

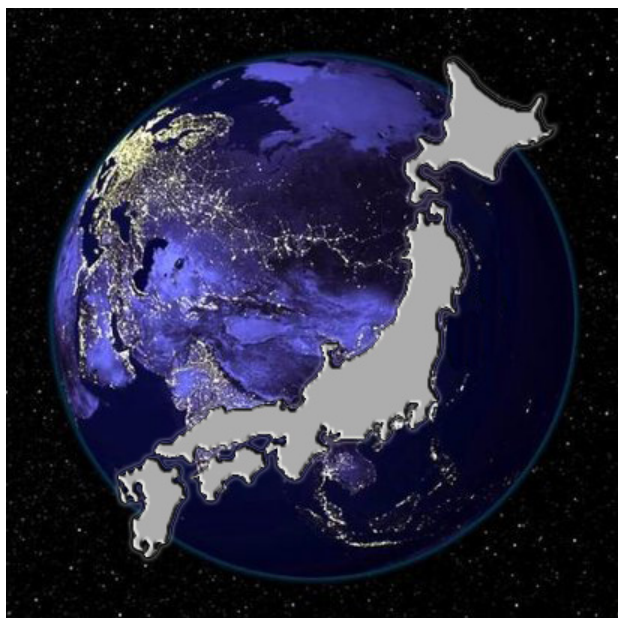
12 October 2012 | 45 pages

Textiles & Apparels (Topix) | Textiles (Citi)  
Japan

# Toray Industries (3402)

## Sticking to its knitting: Toray in a Global Context

- Many view textiles and fibers as a mature industry, and one from which many firms have withdrawn. However, Toray has persevered, generating nearly half (¥45.3bn) of its OP from this business in FY3/12, its highest level in 20 years. In this report we look in depth at the reasons for this success and its future growth potential. One key to Toray's success has been the strategy of partnering with industry leaders: Uniqlo in fibers and textiles, Boeing in carbon fiber, and Samsung Electronics in electronics and IT, and these three customers account for c30% of OP. Toray has built up a strong global platform, with c60% of production located overseas (mainly Asia) and 45% of sales now coming from outside Japan. Its superior technologies and winning relationships make Toray a potential global champion in the materials space.



### Company Update

<b>Buy</b>	<b>1</b>
Price (11 Oct 12)	¥423
Target price	¥580
Expected share price return	37.1%
Expected dividend yield	2.4%
<b>Expected total return</b>	<b>39.5%</b>
Market Cap	¥689,243M
	US\$8,799M

### Price Performance (RIC: 3402.T, BB: 3402 JP)



Consol.	Sales		OP			RP		NP		EPS	PE
	¥M	YOY (%)	¥M	YOY (%)	OPM(%)	¥M	YOY (%)	¥M	YOY (%)	¥	X
3/11A	1,539,693	13.2	100,087	149.5	6.5	98,888	998.0	57,925	nm	36	11.9
3/12A	1,588,604	3.2	107,721	7.6	6.8	109,849	11.1	64,218	10.9	39	10.7
3/13CE	1,730,000	8.9	115,000	6.8	6.6	114,000	3.8	66,000	2.8	41	10.4
3/13E	1,663,400	4.7	100,000	-7.2	6.0	101,000	-8.1	58,100	-9.5	36	11.9
3/14E	1,750,200	5.2	110,000	10.0	6.3	111,500	10.4	66,800	15.0	41	10.3
3/15E	1,821,800	4.1	121,000	10.0	6.6	122,500	9.9	73,600	10.2	45	9.4

A: Actuals, E: Citi Research Ests, CE: Co. Ests, RE: Citi Research Revised Ests, CRE: Co. Revised Ests, NA: Not Available, NM: Not Meaningful

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### See Appendix A-1 for Analyst Certification, Important Disclosures and non-US research analyst disclosures.

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3402.T: Fiscal year end 31-Mar						Price: ¥423; TP: ¥580; Market Cap: ¥689,243m; Recomm: Buy					
Profit & Loss (¥m)	2011	2012	2013E	2014E	2015E	Valuation ratios	2011	2012	2013E	2014E	2015E
Sales revenue	1,539,693	1,588,604	1,663,400	1,750,200	1,821,800	PE (x)	11.9	10.7	11.9	10.3	9.4
Cost of sales	-1,228,782	-1,261,114	-1,341,631	-1,416,431	-1,475,031	PB (x)	1.2	1.1	1.0	1.0	0.9
Gross profit	310,911	327,490	321,769	333,769	346,769	EV/EBITDA (x)	5.2	4.7	5.0	4.6	4.2
Gross Margin (%)	20.2	20.6	19.3	19.1	19.0	FCF yield (%)	10.6	0.1	-1.1	4.2	6.2
EBITDA (Adj)	170,566	175,164	171,000	183,000	193,000	Dividend yield (%)	1.8	2.4	2.4	2.8	3.3
EBITDA Margin (Adj) (%)	11.1	11.0	10.3	10.5	10.6	Payout ratio (%)	21	25	28	29	31
Depreciation	-70,479	-67,443	-71,000	-73,000	-72,000	ROE (%)	10.9	10.5	9.0	9.6	9.9
Amortisation	0	0	0	0	0	Cashflow (¥m)	2011	2012	2013E	2014E	2015E
EBIT (Adj)	100,087	107,721	100,000	110,000	121,000	EBITDA	170,566	175,164	171,000	183,000	193,000
EBIT Margin (Adj) (%)	6.5	6.8	6.0	6.3	6.6	Working capital	-17,323	-34,321	-20,940	-20,857	-17,653
Net interest	-3,637	-2,566	-3,100	-3,000	-2,800	Other	-24,029	-42,027	-42,472	-43,210	-47,410
Non-op/Except	2,438	4,694	4,100	4,500	4,300	Operating cashflow	129,214	98,816	107,588	118,933	127,937
Recurring profit	98,888	109,849	101,000	111,500	122,500	Capex	-55,942	-98,384	-115,000	-90,000	-85,000
Tax	-20,529	-33,328	-32,700	-33,800	-37,500	Net acq/disposals	0	0	0	0	0
Extraord./Min.Int./Pref.div.	-20,434	-12,303	-10,200	-10,900	-11,400	Other	5,208	28,418	8,448	10,000	10,000
Reported net profit	57,925	64,218	58,100	66,800	73,600	Investing cashflow	-50,734	-69,966	-106,552	-80,000	-75,000
Net Margin (%)	3.8	4.0	3.5	3.8	4.0	Dividends paid	-12,220	-16,294	-16,294	-19,552	-22,811
Core NPAT	57,925	64,218	58,100	66,800	73,600	Financing cashflow	-33,039	-29,991	13,991	-29,552	-42,811
Per share data	2011	2012	2013E	2014E	2015E	Net change in cash	45,441	-1,141	15,026	9,380	10,126
Reported EPS (¥)	36	39	36	41	45	Free cashflow to s/holders	73,272	432	-7,412	28,933	42,937
Core EPS (¥)	36	39	36	41	45						
EPS* (¥)	36	39	36	41	45						
DPS (¥)	8	10	10	12	14						
CFPS (¥)	79	61	66	73	79						
FCFPS (¥)	45	0	-5	18	26						
BVPS (¥)	364	385	411	440	471						
Wtd avg ord shares (m)	1,629	1,629	1,629	1,629	1,629						
Wtd avg diluted shares (m)	1,629	1,629	1,629	1,629	1,629						
Growth rates	2011	2012	2013E	2014E	2015E						
Sales revenue (%)	13.2	3.2	4.7	5.2	4.1						
EBIT (Adj) (%)	149.5	7.6	-7.2	10.0	10.0						
Core NPAT (%)	nm	10.9	-9.5	15.0	10.2						
Core EPS (%)	nm	10.9	-9.5	15.0	10.2						
Balance Sheet (¥m)	2011	2012	2013E	2014E	2015E						
Cash & cash equiv.	105,326	81,398	96,315	105,696	115,822						
Accounts receivables	283,404	283,628	296,982	312,479	325,263						
Inventory	270,009	295,745	309,670	325,829	339,158						
Net fixed & other tangibles	531,595	561,923	595,923	602,923	605,923						
Goodwill & intangibles	0	0	0	0	0						
Financial & other assets	377,136	358,807	365,000	365,000	365,000						
Total assets	1,567,470	1,581,501	1,663,890	1,711,927	1,751,166						
Accounts payable	182,184	182,071	193,695	204,495	212,955						
Short-term debt	161,895	183,004	220,000	210,000	190,000						
Long-term debt	329,472	295,961	290,000	290,000	290,000						
Provisions & other liab	252,949	246,316	245,000	245,000	245,000						
Total liabilities	926,500	907,352	948,695	949,495	937,955						
Shareholders' equity	592,923	627,398	669,195	716,432	767,211						
Minority interests	48,047	46,751	46,000	46,000	46,000						
Total equity	640,970	674,149	715,195	762,432	813,211						
Net debt	386,041	397,567	413,685	394,304	364,178						
Net debt to equity (%)	60.2	59.0	57.8	51.7	44.8						

Note: Consolidated data. \* EPS: NP/Est Shares OS.

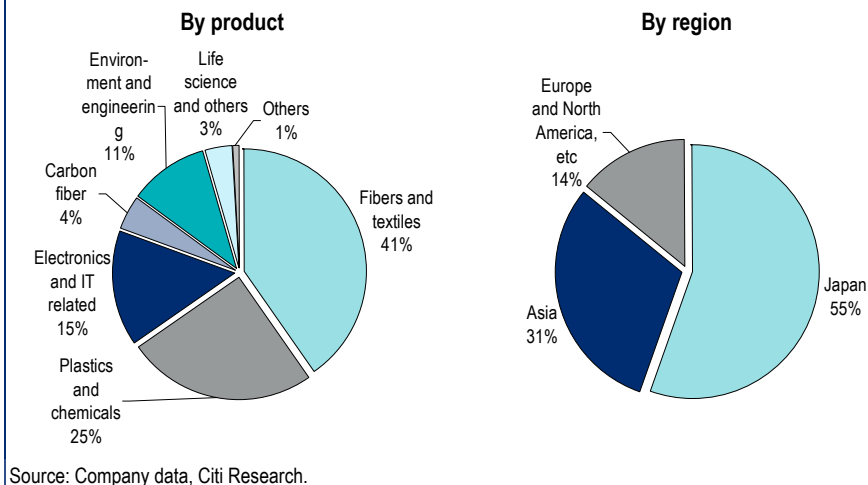
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## Toray (3402) Investment Dashboard

