produced outside the laboratory until William Justin Kroll reduced titanium tetrachloride with magnesium in the Kroll process, which is still used today.

**Chart 19: History of Titanium**

1791	Titanium was discovered at Creed, Cornwall in England by amateur geologist Reverend William Gregor in and gets it name from the Greek God “Titan”, the God of enormous strength.
1910	The metal has always been difficult to extract from its various ores. Pure metallic titanium (99.9%) was first prepared by Matthew A. Hunter by heating TiCl <sub>4</sub> with sodium in a steel bomb at 700-800 °C in the Hunter process.
1948	Titanium metal was not used outside the laboratory until William Justin Kroll proved that titanium could be commercially produced by reducing titanium tetrachloride with magnesium in the Kroll process which is the method still used today.

Source: Jefferies, various materials

Compared to some common base metals, commercial production of titanium has a relatively short history and limited capacity due to its high-cost smelting method, the main processes of which are operated in batches.

**Table 1: History and production capacity of titanium**

	History (y)	Production in 2010 (10k tons)
Copper	> 6000	1,970.0
Ferrum	> 4000	140,000.0
Aluminium	From 1886	4,140.0
Titanium	From 1948	13.2

Source: U.S. Geological Survey, Jefferies



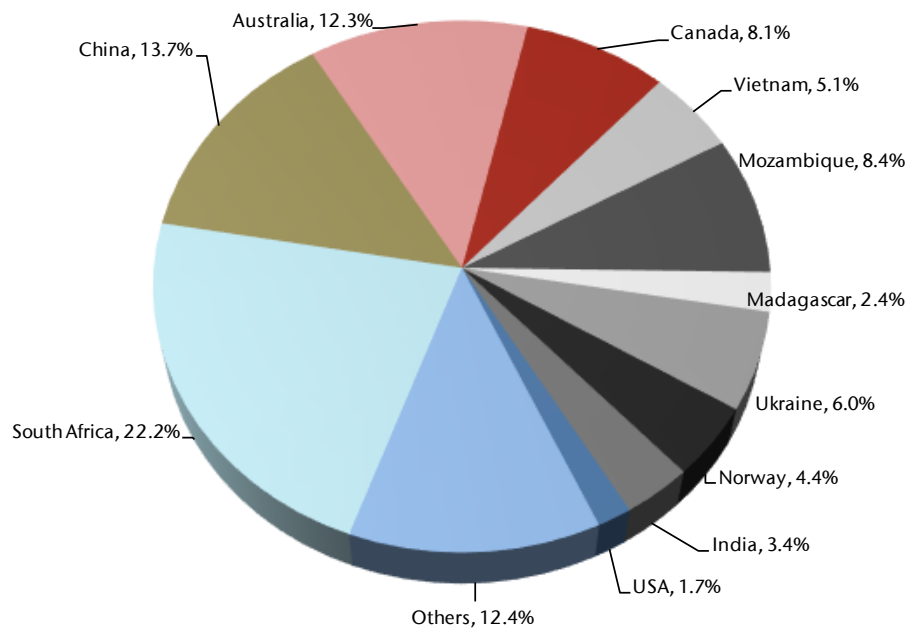
**Characteristics.** So, what’s the fuss about titanium? Its characteristics make it an excellent material, if one can manage to produce it:

- **Light-weight.** Low density, about 60% of stainless steel
- **Strong.** Specific strength that exceeds steel at room temperature
- **Corrosion resistant.** Superior corrosion resistance compared to stainless steel
- **Biocompatibility.** No metal allergy – excellent biocompatibility characteristics
- **Environmentally friendly.** Potential to recycle almost 100%
- **Abundant.** Fourth most abundant deposits as a metallic element

About 90% of ilmenite and rutile is used to produce titanium powders for the chemical industry, and thus high price appreciation of titanium metals does not automatically correlate with rising raw material prices, in our view. It takes about two tons of raw materials (a combination of ilmenite and rutile) to produce a ton of titanium sponge. The price of ilmenite is currently around \$200/ton, rutile around \$1,000/ton vs. titanium sponge is selling at \$10,000/ton.

Production of titanium raw materials is also relatively dispersed between countries. This limits the price inflation due to geographical risks (chart below).

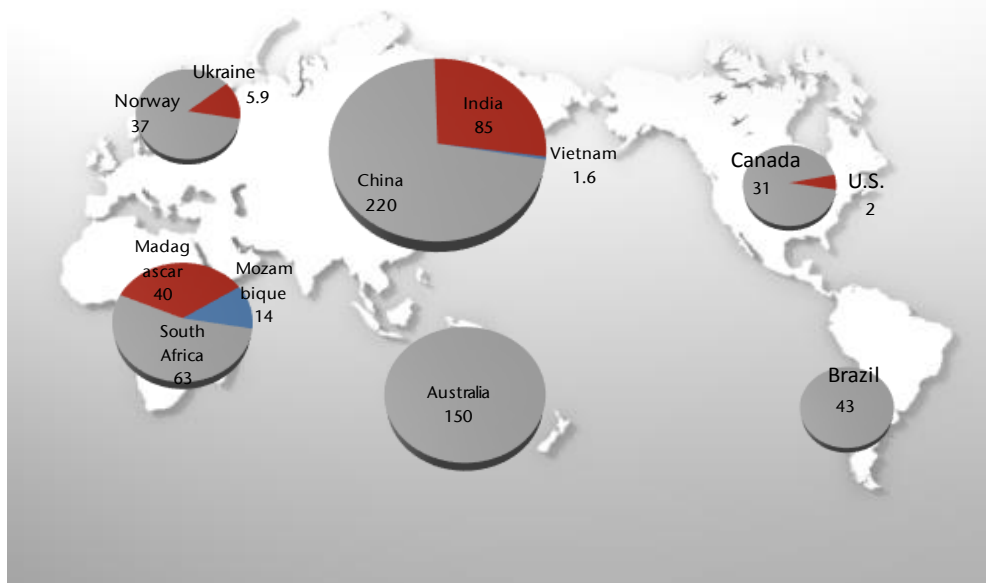
**Chart 20: Global production of ilmenite, the titanium raw material (2016, 5.9mn tons)**



Source: US Geological Survey, Jefferies

**Chart 21: Distribution of titanium raw material - ilmenite and rutile (unit: mn tons, TiO2 base)**

China	220
India	85
Vietnam	1.6
Australia	150
South Africa	63
Madagascar	40
Mozambique	14
Norway	37
Ukraine	5.9
Canada	31
United States	2
Brazil	43
Ilmenite	770
Rutile	59

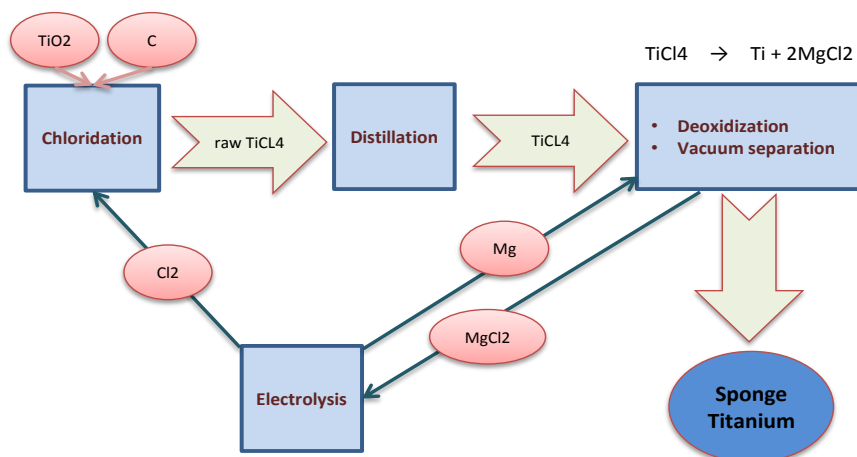
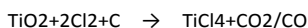


Source: US Geological Survey, Jefferies

## Titanium metal is difficult to produce

So, with all these favorable characteristics and abundant raw materials sources, why were only 132kt of titanium produced vs. 1.4bn tons of steel? The reason is that producing titanium is very difficult; it involves chlorination, electrolysis, deoxidization, and vacuum separation (Chart 22).

**Chart 22: Production process of sponge titanium**



Source: Jefferies, various materials

Only four countries managed to produce titanium successfully; others tried but failed to make profits. Similar to other materials, China became the elephant in the room with about half of the titanium sponge capacity. Nevertheless, **Japan remains a major producer with about a fifth of the world market share. Note that only Japan, US, and the former Soviet block countries are capable of producing titanium for the aerospace industry due to strict quality standards.**

**Table 2: Titanium sponge production capacity by country (unit: tons/year)**

Country	Total	Company	Production capacity
Japan	65,200	Toho Titanium	25,200
		Osaka Titanium Technologies	40,000
USA	23,500	PCC(TIMET)	12,600
		ATI	10,900
Former Soviet Union	88,000	VSMPO-AVISMA(Russia)	44,000
		UKTMP(Kazakhstan)	27,000
		Zaporozhye(Ukraine)	12,000
		Solikamsk(Russia)	5,000
China	173,000	Zunyi Titanium	24,000
		Fushun Titanium	5,000
		Others	144,000
<b>Total</b>	<b>349,700</b>		

Source: Jefferies, Company data

## Many applications

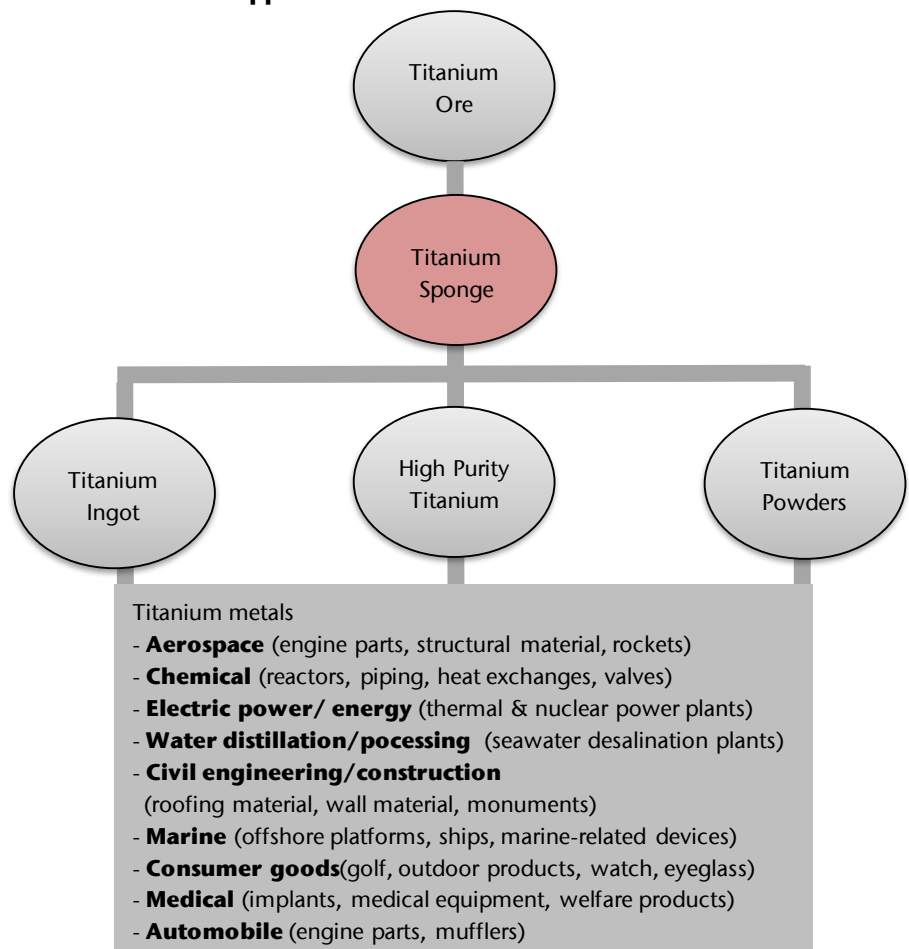
Titanium’s relatively high price limits its usage to certain industries, such as aerospace, chemical, electric power, water distillation, and other high-value-added applications.

About 75% of the high-grade titanium sponge production is used in the aerospace industry. However, main customers of titanium products include power engineering, chemical engineering, oil and gas, as well as consumer products, such as medical equipment, sporting goods etc.

Titanium is almost a perfect construction material for offshore drilling and production platforms, risers, piping systems, fire extinguishing systems and heat-exchange equipment (due to its resistance in sea water). One platform requires 300-500tons of titanium products.

Medicine is the most steadily developing applications of titanium, thanks to properties such as high corrosion resistance, non-toxic, biocompatibility with human tissues, high fatigue characteristics are valued for manufacturing spinal implants, prostheses’ end joints.

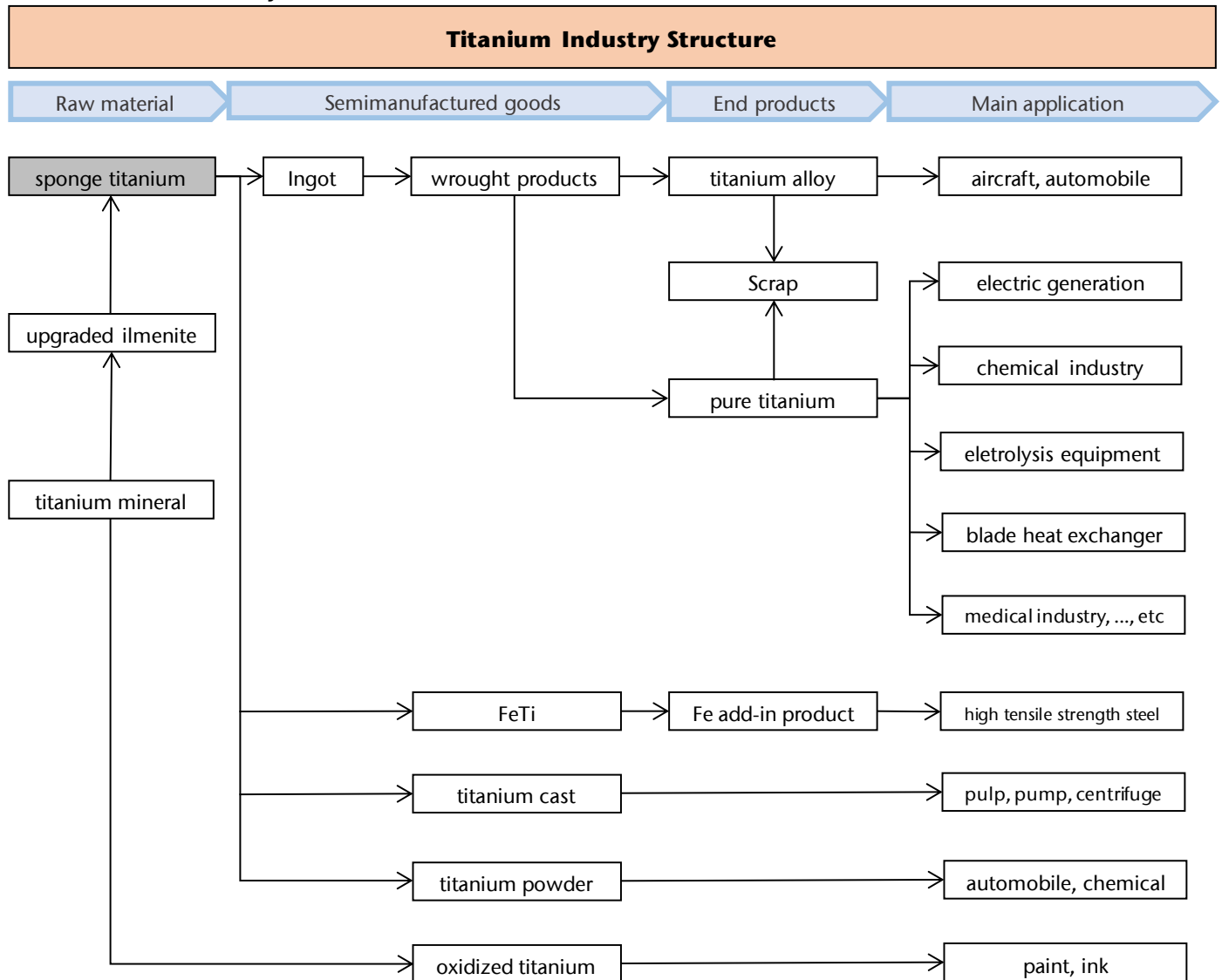
**Chart 23: Titanium Applications**



Source: Jefferies, various materials

About 90% of titanium raw material (rutile, ilmenite) is turned into oxidized titanium, and used to make paints, ink, and other chemicals. Only a tenth is used to produce sponge titanium, which is then rolled and shaped to the metal we know.

**Chart 24: Titanium industry structure**



Source: Jefferies, various materials

## Why We Like It: Aerospace, Russia, War

**The three reasons we like titanium are: 1) US titanium inventories adjusted and solid aerospace order backlog/demand growth are positive for the industry, 2) tensions between the US, Russia, and Ukraine could trigger aerospace companies to look for alternative supplies for titanium, 3) we think that reinterpreting Japan's anti-war constitution and lifting the ban on the right of collective self-defense could start an arms race (price/demand for titanium up).**

### 1) Aerospace and titanium: Galvanic corrosion of metals connected to carbon fiber polymers (CFRP)

**Drawback of carbon composites.** Despite all the excellent properties of carbon fibre reinforced composites (CFRPs), carbon fibre itself causes CFRP to become electrically conductive. Therefore, when a different metal is electrically connected to a CFRP, it is more susceptible to galvanic corrosion\*. This situation becomes worse when a large surface area of carbon composite components (such as a frame/wing of a plane) is coupled to small metallic parts (such as fasteners, bolts and nuts). In these circumstances, the rate of galvanic corrosion is extremely high due to the high cathode to anode surface area ratio.

*\*Galvanic corrosion refers to corrosion damage that occurs when two different metals are in electrical contact in an electrolyte, where the more noble metal is protected and the more active metal tends to corrode.*

**Table 3: A comparison of mechanical strength, mass density and specific strength of different industrial materials**

Material	Mass density (g/cm <sup>3</sup> )	Tensile Strength (Mpa)	Specific Strength (kN.m/kg)
Aluminium 7075-T6	2.8	600	214
Magnesium alloy AZ91D	1.7	230	135
Titanium	4.4	950	216
Carbon Steel (0.45% C)	7.8	850	108
Maraging Steel	8.1	2,500	300
Carbon composite	1.6	1,240	785

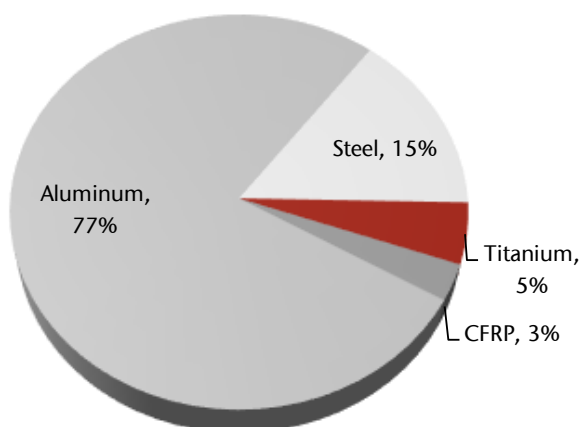
Source: Corrosionpedia, Jefferies

**Aluminium vs. titanium.** Aluminium alloys are extremely vulnerable when they are coupled to a carbon composite – and a white, jelly corrosion product will form on the aluminium surface during galvanic corrosion. On the other hand, while titanium is an active metal, because of the formation of a dense stable and protective oxide layer, titanium is placed among the noble materials. Therefore, there is no significant gap between titanium and CFRP that would create galvanic corrosion. ***This means that commercially pure titanium and its alloys are completely resistant to galvanic corrosion when they are coupled with carbon composites.***

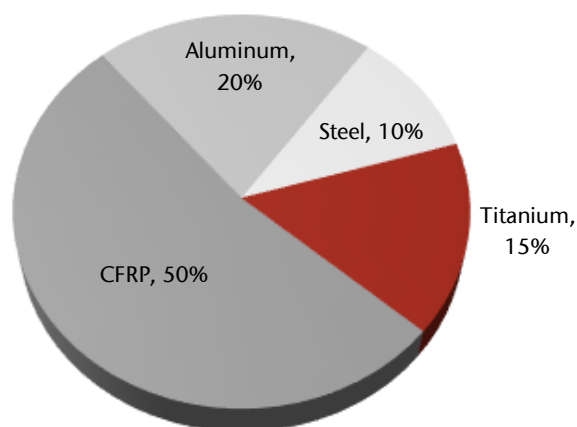
**New generation aircraft use more titanium.** In order to reduce weight and increase fuel efficiency, modern aircraft use more and more CFRP (Carbon Fiber Reinforced Plastic). CFRP and titanium have good chemistry together; while aluminium rusts when contacting CFRP due to its galvanic corrosion behavior, titanium does not. Also, titanium's heat expansion factor is significantly lower than aluminium's, thus its distortion with CFRP is lower.

**Chart 25: Conventional & New type of Boeing aircraft**

**Conventional type of Boeing aircraft (Boeing 767)**



**New type of Boeing aircraft (Boeing 787)**



Source: Toho Titanium Co., Jefferies

Thanks to its unique specific strength, titanium is used in elements of the airframe and landing gear, aircraft engines

Heat resistant titanium alloys are used for making blades, discs, and other elements of compressors, and fan motor

**12k backlog.** According to estimates, there is a 12,000 unit aircraft backlog from Boeing and Airbus alone. Note that new airplanes use significantly more titanium than the traditional ones; for example, the Airbus A380 uses 118 tons of titanium vs. 12-20 tons on older models.

**Table 4: Aircraft backlog and titanium usage per aircraft (as of November 2017)**

Type	Backlog	Amount used per aircraft (t)	Titanium demand (t)
B737	4,489	20	89,780
B747	14	76	1,064
B767	99	19	1,881
B777	433	64	27,712
B787	662	105	69,510
<b>Boeing Total</b>	<b>5,697</b>	<b>-</b>	<b>189,947</b>
A318	0	14	0
A319	72	14	1,008
A320	3,706	12	44,472
A321	1,701	12	20,412
A330	316	20	6,320
A340	0	36	0
A350	725	102	73,950
A380	96	118	11,328
<b>Airbus Total</b>	<b>6,616</b>	<b>-</b>	<b>157,490</b>
<b>Total</b>	<b>12,313</b>	<b>-</b>	<b>347,437</b>

Source: Japan Aircraft Development Corporation, Toho Titanium Co., Jefferies

**Aircraft demand growth at 3.5% CAGR:** As of 2016, the commercial aircraft fleet was 23,480 units, which is expected to increase at a 3.5% CAGR, to 46,956 by 2036. Demand outlook suggests there will be over 40,000 units of new aircraft to be delivered within the next 20 years, meaning 2,500 units/year on a simple average. According to Boeing, passenger airplanes are expected to account for 98% of total demand. The major growth region is likely to be Asia Pacific with 4.8% CAGR growth, and should represent 37% of the total fleet.

**Table 5: Commercial aircraft fleet increase to remain strong over the next 20 years**

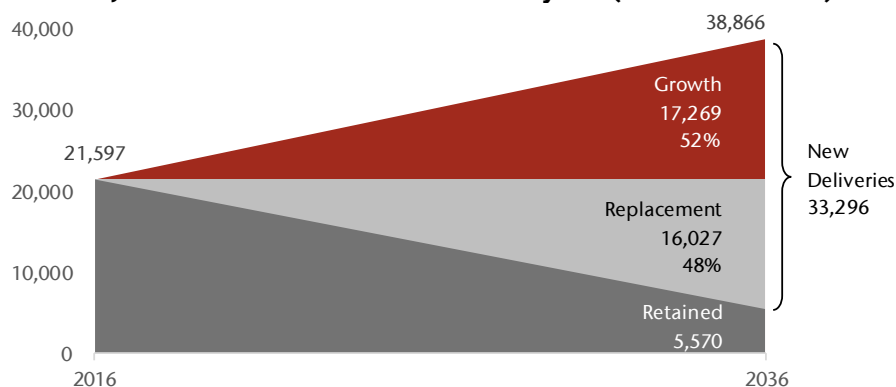
Regions	Fleet in 2016	Fleet in 2036	CAGR 2016-2036	Weight of total in 2036
Asia Pacific	6,830	17,520	4.8%	37%
North America	7,060	10,130	1.8%	22%
Europe	4,800	8,160	2.7%	17%
Latin America	1,550	3,660	4.4%	8%
Middle East	1,430	3,900	5.1%	8%
CIS	1,090	1,980	3.0%	4%
Africa	720	1,600	4.1%	3%
<b>Total</b>	<b>23,480</b>	<b>46,950</b>	<b>3.5%</b>	<b>100%</b>

Source: Jefferies estimates, Boeing

Note: Boeing’s outlook forecast does not coincide with JADC’s outlook

Demand is increasing among LCCs for the A320 and 737, which can fly for relatively short hours and are being utilized for middle length distance flights. Over the next 20 years, demand will likely continue to be focused on single-aisle jets, and by 2036 there is expected to be 32,190 narrow body jets in operation, and demand for new deliveries are expected to be 29,530 units.