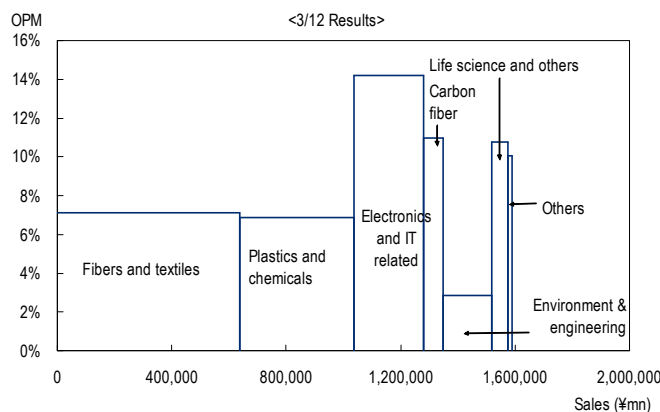
### Reasons to Buy

- Overwhelming leader in textiles and fibers. We see medium-term growth in textiles, particularly in woven and other downstream products for Uniqlo mainly
- We see carbon fiber earnings growth as Boeing 787 production moves into high gear. We also expect market share growth on the back of cost competitiveness of a new South Korean plant
- The bottoming-out of LCD materials demand creates a positive impression
- Although earnings growth looks set to continue at a high pace, the shares look markedly undervalued on a PER of 10x (FY3/14E basis), despite prospects for sustained high-paced earnings growth

### Sales breakdown (FY3/12)

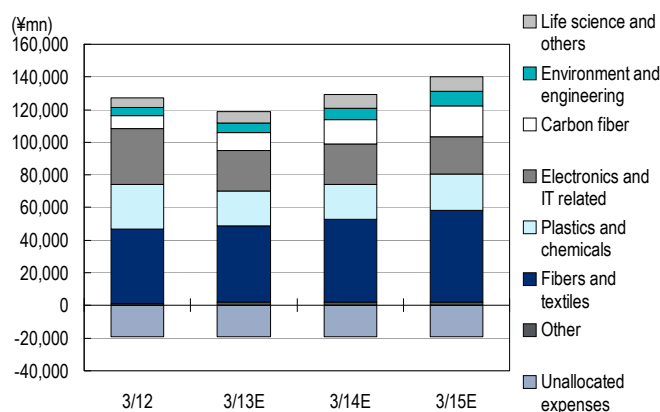


### Business portfolio



Source: Company data, Citi Research.

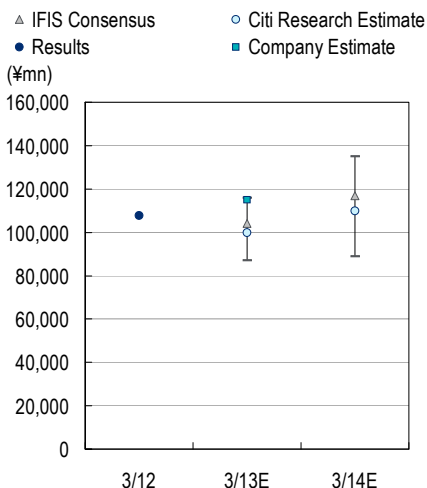
### OP by segment



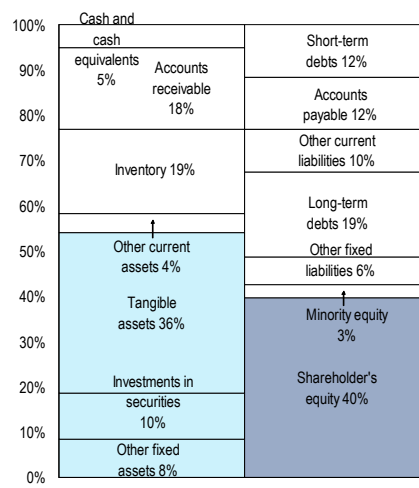
### Alternate scenario: More bullish case

- We estimate a 10% overshoot in LCD demand would boost FY3/13 OP by around ¥4bn and EPS by ¥1.6. Applying our fair value PER of 14x would suggest theoretical upside of some ¥22

### OP forecast comparison



### Balance sheet (end-FY3/12)



Share price drivers	Company description
<ul style="list-style-type: none"> <li>Carbon fiber supply/demand balance</li> <li>B787 production trends</li> <li>LCD and semiconductor cycle</li> </ul>	<p>Toray is a leading maker of advanced materials. The company has businesses in diverse fields, mainly textiles, plastics &amp; chemicals, information communication materials, and carbon fiber composites, and water treatment. Toray has the top share of the carbon fiber market and is highly competitive in the profitable market for aircraft-use carbon fiber materials.</p> <p>In the information communication materials field, Toray has high markets shares in such products as LED-use PET film, semiconductor materials, and PDP materials. Toray led its competitors in developing downstream textile operations and its earnings are thus relatively resilient to market fluctuations.</p>

## Valuation

		Rating		Price	Mkt	FY1E=	EPS		PER (x)		PBR (x)	OPM		EV/EBITDA (x)		RoE	
Code	Company				Cap		FY1E	FY2E	FY1E	FY2E	FY1E	FY1E	FY2E	FY1E	FY2E	FY1E	FY2E
Integrated chemicals					(\$ bn)												
3407.T	Asahi Kasei	1	JPY	406.00	7.3	3/13	35.1	49.4	11.6	8.2	0.8	5.4%	6.5%	2.2	1.9	6.8%	9.1%
4004.T	Showa Denko	1	JPY	114.00	2.2	12/12	10.0	15.4	11.4	7.4	0.7	5.0%	5.7%	4.8	4.1	5.8%	8.5%
4005.T	Sumitomo Chem	1	JPY	187.00	3.9	3/13	15.3	30.6	12.2	6.1	0.6	3.2%	4.1%	5.0	4.4	5.1%	9.7%
4042.T	Tosoh	2	JPY	151.00	1.2	3/13	15.0	22.6	10.0	6.7	0.5	3.0%	4.5%	5.6	4.8	5.2%	7.4%
4183.T	Mitsui Chem	2	JPY	146.00	1.9	3/13	5.0	25.0	29.3	5.9	0.4	1.7%	3.1%	5.6	4.2	1.4%	6.7%
4188.T	Mitsubishi Chem	1	JPY	279.00	5.3	3/13	16.3	38.7	17.1	7.2	0.5	3.5%	4.9%	4.9	4.0	3.1%	7.1%
4208.T	Ube	1	JPY	161.00	2.1	3/13	17.9	21.4	9.0	7.5	0.8	5.9%	6.6%	4.7	4.1	8.7%	9.7%
Electronic materials																	
3436.T	Sumco	2	JPY	511.00	1.7	1/13	-5.8	62.1	nm	8.2	0.9	5.2%	13.5%	5.3	3.8	-1.1%	9.9%
4063.T	Shin-Etsu	1	JPY	4,375.00	23.8	3/13	254.4	308.5	17.2	14.2	1.2	15.2%	17.4%	5.4	4.5	7.3%	8.4%
4185.T	JSR	1	JPY	1,235.00	3.8	3/13	105.7	118.1	11.7	10.5	1.0	9.7%	10.3%	2.8	2.3	8.8%	9.2%
4186.T	Tokyo Ohka Kogyo	2	JPY	1,580.00	0.9	3/13	128.9	131.1	12.3	12.1	0.6	11.7%	11.8%	nm	nm	4.8%	4.8%
4203.T	Sumitomo Bakelit	1	JPY	267.00	0.8	3/13	21.6	30.7	12.4	8.7	0.5	4.7%	5.9%	2.4	2.0	4.4%	6.0%
4205.T	Zeon	2	JPY	536.00	1.6	3/13	51.9	62.7	10.3	8.5	0.9	8.6%	9.8%	3.3	2.6	8.7%	9.8%
4217.T	Hitachi Chem	1	JPY	1,006.00	2.7	3/13	93.6	112.8	10.7	8.9	0.7	6.2%	7.2%	2.6	2.2	6.8%	7.8%
6988.T	Nitto Denko	1	JPY	3,455.00	7.3	3/13	304.0	331.4	11.4	10.4	1.2	10.8%	11.4%	3.4	2.9	11.1%	11.2%
Derivatives and specialty chemicals																	
3405.T	Kuraray	2	JPY	867.00	3.9	3/13	84.1	85.8	10.3	10.1	0.8	14.2%	13.3%	1.9	1.8	7.9%	7.7%
4061.T	DKK	1	JPY	233.00	1.4	3/13	25.4	29.3	9.2	7.9	0.6	6.2%	6.5%	4.1	3.6	7.0%	7.7%
4114.T	Nippon Shokubai	2	JPY	781.00	2.0	3/13	83.7	87.2	9.3	9.0	0.7	7.3%	7.4%	3.2	3.0	8.1%	7.9%
4118.T	Kaneka	2	JPY	377.00	1.6	3/13	26.7	38.6	14.1	9.8	0.5	3.8%	4.7%	2.2	1.9	3.6%	5.1%
4182.T	MGC	2	JPY	371.00	2.1	3/13	42.3	49.6	8.8	7.5	0.6	1.5%	2.0%	5.4	4.7	6.6%	7.4%
4202.T	Daicel	1	JPY	456.00	2.1	3/13	45.8	52.9	10.0	8.6	0.7	7.4%	7.9%	3.3	3.0	7.3%	8.0%
4631.T	DIC	2	JPY	129.00	1.5	3/13	19.6	24.0	6.6	5.4	1.0	5.3%	5.7%	4.4	4.0	16.5%	17.7%
Synthetic fibers																	
3401.T	Teijin	3	JPY	172.00	2.2	3/13	0.6	6.1	nm	28.2	0.6	2.0%	2.4%	4.0	3.8	0.2%	2.1%
3402.T	Toray	1	JPY	423.00	8.8	3/13	35.7	41.0	11.9	10.3	1.0	6.0%	6.3%	5.0	4.6	9.0%	9.6%
Overseas chemical majors																	
DOW.N	Dow Chem	1	USD	28.22	33.8	12/12	1.8	2.8	15.4	10.3	1.1	8.1%	9.9%	7.1	5.9	9.0%	12.9%
DD.N	DuPont	2	USD	48.78	45.4	12/12	3.9	4.4	12.6	11.0	4.3	16.9%	17.0%	6.8	6.3	38.1%	36.8%
BASFn.DE	BASF	2	EUR	64.95	76.8	12/12	5.7	5.7	11.5	11.4	2.3	11.4%	10.5%	6.3	6.5	18.1%	15.8%
WCHG.DE	Wacker Chem	2	EUR	47.74	3.2	12/12	3.0	1.9	15.8	25.4	0.9	6.7%	5.2%	5.0	5.6	5.7%	3.6%
051910.KS	LG Chem	1	KRW	313,000.00	18.6	12/12	24,543.7	34,309.2	12.8	9.1	1.9	9.1%	11.5%	7.0	5.2	15.9%	19.1%
001300.KS	Cheil Ind	1	KRW	95,800.00	4.5	12/12	5,535.8	7,120.3	17.3	13.5	1.4	6.6%	7.4%	6.8	5.3	8.6%	10.0%
011170.KS	Honam Ptrchm	2H	KRW	242,500.00	6.9	12/12	17,469.2	31,367.1	13.9	7.7	1.3	4.6%	7.4%	6.0	3.8	9.7%	15.5%
1301.TW	Formosa Plastics	2	TWD	79.60	16.6	12/12	3.9	5.9	20.6	13.6	2.0	6.4%	9.6%	nm	11.6	9.8%	14.3%
6505.TW	Formosa Petro	3	TWD	86.60	28.1	12/12	1.6	4.4	nm	19.7	3.8	1.6%	5.5%	nm	12.7	6.8%	18.0%

Note: Share prices as of the October 11  
Source: Citi Research.