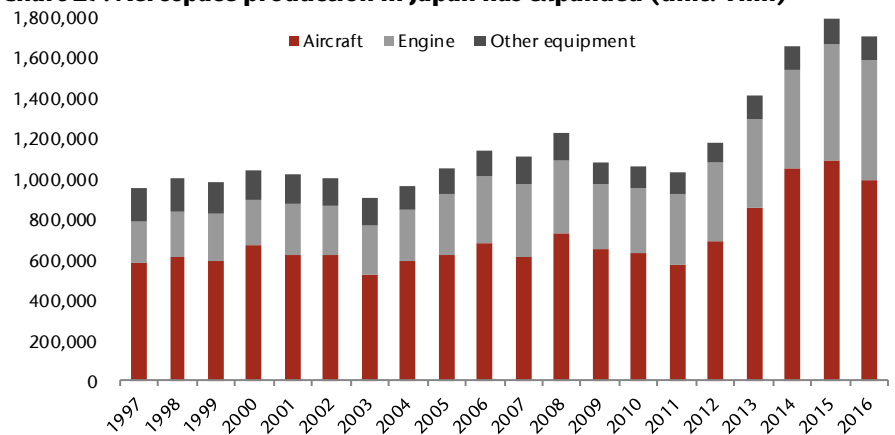
**Chart 26: Jet Fleet to increase over the next 20 years (unit: # of aircraft)**



Source: Jefferies, Japan Aircraft Development Corporation

Major Japanese heavy industrial companies do participate in development of aeroengines for the major aircraft used globally such as B777, B787, A320, etc. MHI, KHI, FHI and Shinmaywa Industries are program partners. Recent B787 project shows higher participation by Japanese players, at a 35% participation rate. B787 order backlog has ramped up, and monthly production is expected to continue to rise in order to consume massive order backlog. Current backlog is well over 600 aircraft and Boeing may want to boost delivery. **We think aerospace industry growth is quite steady for Japanese players.**

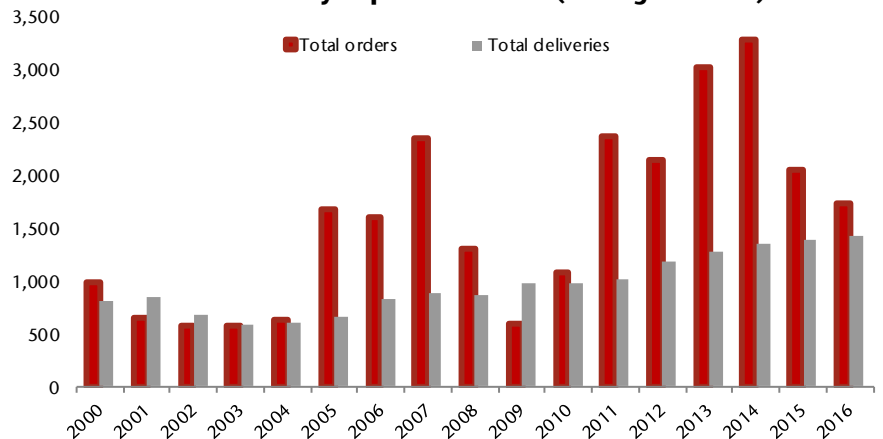
**Chart 27: Aerospace production in Japan has expanded (unit: ¥mn)**



Source: Jefferies, The Society of Japanese Aerospace Companies

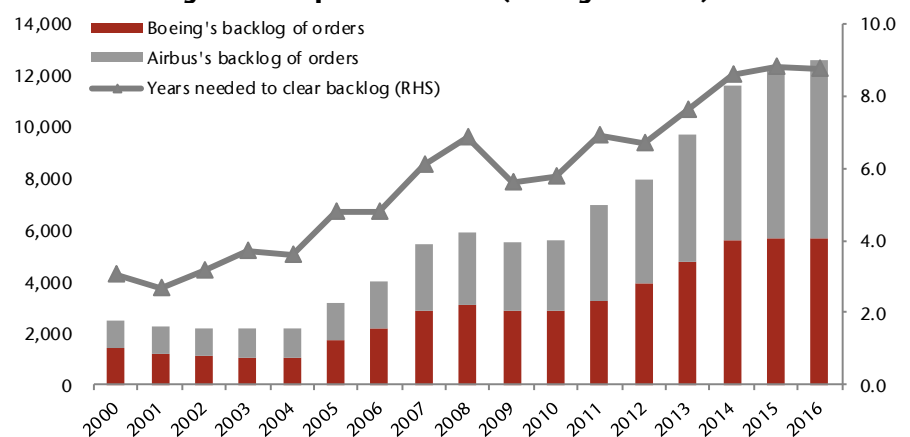
**Orders ripe but deliveries can't catch up.** There is approximately eight years of backlog orders, but delivery of private aircraft is much slower than orders; this is due to the capacity of the manufacturing lines and shipments of parts for the airplanes.

**Chart 28: Orders and delivery of private aircraft (Boeing & Airbus)**



Source: Japan Aircraft Development Corporation, Jefferies

**Chart 29: Backlog orders of private aircraft (Boeing & Airbus)**

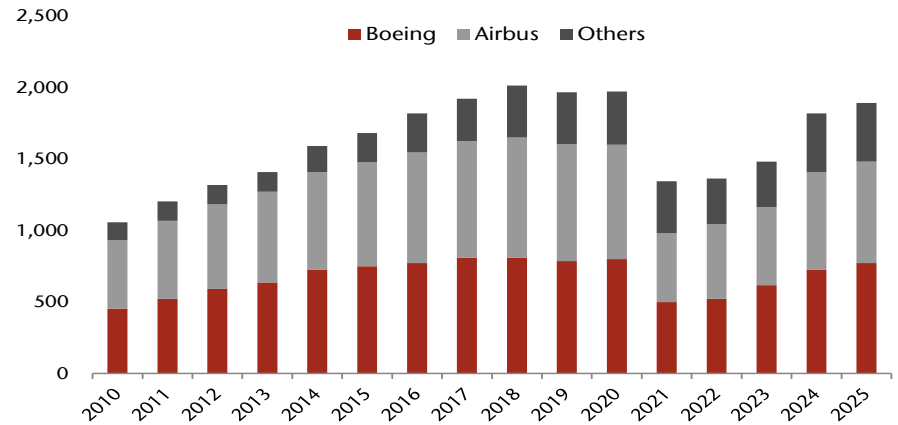


Source: Japan Aircraft Development Corporation, Jefferies



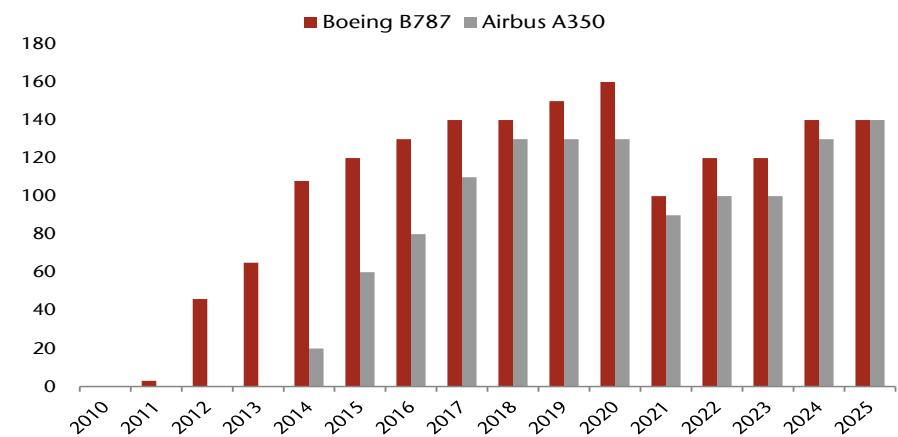
**Growing deliveries until 2020.** We think that the delivery volumes for airplanes will likely top almost 2,000 units per annum until at least 2020. Even after that, replacements should keep demand up. On top of this, deliveries of B787 or A350 type planes should grow. These planes use substantially more titanium than their older peers.

**Chart 30: Estimate of aircraft delivery**



Source: Japan Aircraft Development Corporation, Jefferies

**Chart 31: Estimate of delivery on B787 and A350**



Source: Japan Aircraft Development Corporation, Jefferies

**Dubai AirShow (Nov '17): Record high orders**

**Boeing's new business from Dubai came to an eye-popping list price of \$47.6bn. Airbus managed to eclipse that with a combined value of commercial deals tallying up to \$52.7bn. We think that investors realize that these orders need a lot of materials in order to complete and will focus on titanium.**

**Boeing: largest-ever single-aisle jet order.** On the second day of the Dubai Air Show, Boeing signed an agreement with budget carrier FlyDubai for 225 737-MAX planes, holding a list price of \$27.0bn. The company said the deal represents the largest-ever single-aisle jet order, by both value and number of aircraft. It also stunned observers with an opening day order from Emirates for 40 787-10 Dreamliners (\$15.1bn). Azerbaijan Airlines then placed a new order for five 787-8 Dreamliners (\$1.9bn). Following that, Ethiopian Airlines placed four 777 freighters (\$1.3bn) – in order to take advantage of the rapid aviation growth in Africa. On the last day, Boeing signed a final purchase agreement with Kazakhstan's SCAT Airlines for six 737-MAX 8s (\$674m).

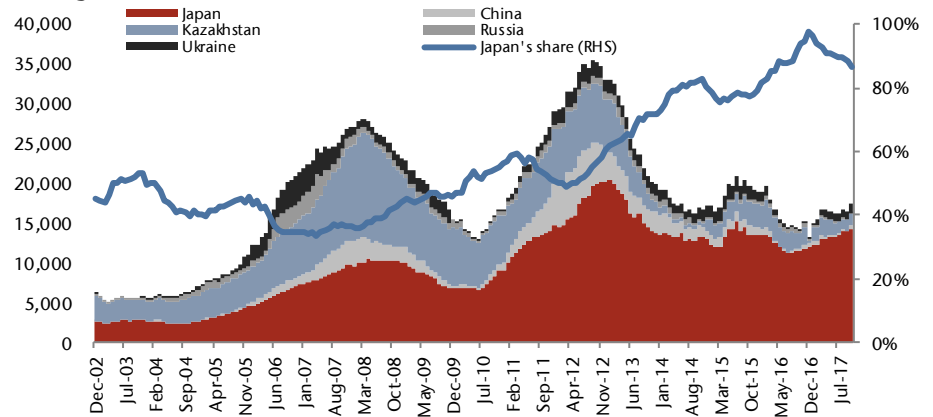
**Airbus: mammoth orders.** US private equity firm Indigo Partners signed a huge order of 430 jets from the A320 family (\$49.5bn) – which could be the largest aircraft order ever. Golden Falcon Aviation signed a memorandum of understanding for 25 of Airbus' popular A320 neo aircraft (\$2.7bn). The planes will be used by Kuwait's resurrected Wataniya Airlines. It also signed a \$500m agreement to sell Air Senegal two A330 neo wide-body aircraft, to develop medium and long-haul routes.

**Turbulence in recent past: Inventory adjustments**

**Japan: 80%+ of US imports.** Applauding the high quality Japanese titanium products and timely deliveries, the share of US imports from Japan has steadily increased over the years, recently representing more than 80% of US imports.

Imports from Kazakhstan declined as they started producing ingots from sponge titanium vs. exporting sponge itself

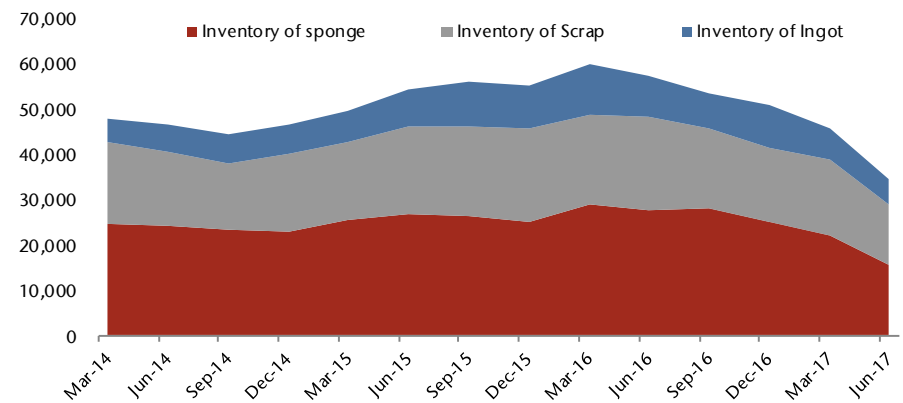
**Chart 32: US Imports of Titanium Sponge by Country (12-month moving average, thousand dollars)**



Source: U.S. Census Bureau, Jefferies

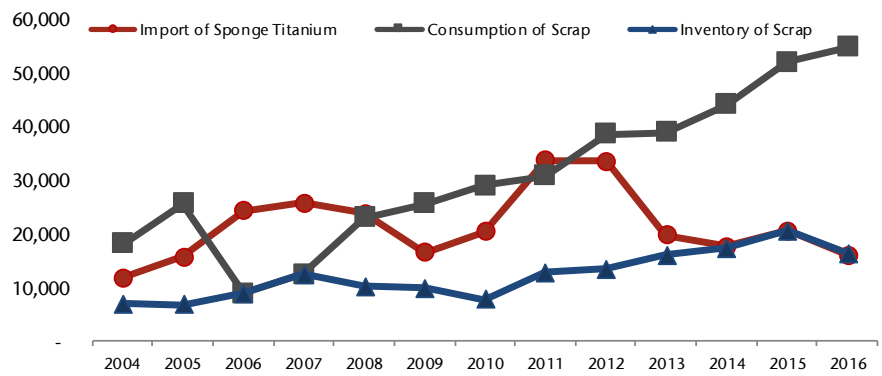
**Inventories and scrap usage.** Despite the positive demand outlook, what was happening in titanium world and why were earnings so weak in the last seven years? We think that this was due to: 1) the large inventory/capacity build-up anticipating increasing demand, and 2) high usage of scrap.

**Chart 33: Inventory of sponge titanium and scrap in US (Unit: tons)**



Source: U.S. Geological Survey, Jefferies

**Chart 34: Scrap consumption is increasing (unit: tons)**

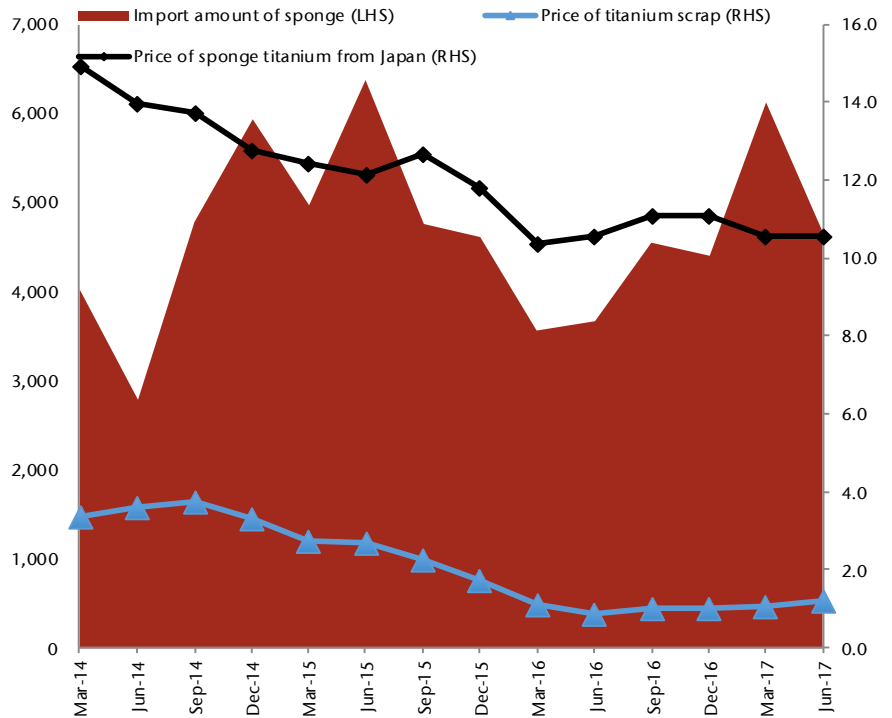


Source: U.S. Geological Survey, Jefferies

Forging parts from a large titanium ingot leaves c80% scrap materials. Obviously, it makes sense to recycle this and reuse it. As scrap prices declined, there was more incentive to use more existing material. However, we think that inventory adjustments are largely over and with less and less inventory, the level of titanium scrap is declining as well. We expect increasing titanium sponge sales from Japan with inventories declining. Increasing scrap prices would also be positive for sponge prices, and inventory restocking could start a cascading effect; not only at the aircraft manufacturers but also with their parts suppliers.

Titanium sponge imports from Japan to the US have bottomed out. With inventory adjustments concluding, the price of both scrap metal and titanium sponge has bottomed and trending up, in our view

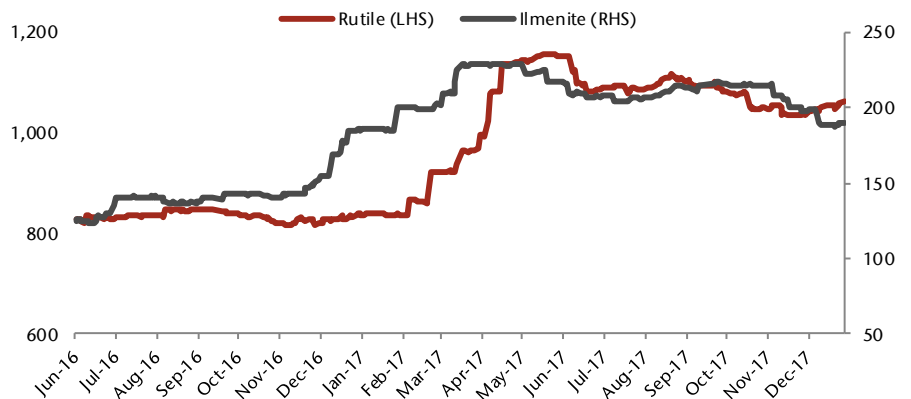
**Chart 35: US import amount and price of sponge titanium and scrap (unit: tons, \$/kg)**



Source: U.S. Geological Survey, Jefferies

**Raw materials declining.** Growing production in China bid up the price for ilmenite and rutile, the raw materials for titanium. However, this trend seems to be fading and raw material prices are declining; this is a positive for the Japanese as they can likely obtain cheaper inputs.

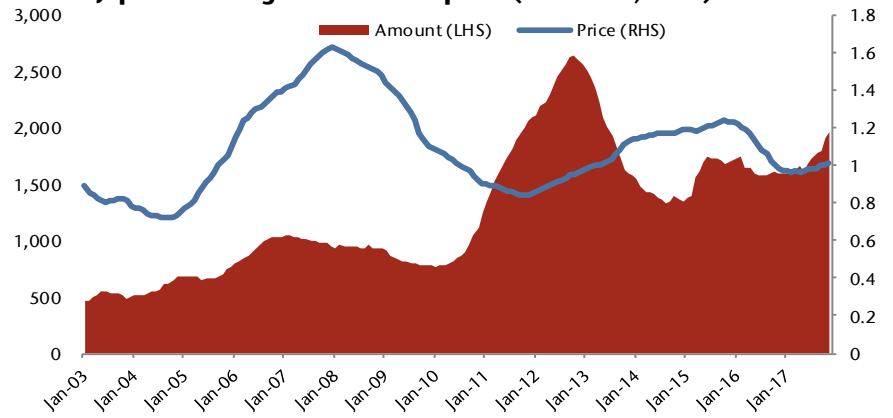
**Chart 36: Historical price of rutile and ilmenite (unit: \$/t)**



Source: Bloomberg, Jefferies

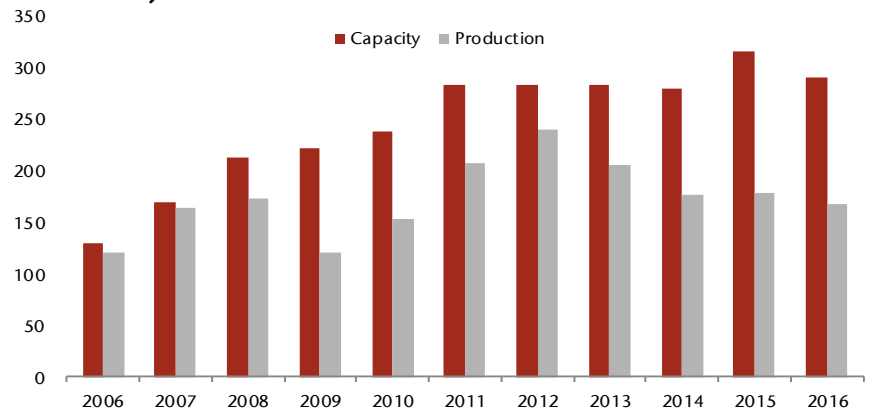
**Shipments from Japan to normalize.** We think that after the inventory adjustments have ended, shipments of sponge titanium from Japan will resume their upward momentum.

**Chart 37: Japan unwrought titanium exports (unit: tons, ¥mn)**



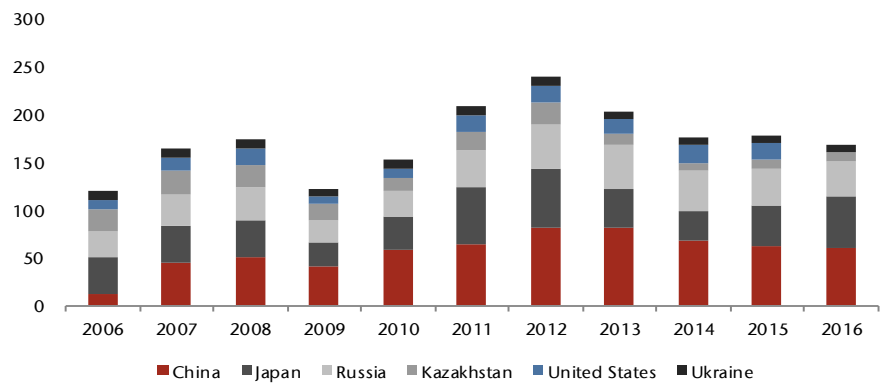
Source: Japan Statistics Bureau, Jefferies

**Chart 38: Titanium sponge world production vs. world capacity (unit: thousand tons)**



Source: U.S. Geological Survey, The Japan Titanium Society, Jefferies  
 Note: US production is not included in 2016

**Chart 39: World titanium sponge production by country (unit: thousand tons)**



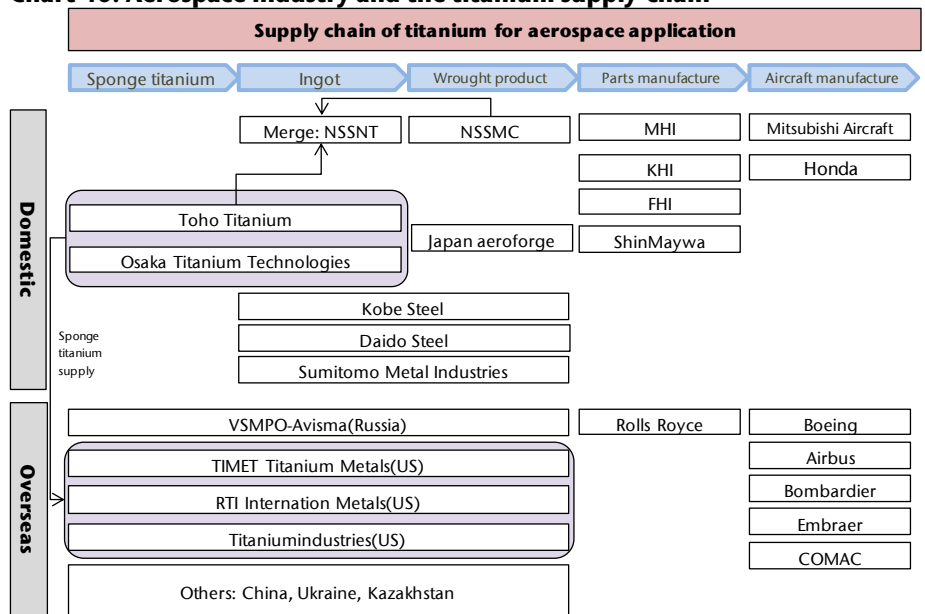
Source: The Japan Titanium Society, Jefferies

## 2) Russia: major supplier – with sanctions

Showing solidarity, the US and Europe have imposed more sanctions against Russia’s financial, defense, and energy sectors in the wake of the shoot-down of Malaysia Airlines’ MH17.

Russia is a major supplier of titanium materials for Airbus and Boeing. Also, Ukraine has been one of the countries capable of producing high-quality titanium sponge. While it is uncertain whether there could be sanctions against these specific industries and companies, we believe that aerospace companies would at least contemplate securing stable sources for their supply-chain and not risk delays in shipments. The logical solution would be solidifying ties with the Japanese titanium names, in our view.