## Executive summary

In this report we unravel the history that Toray has spun for itself, with a focus on fibers and textiles, the platform business, and carbon fiber, for which we anticipate substantial expansion, and discuss the company's competitive edge and future potential. We also give a brief overview of Toray's electronics, IT-related and water treatment businesses.

Over many years, Toray has been developing a twin-pronged strategy: business expansion that can maintain sustained growth and the creation of a robust corporate structure that is uninfluenced by changes in the external environment. To accomplish this, Toray has been strongly oriented to downstream development and has been focusing on teaming up with the strongest clients in the supply chain as the most critical management strategy. In practice, this has seen Toray tying up with industry leaders—Uniqlo in fibers and textiles, Boeing in carbon fiber, and Samsung Electronics in electronics and IT—and building solid win-win relationships with them.

For example, Uniqlo, by tying up with Toray, has generated a stream of hit products, such as Heattech and Ultra Light Down, helping it to maintain high growth. Moving forward, Toray expects to see substantial growth in its fibers and textiles business as Uniqlo expands its business lines. Moreover, Toray has been fielding a substantial increase in enquiries from firms inspired by the huge success of the Uniqlo business model and we forecast that it will continue to expand as the leading company in high-performance fibers.

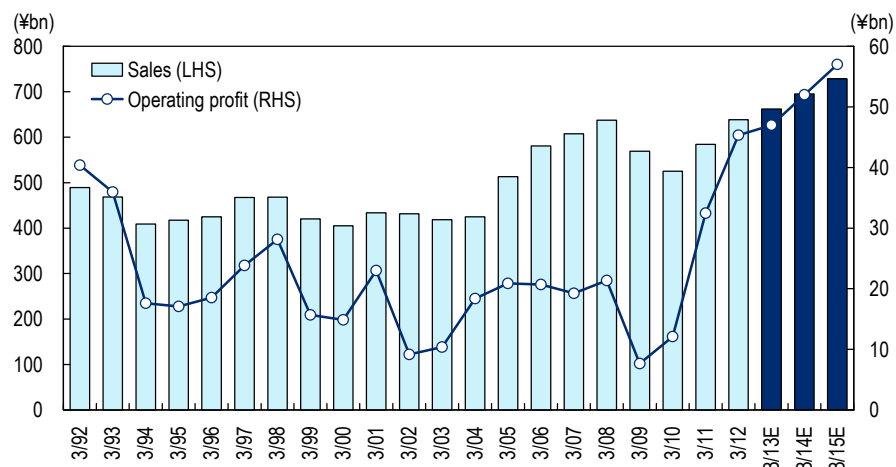
As a result, Toray has built a unique presence in textiles and fibers, where it generated an impressive ¥45.3bn in OP in FY3/12. Toray was early to take its fibers and textiles business global, moving first into Southeast Asia. Currently it has production bases across Asia, chiefly in Thailand, Indonesia, Malaysia, China, and South Korea, and its overseas production ratio has reached c60%. As well as its solid supply chain, which stretches around the whole of Asia, Toray has powerful intangible assets in the shape of the experience, know-how, and connections that it has amassed in the course of its overseas development, and we believe these will give it a major edge in its future development.

## Fibers/textiles: Stability and growth potential

A key earnings source, accounting for nearly 50% of profits

In FY3/12, Toray's fibers and textiles business posted OP of ¥45.3bn (+40%), a record level for the first time in 20 years. There have been negatives in FY3/13 like low cotton prices, but we expect Toray to record OP again at ¥47bn, with the fibers and textiles business amounting to about 47% of Toray's total FY3/13 OP. We believe the fibers and textiles businesses are number one globally in terms of both sales and OP. There appear to be a number of reasons for the rapid rise in earnings from this business, but a big factor is the success of Toray's unique business model: increasing sales of high value-added sewn products to major specialty private-brand apparel retailers, primarily Uniqlo. In the second five-year plan (starting 2011) for Toray's strategic partnership with Uniqlo, the firm set a goal of ¥400bn for material and product supply, a 70% increase over the first five-year plan. We believe material/product supply totaled about ¥80bn in FY3/11 and about ¥100bn in FY3/12, so we think Toray will beat its targets by a significant amount.

Figure 1. Toray fiber and textile business sales and OP: Earnings continue to increase

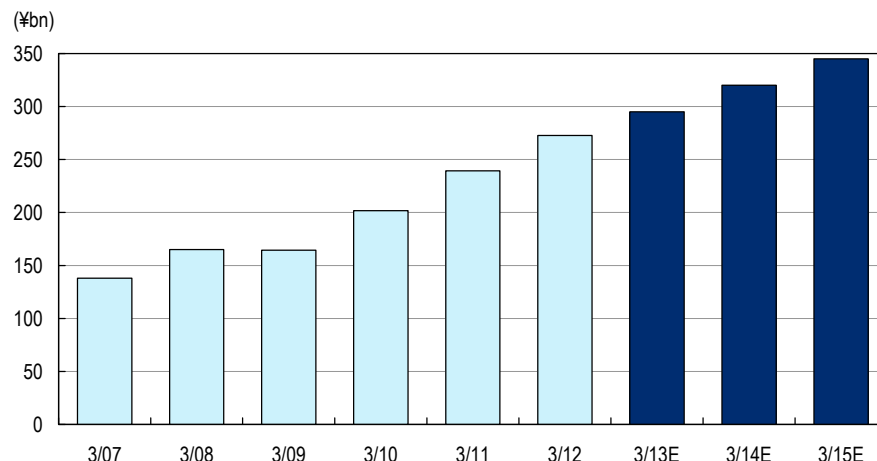


Source: Company data, Citi Research.

Toray dominates peers in overall capabilities

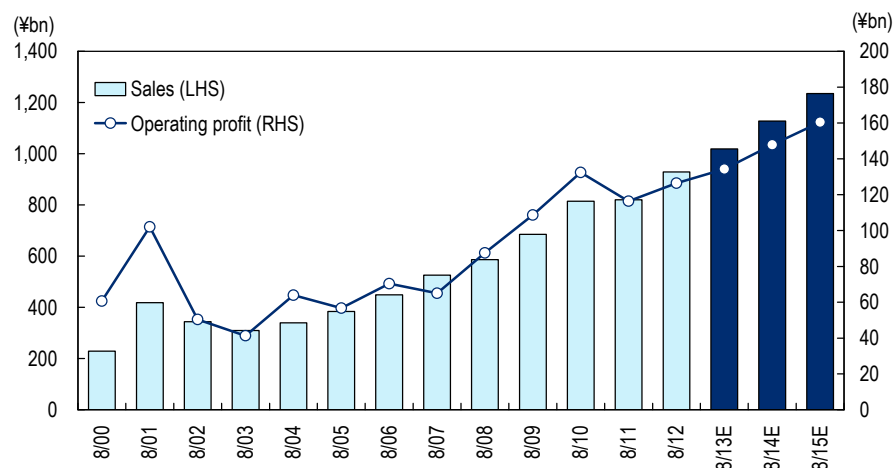
Uniqlo aims to be the number one global retailer, and it chose Toray to be its largest global partner. This was hardly by accident; rather, we feel it is the inevitable result of global expansion, relentless R&D and customer cultivation in Toray's founding business, fibers and textiles, which has gone on for more than 80 years based on the company's faith in its growth potential. In our view, there are no other synthetic fiber companies in the world with Toray's abundant product strengths, strong technological capabilities and advanced R&D system, amassed expertise, top-flight employees, global supply chain network, and high-level quality control. With competition heating up among specialty private-brand apparel retailers (SPAs) and apparel makers, we believe the need to create differentiated products whose performance appeals to consumers has increased further. As such, we expect a continued increase in customer inquiries at Toray, which is well positioned as the world's top synthetic fiber maker with comprehensive capabilities in advanced high-performance fibers.

**Figure 2. Sales of Toray's sewn products: Growth being driven by high-revenue products**



Note: Total for Toray and eight group companies.  
Source: Company data, Citi Research.

**Figure 3. Fast Retailing: Sales and OP**

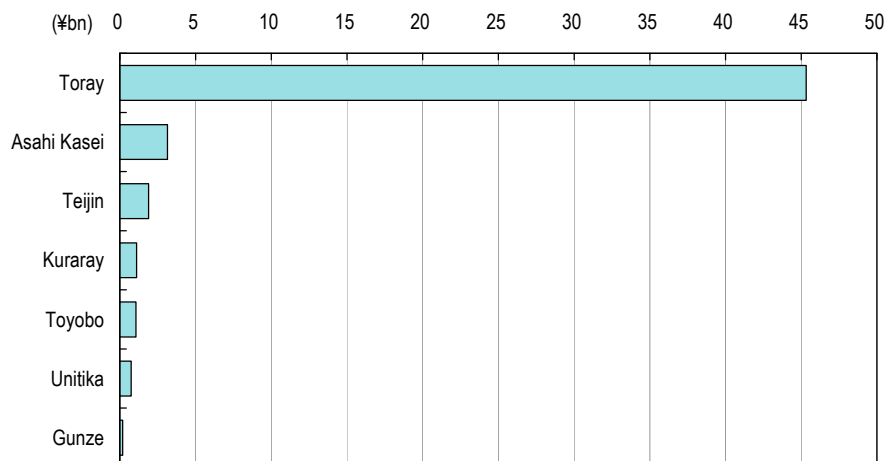


Source: Company data, Citi Research.

### Fundamental transformations due to changes in materials

Apple, which has grown rapidly thanks to the iPhone and iPad, is famous for being more fastidious about materials and components than other device firms. It seems clear that one reason why sales of Samsung's Galaxy products are so strong is that Samsung is the only company in the world that can mass produce AMOLED displays. It is often said that in the time-honored business of clothing, no retailer pays more attention to materials than Uniqlo. Toray's president Akihiro Nikkaku often says that to fundamentally transform a product, one must first change materials. Companies that understand this well are likely to succeed in differentiation. In the end, we believe materials will play an extremely important role in differentiation given increasing commoditization. Toray stands out even among companies at the head of the pack, and we believe its potential should not be underestimated.

Figure 4. OP at fiber and textile segments of major Japanese fiber firms (FY3/12A)

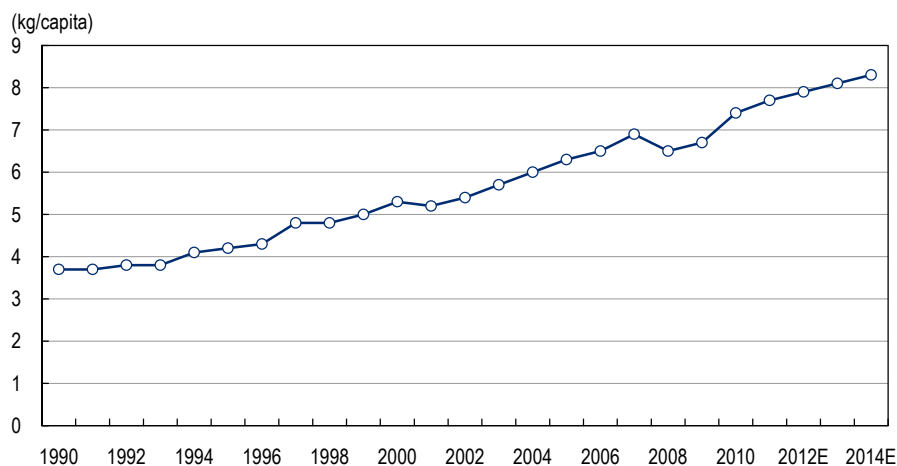


Source: Company data, Citi Research.

**Toray continues to focus on its fibers and textiles business even as peers drop out**

Here we look at why Toray has been able to develop overwhelming earnings power relative to peers. Based on the view that fibers and textiles are a global growth industry, Toray has implemented continuous R&D and capex in the fiber and textile business over the past 80-plus years. On the other hand, well known companies like DuPont, ICI, and Monsanto have completely pulled out of commodity fibers. In addition, Japanese firms like Teijin and Kuraray that used to be dominant globally have said they intend to get out of fibers, and have subsequently left the sector or sold/shrunk their businesses. Toray is the only company in Japan with a product line-up in the three major synthetic fibers (nylon, polyester, and acrylic), spanning both apparel and industrial applications. It is also in a rare position globally in this regard, and moving forward we think its competitive advantages will only increase.

Figure 5. Global synthetic fiber consumption per capita: Average per-capita consumption globally was c7.4kg in 2010, below the figures for North America (18kg) and Western Europe (14kg), and we see significant growth potential via a rise in incomes



Source: PCI Fibers, Citi Research estimates.



Figure 6. Production framework at major fiber makers

Company	Nylon				Polyester			Acrylic Staple
	Garment	Industrial	BCF	Staple	Garment	Industrial	Staple	
<b>Toray</b>	◎	◎	◎	◎	◎	◎	◎	◎
Teijin	×	×	×		△ ※1	△ ※2	△ ※3	
Toyobo	△	◎			△	◎	◎	◎
Asahi Kasei	▲ ※4				▲			×
Kuraray					◎		◎	
Mitsubishi Rayon					▲ ※4		×	△
Unitika	▲ ※5	▲ ※5	×	◎	◎	◎	◎	

Note: ◎ The business is ongoing, × The company has left the business, ▲ The company has ceased production, and △ The business has shrunk. (1) Domestic production ended at end-FY3/11. (2) Shrunk unprofitable areas at end-FY3/12. (3) Consolidated production at Tokuyama in FY3/11. (4) Ended production (OEM). (5) Ended production other than of specialty products.  
Source: Company data, Citi Research.

#### Aiming to control price volatility and stabilize earnings

Toray has a long history in the fiber and textile business, and we think it understands better than anyone else the importance of the supply-chain network, particularly for its Southeast Asia operations. Management has consistently put a priority on finding some way to stabilize earnings in highly cyclical fibers and textiles, which are heavily impacted by the external environment and forex volatility. In terms of forex volatility, a ¥1/\$ change results in a swing of ¥0.4bn in OP at Toray as a whole, thanks in part to the use of overseas facilities. Given OP of ¥100bn or more, it would seem that Toray has managed to minimize forex impact.

Figure 7. Production capacity ('000MT/year) for three major synthetic fibers at global majors: Lags peers in production capacity, but has a wide-ranging product line-up and ranks top globally in sales and OP

Rank	Company	Headquarters	Nylon			Polyester			Acrylic	Total
			Garment	Industrial	Staple	Garment	Industrial	Staple		
1	Reliance Industries	India	38			1,119		759		1,916
2	Sinopec Group	China	8			215	23	1,065	350	1,661
3	Nan Ya Plastics	Taiwan	112	53	2	510	16	420	110	1,223
4	Indo Rama	India				457		495		952
5	Jiangsu Sanfangxuang	China						840		840
6	Rongsheng Chemical Fiber Group	China				530		200		730
7	Zhejiang Yuandong Chemical Fiber Group	China				420		300		720
8	Zhejiang Tong Kun Group	China				680				680
9	Huvis	South Korea				110		549		659
<b>10</b>	<b>Toray</b>	<b>Japan</b>	<b>59</b>	<b>71</b>	<b>4</b>	<b>239</b>	<b>45</b>	<b>213</b>	<b>20</b>	<b>651</b>

Source: Company data, Citi Research

#### Focus on both mid-stream and downstream

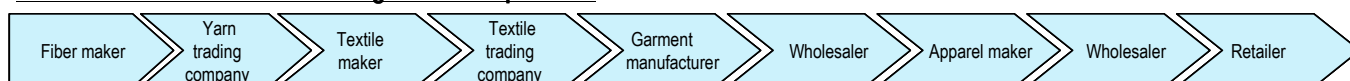
Of course, it is difficult to win out over firms in places like China and India on cost in commodity products. Therefore, Toray focuses on high value-added products and areas where it is strong like mid-stream and downstream operations. Based around its impressive spinning technology that avoids thread breakage (we understand this allows Toray to create polyester filament yarn that is 30%-40% longer than that produced by the average competitor), Toray has amassed sector-leading technology and know-how in thread processing, weaving, dyeing, and sewing. The firm's core strategy has been to use this to form partnerships with leading customers. One example of this is the collaboration with Uniqlo, which we discuss in more detail later. Toray's sales to Uniqlo rose above ¥100bn in FY3/12, a figure we believe is far higher than sales to other key customers such as Samsung, Boeing, and Toyota Motor.

### Capturing value-added by reworking the supply chain

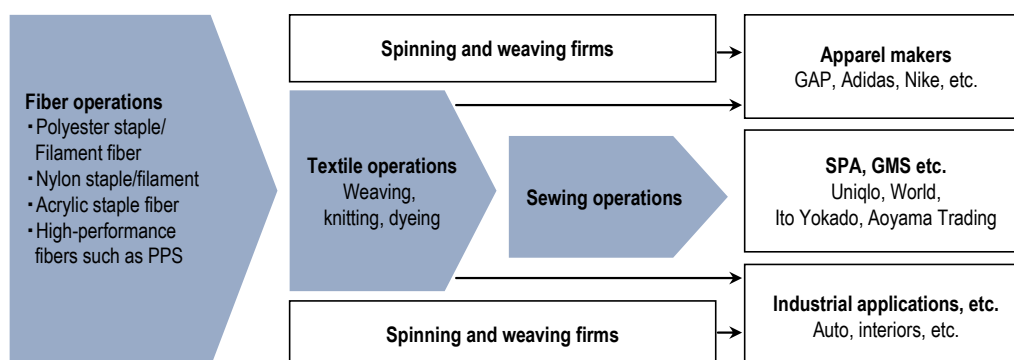
At the same time, Toray has operated its fibers and textiles business with a top priority on capturing value-added by reworking the supply chain. In the past, Japan had a multi-step logistics sector that resulted in high costs. In other words, a supply chain spanning fiber manufacturers, textile makers, textile trading firms, sewn products makers, wholesale traders, and apparel retailers resulted in inventory risk and low margins for all involved. By forming a strong partnership with Uniqlo, Toray is able to handle all stages of production from original thread and raw cotton to woven and knit products, dyeing, and sewn products. This opened up air holes in what had been a hermetically sealed industrial structure, enabling Toray to capture value-added.

Figure 8. Reworking the supply chain and looking to capture value-added

#### Traditional distribution channel for general fiber products



#### Toray's new SCM approach



Source: Company data, Citi Research.

### Further expansion in sales to Uniqlo and lateral development to bring in other customers

In addition to bolstering its relationship with Uniqlo, Toray intends to win other global apparel and SPA customers and further expand its downstream operations. Through its collaboration with Uniqlo, Toray is continuously able to learn what consumers really want. This improved understanding of the consumer point of view seems to be helping ramp up development of proposal-based products. Of late we understand that inquiries from the apparel industry have risen sharply, inspired by successes via Toray's collaboration with Uniqlo. We believe that moving forward adoption of Toray products will increase (e.g., high-performance sports apparel for global apparel firms).

## Solid relationship with Uniqlo

### Full-scale cooperation began in 2000

Dealings between Toray and Uniqlo started with fleece apparel back in 1999. Fleece items subsequently racked up record-breaking sales. The two companies expanded their ties in 2000. Shonosuke Maeda, chairman of Toray at the time, felt that the only way to develop Toray's fiber business was to pursue global operations and to leverage its strengths in high-performance materials, while Uniqlo president Tadashi Yanai believed that his company needed upstream ties and stable sources of materials in order to perform on the global stage, and that Toray was the only suitable partner from this perspective. We think the two approaches fit perfectly. For

Toray, Uniqlo has been a powerful partner that allows the company to make full use of its three major strengths: a global presence, a vertical structure, and a full product line-up. Toray established a global operation promotion department dedicated to Uniqlo business. This was Toray's first attempt to establish a dedicated channel to a specific customer. The result was that the teams in charge at the respective companies launched full-scale efforts to develop new products.

#### Strategic partnership

In June 2005, Toray and Uniqlo signed a strategic partnership agreement that established a unified structure extending beyond the boundaries of their relationship as materials supplier and apparel retailer to include areas such as design, development, production, and distribution in processes from materials to finished goods. This is in our view an unprecedented business model. Numerical targets included total supplies of goods and materials amounting to at least ¥200bn within five years, by 2010; in fact, the figure was significantly higher at about ¥240bn, and in the final year alone we estimate the number was around ¥100bn.

#### Expanding the scale of the partnership

The following year, 2011, marked the start of the second five-year plan for the strategic partnership, targeting total transactions between the two companies amounting to ¥400bn over the five years to 2015. We expect that this target to be exceeded as well. In 2014, a third plan will probably be announced, with even higher goals, and expectations of this business as a key driver for Toray's earnings expansion should continue to rise.

#### Only Toray could make the business model work

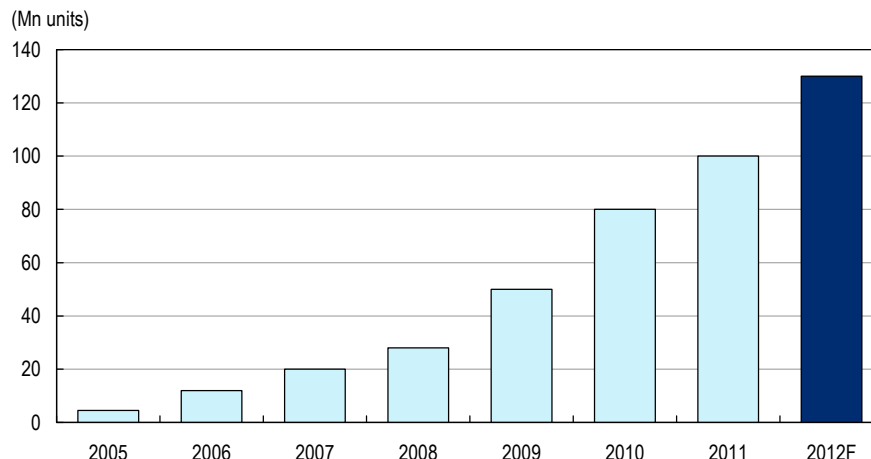
We believe Toray is one of only a few fiber makers in the world that could be part of such a unique business model. In addition to a diverse fiber lineup, Toray has excellent technologies for all fibers, and this enables it to provide the value-added proposals that partners seek. For example, sales of the highly popular Heattech range have eclipsed 100mn pieces. Probably no other company has the capability to replicate the global supply chain (production structure and logistics) needed to support Heattech, not just the enormous volume but the wide range of colors and sizes, the uniform high-grade quality from yarn through to sewn products, and supply customers on a timely basis. Uniqlo considers a low-mix high-volume production and sales model to be critical, which makes it easy to leverage Toray's stable materials supply capabilities. We believe the customer loyalty fostered by the consistently high quality of the products supplied by Toray lead to a virtuous cycle of repeat business.