**Chart 40: Aerospace industry and the titanium supply-chain**



Source: Jefferies, various material

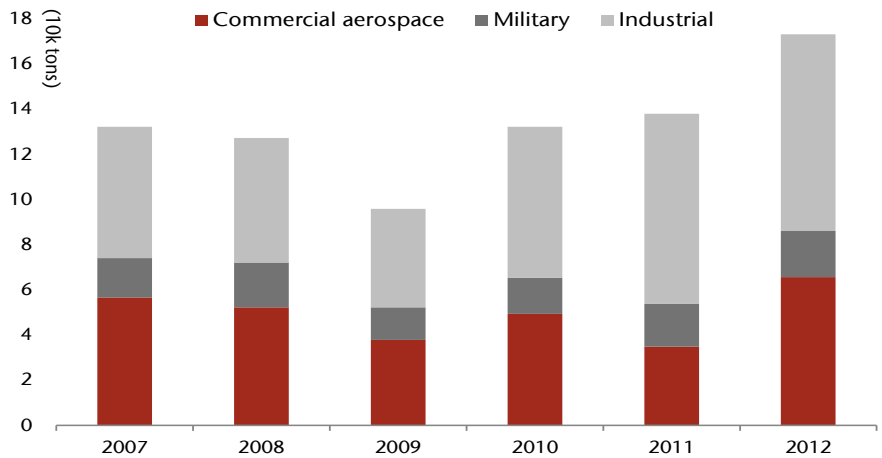
Just a couple years ago, the US had already moved up sanctions against Russia, squeezing finances of companies like Rosneft, Novatek, Gazprombank. The EU was considering cutting off Sberbank, VTB and other state-controlled banks from external funding markets. If this trend continues, we think that aerospace parts producers will at least contemplate hedging their risks by diversifying procurement of titanium raw materials.

Recently, the US implemented new sanctions against Russia (2 Aug 2017), as a result of its alleged interference in the '16 US election, human rights violations, annexation of Crimea, and military operations in eastern Ukraine. There is a 29 Jan 2018 deadline, when the US administration has to come out with a list of businesses and enterprises from various countries that have continued to do business with Russian entities and which face sanctions as well. In retaliation, Moscow told the US to reduce the size of its diplomatic staff by 755 and banned it from using two properties.

A significant amount of titanium is used for military purposes.

### 3) Arms race: My enemy's enemy is my friend

**Chart 41: Utilization of titanium sponge by industry**

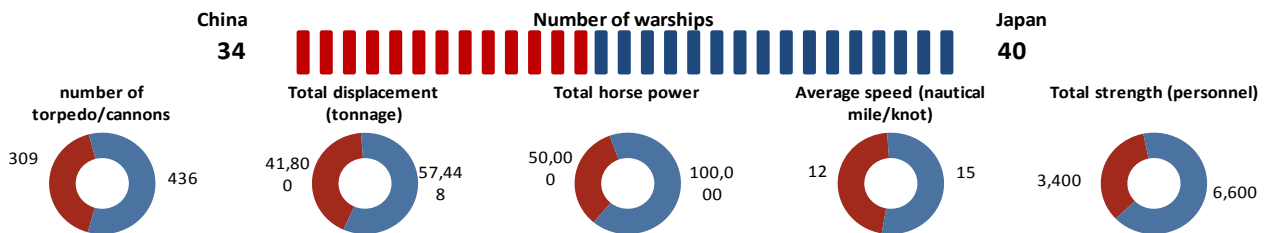


Source: Toho Titanium CO., Jefferies

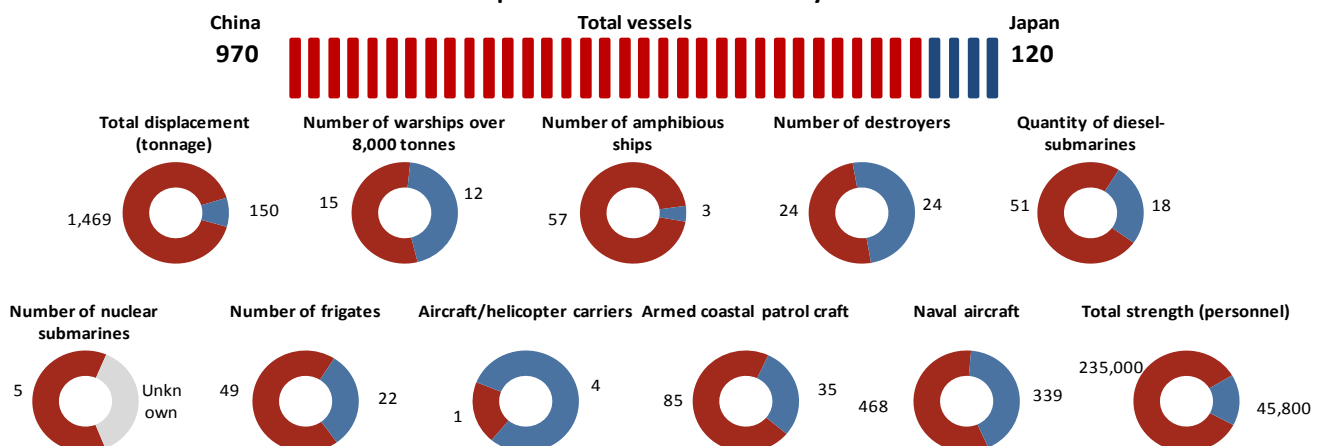
Under Japan's revised constitution, the country could engage in military intervention in the name of collective self-defense. In addition, lifting the ban on exporting arms could mean that the Treaty of Mutual Cooperation and Security between the US and Japan could turn the unilateral military alliance into a bilateral one.

**Chart 42: Comparison of naval force of China and Japan**

#### Comparison of Sino-Japanese maritime forces before 1894



#### Comparison of naval forces today



Source: Historical document from Qing Government and Imperial Japanese Navy General Staff, US Department of Defense to Congress annual reports, China's 2014 Defense White Paper and online reports, Jefferies

This means that Japan could intercede if other countries come under attack, probably at the South China Sea; Japan could form alliances with the Philippines/Vietnam/India against China, and could beef up its naval force in order to enforce maritime safety.

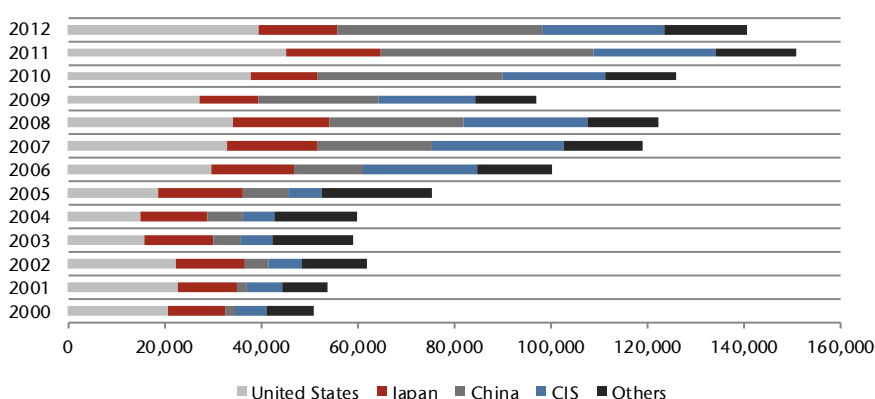
**Only a few listed companies.** Net-net, there are many scenarios that could drive up the price/demand for titanium sponge, in our view. On the other hand, there are not so many listed titanium sponge manufacturers – US companies are either unlisted (TIMET), or the sponge titanium business is just a small part of the conglomerate (ATI), Chinese companies are unlisted, and Ex-Soviet Block companies face low liquidity/disclosure issues. The only place to look is Japan, in our view.

**Chart 43: Major titanium manufacturers in the world**

Country	Company	Listed	Ticker	Product		
				Titanium Sponge	Titanium Ingot	Mill Product
Japan	Osaka Titanium	✓	5726 JP	✓	✓	
	Toho Titanium	✓	5727 JP	✓	✓	
	Kobe Steel	✓	5406 JP		✓	✓
	NSSMC	✓	5401 JP		✓	✓
	Daido Steel	✓	5471 JP		✓	✓
	JFE Steel	✓	5411 JP			✓
	JX Mining & Metal					✓
	Ulvac	✓	6728 JP			✓
	UACJ Copper Tube					✓
	Aichi Steel	✓	5482 JP			✓
	Mitsubishi Materials	✓	5711 JP			✓
US	TIMET			✓	✓	✓
	ATI	✓	ATI US	✓	✓	✓
	RTI				✓	✓
Europe	TIMET UK				✓	✓
	Outkumpu VDM				✓	✓
	Valtimet SA					✓
	TIMET Savoie					✓
Russia	VSMPO-AVISMA	✓	VSMO RU	✓	✓	✓
Kazakhstan	UKTMP			✓	✓	
Ukraine	ZAPOROZHYE			✓		
China	Baoji Titanium	✓	600456 CH		✓	✓
	Zunyi Titanium			✓	✓	
Korea	Posco	✓	005490 KS			✓

Source: The Japan Titanium Society, Jefferies

**Chart 44: Global mill product shipments (unit: tons)**



Source: The Japan Titanium Society, Jefferies



**Chart 45: Titanium sponge capacity (Unit: '000 tons)**

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	YoY
Sponge	China	15	45	78	78	80	114	114	114	114	140	110	-21%
	Japan	39	39	40	46	60	62	62	62	57	65	69	7%
	Russia	32	32	36	38	38	47	47	47	47	47	47	0%
	Kazakhstan	23	26	26	26	26	26	26	27	27	26	26	0%
	United States	12	20	23	24	24	24	24	24	24	25	25	0%
	Ukraine	10	10	10	10	10	10	10	10	10	10	12	12
Total		130	170	213	222	238	283	283	284	279	316	290	-8%

Source: U.S. Geological Survey, Jefferies

**Chart 46: Titanium sponge and unwrought production (unit: '000 tons)**

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	YoY
Sponge	China	13	45	50	41	58	65	81	81	68	62	60	-9%
	Japan	37	39	39	25	36	59	63	42	31	42	54	35%
	Russia	27	32	36	23	26	39	46	46	42	40	38	-5%
	Kazakhstan	25	25	23	17	14	20	23	12	9	9	9	0%
	United States	9	14	17	9	10	17	17	14	19	18	-	-5%
	Ukraine	9	10	10	7	10	10	10	9	7	7	8	0%
	Subtotal	120	164	174	121	153	208	240	205	176	178	169	1%
Wrought products	China	14	24	28	25	38	49	52	44	50	49	-	-2%
	United States	30	38	40	-	-	46	40	36	37	38	-	3%
	Japan	17	19	20	12	14	19	16	12	14	15	-	7%
	CIS	24	28	26	-	-	36	39	30	14	14	-	0%
	EU	10	5	5	-	-	-	-	13	10	10	-	0%
	Subtotal	101	113	117	-	-	150	147	135	125	126	-	1%

Source: The Japan Titanium Society, Jefferies

**Chart 47: Japan production and shipments of titanium products (unit: '000 tons)**

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	YoY
TiO2	Production	143.8	147.4	135.0	97.1	124.4	128.5	111.1	104.2	106.4	104.7	-2%
	Shipment	112.6	110.4	132.6	66.0	76.1	81.7	70.4	71.3	68.8	66.8	-3%
	Export/Inventory	31.2	37.1	2.4	31.1	48.3	16.8	40.7	32.9	37.6	37.9	1%
Sponge	Production	37.8	38.5	39.0	25.0	37.1	52.6	63.4	42.2	30.9	41.9	36%
	Shipment	24.3	27.1	27.2	14.0	18.8	29.3	27.0	17.1	19.1	24.9	30%
	Export/Inventory	13.5	11.4	11.8	11.0	18.3	23.3	36.4	25.0	11.8	17.0	44%
Ingot	Production	24.2	25.3	27.0	13.8	20.7	31.6	24.6	14.9	20.4	23.5	15%
Wrought products	Production	17.3	19.1	19.7	12.0	13.8	19.4	16.2	12.4	14.0	15.5	11%
	Shipment	9.6	11.0	10.2	4.2	4.6	6.1	5.2	4.3	4.9	5.4	10%
	Export/Inventory	7.7	8.1	9.6	7.8	9.2	13.2	11.0	8.0	9.1	10.1	11%

Source: The Japan Titanium Society, JOGMEC, Jefferies

**Chart 48: World titanium ore production (TiO<sub>2</sub>, '000 tons)**

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	YoY
Ilmenite	China	500	550	600	500	550	660	960	1,020	960	850	800	-6%
	Australia	1,330	1,400	1,320	1,020	991	960	940	960	720	720	720	0%
	Vietnam	230	254	330	412	485	550	510	720	560	360	300	-17%
	South Africa	1,050	1,100	1,050	1,050	952	1,110	1,100	1,190	600	1,280	1,300	2%
	Mozambique	-	14	197	283	407	380	350	430	510	460	490	7%
	Canada	791	816	850	650	754	750	750	770	480	595	475	-20%
	Others	1,504	1,587	1,451	1,376	1,626	1,686	1,891	1,644	1,740	1,925	1,775	-8%
	Subtotal	5,400	5,720	5,800	5,300	5,800	6,100	6,500	6,730	5,570	6,190	5,860	-5%
Rutile	Australia	207	297	309	266	361	440	410	423	190	380	350	-8%
	Sierra Leone	13	79	75	61	65	64	89	81	100	113	120	6%
	Ukraine	57	57	57	57	57	56	56	50	63	90	90	0%
	South Africa	117	108	121	127	145	122	120	59	53	67	65	-3%
	India	18	20	20	20	24	24	24	24	17	18	18	0%
	Others	3	3	8	18	21	27	33	30	48	92	100	9%
	Subtotal	415	564	590	550	670	730	730	667	470	760	743	-2%
Total		5,815	6,284	6,390	5,850	6,470	6,830	7,230	7,397	6,040	6,950	6,603	-5%

Source: U.S. Geological Survey, JOGMEC, Jefferies

**Chart 49: Japan titanium supply and demand (unit: '000 tons)**

			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	YoY	
Supply	Import	Ore	130.8	161.9	157.2	96.4	133.8	146.6	199.7	142.4	154.9	175.7	13%	
		Scrap	0.8	1.0	0.7	0.1	0.5	1.5	0.6	1.4	1.5	1.6	7%	
		Unwrought titanium	3.4	6.5	8.5	2.2	3.0	5.2	4.2	1.0	1.3	3.0	131%	
		Finished products	1.5	2.0	3.1	1.3	1.1	1.6	1.7	2.1	2.0	2.7	35%	
		Pigment	37.8	39.4	39.0	36.1	45.8	42.8	38.1	41.0	40.7	38.7	-5%	
	Total			174.4	210.7	208.5	136.1	184.2	197.7	244.3	187.9	200.5	221.8	11%
Demand	Domestic demand	Sponge	27.7	33.4	35.7	17.9	26.0	34.5	31.2	18.2	19.1	24.9	30%	
		TiO <sub>2</sub>	150.5	149.7	171.6	102.0	121.9	124.5	108.4	112.3	109.6	105.5	-4%	
		Subtotal	178.2	183.1	207.3	119.9	147.9	159.1	139.6	130.6	128.7	130.4	1%	
	Export	Ore	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
		Scrap	4.2	3.9	3.9	2.0	2.4	3.7	3.8	3.6	4.2	4.6	10%	
		Ex. Unwrought titanium	0.16	0.17	0.13	0.03	0.03	0.19	0.14	0.13	0.23	0.20	-13%	
		Unwrought titanium	12.5	11.3	11.2	9.3	15.0	25.1	30.7	19.1	16.1	20.6	28%	
		Finished products	9.9	10.3	12.8	9.2	10.2	14.1	12.3	9.7	10.2	12.0	18%	
		Pigment	53.9	57.2	46.9	37.0	50.6	47.2	34.4	39.2	36.1	33.8	-6%	
	Subtotal			80.6	82.9	74.9	57.6	78.2	90.4	81.4	71.6	66.9	71.3	7%
Total			258.8	266.1	282.2	177.5	226.1	249.4	221.1	202.2	195.5	201.7	3%	
Supply - Demand			-84.5	-55.4	-73.7	-41.4	-41.9	-51.7	23.2	-14.2	4.9	20.1		

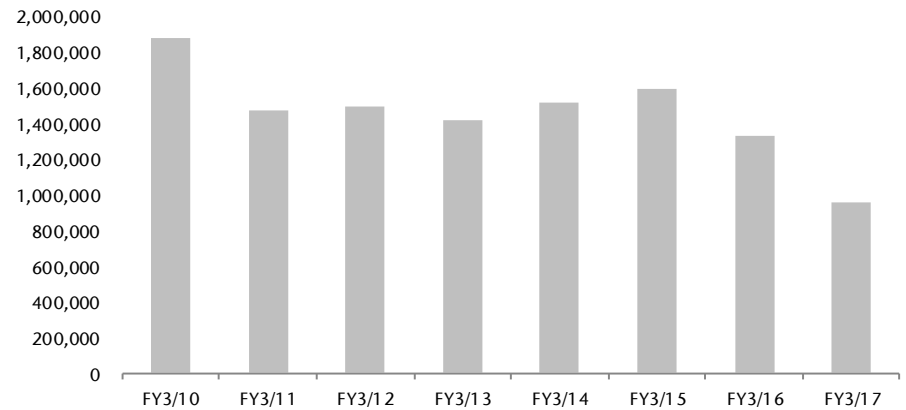
Source: Trade Statistic of Japan, JOGMEC, Jefferies

Note that costs/ton include polysilicon and high-performance material production costs and pure titanium production costs per ton is significantly lower (but there is no breakdown)

## Cost cuts: Contractors, depreciation costs declined

After years of bad results, titanium companies have been optimizing, and cutting costs. We analyze below the factors that lowered production costs.

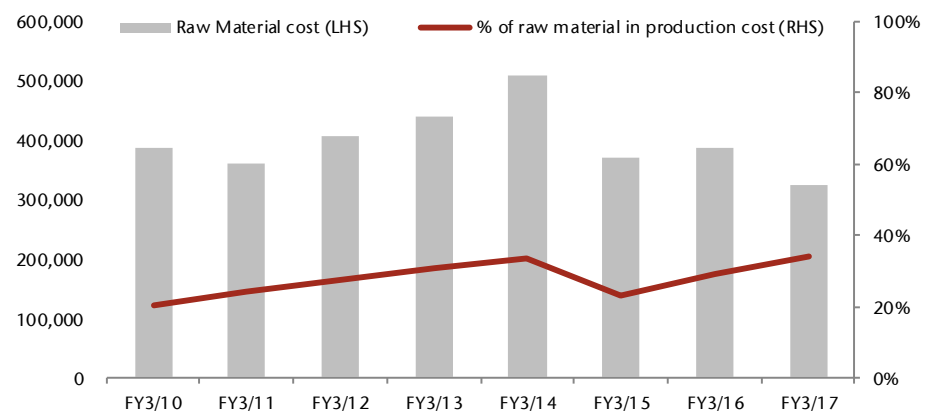
**Chart 50: Production cost per ton has been declining (unit: ¥)**



Source: Jefferies estimates

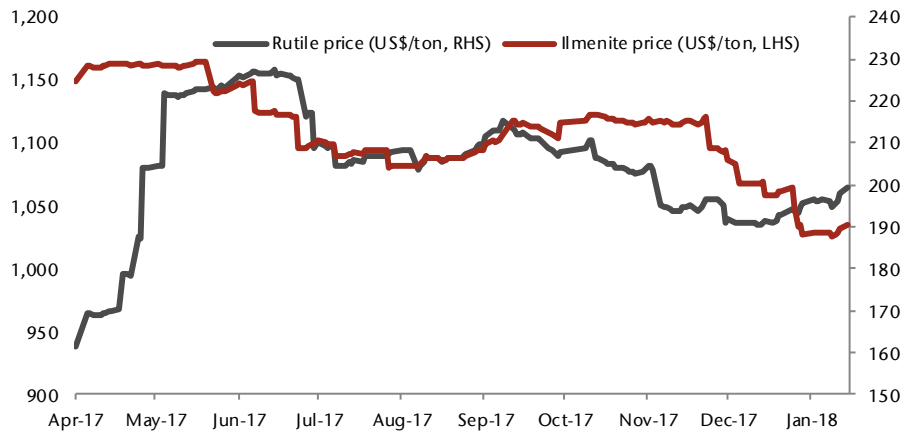
Note: Production costs include the costs of producing polysilicon and high-performance materials as well and is not a good indication of per ton costs. However, there is no breakdown

**Chart 51: Raw material costs have been more or less stable at around one-third of production costs (unit: ¥)**



Source: Jefferies estimates

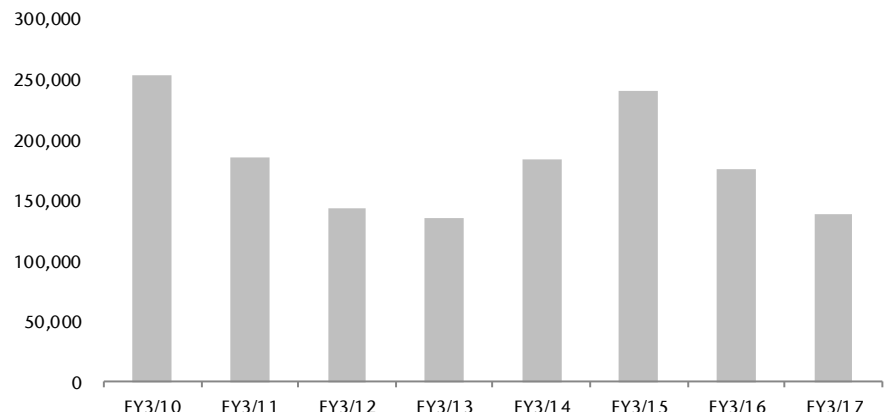
**Chart 52: Ilmenite and rutile prices have been normalizing - on average, spot prices are \$20/ton cheaper vs. avg. FY3/18**



Source: Bloomberg, Jefferies

With economies of scale, labor cost per ton declines – even if companies pay marginally higher bonuses to individuals

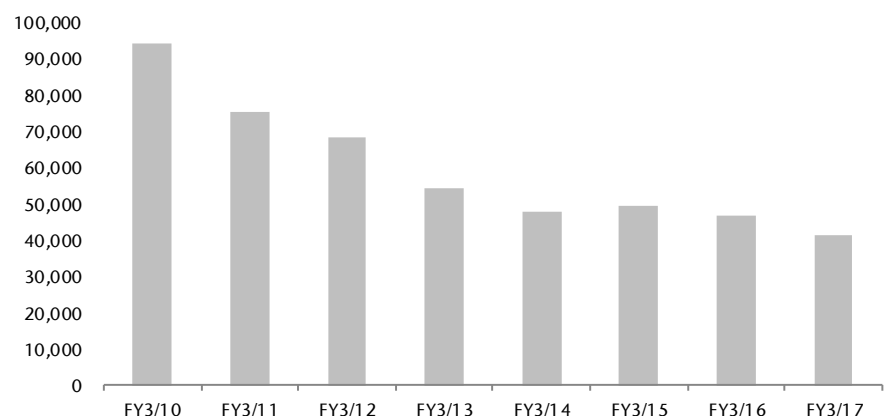
**Chart 53: Labor cost/ton (unit: ¥)**



Source: Jefferies estimates

With continuous cost-cutting efforts, fees for outside contractors is declining as well

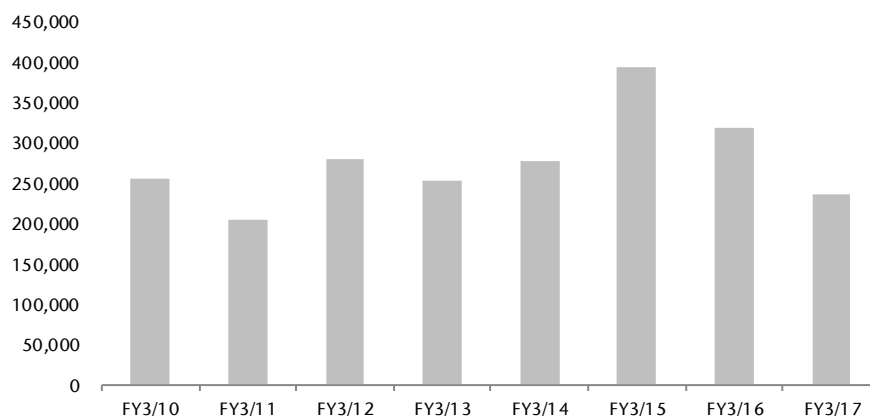
**Chart 54: Outside contractors/ton - negotiating better terms in bad years (unit: ¥)**



Source: Jefferies estimates

Electricity costs are high at around ¥250k/ton and could rise with higher oil prices

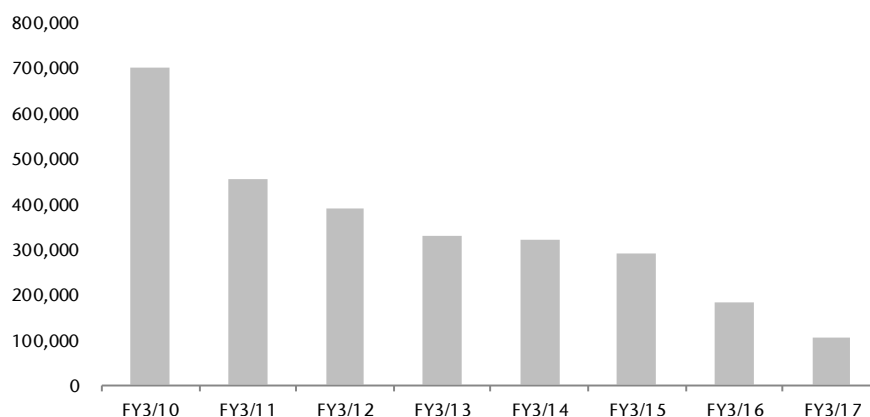
**Chart 55: Electricity costs/ton (unit: ¥)**



Source: Jefferies estimates

High depreciation costs due to expansion CAPEX have peeled off and are not a burden anymore

**Chart 56: Depreciation costs/ton declining rapidly (unit: ¥)**

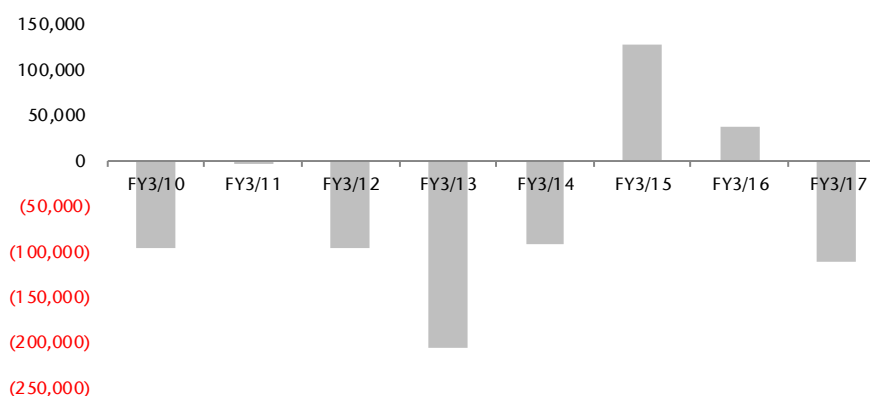


Source: Jefferies estimates

Technical in nature but inventory gains and losses do impact optimal accounting earnings.