### Heattech

#### Forecasting substantial growth in FY3/13

The pivotal product in the partnership with Uniqlo is Heattech, which was released in 2003. Heattech sales surpassed 10mn pieces in 2006 (12mn), reached 50mn pieces in 2009, and 100mn pieces in 2011. At a press conference on September 26, Fast Retailing said it had a 2012 autumn/winter sales target of 130mn pieces, up 30% on the previous year. Fast Retailing will about double the number of Heattech items and increase the number of colors by 2.5x in a bid to create new demand, and we believe it will also implement sales expansion strategies overseas.

**Figure 9. Heattech sales volume**



Source: Company data, Citi Research forecast.

#### Heattech functionality continues to improve

Heattech's most important functions are heat generation and heat retention. Heattech absorbs perspiration quickly, keeping the wearer dry and refreshed. When it was released in 2003, Heattech was a blend of highly moisture absorbent acrylic fiber and rayon fiber, which generates heat from perspiration vapor. In 2004, polyester fiber was added to speed up drying of absorbed perspiration, and antibacterial agents were added. In 2007, polyurethane was added to improve Heattech's stretchability, comfort, and fit. In response to women's needs, Fast Retailing improved the moisture retention of women's lines by permeating the rayon fiber with milk protein. In 2009, shape retention and anti-static electricity properties were enhanced and in 2011 deodorizing agents were added and fiber weight was reduced. To improve moisture retention even further, milk product makers have been invited to join product planning and milk whey has been used to thicken raw cotton amid ongoing efforts to improve the functionality of Heattech.

#### Blending four different types of fibers extremely difficult

Heattech performs a diverse range of functions, some of which are contradictory. To achieve this, it is manufactured from four fibers that have different qualities: acrylic, rayon, polyester, and polyurethane. Changing the blend completely changes the functionality. Using the strengths of the different fibers to compensate for the weaknesses of others enables Uniqlo to provide products that meet the performance required by users. The qualities of the different fibers are as follows. Rayon is soft, has a good texture, generates heat through moisture absorption, and controls static electricity, but it is not strong. Polyester is traditionally a hard fiber, but the texture has been softened by increasing its fineness while retaining polyester's inherent shape retention and moisture absorption/quick drying qualities. Toray's proposal to use its proprietary LOC II CEO  $\alpha$ , polyester with a specially modified cross-section that enhances moisture absorption and offers superior color characteristics was the starting point for the development of Heattech. Acrylic fiber has superior moisture retention, is the softest of all synthetic fibers and has an excellent texture. The source of Toray's textile business competitiveness is the accumulated design know-how and knit technologies needed to bring out the best qualities of these fibers.

#### Polymer design technologies and extrusion technologies superior to peers

Fiber technology forms the base of this know-how. Polymer design using high-polymer chemistry and nanotechnology is one of Toray's strengths. The most notable point is probably Toray's excellence in field of die technologies needed to

make the aforementioned LOC II CEO  $\alpha$  polyester with a modified cross-section, particularly a special extrusion technique (star shaped for LOC II CEO  $\alpha$ ). We believe the high-level technologies acquired by the Toray group over the years and excellent die manufacturing equipment enable Toray to manufacture high-precision, high-quality spinnerets for synthetic fibers with special cross-sectional patterns.

**Dyeing technologies also excellent**

Extremely high level dyeing technologies are needed to achieve a uniform color for fabrics made through a blend of four fibers with different properties. We believe a special technique that is divided into several cycles is used to achieve a uniform dye for intermediate colors, which are difficult, and to broaden color valuations.

**Focusing on downstream development through to sewn products**

To promote further downstream development, in 2007 Toray set up a sewn products business division. The new division is working with around 300 textiles and sewn outsourcing companies that deal with Toray, the majority of which are in China, to improve production activities with an emphasis on capital efficiency. In 2011, Toray set up a large specialty factory in Bangladesh with 3,000 employees as a joint venture with Uniqlo and others.

**Line-up of other products for Uniqlo also expanding**

**Partnership has yielded many products**

Toray has worked with Uniqlo on the development of many other products. These include Airtech, a 100% polyester high-performance insulation material that went on sale in 2000, Dry T-Shirts (2001), bra tops (2004), Stylish White opaque white underwear (2007), and Silky Dry (2008). Toray was also involved in the development of a ground-breaking washable sweater.

**High expectations for Ultra Light Down**

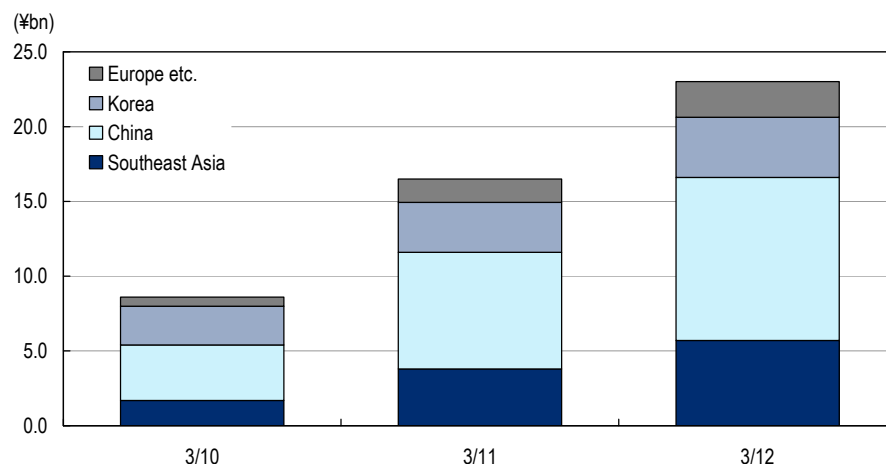
In 2009, Uniqlo unveiled its Ultra Light Down range, which uses a high density nylon material developed by Toray to achieve a light and thin finish without the use of a down pack (bag filled with down). According to a Fast Retailing release, in autumn/winter 2012 the company says it will more than double the number of colors and patterns available in the Ultra Light Down range and aims to increase sales to 13mn pieces. We believe Ultra Light Down also has real potential as a high-performance material for casual sports wear.

**Global development one source of  
Toray's competitiveness**

## Global development spans over 50 years<sup>1</sup>

Global development activities spanning more than 50 years have played a major role in establishing Toray's cost-competitiveness and the key platform of its supply chain, the cornerstones of its alliances with major SPAs, most notably Uniqlo, and other partners. Overseas Toray group companies now account for 59% of fibers and textiles business production. These are considered export bases more than anything else, but we expect them to contribute to local demand growth in their regions moving forward.

**Figure 10. Toray's fiber/textile OP by overseas production base: Well-balanced earnings growth**



Source: Company data, Citi Research estimates.

**Investment in TAL the starting point for  
downstream bases in China and  
Southeast Asia**

Toray's first venture overseas came in 1956 when it invested in a Hong Kong trading company called Trilon. In 1971, Toray took a stake in TAL, Hong Kong's largest textile converter. TAL had textile production bases across Southeast Asia, which were of great appeal as customers for Toray's fibers as well as bases for export to Europe and the US. However, the "Nixon shock" and the first oil crisis combined with overstretched resources caused TAL's earnings to deteriorate rapidly. TAL went bankrupt in the second half of the 1970s and the group was broken up. But Toray provided steadfast support on a financial and personnel level to TAL's businesses and the management of LTX (Thailand), Penfiber and PAB (Malaysia), ETX (Indonesia) and others was transferred to Toray. Today, these are core midstream businesses (weaving, dyeing) for Toray in Southeast Asia and a cornerstone of its global development.

<sup>1</sup> Toray's predecessor Toyo Rayon was founded in 1926. With a silk-like lustre and excellent moisture release, rayon was regarded as a dream chemical fiber alternative to expensive silk. In 1951, Toray signed a licensing agreement with DuPont for nylon production. Post-war reconstruction demand and population growth supported rapid sales expansion. Toray signed a polyester fiber licensing agreement with ICI (UK) in 1957 and began making Tetoron polyester fiber in 1958 and selling Lumirror polyester film in 1959. Nylon fiber, polyester fiber, and acrylic fiber are the three pillars of Toray's business.

**Full-scale development in Thailand and Indonesia**

Toray was faster than peers to develop fabric and other downstream businesses in Asia that do not compete directly with its customers. In 1963, Toray opened Thai Textile Toray Mills, its first overseas plant. TTTM makes polyester/rayon blended yarn fabric, and Toray was involved in the plant from design through construction. Toray Nylon Thai (TNT), a nylon plant, was opened in the same year. Toray entered the Indonesian market in earnest in 1970 when it set up Indonesia Synthetics Textile Mills (ISTEM), a polyester/rayon blended yarn fabric plant, in the Tangerang region. This was followed by the start of operations at polyester short-cut fiber plant Indonesia Toray Synthetics (ITS) and spun acrylic plant Acryl Textile Mills (ACTEM). At the time this giant project was known as the Tangerang project, and it was to become the platform for Toray's development in China. Toray has gained vast experience through global development and we believe this gives it a competitive edge over rivals.

**Ventures into China in the 1990s**

Toray began expanding in China in the 1990s, and invested ¥50bn in the first phase of development alone. Toray secured a 1mn m<sup>2</sup> site in Nantong on which it built an integrated plant that handles everything from the production of nylon thread to the production and dyeing of nylon fabric. Toray Fiber Nantong (TFNL) makes polyester staple. TNFL started out as a low-mix high-volume manufacturer, with only two products, but the earnings environment has become increasingly harsh, especially since 2000 as rivals have brought large plants on-stream in China. In response, around 2004 Toray stepped up efforts to offer differentiated products that adopt specialty polymers and change yarn cross sections.

**Increases ratio of specialized products in order to differentiate**

Specialized products now account for around 80% of production at TFNL, much higher than the average for local makers of 30%. Production capacity at Toray Sakai Weaving & Dyeing Nantong (TSD) has reached 9mn m<sup>2</sup>/month for woven goods and 1.2mn m<sup>2</sup>/month for knitted goods. The introduction of state-of-the art machinery that can process specialty yarn along with world-class dyeing technology has enabled TSD to increase the ratio of lightweight products that require high-level technologies to around 85%. This has driven sales to Chinese sports apparel companies and large SPAs. Toray is now focusing more on the upper mid-market, where high growth is expected.

**Started in South Korea through a JV with Samsung**

Toray began operations in South Korea in 1972 when it set up Daiichi Gosei, a joint venture with Samsung, whose name subsequently changed to Saehan. During the Asian currency crisis in the second half of the 1990s, Saehan fell into difficulty and Toray provided financial support of around ¥55bn, resulting in the creation of Toray Saehan. Toray then made it a wholly owned subsidiary in 2010 and the name was changed to Toray Advanced Materials Korea (TAK). TAK entered the information and telecom field in 2002 and has since maintained a close relationship with Samsung Electronics. The fiber business is at the heart of this relationship. In addition to a textile business that centers on non-woven fabric, TAK has IT and industrial-use PET film businesses, and at the start of 2013 it will launch a carbon fiber business.

**Developing business in the UK, Czech Republic, Italy and elsewhere in Europe**

In Europe, Toray acquired the textiles division of the prestigious UK company Courtaulds in 1989 to create Toray Textiles Europe (TTEL), and it also made high-grade artificial leather maker Alcantara a subsidiary. Toray Textiles Central Europe (TTCE), established in the Czech Republic in 1997, makes airbag-use thread and fabrics and polyester taffeta used in the lining of men's and women's clothing.

**Drawing on a wealth of experience to expand into India, Brazil and other countries**

The basic philosophy behind Toray's global development is to establish roots for local business growth over the medium term. We believe the know-how, technology, management expertise, human networks and other intangible assets Toray has acquired over more than 50 years of overseas activity will be an invaluable resource

for further expansion abroad. Toray has set up an office in India and has decided to set up a new office in Brazil. We expect Toray to expand in Eastern Europe and other new regions moving forward.

**Figure 11. Toray's textile business global production bases (thread and cotton)**

Product	Country	Plant	Capacity ('000 MT/year)
Nylon filament yarn	Japan	Aichi/Ishikawa/Okazaki	77.3
	Indonesia	ITS	16.4
	Thailand	TTS	30.5
	China	TFNL	6.0
	Subtotal		130.2
Nylon staple fiber	Japan	Ehime	3.6
Polyester filament yarn "Tetron"	Japan	Mishima/Ishikawa/Okazaki	114.1
	Thailand	TTS	40.8
	Indonesia	ITS	9.0
	China	TFNL	60.0
	South Korea	TAK	50.4
	Subtotal		274.3
Polyester staple fiber "Tetron"	Japan	Ehime	81.6
	Indonesia	ITS	71.6
	Malaysia	Penfibre	60.0
	Subtotal		213.2
Acrylic fiber "Toraylon"	Japan		19.8
Non-woven fabric	Japan	Shiga	4.8
	Korea	TAK	47.4
	China	TPN	38.0
	Subtotal		90.2
Total			731.4

Source: Company data, Citi Research.

**Figure 12. Toray: Textile business global production bases (textiles)**

Product	Country	Plant	Spun (mn pounds/year)	Woven (mn yards/year)	Dyed (mn yards/year)
Polyester/cotton mixed spun textile	Thailand	LTX	37.2	129.6	135.6
	Malaysia	PAB	30.1	101.88	122.4
	Indonesia	CENTEX/ETX	43.6	135.72	39.6
	China	TJQ	11.4	38.64	40.8
	Subtotal		122.3	405.84	338.4
Denim	Thailand	LTX	14.4	9.6	0
Polyester/rayon mixed spun textile	Thailand	TTTM	13.0	37.32	29.52
	Indonesia	ISTEM	13.4	26.4	23.04
	Subtotal		26.5	63.72	52.56
Acrylic textile	Indonesia	ACTEM	10.2	0	0
100% polyester textile	UK	TTEL	0	15	18
	Thailand	LTX	0	91.2	103.2
	China	TSD	0	109.2	112.8
	Czech Republic	TTCE	0	45.6	43.2
	Subtotal		0	261	277.2
Total			173.4	740.16	668.16

Source: Company data, Citi Research.



Figure 13. Toray: Textile business global production bases (artificial leather)

Product	Country	Plant	Capacity (mn m <sup>2</sup> /year)
Artificial suede "Eccsaine/Alcantara"	Japan	Shiga/Gifu	6.0
	Italy	Alcantara	10.0
Total			16.0

Source: Company data, Citi Research.

## Highly competitive and unique value-added fibers

### Diaper-use polypropylene non-woven fabric

#### Number one in Asia

Toray currently has annual production capacity for polypropylene spunbond, a high-performance filament non-woven fabric used for diapers, of around 100,000MT, mainly in South Korea and China. In the rapidly growing Asian diaper market, Toray is the top material supplier with a market share of around 25%. A new 20,000MT production line at TPJ in Indonesia is scheduled to start operations in June 2013 as part of plans to increase sales to global diaper makers. In FY3/12, we understand sales of diaper-use polypropylene spunbond increased 17% YoY to around ¥17bn. Diaper materials have shifted from traditional staple fibers to filament, one of Toray's strengths. Filament has superior strength and absorption and a lighter weight per unit area. In the short term, we believe the explosion and fire at the Nippon Shokubai plant could affect the SAP supply chain, but longer term we believe growth potential is high.

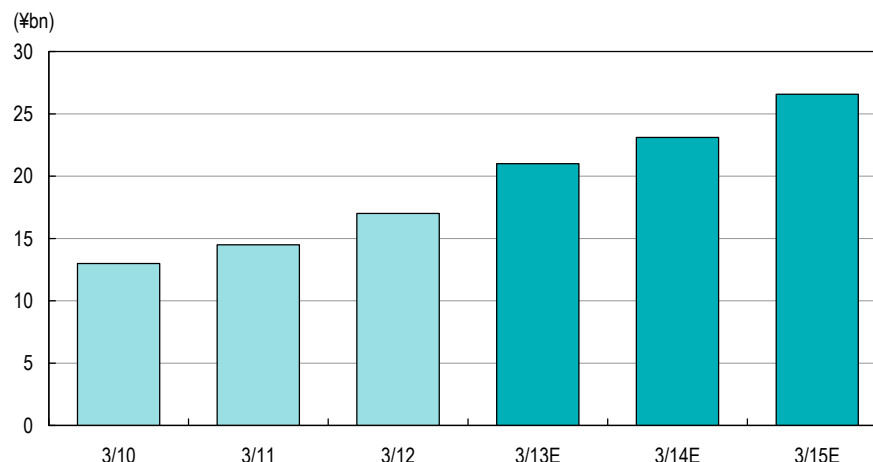
#### Indonesian disposable diaper market reaching critical momentum

It has been estimated that countries start to use disposable diapers when annual household income surpasses \$3,500 and that when annual income reaches \$8,000 almost all households use them. China has an average household income of around \$4,000. And in Indonesia, which has the world's fourth largest population, the average income is around \$3,500, so we expect the market for disposable diapers in these countries to expand quickly. In India, average annual disposable income is around \$1,000, and disposable diaper market penetration is extremely low at around 2%, so it will probably be some time before the market gathers real momentum, but with around 25mn newborns each year, we believe the growth potential for disposable diaper use is extremely high, mainly in developing nations. We also believe polypropylene spunbond has large growth potential for medical and agricultural material applications.

#### High barriers to entry; Toray investing in facilities aggressively with aim of increasing market share

Given that polypropylene spunbond is made using highly individuated machinery and quality certification from global diaper makers is difficult to obtain, we believe competition to supply the big diaper makers is limited to only a few companies, which include PGI of the US and Mitsui Chemicals. Toray is investing aggressively in China and Indonesia and we forecast its production capacity will expand by more than 2.5x by 2020.

Figure 14. Polypropylene spunbond sales



Source: Company data, Citi Research estimates and forecasts.

## Artificial leather

**Adoption for auto and high-end electronic applications supporting continued growth**

Ecsaine is a suede texture artificial leather developed by Toray using ultrafine microfiber (approximately 1/400th the width of hair). It has a three-dimensional non-woven fabric structure. The versatility afforded by Ecsaine's soft feel and elegant look has resulted in it being developed for fashion materials through to industrial materials. In Europe and auto applications, it is being developed as the Alcantara brand. Ecsaine is highly chromogenic and compared with other materials has superior durability and resistance to light damage and ultraviolet rays, so it hardly fades. Because of these characteristics, in the 1980s Ecsaine started to be adopted as a substitute for real leather in luxury cars. Today it is used mainly used by European automakers like Mercedes-Benz and BMW as well as Toyota, Honda, Nissan and other Japanese automakers. Recently, Ecsaine's use has expanded to the unlikely field of electronics, and we believe demand for it is strong.

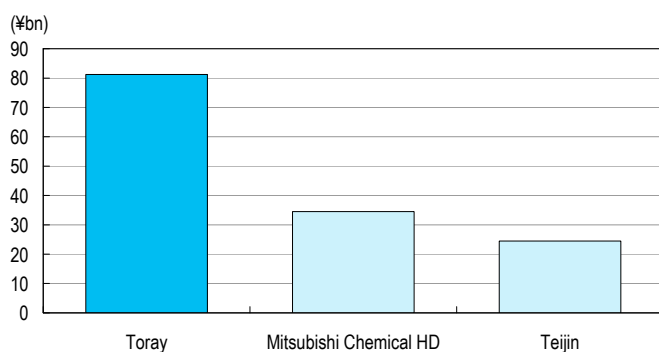
## Carbon fiber and composite materials

### Competitive advantage in carbon fiber

**We forecast a winning pattern in carbon fiber from the application of the textile business model**

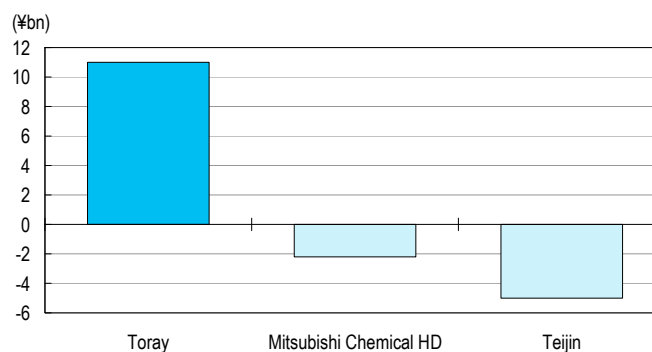
The success of Toray's textile operations bodes well for the future of the carbon fiber business. Toray has built a profitable business on the back of world-class technologies and know-how acquired over many years. While Mitsubishi Chemical and Teijin, the second and third-highest holders of carbon fiber market share, continue to post losses, Toray is generating strong profits. A large proportion of Toray's carbon fiber sales are for aircraft and a feature of the business is the high ratio of value-added product sales, notably prepreg for the Boeing 777 and the 787. Toray also has a dominant market share for such industrial-use applications as CNG tankers, high-speed rolling stock, and power-line core materials, and it supplies many products that competitors cannot make. We believe this enables Toray to keep carbon fiber facility operating rates high and maintain prices. Below we describe how Toray has arrived at such a competitive position.