Large inventory gains in FY3/17 lowered production costs. This should reverse in FY3/18 (increasing costs) but have no impact in FY3/19 as production/sales even out

**Chart 57: Impact of inventory gains/losses to production costs (unit: ¥)**



Source: Jefferies estimates

## Valuations

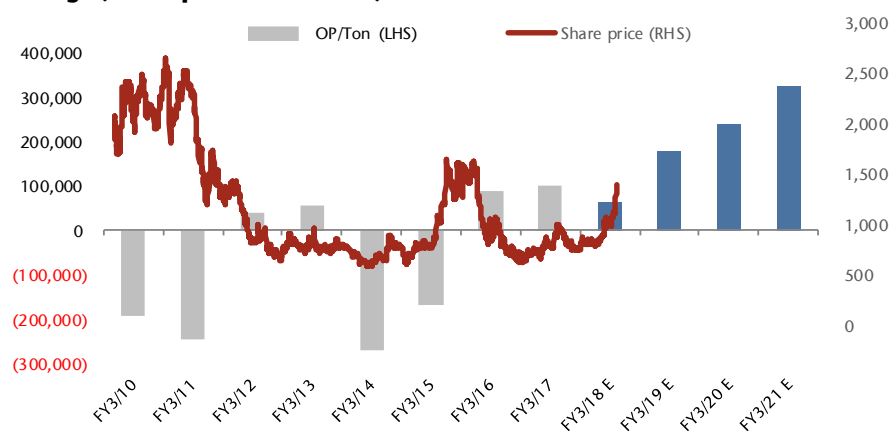
**Except for Russian competitor, there is no listed pure titanium play. We use FY3/20 EPS as our base year – as stocks historically tend to price in two-year forward earnings. Our earnings multiples are in line with historical averages.**

**Chart 58: Only Japanese companies provide exposure to titanium dynamics**

Location	Company Name	Ticker	Mkt Cap (US\$ million)	Last Price	Share Price Performance				Avg. Trade Vol (\$m/d)	P/B Ratio	P/E Ratio BBG Est.	ROE BBG Est.
					1-M	3-M	6-M	1-YR				
Japan	Osaka Titanium	5726 JP Equity	823.5	2,476	30.5	52.2	35.0	53.4	6.0	2.6	49.5	5.3
Japan	Toho Titanium	5727 JP Equity	898.5	1,395	30.3	58.5	71.8	82.4	6.9	2.5	44.5	9.9
US	ATI	ATI US Equity	3,612.3	29	22.2	15.0	63.6	74.9	61.1	2.3	31.3	(5.9)
Russia	VSMPO- AVISMA	VSMO RX Equity	3,554.8	17,400	3.1	(2.7)	11.0	18.0	0.1	4.9	N/A	N/A
Kazakhstan	UKTMP	Not listed										
Ukraine	ZAPORozHYE	Not listed										
China	Zunyi Titanium Industry	Not listed										
US	TIMET	Not listed										
Japan	TOPIX	TPX Index		1,894	5.6	10.2	16.5	23.8	28,046.7	1.5	16.3	9.1
Japan	TOPIX Non-Metals	TPNMET Index		1,393	14.0	13.3	26.8	41.9	406.7	1.2	14.6	7.1

Source: Bloomberg estimates

**Chart 59: Toho Titanium – stocks are pricing in two-year forward expected earnings (Share price vs. OP/Ton)**

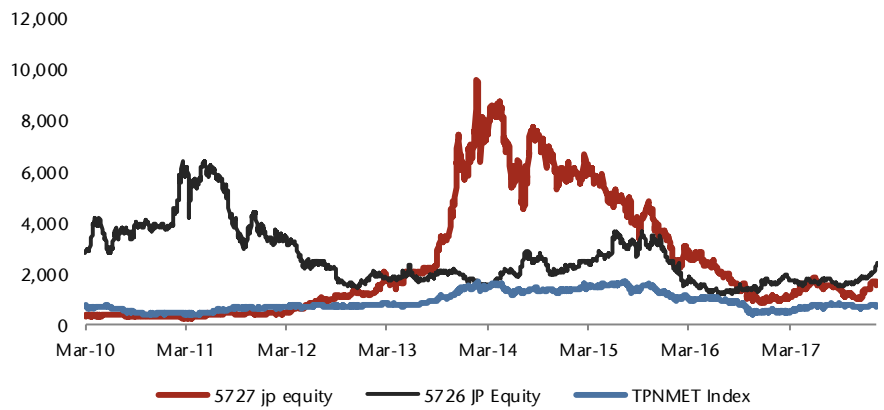


Source: Jefferies estimates

**High upside potential.** Titanium companies have been loss-making in the last couple of years, dampening their equity. We expect sales volumes, and prices rebounding, which should lead to a significant margin improvement. We base our valuations on FY3/20 earnings forecasts assuming 7.5% CAGR price, and 5% CAGR volume increase in the four years.

If/when titanium fundamentals improve, the share price of related companies could significantly outperform the Topix non-ferrous metals sector

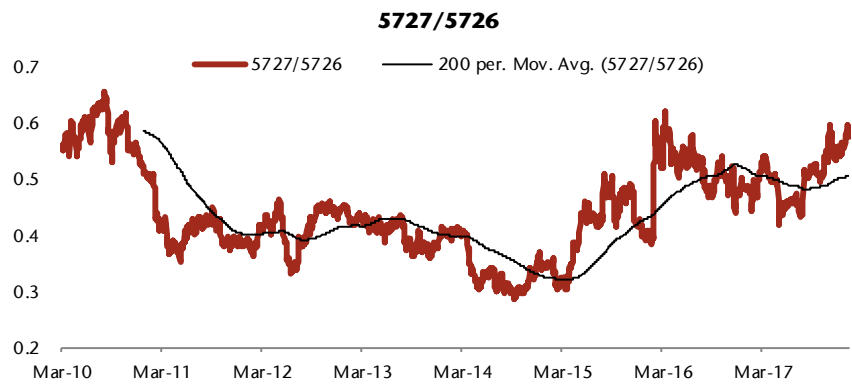
**Chart 60: Titanium stocks vs. Topix non-ferrous metals index**



Source: Bloomberg

Toho Titanium has been outperforming Osaka Titanium in the last couple years due to the differential of its non-titanium businesses. Nevertheless, we think both names are a Buy

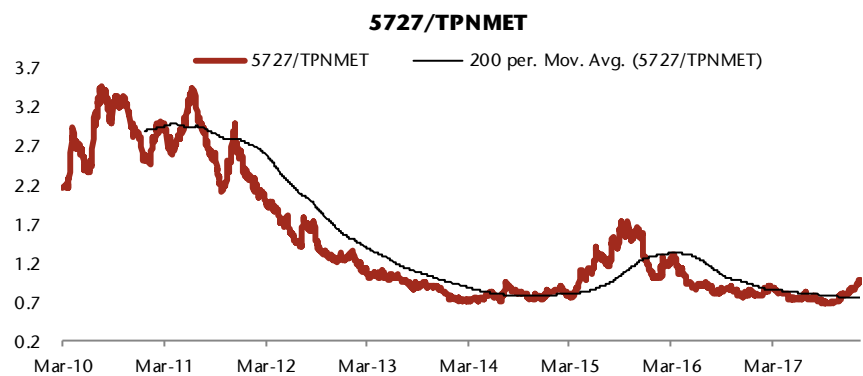
**Chart 61: Toho Titanium vs. Osaka Titanium**



Source: Bloomberg, Jefferies

Due to inventory adjustments, earnings were very disappointing for the titanium names in the last several years. However, this is largely done, and we think that stocks could significantly outperform the sector

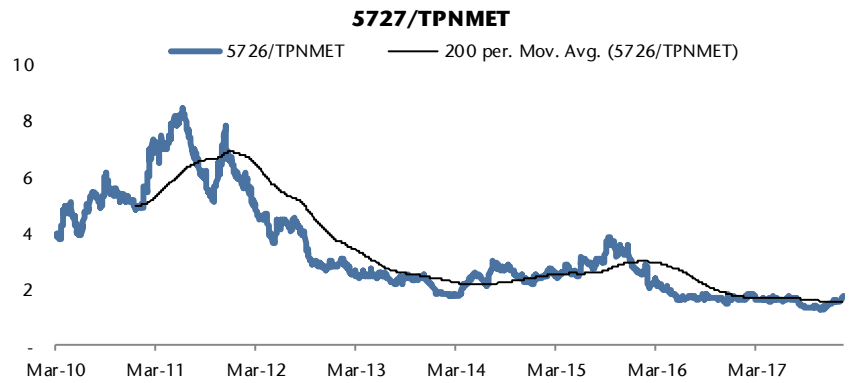
**Chart 62: Toho Titanium vs. Topix Non-Ferrous Metals Index**



Source: Bloomberg, Jefferies

Similar for Toho Titanium; the upside for Osaka Titanium to outperform the TOPIX Non-Ferrous Metals segment could be significant, in our view

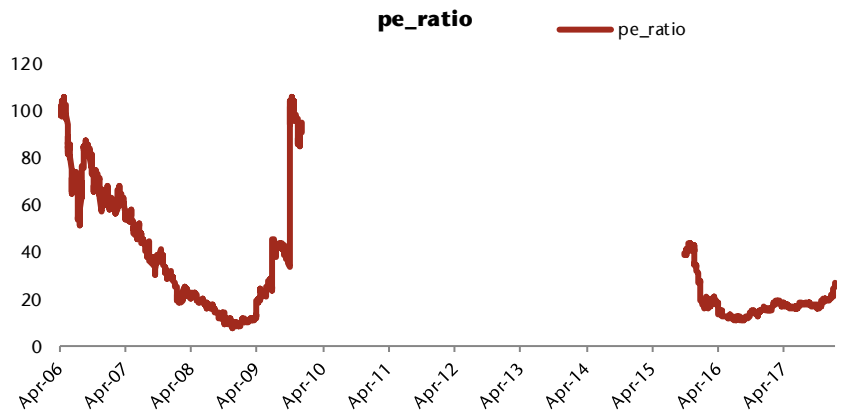
**Chart 63: Osaka Titanium vs. TPNMET Index**



Source: Bloomberg, Jefferies

Historical P/E ratio has been all over the place, most recently at around 20x

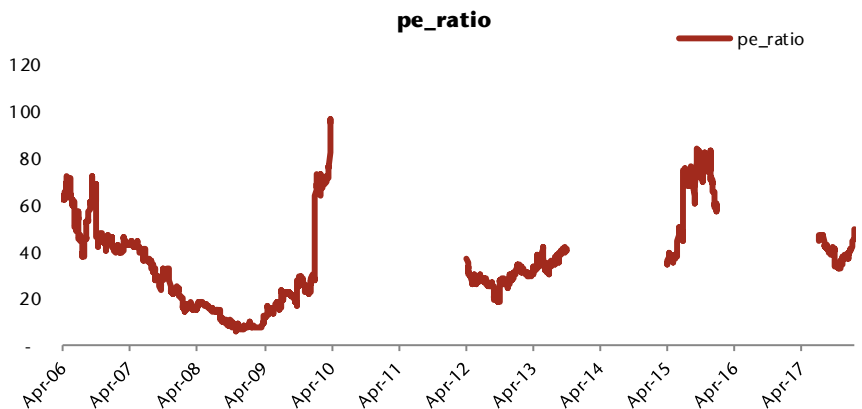
**Chart 64: Toho Titanium - Historical P/E ratio**



Source: Bloomberg

P/E ratio – patchy as earnings tend to be volatile. However, a 20x multiple is reasonable, in our view

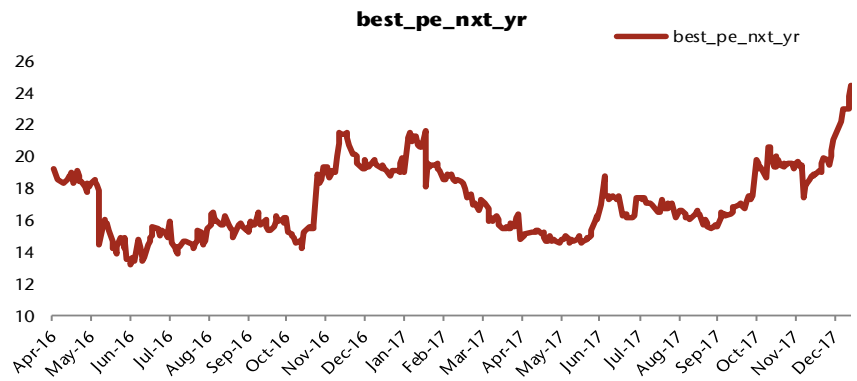
**Chart 65: Osaka Titanium - Historical P/E ratio**



Source: Bloomberg



**Chart 66: Toho Titanium Forward P/E multiple - We use 20x forward P/E for our valuation, which is in-line with market expectations**



Source: Bloomberg

When margins improve, the share price tends to ignore P/B

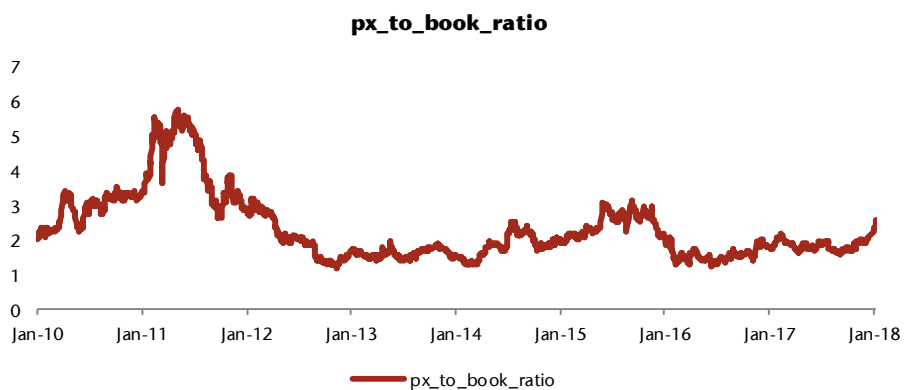
**Chart 67: Toho Titanium - Price to Book ratio**



Source: Bloomberg

P/B ratios seem to have bottomed out

**Chart 68: Osaka Titanium - Price to Book ratio**



Source: Bloomberg

## Risks

**Macroeconomic risks.** While the titanium industry is growing steadily, the slowdown of the Chinese economy, higher interest rates, as well as an unstable geopolitical environment raises uncertainty and market volatility, which impacts demand for titanium products.

**Raw material costs.** Titanium is extracted from ilmenite and rutile ore through a multi-step process that includes magnesium. Volatility of raw material prices affects input costs.

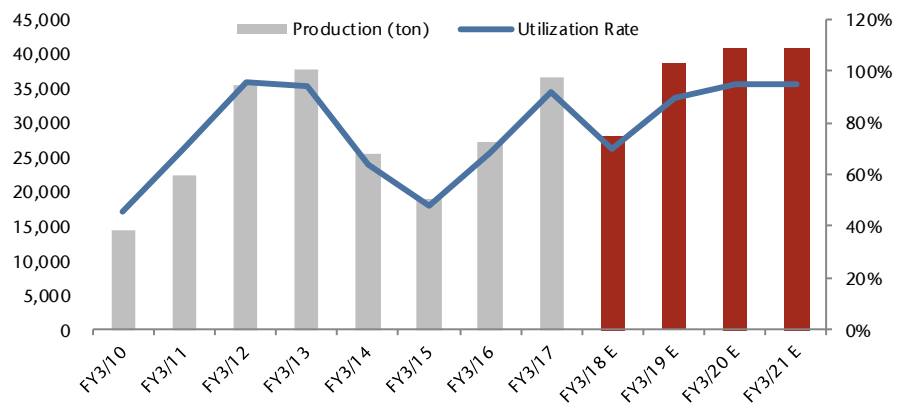
**Energy prices.** Production requires a lot of energy; rising oil prices push electricity prices higher, weighing on costs.

# Osaka Titanium Technologies (5726 JP)

**We initiate coverage of Osaka Titanium with a Buy rating and ¥3,400 price target. We expect increasing sales volumes and titanium prices to boost earnings.**

**Sales to significantly increase in FY3/19.** Osaka Titanium is currently producing at around a 70% utilization rate vs. 90% in FY3/17 and 80% in FY3/16 (Jefferies estimates). On the other hand, sales remain solid at around 90% of production capacity. The reason for the low utilization rate this year is destocking of inventories. Obviously, unit costs are high on a low utilization rate, but this should normalize in the next fiscal year. Thus, we expect higher utilization rates to result in a YoY earnings increase in FY3/19.

**Chart 69: Demand for titanium to push production/utilization rates up**

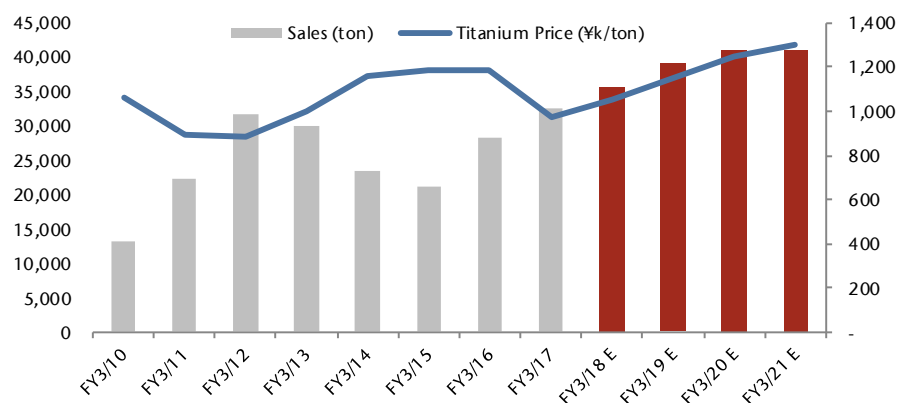


Source: Jefferies estimates

**ATI's plant closure is a positive.** In early '14, Allegheny Technologies (ATI) decided to permanently close down its Albany sponge plant in Oregon. The company said that existing supply in both the United States and Japan were more competitive. Now the US has only two plants, ATI's Rowley plant, and Titanium Metals' plant in Henderson, Nevada. Thus, US titanium companies are buying titanium sponge from Japan.

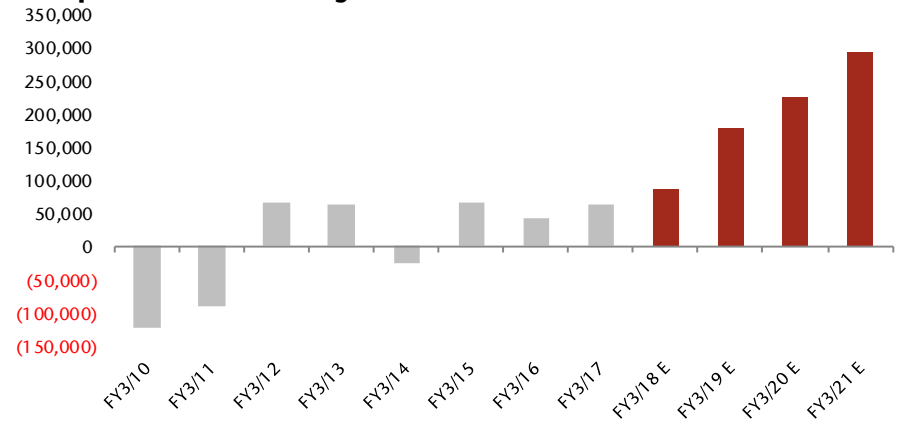
**Debottlenecking existing facilities.** Osaka Titanium currently has 40kt/annum production capacity, but it also has two fully impaired plants, which could be restarted if necessary. We think this is a good optionality.

**Chart 70: Sales volumes increasing with demand for aircrafts rising - pushing up prices as well**



Source: Jefferies estimates

**Chart 71: Operational leverage: As a result of higher utilization rate and ASP, we expect OP/ton increasing**

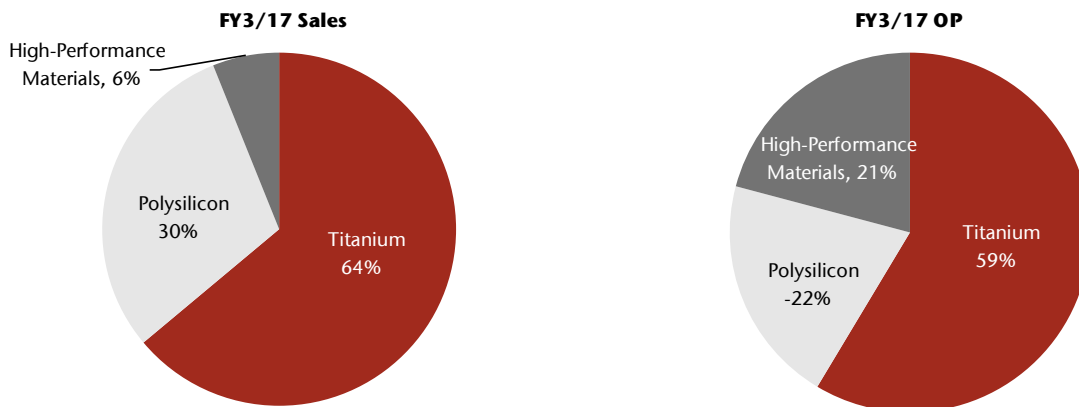


Source: Jefferies estimates

**Yen sensitivity: ¥1/\$ moves OP by ¥100m.** Titanium companies usually buy raw materials on an annual contract (raw materials are about a third of the costs), denominated in US\$. As about 60% of the end-product is exported, the weaker Yen is positive for earnings.

**Who is OTC.** Osaka Titanium Technologies Co. (OTC) is a titanium metals manufacturer founded in 1952. The company operates in three business segments, Titanium, Polycrystalline Silicon, and High-Performance Materials. The Titanium segment manufactures and sells titanium sponges, titanium ingots, and others. The Polycrystalline Silicon segment is engaged in the manufacture and sale of semiconductor-grade polysilicon. The High-Performance Material segment is involved in the manufacture and sale of highly functional titanium and silicon products, including high-purity titanium, titanium powder, silicon monoxide (SiO), and titanium low oxygen powder (TILOP), among others.

**Chart 72: FY3/17 sales and OP by segment**



Source: Company Data

## Titanium Business

**OTC is the first company** in Japan to succeed in commercially manufacturing titanium. OTC, a pioneer of the titanium sponge industry in Japan, mainly produces titanium sponge and titanium ingot in Titanium business. Titanium business also includes TiCl<sub>4</sub>, Titanium tetrachloride aqueous solution, and Ferro-titanium.

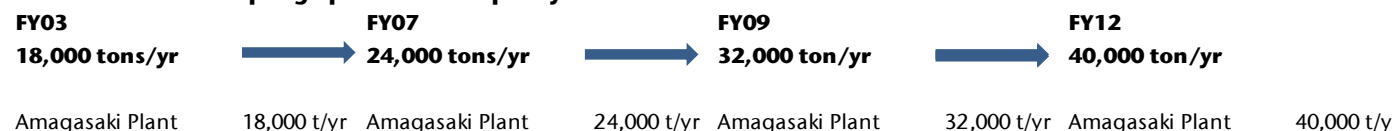
**Titanium sponge** is mainly manufactured in Japan, the United States, Russia, Kazakhstan, Ukraine, and China. However, only a few manufacturers, including OTC, have the technology for manufacturing high-quality titanium sponge (referred to as premium grade) for use in the manufacture of critical parts such as aircraft engine components.