Figure 15. Sales at Japan's three carbon fiber makers (FY3/13E)



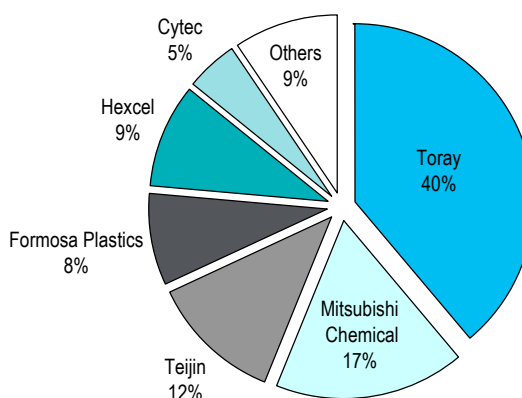
Source: Citi Research estimates.

Figure 16. OP of Japan's three carbon fiber makers (FY3/13)



Source: Citi Research estimates.

Figure 17. Carbon fiber global market share (shipment basis)



Source: Citi Research estimates.

### 1) Vertically integrated business model that leverages excellent precursor and firing technologies

#### Integrated production system and high quality products

Toray has an integrated production structure that makes high-quality products every step of the way, from precursor to intermediate products (carbon fiber, prepreg, fabric, etc.) and composites such as molded products, etc. Toray's technical expertise, experience and know-how, production capacity, and supply chain network are not things that can be replicated overnight, and we believe Toray holds and advantage over competitors on various fronts.

#### Carbon fiber business founded on the quality of the precursor

In 1971, Toray became the first company in the world to start commercial production of carbon fiber. Various proprietary manufacturing techniques acquired through many years of making nylon fiber, polyester fiber, and acrylic fiber have given Toray the ability to make carbon fiber precursor filament with a thinness, strength, and uniformity of quality that cannot be matched by peers. Toray's original wet-dry spinning technology is a combination of wet spinning techniques developed for low-cost production of apparel-use acrylic fiber and dry spinning techniques that make high-grade fiber with few surface defects. This technology base enables Toray to manufacture high value-added carbon fiber for aircraft applications at low cost.

#### Firing facilities based on proprietary engineering technology

Although Toray is a synthetic fiber maker, it has an engineering R&D facility, and we believe design technologies developed in close cooperation with the engineering department are a source of competitiveness. Carbon fiber is made through a three-stage manufacturing process involving a firing furnace (200°C–300°C), a carbonizing surface (1,000°C–2,000°C), and a graphitizing furnace (2,000°C–3,000°C). As Toray has excellent firing technologies, we believe it has the ability to maintain stable processing and produce high-quality carbon fiber at high yields.

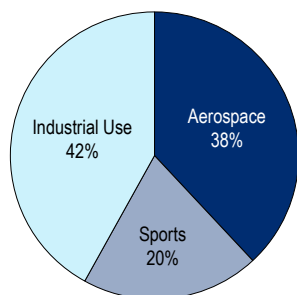
#### Molding process technologies acquired through downstream development

Since it commercialized carbon fiber, Toray has been focusing on the development of prepreg<sup>2</sup> for golf club shafts, fishing rods, and other downstream applications. The molding process technology it has acquired along the way is highly regarded. In 1981, Toray's prepreg became the first ever to be adopted as an aircraft structural material. We believe epoxy resins that employ alloy technologies developed in plastics operations are also highly competitive. Toray has a wealth of molding technologies: PC housing hybrid molding, high-speed resin transfer molding (RTM) for auto exterior panels and structural components, and advanced vacuum-assisted resin transfer molding (AVaRTM) used for various molded aircraft parts. Mid-stream and downstream product (intermediate base materials, molded products) sales account for the majority of sales in the carbon fiber and composite materials segment. We believe this is purely due to the application of downstream development know-how that Toray has nurtured in its textiles and fibers segment and elsewhere.

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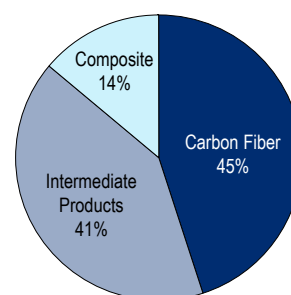
<sup>2</sup> Carbon fiber sheet impregnated with resin.

Figure 18. Toray: Sales breakdown by application (FY3/12A)



Source: Company data, Citi Research.

Figure 19. Toray: Sales breakdown by product format (FY3/12A)



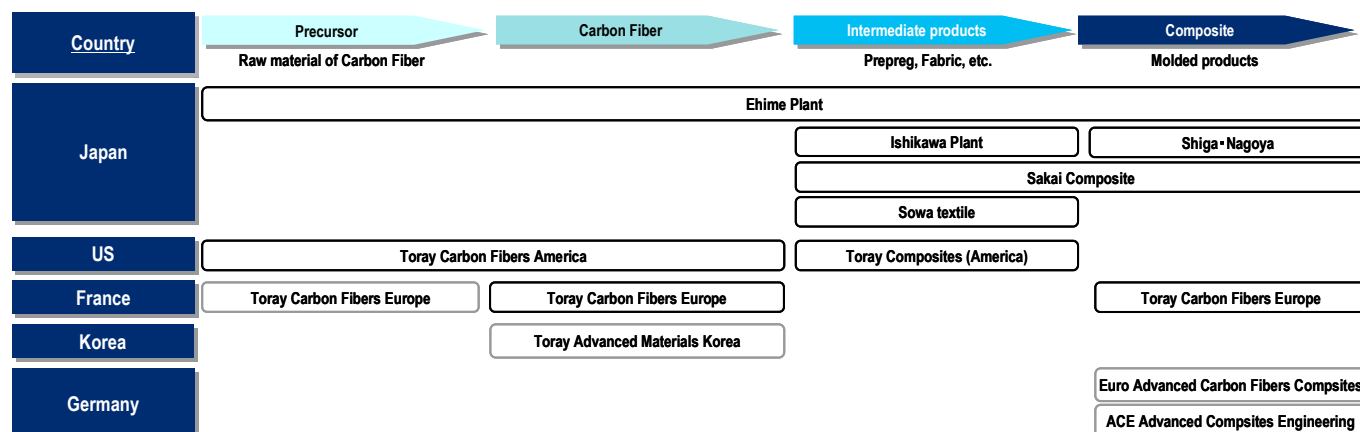
Source: Company data, Citi Research estimates.

### South Korean cost-competitiveness to be particularly commanding

## 2) Global operations with four main bases: Customer proximity and cost competitiveness

Toray's global carbon fiber operations have for four main production bases: Japan, the US, France, and South Korea, where operations are scheduled to start soon. This enables Toray to work closely with clients in business development, control the effects of exchange rate fluctuations, and minimize product changeover losses and transportation costs. Japan is the global "mother factory" and is expanding the production of high value-added products. The US not only supplies Boeing but is meeting expanding environmental and energy-related demand, centering on CNG tanks. France supplies Airbus and also luxury automakers, including Daimler. South Korea will leverage its dominant cost competitiveness, founded on low electricity, utility, and construction costs to make industrial-use carbon fiber for CNG tanks and other applications. We believe a strength of the South Korean plant will be that can benefit from low tariffs on exports to China and other countries. Over the medium term, we expect the South Korean plant to develop carbon fiber for auto parts in a tie-up with Hyundai Motor.

Figure 20. Toray group production bases

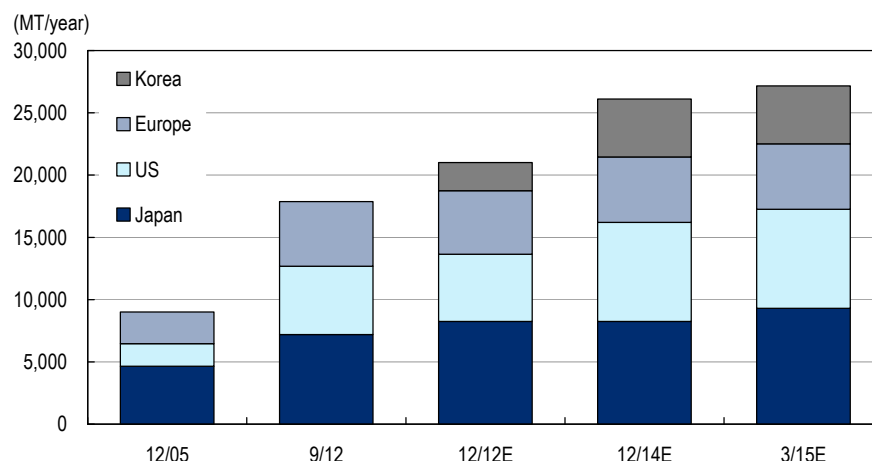


Source: Company data, Citi Research.

### Geographically balanced capacity expansion plans

Toray currently has annual production capacity of 18,900MT, although TAK (Korea) will bring its 2,200MT plant on-stream at the start of 2013 and is scheduled to increase capacity by 2,500MT in March 2014. In Japan, a 1,000MT line that makes particularly fine carbon fiber for aircraft and luxury cars was opened in September 2012. There are plans to increase capacity by another 1,000MT in March 2015. In the US, there are plans to increase the capacity of CFA by 2,500MT, which would raise global capacity to 27,100MT. Also, there are plans to start the first precursor facility in France in 2014.

Figure 21. Toray: Production base capacity expansion plans



Source: Company data, Citi Research.

### 3) Ability to create markets: Proposal-based business model

#### Proposal-based business model

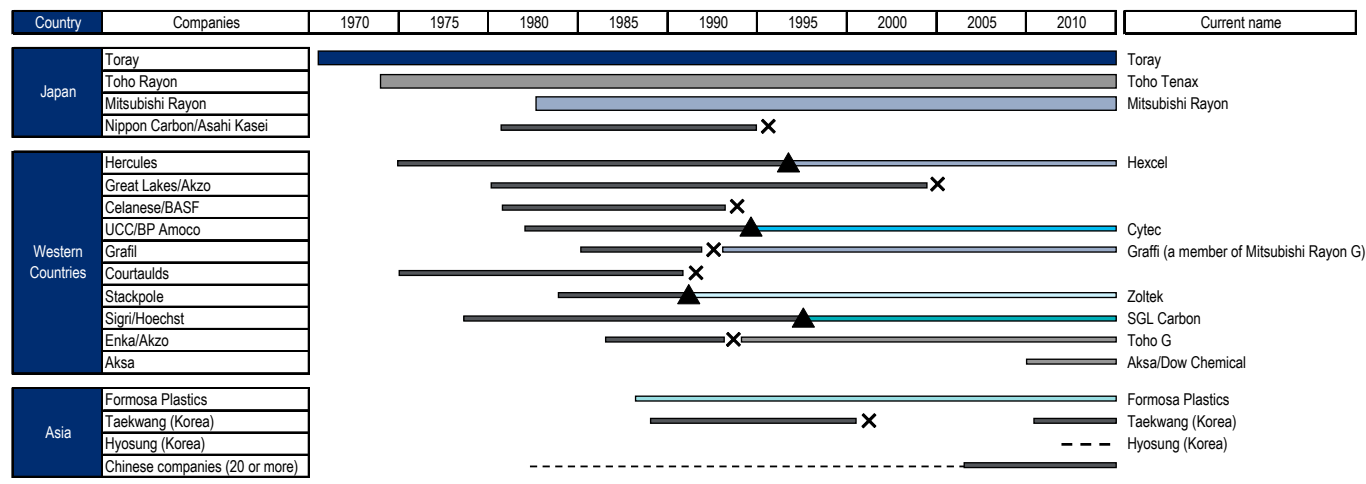
Toray has the ability to create markets based on its integrated technological development capabilities. The company is nurturing demand with a proposal-based business model. By developing high-quality and competitive intermediate materials in response to market requirements, the company is focusing on establishing new markets as new forming and processing technologies evolve. Toray aims to increase the use of carbon fiber for automotive applications and has completed a next-generation concept electric vehicle named the Teewave AR1 in order to demonstrate such applications to the automobile industry. Via the fibers and textiles business, proposal-based thinking from the consumer perspective has taken hold, and we think that this is a key standpoint that can be deployed laterally in the carbon fiber operations, too.