**Titanium ingot** is also the main product. Titanium sponge is used as a raw material of titanium ingot. Titanium ingots are processed into pipes and sheets; pipes for such large-scale facilities as thermal power plants, petrochemical and seawater desalination plants, and sheets for heat exchangers used in ships and LNG manufacturing plants.

**Production capacity** of titanium sponge and titanium ingot is 40,000 tons per year and 6,000 tons per year respectively. Both titanium sponge and titanium ingot are manufactured at Amagasaki Plant in Hyogo Prefecture.

**Applications.** Titanium is used for aerospace, power and other plants, construction, marine/civil engineering, automotive, sporting goods, medical, food, general articles, etc.

**Chart 73: Titanium sponge production capacity**



Source: Company Data, Jefferies

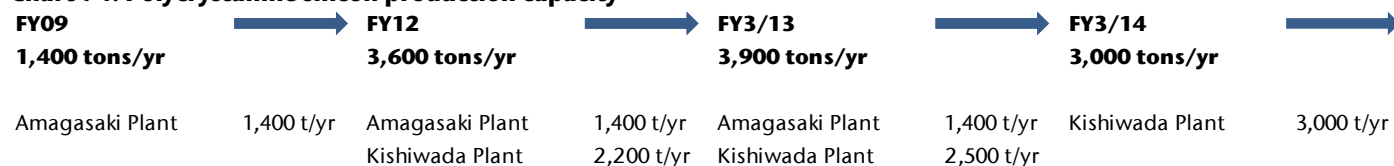
## Polycrystalline Silicon Business

**Inventory levels are still high.** Osaka Titanium produces polysilicon and sells it to semiconductor wafer manufacturers, such as Sumco (3436 JP, Buy), under annual contracts. As inventory levels at customers are still very high, prices are hovering at low levels. Note that earnings from this business segment is skewed in H2 as there is usually periodic maintenance in H2.

**High-purity polycrystalline silicon**, a raw material of silicon wafer is the main product of this business. OTC has manufactured polycrystalline silicon since 1960 and maintains the world's top quality standards for semiconductor-grade products. As an extremely high purity level is required for semiconductor-grade polycrystalline silicon, the number of manufacturers of this material worldwide is limited. OTC has 3,000 tons per year of production capacity at Kishiwada Plant.

**Silicon wafers** are used as substrate materials for all semiconductors in products including personal computers, smartphones and digital cameras, and are indispensable materials in the electronics industry.

**Chart 74: Polycrystalline silicon production capacity**



Source: Company Data, Jefferies

## High-Performance Materials

**Third core business.** OTC is planning to foster High-Performance Materials business as a third core business. In this business, OTC manufactures and sells high purity titanium, silicon monoxide (SiO), gas-atomized titanium powder (TiLOP), titanium powder, photocatalysts, etc.

**High-purity titanium**, with its high purity levels from 4N (99.99%) to 5N (99.999%), is mainly used for producing high-purity titanium sputtering targets used in the semiconductor industry.

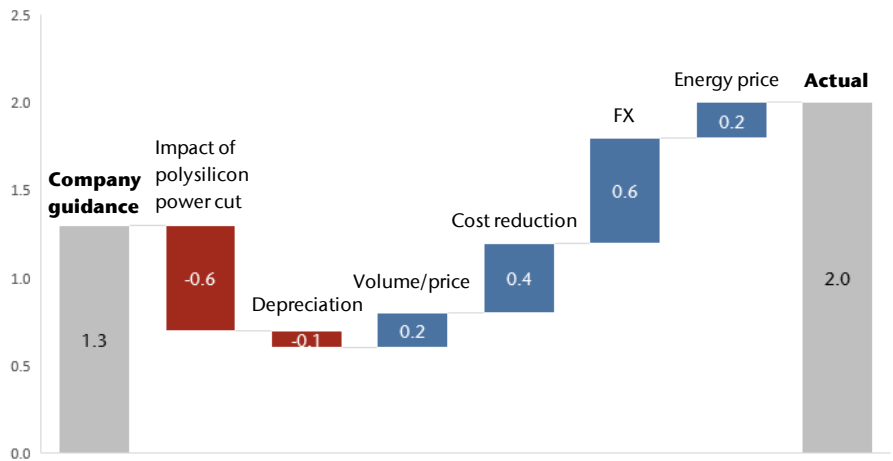
**SiO** is used for making gas barrier packaging films. High-quality SiO already has a proven track record as a barrier material for food packaging and commands the largest share of the industry market. The range of uses of SiO is expanding, such as in solar cell back sheets, where even greater barrier properties are required, and as industrial packaging. Also, its use in next-generation negative electrodes of lithium-ion rechargeable batteries is expected to grow. Semiconductor silicon-grade high-purity silicon is used as the raw material.

**TiLOP.** A method called the Induction Melting Gas Atomizing Process (IAP) is applied in the manufacture of titanium and titanium alloy powder, a technology which OTC was the first to put to practical use for processing titanium and titanium alloy, an active metal with a high melting point. TiLOP is used for Additive Manufacturing (AM), Metal Powder Injection Molding (MIM), spraying, sputtering targets. TiLOP is also suitable for use with 3D printers, and there are expectations for expanding its application as a material for manufacturing medical or aircraft parts.

**Titanium powder** range includes two different types of titanium powder and a titanium hydride powder. These titanium powders use high-quality titanium sponge as a raw material, and are manufactured by means of gas-atomization or hydride-dehydride processes. The properties of titanium powder give it a very wide range of uses. In particular, it is used as a material for powder metallurgy, or as a getter, but its application scope is steadily expanding. The quality of OTC's titanium powder is highly rated by users worldwide.

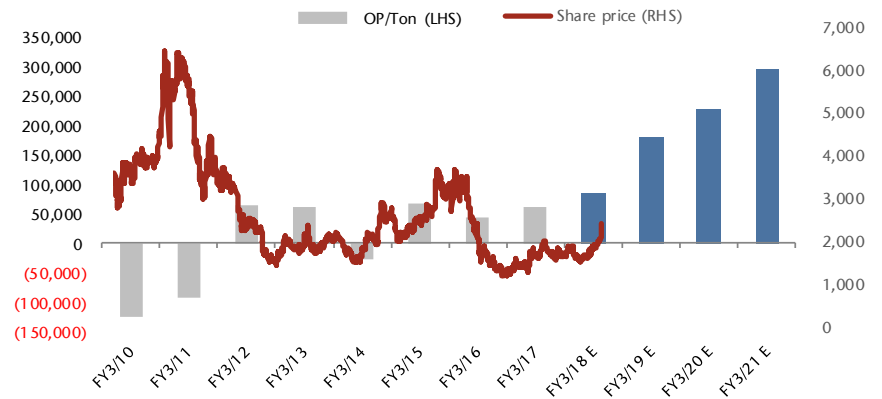
**Photocatalysts.** OTC is the leading manufacturer of commercial-use titanium tetrachloride (TiCl<sub>4</sub>), a material for photocatalysts. Through its integrated manufacturing system, the company has developed photocatalysts with outstanding properties and features.

**Chart 75: FY3/17 company guidance and factors impacting earnings (unit: ¥bn)**



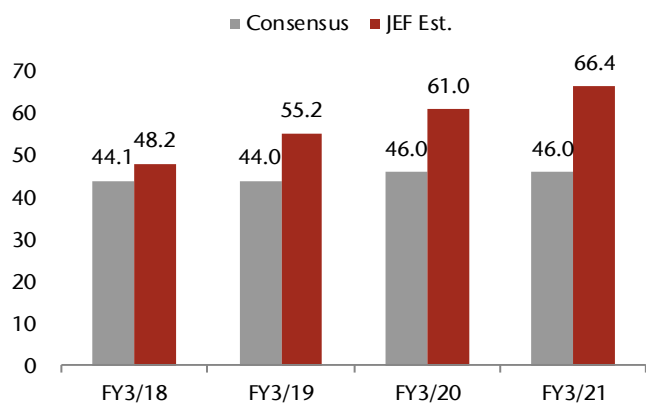
Source: Company Data

**Chart 76: Share price vs. OP/Ton (unit: ¥)**



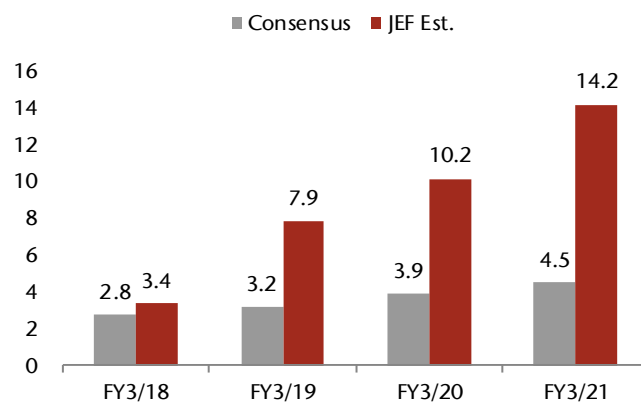
Source: Jefferies estimates, Bloomberg

**Chart 77: Osaka Titanium – revenue estimates vs consensus (unit: ¥bn)**



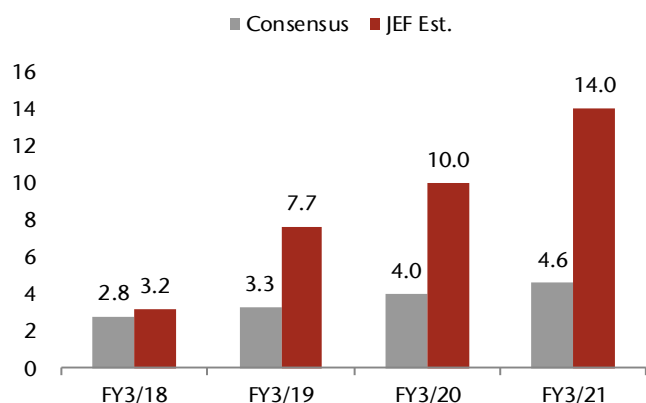
Source: Bloomberg, Jefferies

**Chart 80: Osaka Titanium – OP estimates vs consensus (unit: ¥bn)**



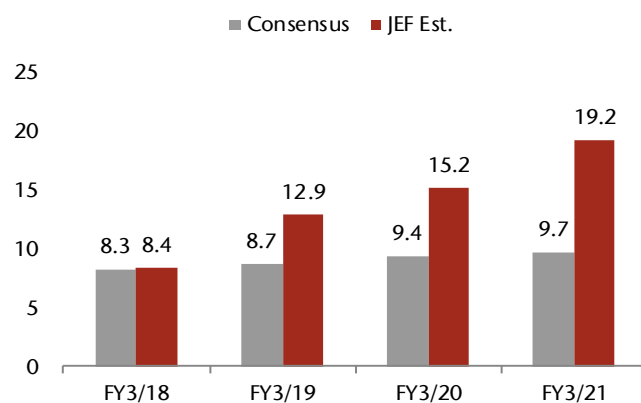
Source: Bloomberg, Jefferies

**Chart 78: Osaka Titanium – RP estimates vs consensus (unit: ¥bn)**



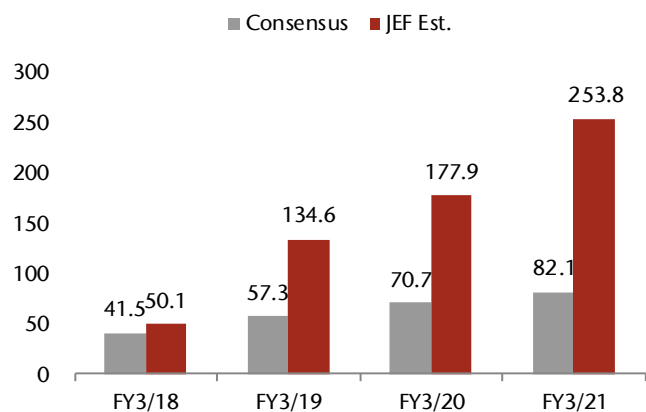
Source: Bloomberg, Jefferies

**Chart 81: Osaka Titanium – EBITDA estimates vs consensus (unit: ¥bn)**



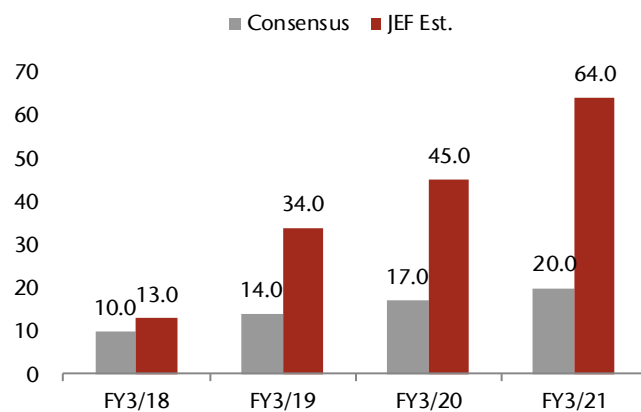
Source: Bloomberg, Jefferies

**Chart 79: Osaka Titanium – EPS estimates vs consensus (unit: ¥)**



Source: Bloomberg, Jefferies

**Chart 82: Osaka Titanium – DPS estimates vs consensus (unit: ¥)**



Source: Bloomberg, Jefferies



## Medium-Term Plan (FY3/16 – FY3/18)

FY3/18 is the last year of the current medium-term plan. OTC expects its revenue to increase in all of three segments and OP to significantly improve from -¥1.6bn to ¥6.3bn. Guided three-year total of operating cash-flow for a positive ¥28.0bn.

**Table 6: Company estimates for FY3/18 (unit: ¥bn)**

	FY3/16 Actual	FY3/18 CoE
<b>Revenue</b>	41.2	50.0
Titanium	27.9	33.0
Polycrystalline Silicon	10.9	14.0
High-Performance Material	2.4	3.0
<b>OP</b>	-1.6	6.3
Titanium	1.3	5.0
Polycrystalline Silicon	-3.3	0.3
High-Performance Material	0.4	1.0
<b>RP</b>	-2.0	6.3
<b>NP</b>	-8.8	4.0
<b>ROE</b>	-23%	10%
<b>D/E ratio</b>	1.3	0.8
<b>Payout ratio</b>	-	25-35%
<b>FX assumption (¥/\$)</b>	121	110

Source: Company Data

**Titanium business.** For the next several years, OTC expects demand for mill products would keep growing, mainly due to the increase in fuselage products. OTC aims for sales growth that exceeds market growth rate. To respond the increasing demand, the company plans to expand production capacity to over 40,000 tons per year by restarting out-of-service reserve reducing furnaces. Also, OTC targets ¥2.0bn of cost reduction during the period.

**Polycrystalline Silicon business.** The company focuses on comprehensive cost reduction through maintaining full utilization of functions at Kishiwada works, improving energy consumption per unit, and raising productivity. Cost reduction targets in Polycrystalline Silicon segment is ¥1.5bn.

**High-Performance Materials business.** OTC is planning to foster High-Performance Materials business as a third core business. Aims to establish a minimum cost production of TILOP.

## Company History

### Chart 83: Company history

1937	Established as Osaka Special Steel Manufacturing
1951	Commenced research into manufacture of titanium metal
1952	Built Japan's first titanium pilot plant and changed its name to Osaka Titanium Co.
1954	Completed titanium sponge plant with an initial capacity of 300t/y
1960	Started production of polycrystalline silicon
1961	Completed the magnesium chloride electrolysis plant
1967	Completed 14 silos to hold raw materials for titanium
1975	Completed 80,000 ampere electrolysis cell
1977	Completed reduction/separation furnaces (unit weight: 2 tons)
1981	Completed the titanium ingot plant
1982	Completed the new titanium sponge plant and started operation
1992	Merged with Kyushu Electronic Metal
1993	Changed the company name to Sumitomo Sitix Corporation
1996	Headquarters/Amagasaki Plant received ISO9002 certification
1999	Received ISO14001 certification
2002	Listed on the 2nd section of Tokyo Stock Exchange Received AS9000 certification
2006	Sponge titanium capacity increased to 24,000t/y from 8,000t/y
2007	Polycrystalline silicon capacity increased to 1,300t/y from 800t/y
2008	Sponge titanium capacity reached 32,000t/y Polycrystalline silicon capacity reached 1,400t/y
2009	Completed the titanium ingot plant at the Kishiwada Works Titanium ingot capacity reached 10,000t/y
2011	Polycrystalline silicon capacity reached 3,600t/y Sponge titanium capacity reached 40,000t/y
2012	Polycrystalline silicon capacity reached 3,900t/y
2013	Concentrated production at the Kishiwada Plant for the polycrystalline silicon business (annual production capacity modified to 3,000t/y)
2014	Concentrated production at the Kishiwada Plant for the titanium melting business (annual production capacity modified to 6,000t/y)

Source: Company Data

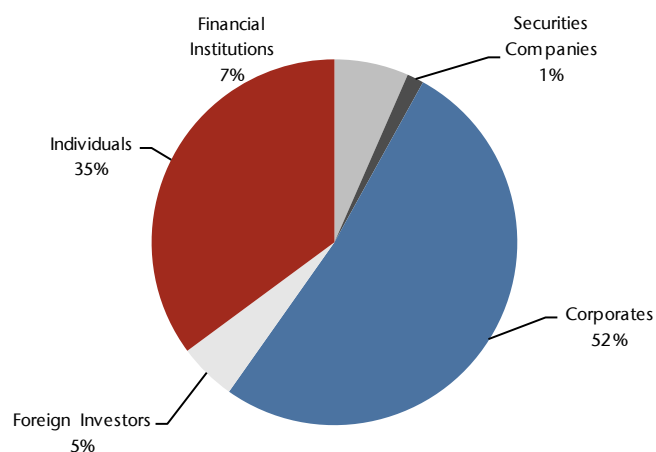
## Management

**President:** Mr. Yasuaki Sugizaki is the President and CEO. He joined Kobe Steel in April 1988 and became a Director in 2011, Managing Director and the Head of R&D in 2013, and Senior Managing Director in 2016. He joined Osaka Titanium Technologies as the President in June 2016.

**Vice President:** Mr. Takahisa Miyake is the Vice President. He joined Sumitomo Metal Industries (currently NSSMC) in April 1979, became a Director in 2008, Managing Director in 2009, and Senior Managing Director in 2012. After two years as a Head of Wakayama Works, he transferred to Osaka Titanium in June 2014. Mr. Miyake has been Vice President since June 2016.

## Shareholders

**Chart 84: Ownership Ratio**



Source: Company Data

**Chart 85: Major Shareholders**

	Number of shares ( '000 shares)	% of ownership
NIPPON STEEL & SUMITOMO METAL	8,800	23.9
Kobe Steel	8,800	23.9
Sumitomo Corporation	864	2.4
Japan Trustee Services (Trust account 5)	419	1.1
Japan Trustee Services (Trust account)	342	0.9
BNP Paribas Securities Service Luxembourg	335	0.9
The Master Trust Bank of Japan (Trust account)	315	0.9
Japan Trustee Services (Trust account 1)	303	0.8
Japan Trustee Services (Trust account 2)	302	0.8
Juniper	229	0.6
<b>Total</b>	<b>20,712</b>	<b>56.3</b>

Source: Company Data

**Chart 86: Osaka Titanium – Earnings by Segment (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Segments</b>							
<b>Sales</b>	<b>40.4</b>	<b>41.1</b>	<b>39.2</b>	<b>48.2</b>	<b>55.2</b>	<b>61.0</b>	<b>66.4</b>
<b>Titanium</b>	23.4	27.9	25.0	34.1	41.0	46.8	48.7
<b>Domestic</b>	9.4	13.2	10.2				
<b>Export</b>	14.0	14.7	14.9				
<b>Polysilicon</b>	14.7	10.8	11.8	11.8	11.8	11.8	15.3
<b>High-Performance Materials</b>	2.3	2.4	2.4	2.4	2.4	2.4	2.4
<b>OP</b>	<b>2.8</b>	<b>-1.6</b>	<b>2.1</b>	<b>3.4</b>	<b>7.9</b>	<b>10.2</b>	<b>14.2</b>
<b>Titanium</b>	1.4	1.2	2.0	3.1	7.1	9.4	12.2
<b>Polysilicon</b>	1.0	-3.3	-0.7	-0.2	0.3	0.3	1.5
<b>High-Performance Materials</b>	0.3	0.4	0.7	0.5	0.5	0.5	0.5
<b>OP Margin</b>	<b>6.8%</b>	<b>-4.0%</b>	<b>5.2%</b>	<b>7.0%</b>	<b>14.3%</b>	<b>16.7%</b>	<b>21.4%</b>
<b>Titanium</b>	6.1%	4.4%	8.1%	9.0%	17.2%	20.0%	25.0%
<b>Polysilicon</b>	6.8%	-30.4%	-6.1%	-1.7%	2.6%	2.6%	10.0%
<b>High-Performance Materials</b>	14.9%	17.4%	30.5%	21.0%	21.0%	21.0%	21.0%
<b>Production</b>	<b>37.4</b>	<b>38.1</b>	<b>46.7</b>				
<b>Titanium</b>	20.5	23.2	32.5	26.7	40.5	46.4	48.3
<b>Polysilicon</b>	14.5	12.2	11.8				
<b>High-Performance Materials</b>	2.3	2.7	2.5				
<b>Cost Breakdown</b>							
<b>Production Cost</b>	<b>30.5</b>	<b>36.5</b>	<b>35.4</b>				
<b>Raw Materials</b>	7.1	10.5	12.0				
<b>Labor Cost</b>	4.6	4.8	5.1				
<b>Other Costs</b>	18.9	20.2	18.6				
<b>Outside Contracts</b>	0.9	1.3	1.5				
<b>Electricity Cost</b>	7.5	8.7	8.7				
<b>Depreciation</b>	5.5	4.9	3.8				
<b>Inventory G/L</b>	2.4	1.0	-4.1				
<b>Inventories at Beginning</b>	14.6	12.2	11.1	15.2			
<b>Inventories at End</b>	12.2	11.1	15.2	7.10			
<b>Titanium Price (¥k/ton)</b>	1,184	1,189	974	1,050	1,150	1,250	1,300
<b>Production (ton)</b>	19,059	27,308	36,655	28,000	38,700	40,850	40,850
<b>Sales (ton)</b>	21,128	28,178	32,439	35,683	39,251	41,214	41,214
<b>Capacity</b>	40,000	40,000	40,000	40,000	43,000	43,000	43,000
<b>Utilization Rate</b>	48%	68%	92%	70%	90%	95%	95%
<b>Sponge Production</b>							
<b>Annual</b>							
<b>OP/ton</b>	67,115	43,899	62,857	85,909	180,008	227,273	295,455
<b>Per Ton cost analysis</b>							
<b>Production Cost</b>	1,602,352	1,337,714	965,022				
<b>Raw Materials</b>	372,058	386,044	326,203				
<b>Labor Cost</b>	240,728	175,225	138,616				
<b>Outside Contracts</b>	49,636	46,910	41,440				
<b>Electricity Cost</b>	393,150	319,396	236,638				
<b>Depreciation</b>	291,151	180,278	104,378				
<b>Inventory G/L</b>	128,497	37,901	(112,017)				
<b>Inventories at Beginning</b>	766,572	445,770	303,314				
<b>Inventories at End</b>	638,705	407,137	413,803				

Source: Company Data, Jefferies Estimates

**Chart 87: Osaka Titanium – P/L (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Net Sales</b>	40.36	41.15	39.18	48.20	55.18	60.97	66.38
<b>YoY (%)</b>	-5.9%	2.0%	-4.8%	23.0%	14.5%	10.5%	8.9%
<b>Cost of Sales</b>	32.99	37.57	31.27	38.98	41.45	44.95	46.31
<b>YoY (%)</b>	-9.7%	13.9%	-16.8%	24.7%	6.3%	8.4%	3.0%
<b>Gross Profit</b>	7.37	3.58	7.91	9.23	13.73	16.03	20.07
<b>SG&amp;A</b>	4.60	5.23	5.86	5.86	5.86	5.86	5.86
<b>Operating Income</b>	2.76	-1.64	2.05	3.37	7.87	10.17	14.21
<b>Non-operating Income</b>	1.07	0.30	0.41	0.41	0.41	0.41	0.41
<b>Interest and Dividends Income</b>	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<b>Rent income</b>	0.05	0.04	0.05	0.05	0.05	0.05	0.05
<b>Foreign exchange gains</b>	0.40	0.00	0.00	0.00	0.00	0.00	0.00
<b>Others</b>	0.62	0.25	0.36	0.36	0.36	0.36	0.36
<b>Non-operating Expenses</b>	0.34	0.71	1.24	0.61	0.60	0.59	0.58
<b>Interest Expenses</b>	0.28	0.21	0.21	0.20	0.19	0.18	0.17
<b>Foreign exchange losses</b>	0.00	0.00	0.62	0.00	0.00	0.00	0.00
<b>Other</b>	0.06	0.50	0.41	0.41	0.41	0.41	0.41
<b>Recurring Profits</b>	3.50	-2.06	1.23	3.17	7.68	9.99	14.04
<b>RP Margin</b>	8.7%	-5.0%	3.1%	6.6%	13.9%	16.4%	21.1%
<b>Extraordinary Income</b>	1.20	0.00	0.00	0.00	0.00	0.00	0.00
<b>Extraordinary Loss</b>	0.60	9.65	0.32	0.50	0.50	0.50	0.50
<b>Loss on Retirement of Noncurrent Assets</b>	0.28	0.14	0.32				
<b>Others</b>	0.32	9.52	0.00				
<b>Net Income before Taxes</b>	4.09	-11.71	0.90	2.67	7.18	9.49	13.54
<b>Taxes</b>	1.43	-2.87	0.32	0.83	2.23	2.94	4.20
<b>Corporate tax, residential tax</b>	0.39	0.07	0.01				
<b>Tax adjustment</b>	1.03	-2.94	0.31				
<b>Net Income</b>	2.67	-8.84	0.58	1.84	4.95	6.55	9.34
<b># of Shares (ex. Treasury)</b>	36.80	36.80	36.80	36.80	36.80	36.80	36.80
<b>EPS</b>	¥72.47	-¥240.25	¥15.76	¥50.07	¥134.61	¥177.93	¥253.82
<b>Diluted EPS</b>							
<b>BPS</b>	¥1,183.18	¥919.13	¥937.45	¥974.52	¥1,075.13	¥1,208.05	¥1,397.87
<b>Dividends</b>	¥20.00	¥0.00	¥5.00	¥13.00	¥34.00	¥45.00	¥64.00
<b>Effective Tax Rate</b>	0.35	0.25	0.36	0.31	0.31	0.31	0.31
<b>Depr. &amp; Amort.</b>	6.21	5.54	4.33	5.00	5.00	5.00	5.00
<b>EBITDA</b>	8.97	3.89	6.38	8.37	12.87	15.17	19.21
<b>EV</b>	146.5	103.1	112.9				
<b>Market Cap</b>	93.7	56.3	63.5	91.1	91.1	91.1	91.1
<b>Prefs</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Minority Interest</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total Debt</b>	49.3	44.8	47.2	45.2	43.2	41.2	39.2
<b>Cash</b>	3.5	2.0	2.2	3.5	3.7	6.0	11.8
<b>EV/EBITDA</b>	16.3	26.5	17.7	0.0	0.0	0.0	0.0
<b>Debt/Equity Ratio</b>	1.1	1.3	1.4	1.3	1.1	0.9	0.8
<b>Adjusted EPS</b>	¥72.47	-¥240.25	¥15.76	¥50.07	¥134.61	¥177.93	¥253.82
<b>Adjusted BPS</b>	¥1,183.18	¥919.13	¥937.45	¥974.52	¥1,075.13	¥1,208.05	¥1,397.87

Source: Company Data, Jefferies Estimates

**Chart 88: Osaka Titanium – B/S (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Current Assets</b>	39.36	36.27	43.32	43.16	46.96	52.77	61.97
<b>Cash</b>	3.47	2.04	2.18	3.46	3.72	5.96	11.75
<b>Receivable notes and accounts</b>	12.11	10.70	15.46	19.02	21.77	24.06	26.19
<b>Inventories</b>	22.94	22.50	24.98	19.98	20.77	22.05	23.32
<b>Merchandise and Finished Goods</b>	12.17	11.12	15.17	12.13	13.89	15.35	16.71
<b>Raw Materials and Supplies</b>	5.25	4.06	4.22	3.38	2.12	1.54	1.30
<b>Work in Process</b>	5.51	7.32	5.59	4.47	4.76	5.16	5.31
<b>Advance Payments</b>	0.01						
<b>Prepaid Expenses</b>	0.10						
<b>Deferred Tax Assets</b>	0.70						
<b>Other</b>	0.04	1.03	0.71	0.71	0.71	0.71	0.71
<b>Allowance for Doubtful</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Noncurrent Assets</b>	63.04	52.64	49.94	49.94	49.94	49.94	49.94
<b>PP&amp;E</b>	60.25	47.68	44.91	44.91	44.91	44.91	44.91
<b>Buildings</b>	14.21	12.42	11.65	11.65	11.65	11.65	11.65
<b>Machinery and Equipment</b>	28.52	19.22	17.47	17.47	17.47	17.47	17.47
<b>Land</b>	16.03	14.82	14.82	14.82	14.82	14.82	14.82
<b>Construction in Progress</b>	0.56	0.62	0.40	0.40	0.40	0.40	0.40
<b>Other</b>	0.93	0.59	0.56	0.56	0.56	0.56	0.56
<b>Intangible Assets</b>	1.13	0.73	0.57	0.57	0.57	0.57	0.57
<b>Investments and Other</b>	1.66	4.23	4.46	4.46	4.46	4.46	4.46
<b>Total Assets</b>	102.40	88.91	93.27	93.11	96.90	102.71	111.91
<b>Current Liabilities</b>	24.522	30.841	25.911	25.62	26.30	27.39	29.29
<b>Notes and accounts payable</b>	3.57	4.78	4.23	5.20	5.96	6.58	7.17
<b>Notes Payable</b>	0.24	0.41	0.35	0.43	0.49	0.54	0.59
<b>Accounts Payable</b>	3.33	4.36	3.88	4.78	5.47	6.04	6.58
<b>Short Term Loans</b>	18.04	23.79	18.2	17.20	16.20	15.20	14.20
<b>Accounts Payable-facilities</b>	0.38	0.47	0.19	0.19	0.19	0.19	0.19
<b>Income Taxes Payable</b>	0.43	0.05	0.06	0.16	0.44	0.58	0.83
<b>Other</b>	2.11	1.76	3.22	2.86	3.51	4.83	6.90
<b>Noncurrent Liabilities</b>	34.33	24.24	32.86	31.63	31.03	30.87	31.17
<b>Long-Term Loans</b>	31.29	21.00	29.00	28.00	27.00	26.00	25.00
<b>Provision for Retirement Benefits</b>	1.67	1.77	1.83	1.83	1.83	1.83	1.83
<b>Long Term Lease Obligation</b>							
<b>Other</b>	1.37	1.47	2.03	1.80	2.21	3.04	4.35
<b>Total Liabilities</b>	58.856	55.083	58.767	57.24	57.33	58.26	60.47
<b>Shareholders' Equity</b>	43.44	33.86	34.44	35.80	39.51	44.40	51.38
<b>Capital</b>	8.74	8.74	8.74	8.74	8.74	8.74	8.74
<b>Capital Surplus</b>	8.94	8.94	8.94	8.94	8.94	8.94	8.94
<b>Retained Earnings</b>	25.76	16.19	16.77	18.13	21.83	26.72	33.71
<b>Treasury stock</b>	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
<b>Valuation Adjustments</b>	0.10	-0.04	0.06	0.06	0.06	0.06	0.06
<b>Valuation difference on securities</b>	0.15	0.06	0.10	0.10	0.10	0.10	0.10
<b>Deferred G/L on hedges</b>	-0.05	-0.10	-0.04	-0.04	-0.04	-0.04	-0.04
<b>Total Net Assets</b>	43.54	33.82	34.50	35.86	39.56	44.45	51.44
<b>Liabilities &amp; Equity</b>	102.40	88.91	93.27	93.11	96.90	102.71	111.91

Source: Company Data, Jefferies Estimates

**Chart 89: Osaka Titanium – C/F (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Income before Taxes</b>	4.09	-11.71	0.90	2.67	7.18	9.49	13.54
<b>Depreciation &amp; Amortization</b>	6.21	5.54	4.33	5.00	5.00	5.00	5.00
<b>Interest and Dividends Income</b>	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
<b>Interest Expenses</b>	0.28	0.21	0.21	0.20	0.19	0.18	0.17
<b>Working capital</b>	5.45	3.04	-7.78	0.46	-4.29	-4.19	-3.99
<b>Notes &amp; Accounts Receivable (+/-)</b>	2.51	1.41	-4.76	-3.56	-2.75	-2.29	-2.13
<b>Inventories (+/-)</b>	2.50	0.44	-2.47	5.00	-0.79	-1.28	-1.27
<b>Notes &amp; Accounts Payable (+/-)</b>	0.44	1.20	-0.55	-0.97	-0.75	-0.63	-0.58
<b>Other</b>	0.79	9.01	0.43	0.43	0.43	0.43	0.43
<b>Operating Cash-Flow</b>	16.81	6.08	-1.91	8.76	8.51	10.90	15.15
<b>Capex</b>	-4.89	-2.13	-1.84	-5.00	-5.00	-5.00	-5.00
<b>Other Investment CF</b>	0.87	0.00	-0.06	0.00	0.00	0.00	0.00
<b>Investment Cash-Flow</b>	-4.02	-2.13	-1.91	-5.00	-5.00	-5.00	-5.00
<b>Free-Cash-Flow</b>	12.79	3.95	-3.81	3.76	3.51	5.90	10.15
<b>Short-Term Loans (+/-)</b>	-4.30	5.00	1.20	-1.00	-1.00	-1.00	-1.00
<b>Long-Term Loans (+/-)</b>	-5.67	-9.54	1.21	-1.00	-1.00	-1.00	-1.00
<b>Cash Dividends Paid (-)</b>	-0.37	-0.74	0.00	-0.48	-1.25	-1.66	-2.36
<b>Other</b>	0.00	0.00	1.64	0.00	0.00	0.00	0.00
<b>Financing Cash-Flow</b>	-10.34	-5.28	4.05	-2.48	-3.25	-3.66	-4.36
<b>Cash (+/-)</b>	2.54	-1.43	0.15	1.28	0.25	2.25	5.79
<b>Cash at Beginning</b>	0.93	3.47	2.04	2.18	3.46	3.72	5.96
<b>Cash at Period End</b>	3.47	2.04	2.18	3.46	3.72	5.96	11.75

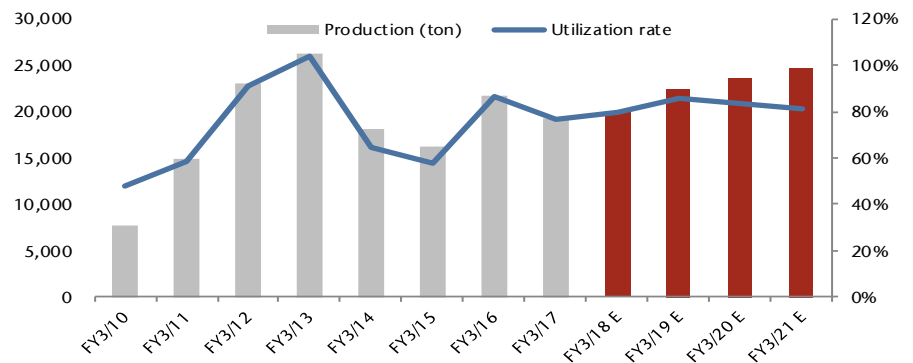
Source: Company Data, Jefferies Estimates

## Toho Titanium (5727 JP)

**We initiate coverage of Toho Titanium with a Buy rating and a ¥1,700 PT. We think that earnings are bottoming out as inventory adjustments have run their course. We expect both sales and prices to increase by double digits, and operational leverage to boost profitability. Long-term growth should come from Toho's JV in Saudi Arabia, and JV with NSSMC.**

**Expect production/sales to rise.** Toho Titanium's utilization rate is steadily increasing; from sub-60% in FY3/15, to 80%+ in FY3/16, 77% in FY3/17, and around the same in FY3/18. The company is currently lowering inventories (similar to Osaka Titanium), and sales are higher vs. production. As new orders are robust, we expect both sales/production to increase in FY3/19.

**Chart 90: Toho Titanium: production and utilization rate**

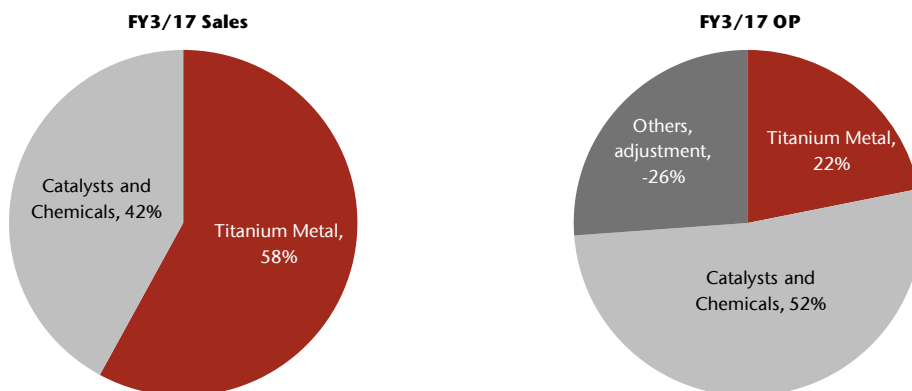


Source: Jefferies estimates

Note: We include the new Saudi project in total capacity, thus utilization rate looks flattish, but excluding it, we forecast utilization rates at the Japanese facilities to rise steadily with higher output

**About TTC.** Toho Titanium Corporation (TTC) is one of the largest global titanium metal manufacturers, based in Japan. The company operates through two business segments, Titanium Metal and Catalyst & Chemical. Titanium Metal products include titanium sponges, titanium ingots, high-purity titanium and processed titanium products. In the Catalyst & Chemical segment, the company manufactures catalysts for polypropylene production, high-purity titanium dioxide for electric materials, and ultra-fine nickel powder for multi-layer ceramic capacitors (MLCC) using materials gained in the titanium production process.

**Chart 91: FY3/17 sales and OP by segment**



Source: Company Data, Jefferies

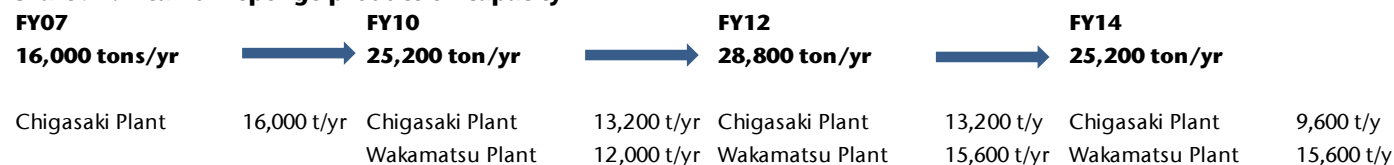


## Titanium Metal segment

**Titanium Metal business.** Main products of Titanium Metal segment are titanium sponge and titanium ingot. Toho applies its own in-house technology to produce titanium sponge. A major feature of Toho's method is vacuum distillation, which effectively removes magnesium and magnesium chloride contained in the titanium sponge. This method allows production of high-quality titanium sponge. Toho exports titanium sponge mainly for aircraft materials and has a solid track record and reputation. The company also manufactures titanium ingot using electron beam (EB) melting furnaces or a vacuum consumable arc re-melting (VAR) furnaces. Ingots can be provided in various product types depending on customer requirements including square shaped DC Slab®, EB ingots, or round shaped VAR ingots. Titanium tetrachloride is an intermediate raw material for titanium products and is used in many fields. It is used, for example, as a catalyst for manufacturing macromolecule chemical products such as polyethylene resin, as a raw material for pearl pigment, and as a vapor agent for certain tools. Titanium Metal products further include high-purity titanium used for sputtering targets for forming semiconductor films, and titanium powder and fabricated titanium products.

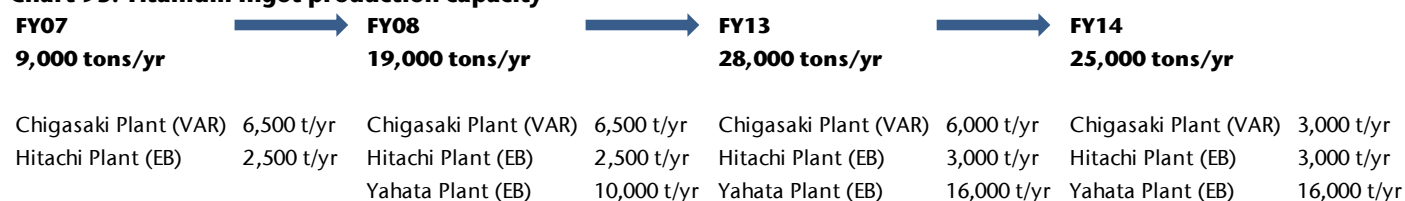
**Production ramp-up caused D&A ballooning, this is over now.** Toho ramped up production capacity anticipating higher demand for titanium sponge and ingots. The company built the Wakamatsu Plant, more than doubling titanium sponge capacity, and the Yahata Plant where it operates EB furnaces. At the same time, it is now reducing capacity at the Chigasaki Plant as equipment is fairly old, and same for VAR furnaces.

**Chart 92: Titanium sponge production capacity**



Source: Company Data, Jefferies

**Chart 93: Titanium Ingot production capacity**

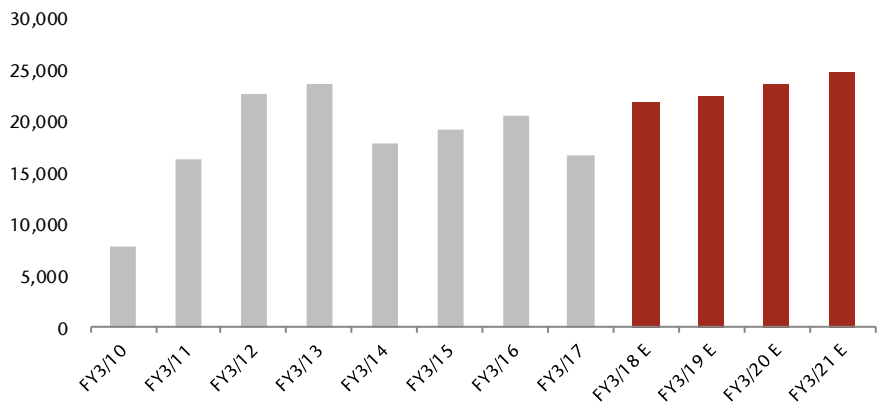


Source: Company Data, Jefferies

**Volumes declined on inventory adjustments.** With higher capacity, Toho and the other titanium makers were shipping record high quantities in FY11-12. This led to a massive inventory build-up and as about 80-90% of the titanium would come out as scrap during the forging process, scrap prices fell as well.

There has been an order cancellation in FY3/17 in order to adjust inventories at the customer's side – this order is now coming back with a vengeance

**Chart 94: Sales volumes to resume upward trend (unit: tons)**

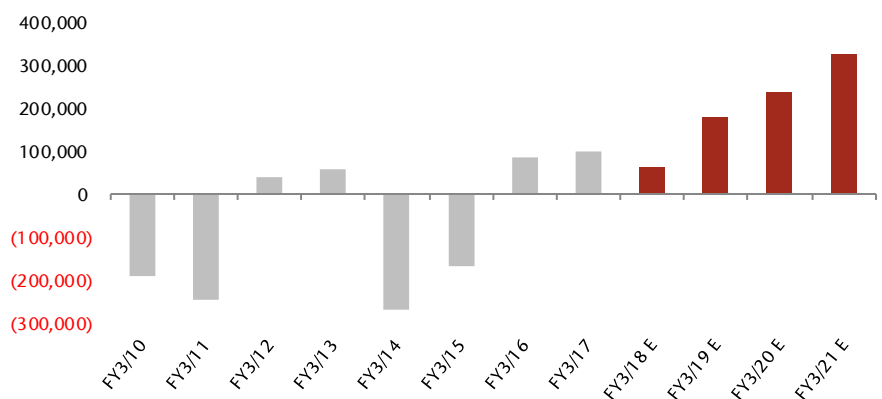


Source: Company Data, Jefferies Estimates

A double whammy created a perfect storm for titanium and both volumes and prices declined. As input prices, such as raw materials and electricity costs in Japan is creeping up, margins were squeezed and Toho was losing around ¥350k/ton in FY14 while they made close to a million Yen per ton back in FY07.

We expect margin/ton steadily increasing

**Chart 95: OP/ton (unit: ¥)**



Source: Jefferies estimates

## Catalysts and Chemical segment

**Catalysts business.** Toho mainly manufactures Toho High-Efficiency Catalyst (THC) for producing “polypropylene” (PP). The company’s advantage is in utilizing self-sufficient titanium tetrachloride as a starting raw material to produce THC catalyst, which is recognized as an industry standard for its performance and quality consistency.

**THC** is a Mg-Ti based high performance catalyst constituting a catalyst system together with alkylaluminium and external donors to polymerize propylene monomer to polypropylene. In response to expectations for improved mechanical properties and processability of polypropylene ever increasing year by year, the catalyst has a major role to answer to the needs of industries. Requirements for catalyst characteristics varies depending polypropylenes processes and polypropylene grades produced. THC catalysts serve to wide range of needs and expectations from customers. THC catalyst is an unrivaled catalyst for propylene polymerization developed by unique chemical immobilization of electron donors and control of morphology and porous geometry of catalyst, which are important to realize polymerization activity and stereoregularity

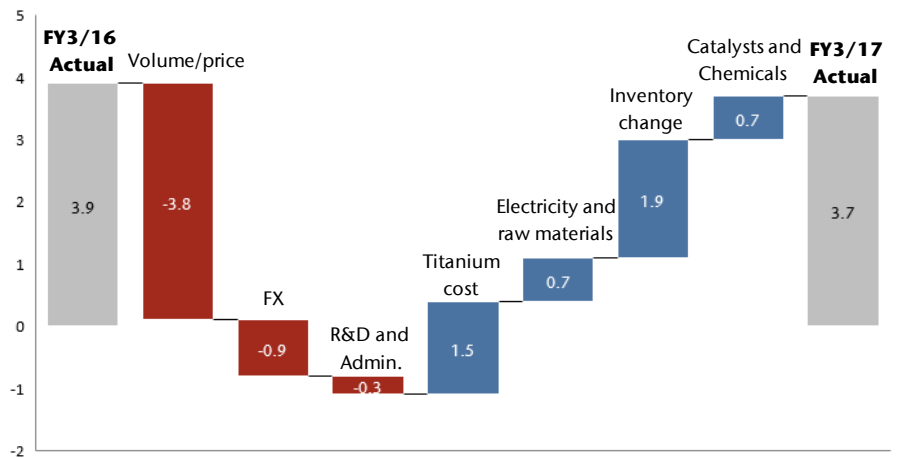
control. THC catalyst is capable of producing PP grades with high stiffness and high impact resistance, particularly used for an automotive application such as bumper, instrument panels, engine compartments, and console boxes. Its high polymerization activity improves the economy even for producing general purpose PP grades.

**Functional Chemicals business.** Toho manufactures high-purity titanium dioxide, ultra-fine nickel powder and other materials which are used in electronics, such as multi-layered ceramic capacitors, PTC thermistors and dielectric resonators. High-purity titanium dioxide is one of the main products in this business. It is produced by a gas phase reaction of titanium tetrachloride and oxygen. Ultra-fine nickel powder, another major product in this business, is manufactured by applying material reduction and powder processing technologies.

**Applications.** High-purity titanium dioxide is used in a broad range of products such as multi-layered ceramic capacitors, PTC thermistors (thermally sensitive resistor), dielectric filters, piezoelectric ceramics, and semiconductor capacitors. It is also widely used in pharmaceutical applications such as coating for pills and optical products such as an additive for glass manufacturing.

**Sales volumes/prices were the biggest negatives in FY3/17.** Both sales volumes and titanium prices are now rebounding. This would be a positive for FY3/18 earnings. On the other hand, titanium companies are currently selling more vs. production to adjust inventories at the producer side. Thus “inventory change” shall be a negative factor for FY3/18 profits. Without this technicality in FY3/19, earnings should naturally show earnings growth, in our view.

**Chart 96: FY3/16-17 OP and factors impacting earnings (unit: ¥bn)**

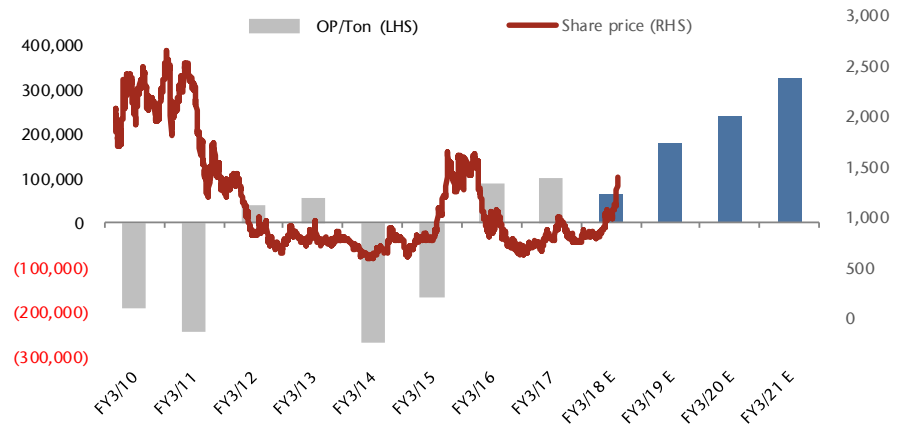


Source: Company Data

**Stocks follow earnings.** As historically stock prices follow 1Y-2Y forward earnings, we think that the bottoming out and improving earnings should trigger share prices to move as well. Obviously, we need to confirm this trend with Toho, and we’d revisit our stance after we have a clearer picture on 1) inventory adjustment trends, 2) the pricing and demand situation, and 3) cost-cutting efforts and their progress.

## Stock Price Analysis

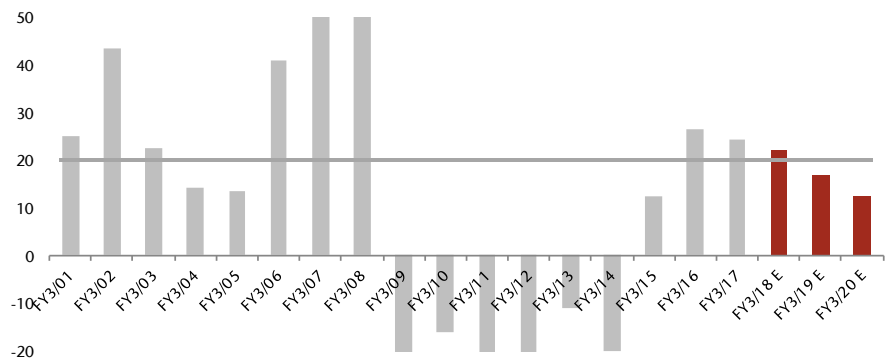
**Chart 97: Stocks are pricing in two-year forward expected earnings (OP/Ton vs. share price, unit: ¥)**



Source: Jefferies estimates

**Stock price: avg. 20x P/E.** Toho has been loss-making or barely profitable in the last six years, but when it made positive profits, the share price trades on average 20x+ forward EPS. We set our PT at ¥1,700 based on 20x FY3/20 EPS.

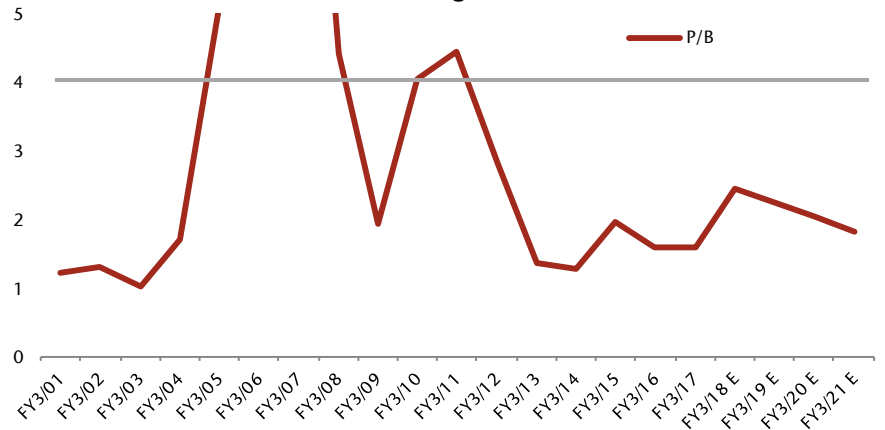
**Chart 98: P/E ratio – 1yr forward EPS vs avg. annual share price**



Source: Jefferies estimates

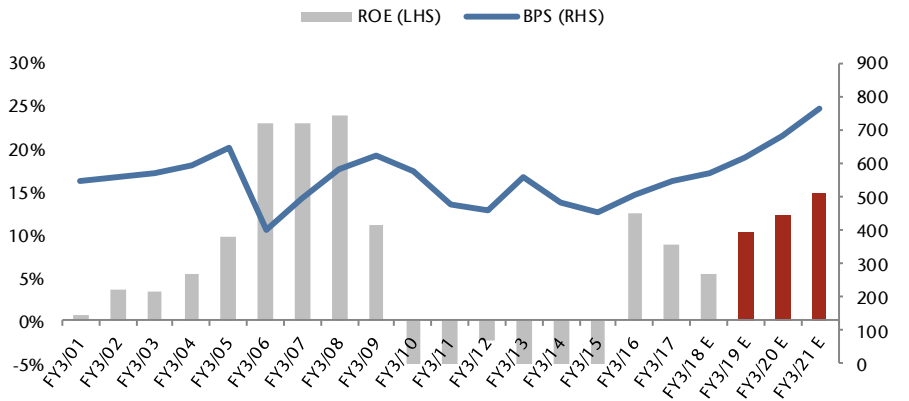
**P/B vs. ROE: 4.0x avg. P/B.** For the last decade and a half, Toho traded on average at a 4.0x P/B multiple, in the range between 1.0x and a whopping 20.9x. The stock is now trading at 2.4x, at the lower end of the range as earnings were in the red for the last six years.

**Chart 99: P/B ratio – Toho traded on avg. 4.0x P/B over the last decade**



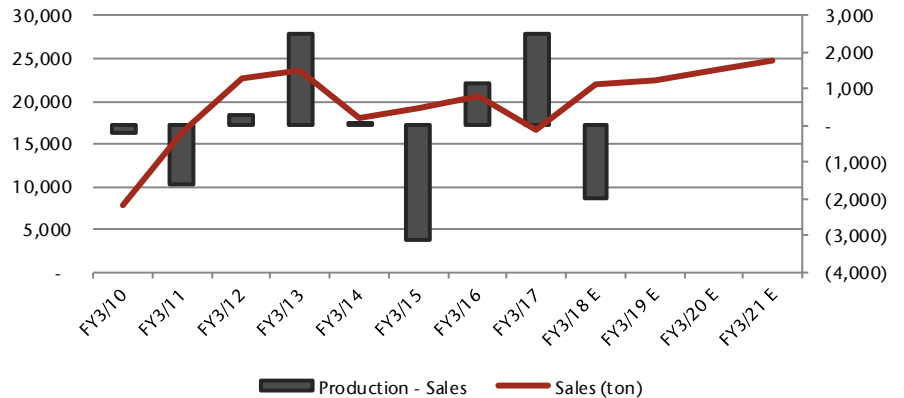
Source: Jefferies estimates

**Chart 100: BPS vs. ROE – double-digit ROE is a norm in titanium when profitable**



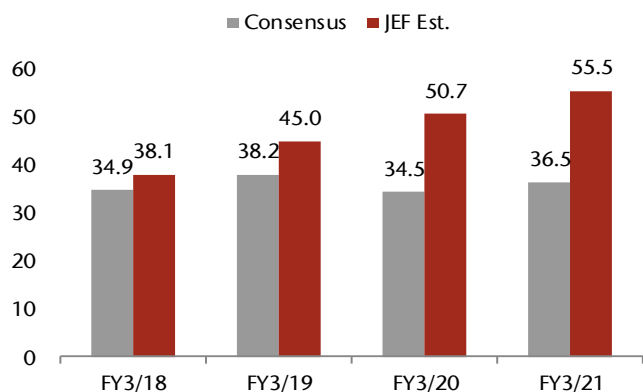
Source: Jefferies estimates

**Chart 101: In FY3/18, Toho Titanium is selling more vs. it produces to adjust inventories. This should end and both production and sales will likely increase in FY3/19 (unit: tons)**



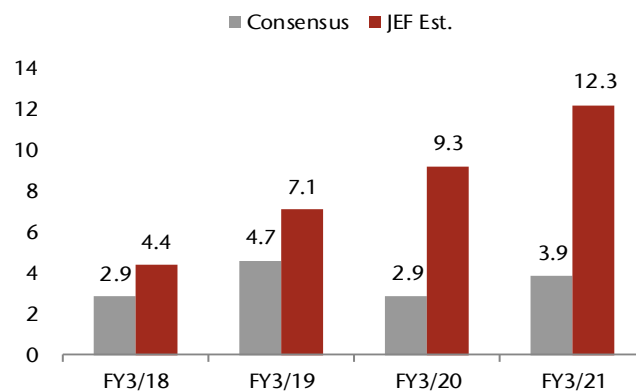
Source: Jefferies estimates

**Chart 102: Toho Titanium – revenue estimates vs consensus (unit: ¥bn)**



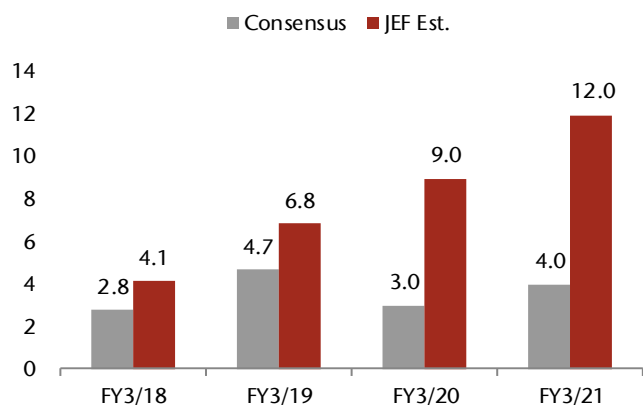
Source: Bloomberg, Jefferies

**Chart 105: Toho Titanium – OP estimates vs consensus (unit: ¥bn)**



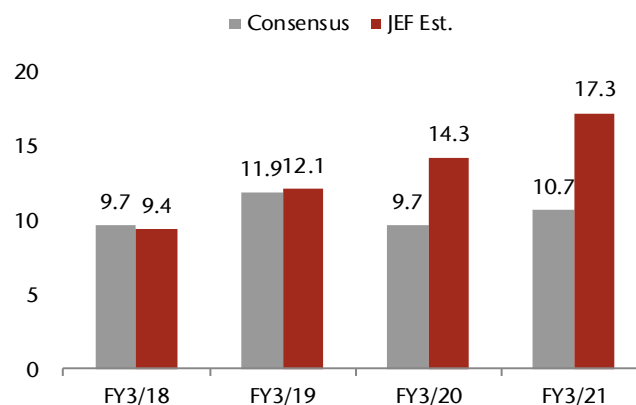
Source: Bloomberg, Jefferies

**Chart 103: Toho Titanium – RP estimates vs consensus (unit: ¥bn)**



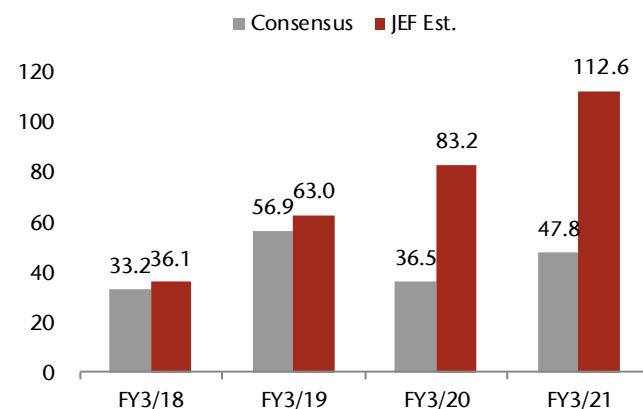
Source: Bloomberg, Jefferies

**Chart 106: Toho Titanium – EBITDA estimates vs consensus (unit: ¥bn)**



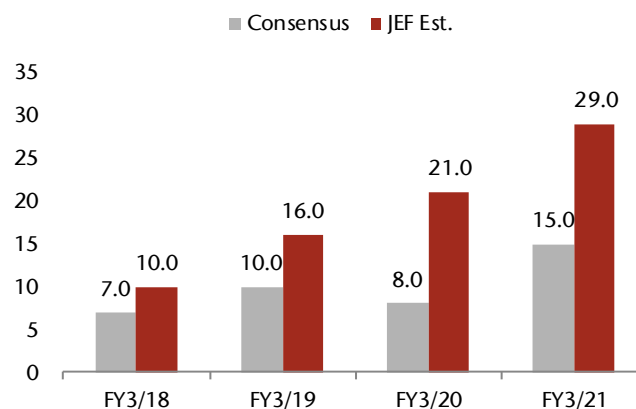
Source: Bloomberg, Jefferies

**Chart 104: Toho Titanium – EPS estimates vs consensus (unit: ¥)**



Source: Bloomberg, Jefferies

**Chart 107: Toho Titanium – DPS estimates vs consensus (unit: ¥)**



Source: Bloomberg, Jefferies

## Medium and Long-Term Plan

The current fiscal year is the first year of the medium-term plan period (FY3/18 to FY3/20). Main issues include cost reduction, allocation of management resources, development of new products, and reinforcement of R&D.

**ROE: 10% or more.** Toho aims to improve ROE to 10% or more by FY3/22 as a long-term goal. The company guides four approaches to achieve the target: earnings, growth, financial health, and human resources.

**Table 7: Four approaches to achieve the goal**

Approaches	Targets
Earnings	ROS: over 10%
Growth	Revenue growth: over 10%
Financial Health	D/E ratio: less than 1.0
Human Resources	Increase of personnel in R&D and work style reforms

Source: Company Data

**Table 8: Company estimates for FY3/20 (unit: ¥bn, %)**

	FY3/17 Actual	FY3/18 CoE	FY3/20 CoE	FY3/22 Target
FX rates (¥/\$)	108.8	110.0	110.0	-
Revenue	31.2	34.0	44.5	-
OP	3.7	2.4	6.0	-
RP	3.9	2.3	5.9	-
NP	3.4	2.1	5.1	-
ROE	9.0%	5.2%	10.5%	Over 10%
ROS	12.4%	6.8%	13.3%	Over 10%
Revenue growth	-28.0%	9.0%	14.4%	Over 10%
			(FY3/18-20)	
D/E ratio	0.98	0.89	0.50	Less than 1.0

Source: Company Data

**Table 9: Company estimates for FY3/20 by segment (unit: ¥bn)**

	FY3/17 Actual	FY3/18 CoE	FY3/20 CoE
<b>Revenue</b>	31.2	34.0	44.5
Titanium Metal	18.1	19.7	27.5
Catalysts and Chemicals	13.1	14.3	17.0
<b>OP</b>	3.7	2.4	6.0
Titanium Metal	1.7	0.9	3.4
Catalysts and Chemicals	4.0	4.1	5.4
Other adjustments	-2.0	-2.6	-2.8

Source: Company Data

**¥15bn of CAPEX.** The company plans to use ¥6.5bn in investments for growth strategies such as process improvement of titanium production, new nickel powder plant, debottlenecking and expansion of the existing catalyst plants, R&D, etc. Remaining ¥8.5bn will be used for maintenance, repairs, replacements, etc.

**Titanium Metal segment.** Toho establishes an optimal titanium sponge production system with three plants, Wakatmatsu Plant, Chigasaki Plant, and Saudi Arabia Plant which was completed in May 2017. Toho's sponge production capacity will be expanded to 30,600 tons per year when Saudi Arabia Plant starts operations. Start-up of commercial operations of Saudi Arabia Plant, which is previously scheduled around March 2018, is delayed due to later-than-expected commencement of TiCl<sub>4</sub> supply to the new plant.

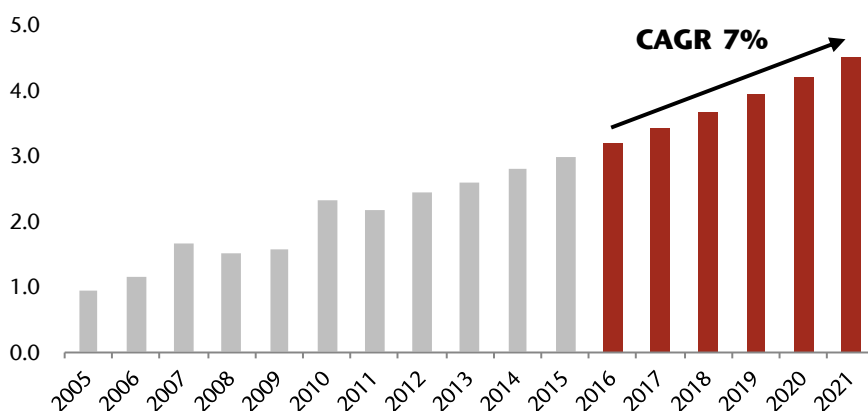
**Chart 108: Outline of Joint Venture in Saudi Arabia**

Company name	Advanced Metal Industries Cluster and Toho Titanium Metal
Headquarters	Yanbu, Saudi Arabia
Incorporation	February 29, 2016
Shareholders	Toho Titanium Co. 35.0% Advanced Metal Industries Cluster 65.0%
Production capacity	Titanium sponge 15,600 t/y
Schedule	Started construction in May 2015 Construction completed in May 2017 Planned start-up of commercial operation in 2018

Source: Company Data

**Catalysts and Chemical.** Toho estimates that demand for multilayer ceramic capacitors (MLCC) keeps growing with CAGR of 7% by CY2021. In order to meet growing demand of the market, Toho is working on expansion of the capacity of nickel power, a raw material for MLCC. Production capacity is expected to increase by 30 tons per month.

**Chart 109: MLCC production estimates (unit: trillion pieces)**



Source: Company Data

**Chart 110: Outline of new nickel power plant**

Location	Wakamatsu Plant (Kitakyushu, Fukuoka)
Production capacity	30 t/m (existing capacity at Chigasaki Plan is 60 t/m)
Schedule	Completed in December 2017 Scheduled to start operation in February 2018
CAPEX	¥3.2bn

Source: Company Data



## Company History

### Chart 111: Company history

1953	Established by Nippon Mining (40%), Mitsui & Co (20%), and etc.
1954	Began titanium sponge production with an initial capacity of 240t/y
1955	Went public with over-the-counter transactions on the Tokyo Stock Exchange
1960	Began titanium ingot production with an initial capacity of 120t/y
1961	Listed on the Second Section of the Tokyo Stock Exchange
1965	Facility built for production of trichloride titanium catalyst with an initial procurement
1980	Sponge production capacity reached 12,000t/y
1985	Ingot production capacity reached 7,800t/y
1989	Production capacity for high-purity titanium dioxide reached 2,040t/y ISO 14001 certified (all departments at Chigasaki Plant)
1998	Electron beam furnace for titanium ingot (Hitachi Plant) completed with an initial capacity of 2,640t/y Established Toho Catalyst Kurobe
1999	ISO 9001 certified Production facility for ultra-fine nickel powder production completed (24t/y)
2000	Toho Catalyst Kurobe changed its name to Toho Catalyst
2003	Sponge production capacity reached 13,000t/y
2005	Sponge production capacity reached 15,000t/y
2006	Transferred from the 2nd section to the 1st section of Tokyo Stock Exchange
2007	Sponge production capacity reached 16,000t/y Merged with Toho Catalyst
2008	Electron beam furnace for titanium ingot (Yahata Plant) completed with an initial capacity of 10,000t/y
2010	Sponge production capacity reached 26,400t/y Wakamatsu sponge plant started operations in April
2011	Mass-production of direct-cast titanium slab (DC Slab) begun
2012	Sponge production capacity reached 28,800t/y Expansion of titanium sponge capacity in Wakamatsu Plant completed
2013	Titanium sponge manufactured at Wakamatsu Plant obtained certification of aerospace
2014	Eb2 furnace completed at Yahata Plant Taking shares of Nittetsu Sumikin Naoetsu Titanium (NSSMC 66%, Toho Titanium 34%)
2016	Established Advanced Metal Industries Cluster and Toho Titanium Metal Company in Saudi Arabia (Advanced Metal Industries Cluster Company 65%, Toho Titanium 35%)

Source: Company Data

## Management

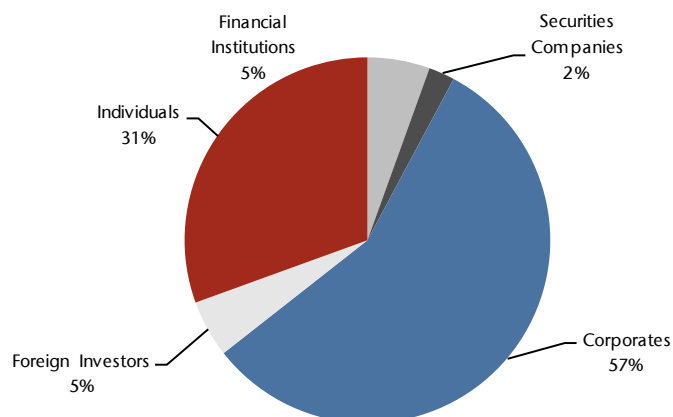
**President:** Mr. Yoshihiro Nishiyama is the President and CEO. He joined Nippon Mining (currently JX Nippon Mining & Metal) in April 1978, became a Director in 2008, and Managing Director in 2013. He joined Toho Titanium as the President in June 2017.

**Vice President:** Mr. Tomoyuki Urabe is the Vice President. He joined The Industrial Bank of Japan in April 1976 and transferred to Nippon Mining & Metal in 2000. Mr. Urabe became a Director in 2009, and Managing Director in 2010. He joined Toho Titanium in 2013 and has been the Vice President Since June 2015.

**Vice President:** Mr. Hideo Takatori is the Vice President and the Head of Titanium Department. He joined Nippon Mining in April 1983 and transferred to Toho Titanium in 2002. He became a Director in 2010, Managing Director in 2014, and has been the Vice President since June 2017.

## Shareholders

**Chart 112: Ownership Ratio**



Source: Company Data

**Chart 113: Major Shareholders**

	Number of shares ( '000 shares)	% of ownership
JX Holding, Inc.	35,859	50.3
NIPPON STEEL & SUMITOMO METAL	3,500	4.9
Japan Trustee Services (Trust account 5)	650	0.9
Japan Trustee Services (Trust account)	576	0.8
Chase Manhattan Bank GTS Clients Account	569	0.8
Japan Trustee Services (Trust account 2)	543	0.8
The Master Trust Bank of Japan (Trust accour	543	0.8
Japan Trustee Services (Trust account 1)	501	0.7
Daiwa Securities Co.	359	0.5
JP Morgan Chase Bank 385151	314	0.4
<b>Total</b>	<b>43,418</b>	<b>60.9</b>

Source: Company Data

**Chart 114: Toho Titanium – Earnings by Segment (unit: ¥bn)**

	<b>FY3/15</b>	<b>FY3/16</b>	<b>FY3/17</b>	<b>FY3/18</b>	<b>FY3/19</b>	<b>FY3/20</b>	<b>FY3/21</b>
	<b>A</b>	<b>A</b>	<b>A</b>	<b>E</b>	<b>E</b>	<b>E</b>	<b>E</b>
<b>Segments</b>							
<b>Sales</b>	<b>33.7</b>	<b>43.4</b>	<b>31.2</b>	<b>38.1</b>	<b>45.0</b>	<b>50.7</b>	<b>55.5</b>
Titanium Metal	22.8	30.6	18.1	23.3	28.8	32.8	35.8
Catalysts and Chemicals	11.8	13.8	13.1	14.8	16.3	17.9	19.7
<b>OP</b>	<b>-2.6</b>	<b>3.9</b>	<b>3.7</b>	<b>4.4</b>	<b>7.1</b>	<b>9.3</b>	<b>12.3</b>
Titanium Metal	-3.2	1.8	1.7	1.9	4.1	5.7	8.1
Catalysts and Chemicals	2.3	3.8	4.1	4.9	5.4	5.9	6.5
Other	-1.7	-1.8	-2.0	-2.3	-2.3	-2.3	-2.3
<b>Depreciation</b>	<b>6.8</b>	<b>6.0</b>	<b>5.5</b>				
Titanium Metal	5.2	4.7	4.4				
Catalysts and Chemicals	1.3	1.3	1.1				
<b>OP Margin</b>	<b>-7.8%</b>	<b>9.0%</b>	<b>11.9%</b>	<b>11.6%</b>	<b>15.8%</b>	<b>18.3%</b>	<b>22.1%</b>
Titanium Metal	-14.1%	5.9%	9.4%	8.0%	14.2%	17.3%	22.6%
Catalysts and Chemicals	19.8%	27.9%	30.9%	33.0%	33.0%	33.0%	33.0%
<b>Production</b>	<b>29.8</b>	<b>41.5</b>	<b>34.3</b>				
Titanium Metal	19.1	28.8	20.8				
Catalysts and Chemicals	10.7	12.7	13.5				
<b>Sales/ton</b>							
<b>Spread between Ingot and Sponge</b>				1.08	1.10	1.09	1.04
<b>Sponge Price (k¥/ton)</b>	1,184	1,189	974	1,050	1,150	1,250	1,300
<b>Production (ton)</b>	16,170	21,777	19,238	20,000	22,500	23,625	24,806
<b>Sales (ton)</b>	19,288	20,618	16,718	22,000	22,500	23,625	24,806
<b>Capacity</b>	28,000	25,200	25,200	25,200	26,200	28,200	30,660
<b>Utilization rate</b>	58%	86%	76%	79%	86%	84%	81%
<b>Production - Sales</b>	(3,119)	1,159	2,519	(2,000)	-	-	-

Source: Company Data, Jefferies Estimates

**Chart 115: Toho Titanium – Consolidated P/L (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Net Sales</b>	<b>33.7</b>	<b>43.4</b>	<b>31.2</b>	<b>38.1</b>	<b>45.0</b>	<b>50.7</b>	<b>55.5</b>
YoY (%)	10.8%	28.8%	-28.1%	22.2%	18.1%	12.6%	9.5%
<b>Cost of Sales</b>	<b>31.7</b>	<b>34.8</b>	<b>22.5</b>	<b>28.7</b>	<b>32.9</b>	<b>36.4</b>	<b>38.3</b>
YoY (%)	5.8%	9.8%	-35.1%	27.3%	14.6%	10.8%	5.0%
<b>Gross Profit</b>	<b>2.0</b>	<b>8.7</b>	<b>8.7</b>	<b>9.5</b>	<b>12.2</b>	<b>14.3</b>	<b>17.3</b>
<b>SG&amp;A</b>	<b>4.7</b>	<b>4.8</b>	<b>4.9</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>
<b>Operating Income</b>	<b>-2.6</b>	<b>3.9</b>	<b>3.7</b>	<b>4.4</b>	<b>7.1</b>	<b>9.3</b>	<b>12.3</b>
<b>Non-operating Income</b>	<b>0.5</b>	<b>0.1</b>	<b>0.6</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
Interest on Securities	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dividends Income	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earnings of Affiliates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.5	0.1	0.6	0.1	0.1	0.1	0.1
<b>Non-operating Expenses</b>	<b>0.5</b>	<b>0.5</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>
Interest Expenses	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Other	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<b>Recurring Profits</b>	<b>-2.6</b>	<b>3.5</b>	<b>3.9</b>	<b>4.1</b>	<b>6.8</b>	<b>9.0</b>	<b>12.0</b>
<b>Extraordinary Income</b>	<b>0.6</b>	<b>1.6</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Extraordinary Loss</b>	<b>0.6</b>	<b>1.6</b>	<b>0.1</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>
<b>Net Income before Taxes</b>	<b>-2.6</b>	<b>3.5</b>	<b>3.8</b>	<b>3.6</b>	<b>6.3</b>	<b>8.5</b>	<b>11.5</b>
<b>Income Taxes</b>	<b>0.1</b>	<b>-0.7</b>	<b>0.5</b>	<b>1.0</b>	<b>1.8</b>	<b>2.5</b>	<b>3.4</b>
<b>Minority Interests</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Net Income</b>	<b>-2.6</b>	<b>4.2</b>	<b>3.4</b>	<b>2.6</b>	<b>4.5</b>	<b>5.9</b>	<b>8.0</b>
<b># of Shares (ex. Treasury)</b>	<b>71.2</b>	<b>71.2</b>	<b>71.2</b>	<b>71.2</b>	<b>71.2</b>	<b>71.2</b>	<b>71.2</b>
<b>EPS</b>	<b>-¥37.00</b>	<b>¥60.27</b>	<b>¥47.32</b>	<b>¥36.06</b>	<b>¥62.97</b>	<b>¥83.23</b>	<b>¥112.60</b>
<b>Diluted EPS</b>							
<b>BPS</b>	<b>¥450.91</b>	<b>¥506.83</b>	<b>¥548.44</b>	<b>¥574.48</b>	<b>¥621.45</b>	<b>¥683.67</b>	<b>¥767.28</b>
<b>Dividends</b>	<b>¥0.00</b>	<b>¥7.00</b>	<b>¥7.00</b>	<b>¥10.00</b>	<b>¥16.00</b>	<b>¥21.00</b>	<b>¥29.00</b>
<b>Effective Tax Rate</b>	<b>-2.2%</b>	<b>-20.8%</b>	<b>12.0%</b>	<b>29.0%</b>	<b>29.0%</b>	<b>30.0%</b>	<b>30.0%</b>
<b>Depr. &amp; Amort.</b>	<b>6.8</b>	<b>6.0</b>	<b>5.5</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>
<b>EBITDA</b>	<b>4.2</b>	<b>9.9</b>	<b>9.3</b>	<b>9.4</b>	<b>12.1</b>	<b>14.3</b>	<b>17.3</b>
<b>EV</b>	<b>104.9</b>	<b>92.0</b>	<b>93.5</b>	<b>130.4</b>	<b>131.9</b>	<b>130.7</b>	<b>123.8</b>
<b>Market Cap</b>	<b>62.9</b>	<b>57.7</b>	<b>62.0</b>	<b>99.0</b>	<b>99.0</b>	<b>99.0</b>	<b>99.0</b>
<b>Prefs</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Minority Interest</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
<b>Total Debt</b>	<b>44.2</b>	<b>35.4</b>	<b>33.0</b>	<b>32.5</b>	<b>33.5</b>	<b>33.5</b>	<b>32.5</b>
<b>Cash</b>	<b>2.4</b>	<b>1.2</b>	<b>1.6</b>	<b>1.2</b>	<b>0.7</b>	<b>1.9</b>	<b>7.8</b>
<b>EV/EBITDA</b>	<b>25.2</b>	<b>9.3</b>	<b>10.1</b>	<b>13.8</b>	<b>10.9</b>	<b>9.2</b>	<b>7.2</b>
<b>Debt/Equity Ratio</b>	<b>1.4</b>	<b>1.0</b>	<b>0.8</b>	<b>0.8</b>	<b>0.8</b>	<b>0.7</b>	<b>0.6</b>

Source: Company Data, Jefferies Estimates

**Chart 116: Toho Titanium – Consolidated B/S (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Current Assets</b>	32.9	29.2	33.1	33.9	35.8	41.5	51.1
<b>Cash</b>	2.4	1.2	1.6	1.2	0.7	1.9	7.8
<b>Accounts Receivable</b>	4.9	5.1	4.9	5.9	7.0	7.9	8.7
<b>Inventories</b>	23.0	19.6	23.4	23.8	28.1	31.7	34.7
<b>Finished Goods</b>	13.2	11.0	14.6	14.8	17.5	19.7	21.6
<b>Semi-Finished Goods</b>	4.8	4.4	4.3	4.8	5.6	6.3	6.9
<b>Raw Materials</b>	5.0	4.2	4.5	4.2	4.9	5.6	6.1
<b>Other Current Assets</b>	2.6	3.2	3.2	2.9	0.0	0.0	0.0
<b>Allowance for Doubtful</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Noncurrent Assets</b>	55.6	53.9	50.3	50.3	50.3	50.3	47.8
<b>PP&amp;E</b>	54.7	48.2	44.1	44.1	44.1	44.1	41.6
<b>Buildings</b>	15.2	14.4	13.6	13.6	13.6	13.6	12.8
<b>Equipment</b>	29.7	25.3	22.1	22.1	22.1	22.1	20.9
<b>Intangible Assets</b>	0.4	0.3	0.3	0.3	0.3	0.3	0.3
<b>Investments and other</b>	0.6	5.4	5.9	5.9	5.9	5.9	5.9
<b>Securities</b>	0.2	4.8	5.2	5.2	5.2	5.2	5.2
<b>Investment Securities</b>	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<b>Stocks of Subs, Affiliates</b>	0.1	4.8	5.2	5.2	5.2	5.2	5.2
<b>Other Investments</b>	2.9	0.6	0.7	0.7	0.7	0.7	0.7
<b>Allowance for Doubtful</b>	-2.5	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total Assets</b>	88.5	83.0	83.4	84.2	86.1	91.8	99.0
<b>Current Liabilities</b>	35.7	24.5	24.8	24.2	23.5	24.2	25.2
<b>Accounts Payable</b>	1.7	1.6	1.6	2.0	2.4	2.7	2.9
<b>Short-Term Loans</b>	30.8	19.5	19.3	18.8	18.8	18.8	18.8
<b>Bonds</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Other</b>	3.2	3.4	3.8	3.4	2.3	2.7	3.4
<b>Noncurrent Liabilities</b>	20.6	22.3	19.5	18.9	18.2	18.8	18.9
<b>Bonds Payable</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Long-Term Loans</b>	13.4	16.0	13.7	13.7	14.7	14.7	13.7
<b>Other</b>	7.2	6.4	5.8	5.2	3.5	4.1	5.3
<b>Total Liabilities</b>	56.3	46.8	44.3	43.1	41.6	42.9	44.1
<b>Shareholders' Equity</b>	31.6	35.9	38.9	40.7	44.1	48.5	54.4
<b>Capital</b>	25.0	25.0	25.0	25.0	25.0	25.0	25.0
<b>Retained Earnings</b>	6.7	11.0	14.0	15.8	19.2	23.6	29.5
<b>Treasury Stock</b>	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
<b>Valuation Adjustments</b>	0.5	0.2	0.2	0.2	0.2	0.2	0.2
<b>Minority Interests</b>	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<b>Total Net Assets</b>	32.2	36.2	39.2	41.0	44.4	48.8	54.7
<b>Liabilities &amp; Equity</b>	88.5	83.0	83.4	84.1	86.0	91.7	98.8

Source: Company Data, Jefferies Estimates

**Chart 117: Toho Titanium – Consolidated C/F (unit: ¥bn)**

	FY3/15	FY3/16	FY3/17	FY3/18	FY3/19	FY3/20	FY3/21
	A	A	A	E	E	E	E
<b>Income before Taxes</b>	-2.6	3.5	3.8	3.6	6.3	8.5	11.5
<b>Depreciation &amp; Amortization</b>	6.8	6.0	5.5	5.0	5.0	5.0	5.0
<b>Interest and Dividends Income</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Interest Expenses</b>	0.4	0.4	0.3	0.3	0.3	0.3	0.3
<b>Notes &amp; Accounts Receivable (+/-)</b>	0.6	-0.3	0.3	-1.1	-1.1	-0.9	-0.8
<b>Inventories (+/-)</b>	2.5	3.4	-3.8	-0.4	-4.3	-3.6	-3.0
<b>Notes &amp; Accounts Payable (+/-)</b>	1.3	-0.1	0.0	-0.4	-0.4	-0.3	-0.3
<b>Other</b>	-1.3	0.1	0.1	0.1	0.1	0.1	0.1
<b>Operating Cash-Flow</b>	7.8	12.9	6.2	7.2	6.0	9.1	12.8
<b>Capex</b>	-9.8	-0.9	-1.1	-5.0	-5.0	-5.0	-2.5
<b>Other Investment CF</b>	8.7	-3.1	-0.4	-0.4	-0.4	-0.4	-0.4
<b>Investment Cash-Flow</b>	-1.1	-4.0	-1.4	-5.4	-5.4	-5.4	-2.9
<b>Free-Cash-Flow</b>	6.7	9.0	4.8	1.8	0.6	3.7	10.0
<b>Short-Term Loans (+/-)</b>	-6.6	-6.6	2.8	-0.5	0.0	0.0	0.0
<b>Long-Term Loans Payable (+/-)</b>	-0.5	-2.2	-5.2	0.0	1.0	0.0	-1.0
<b>Cash Dividends Paid (-)</b>	0.0	0.0	-0.4	-0.7	-1.1	-1.5	-2.1
<b>Other</b>	0.6	-1.3	-1.2	-1.0	-1.0	-1.0	-1.0
<b>Financing Cash-Flow</b>	-6.4	-10.1	-4.0	-2.2	-1.1	-2.5	-4.1
<b>Cash (+/-)</b>	-0.2	-1.1	0.4	-0.4	-0.6	1.2	5.9
<b>Cash at Beginning</b>	2.5	2.4	1.2	1.6	1.2	0.7	1.9
<b>Cash at Period End</b>	2.4	1.2	1.6	1.2	0.7	1.9	7.8

Source: Company Data, Jefferies Estimates

**Scenarios**
**Base Case**

- Titanium sponge prices at ¥1,050/kg in FY3/18, ¥1,150 (FY3/19), ¥1,250 (FY3/20), ¥1,300 (FY3/21)
- Production at 28.0kt in FY3/18, 38.0k (FY3/19), 40.8k (FY3/20), 40.8k (FY3/21)
- Sales at 36.0kt in FY3/18, 39.0kt (FY3/19), 40.8kt (FY3/20), 40.8kt (FY3/21)
- JEF's FX assumption at ¥110/\$
- 20x P/E multiple FY3/20 EPS, ROE: 15.6%; PBR: 2.8x; Target Price: ¥3,400

**Upside Scenario**

- Macroeconomic outlook improves
- China continues environmental regulations
- S/D for titanium sponge tighten with aerospace demand accelerating
- Polycrystalline silicon prices increase
- 25x P/E multiple FY3/20 EPS, ROE: 20.0%; PBR: 3.5x; Target Price: ¥5,000

**Downside Scenario**

- Chinese hard-landing, European debt issues deteriorate, demand for steel weakens
- Oil prices rise rapidly, soaring electricity prices
- Nikkei average below ¥18,000
- Competition among titanium producers (Japan, Russia, Kazakhstan) intensifies
- 15x P/E multiple FY3/20 EPS, ROE: 10.0%; PBR: 2.5x; Target Price: ¥2,000

**Investment Thesis / Where We Differ**

Jefferies is the first and only foreign broker covering Japanese titanium names.

First broker calling for the end of inventory adjustments, price increase

**Catalysts**

- Titanium pricing
- Aircraft orders, deliveries
- Sponge titanium shipments
- Polysilicon prices
- Crude oil prices
- Raw material prices
- Currency exchange

**Long Term Analysis**
**Long Term Financial Model Drivers**

<b>LT Earnings CAGR</b>	<b>10.0%</b>
Organic Revenue Growth	<b>5.0%</b>
Acquisition Contribution	<b>0.0%</b>
Operating Margin Expansion	<b>5.0%</b>

**Industrials**

Initiating Coverage

23 January 2018

**Toho Titanium (5727 JP)****Buy: ¥1,700 Price Target****Scenarios****Base Case**

- Titanium sponge prices at ¥1,050/kg in FY3/18, ¥1,150 (FY3/19), ¥1,250 (FY3/20), ¥1,300 (FY3/21)
- Production at 20.0kt in FY3/18, 22.5k (FY3/19), 23.5k (FY3/20), 24.5k (FY3/21)
- Sales at 22.0kt in FY3/18, 22.5kt (FY3/19), 23.5kt (FY3/20), 24.5kt (FY3/21)
- JEF's FX assumption at ¥110/\$
- 20x P/E multiple FY3/20 EPS, ROE: 12.8%; PBR: 2.5x; Target Price: ¥1,700

**Upside Scenario**

- Macroeconomic outlook improves
- China continues environmental regulations
- S/D for titanium sponge tighten with aerospace demand accelerating
- Functional material demand rallying with MLCC demand up
- 25x P/E multiple FY3/20 EPS, ROE: 16.0%; PBR: 3.5x; Target Price: ¥2,300

**Downside Scenario**

- Chinese hard-landing, European debt issues deteriorate, demand for steel weakens
- Oil prices rise rapidly, soaring electricity prices
- Nikkei average below ¥18,000
- Competition among titanium producers (Japan, Russia, Kazakhstan) intensify
- 15x P/E multiple FY3/20 EPS, ROE: 9.0%; PBR: 1.6x; Target Price: ¥1,100

**Investment Thesis / Where We Differ**

Jefferies is the first and only foreign broker covering Japanese titanium names.

First broker calling for the end of inventory adjustments, price increase

**Catalysts**

- Aircraft orders, deliveries
- Titanium pricing
- Sponge titanium shipments
- Electronics material prices
- Crude oil prices
- Raw material prices
- Currency exchange

**Long Term Analysis****Long Term Financial Model Drivers**

<b>LT Earnings CAGR</b>	<b>10.0%</b>
Organic Revenue Growth	<b>5.0%</b>
Acquisition Contribution	<b>0.0%</b>
Operating Margin Expansion	<b>5.0%</b>



## Company Description

OSAKA is the largest producer of titanium sponges in Japan. Operating in three business segments, it mainly manufactures and sells titanium sponges, titanium ingots, and others. The Polysilicon segment produces semiconductor-grade polysilicon. The Functional Material segment is involved in functional titanium and silicon products.

Toho is one of the largest titanium metals manufacturers in Japan, operating through two business segments, the metallic titanium segment and functional chemicals segment. Metallic titanium products include titanium sponges, titanium ingots, high-purity titanium and processed titanium products. The functional chemicals segment is engaged in the manufacture and sale of catalyst for propylene polymerization.

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## Investment Recommendation Record

### (Article 3(1)e and Article 7 of MAR)

Recommendation Published , 00:59 ET. January 23, 2018  
Recommendation Distributed , 01:00 ET. January 23, 2018

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Buy - Describes securities that we expect to provide a total return (price appreciation plus yield) of 15% or more within a 12-month period.

Hold - Describes securities that we expect to provide a total return (price appreciation plus yield) of plus 15% or minus 10% within a 12-month period.

Underperform - Describes securities that we expect to provide a total return (price appreciation plus yield) of minus 10% or less within a 12-month period.

The expected total return (price appreciation plus yield) for Buy rated securities with an average security price consistently below \$10 is 20% or more within a 12-month period as these companies are typically more volatile than the overall stock market. For Hold rated securities with an average security price consistently below \$10, the expected total return (price appreciation plus yield) is plus or minus 20% within a 12-month period. For Underperform rated securities with an average security price consistently below \$10, the expected total return (price appreciation plus yield) is minus 20% or less within a 12-month period.

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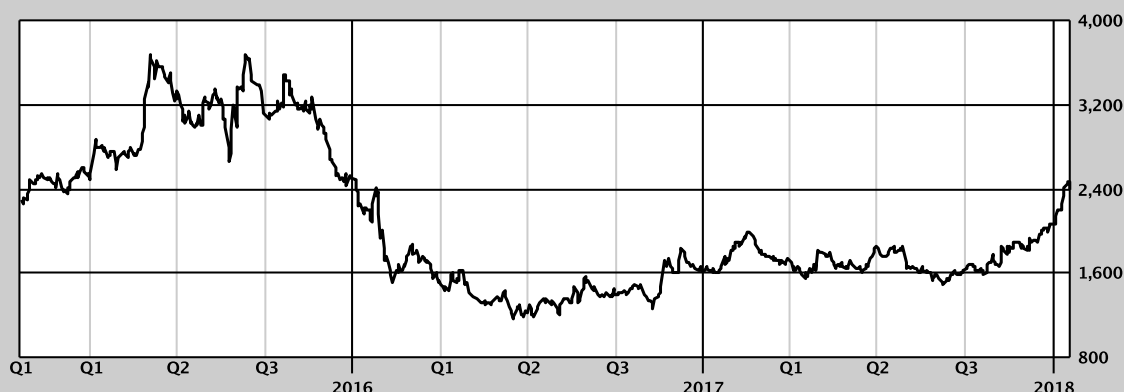
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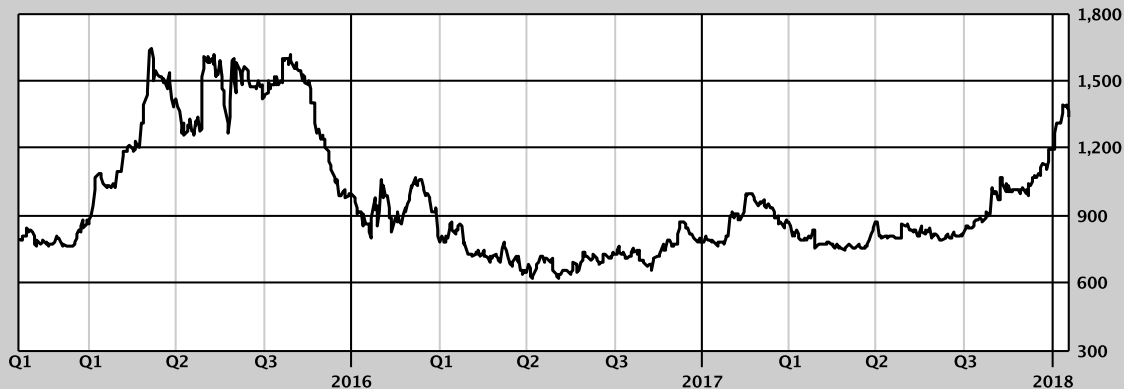
## Other Companies Mentioned in This Report

- Kobe Steel (5406 JP: ¥1,100, BUY)
- Nippon Steel & Sumitomo Metal Corporation (5401 JP: ¥2,871, UNDERPERFORM)
- OSAKA Titanium Technologies Co.,Ltd. (5726 JP: ¥2,424, BUY)
- Toho Titanium Co., Ltd. (5727 JP: ¥1,345, BUY)

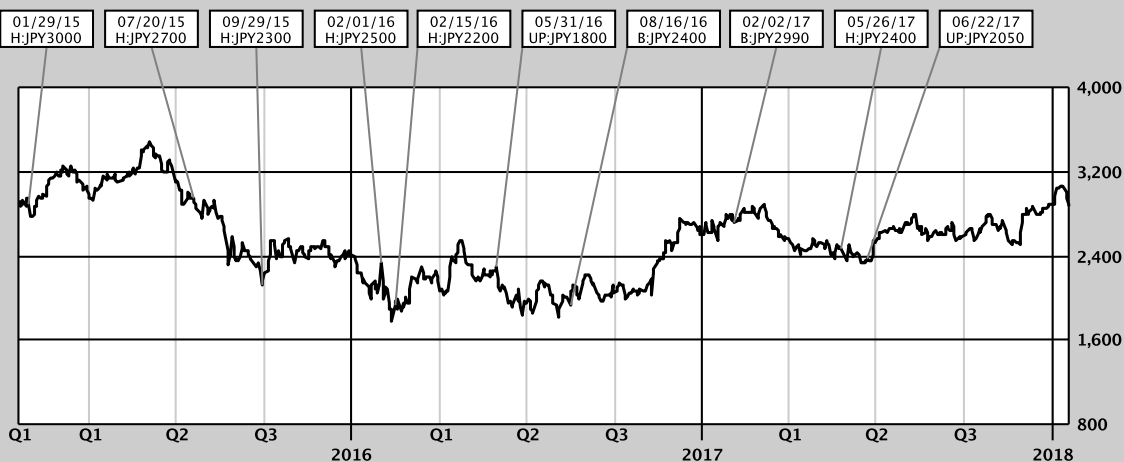
Rating and Price Target History for: OSAKA Titanium Technologies Co.,Ltd. (5726 JP) as of 01-18-2018

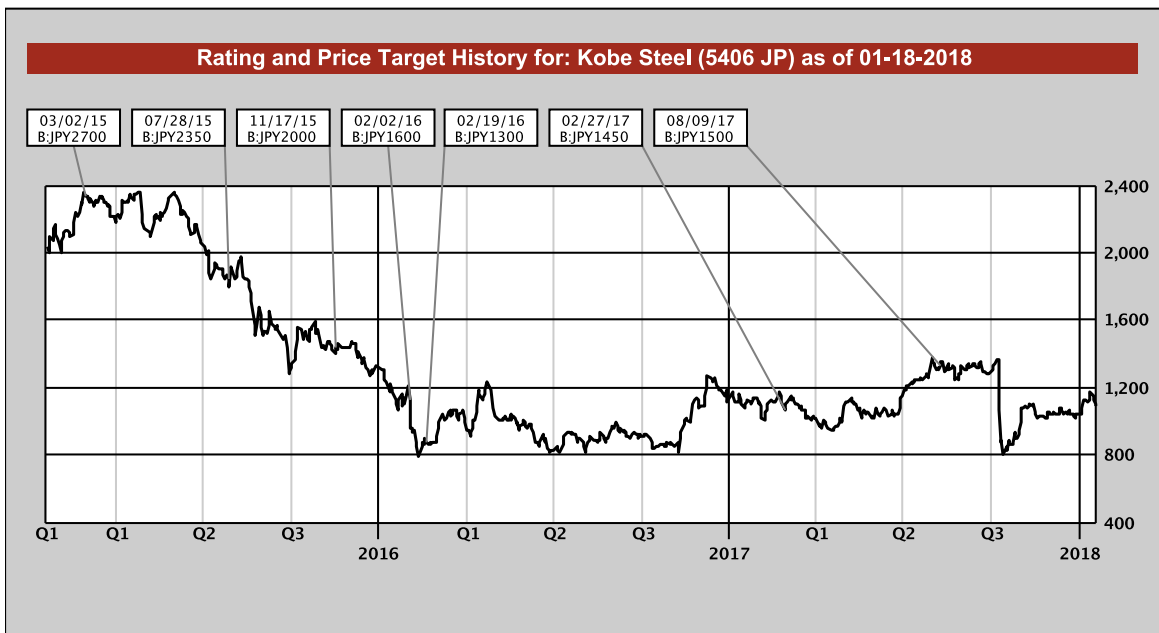


**Rating and Price Target History for: Toho Titanium Co., Ltd. (5727 JP) as of 01-18-2018**



**Rating and Price Target History for: Nippon Steel & Sumitomo Metal Corporation (5401 JP) as of 01-18-2018**





**Notes:** Each box in the Rating and Price Target History chart above represents actions over the past three years in which an analyst initiated on a company, made a change to a rating or price target of a company or discontinued coverage of a company.

Legend:

I: Initiating Coverage

D: Dropped Coverage

B: Buy

H: Hold

UP: Underperform

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Rating	Count	Percent	IB Serv./Past 12 Mos.		JIL Mkt Serv./Past 12 Mos.	
			Count	Percent	Count	Percent
<b>BUY</b>	1095	53.16%	340	31.05%	66	6.03%
<b>HOLD</b>	822	39.90%	162	19.71%	23	2.80%
<b>UNDERPERFORM</b>	143	6.94%	20	13.99%	3	2.10%

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