### 4) Ongoing R&D and capital investments

#### R&D investment accumulated over many years

Toray has taken a long-term view and continued to pursue investments in R&D and facilities. As demonstrated by the fact that major global players including Asahi Kasei, Celanese, BASF, and Azko have been forced to dispose of or sell off carbon fiber operations, this is a business where significant outlays on development and facilities are required, and also where experience and knowhow are critical. It is not easy to come up with a stream of earnings to reinvest. In fiber and textile business, while rivals are pulling out of, selling off, or downsizing their businesses, Toray has persevered and maintained its focus, steadily achieving results; we think this is a key component of its corporate DNA.

Figure 22. Changes at carbon fiber makers



Source: Company data, Citi Research.

## Competitive landscape

### Japanese makers

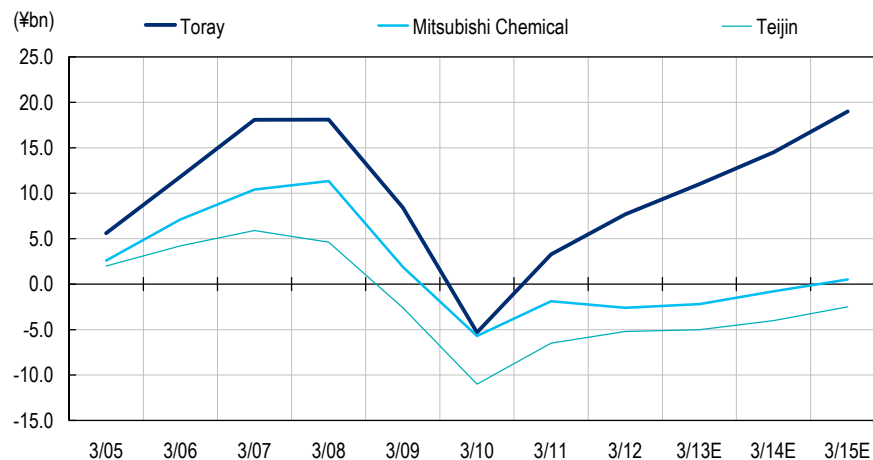
#### Teijin

Teijin subsidiary Toho Tenax manufactures and markets carbon fiber, and we expect it to rack up sales of ¥24.5bn in FY3/13. General industrial applications account for about 50% of sales, aerospace for about 30%, and sporting goods for about 20%. Low-added-value chopped fiber accounts for a very high percentage of sales for industrial applications. We understand principal customers in the aerospace field are Airbus and Bombardier, and the company lags Toray in downstream businesses such as prepreg. Earnings are extremely weak. We expect an operating loss of ¥5bn in FY3/13, and continued net losses. Toho Tenax has production bases in Japan, the US, and Germany, with total capacity of 14,000MT a year, but we anticipate only about 7,000MT of shipments in FY3/13, due to the lowest expected operating rates and yields among the three major Japanese makers.

#### Mitsubishi Chemical

Mitsubishi Chemical subsidiary Mitsubishi Rayon handles the carbon fiber business. We estimate FY3/13 sales at ¥34.5bn. The company has virtually no sales for aerospace applications; about half its sales are for general industrial applications and about half for sport goods. Like Toho Tenax, commodity-grade product accounts for a large part of its industrial business, with substantial sales for windpower applications. In June 2011, Mitsubishi Rayon added new facilities with capacity for 2,700MT/year of high-performance large tow carbon fiber. The company has global capacity of 10,900MT, but a significant depreciation burden as well, and like Toho Tenax, earnings are struggling. We anticipate further losses through FY3/14.

Figure 23. OP at Japanese carbon fiber makers



Note: Teijin figures after adjustment for depreciation accompanying acquisition of Toho Tenax.  
Source: Citi Research.

## New entrants

Many have tried to break in, but it is very difficult to generate earnings for reinvestment in this business

Until recently, the three Japanese makers—Toray, Toho Tenax, and Mitsubishi Rayon—have accounted for about 70% of the market for polyacrylonitrile (PAN) carbon fibers, but companies in developing nations have been stepping up efforts to enter the market of late. Turkey's Akso is the world's largest producer of acrylic fiber used as one type of precursor for carbon fiber and is establishing a presence in commodity-grade markets, but not many other makers from China and elsewhere have been able to pursue mass-production or successfully sell decent volumes to market. As noted previously, most of the companies that did manage to break into the business in the past have been forced to withdraw from or sell operations, and for makers without superior fiber technologies in particular it is hard to realize mass-production of carbon fiber with high yields. Carbon fiber also requires investment in facilities and R&D, and we expect further weeding out of companies that cannot generate a stream of profit for reinvestment. Even a company with close to 40 years of experience in carbon fiber and a solid earnings track record like Toho Tenax can have a protracted earnings slump, underscoring how tough this business is. Furthermore, in terms of whether or not a direct threat might be posed to Toray, the company is involved in aircraft applications and high-end fields requiring rigorous design capabilities and its direct competition with new participants is limited, so we do not anticipate much impact on its earnings. We outline the situation with regard to individual companies below.

## South Korea

Taekwang Industrial, Hyosung

Taekwang Industrial entered the carbon fiber business in 1988, but withdrew in 2001 because of deteriorating earnings. The company decided to try again and in 2008 it built a pilot plant. The plant started operating in FY3/12 and soon after there was an explosion. There have been media reports that the plant restarted in August but details are unclear. Synthetic fiber major Hyosung is starting up a carbon fiber business. Hyosung has invested KRW250bn, including R&D, and built a 2,000MT plant that is scheduled to start commercial production in January 2013. It plans to invest a further KRW1,200bn and raise capacity to 17,500MT/year by 2020.



Many companies have entered the carbon fiber business, but....

### China

As part of its 12th five-year economic plan (2011-2015), China aims to commercialize production of high-strength carbon fiber, increase production capacity to 20,000MT/year, and develop a composite materials industry. We estimate more than 20 Chinese SMEs already have entered or plan to enter the carbon fiber business and that nominal carbon fiber production capacity already exceeds 20,000MT/year. However, the only makers to have realized commercial production are Zhongfu Shenying (estimated capacity of 3,000MT/year) and Weihai Tuoqian Fiber (2,000MT/year). We estimate their real combined production capacity is only 2,000MT-3,000MT/year and we understand the carbon fiber they make can only be used for a limited number of applications, including sport goods and some civil engineering and construction. We believe earnings are depressed, illustrating how difficult it is to build a profitable carbon fiber business.

### Turkey

Aksa

Aksa began manufacturing carbon fiber at the start of 2010. It also plans to steadily ramp production in its JV with Dow. Aksa increased capacity to 3,500MT/year in July 2012 and over the next five years it plans to invest up to \$1bn. Aksa is the world's largest maker of feedstock acrylic fiber (capacity of around 310,000MT/year, about 15% of the global total) and we believe it has excellent precursor technologies. Dow has an agreement with Ford to develop carbon fiber for auto applications and we believe Aksa is likely to supply Dow with precursor. We see this tie up as the biggest threat to Japanese carbon fiber makers in the immediate future.

### Saudi Arabia

SABIC

SABIC has signed a licensing agreement with Italian company Montefibre and plans to build a new plant in Saudi Arabia. There are also plans to build carbon fiber facilities at Montefibre's acrylic fiber production base in Spain to create an integrated plant. The timing has not been decided, but we estimate the plant will have carbon fiber production capacity of 3,000MT/year.

### India

Chemlok Industries

Chemlok Industries started operations at a 400MT/year carbon fiber plant in May 2010. Development will center on carbon fiber for jet fighters as well as rockets, satellites, and other aerospace applications.

Figure 24. PAN carbon fiber manufacturers: Production capacity (CY, period-distributed basis)

MT/year	2006	2007	2008	2009	2010	2011	2012E	2013E
Toray	4,700	5,800	7,300	7,300	7,300	7,300	7,550	8,300
SOFICAR (France)	2,600	2,933	3,400	5,200	5,200	5,200	5,200	5,200
CFA (US)	3,600	3,600	3,600	5,400	5,400	5,400	5,400	5,400
South Korea								2,200
<b>Toray total</b>	<b>10,900</b>	<b>12,333</b>	<b>14,300</b>	<b>17,900</b>	<b>17,900</b>	<b>17,900</b>	<b>18,150</b>	<b>21,100</b>
Mitsubishi Rayon	3,200	4,667	5,400	5,400	5,400	6,750	8,100	8,100
Grafil (US)	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
SGL (Relocation of factories, Britain)	500	600	700	750	750	750	750	750
<b>Mitsubishi Rayon total</b>	<b>5,700</b>	<b>7,267</b>	<b>8,100</b>	<b>8,150</b>	<b>8,150</b>	<b>9,500</b>	<b>10,850</b>	<b>10,850</b>
Toho Tenax	3,700	3,700	5,725	6,400	6,400	6,400	6,400	6,400
TTE (Germany)	2,275	3,400	3,400	3,400	3,400	3,400	3,400	3,400
TTA (US)	3,733	4,200	4,200	4,200	4,200	4,200	4,200	4,200
<b>Toho Tenax total</b>	<b>9,708</b>	<b>11,300</b>	<b>13,325</b>	<b>14,000</b>	<b>14,000</b>	<b>14,000</b>	<b>14,000</b>	<b>14,000</b>
Formosa Plastics	2,550	3,950	5,692	6,150	7,450	7,450	8,750	8,750
Hexcel	2,300	2,900	3,500	4,900	6,200	6,200	7,200	7,200
Cytec	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
AKSA					1,500	1,800	3,500	3,500
Hyosung								2,000
Others				3,500	3,500	7,000	8,000	8,000
<b>World total</b>	<b>33,458</b>	<b>40,050</b>	<b>47,217</b>	<b>56,900</b>	<b>61,000</b>	<b>66,150</b>	<b>72,750</b>	<b>77,700</b>

Source: Company data, The Heavy & Chemical News Agency, Citi Research estimates and forecasts.

## Demand for main carbon fiber applications

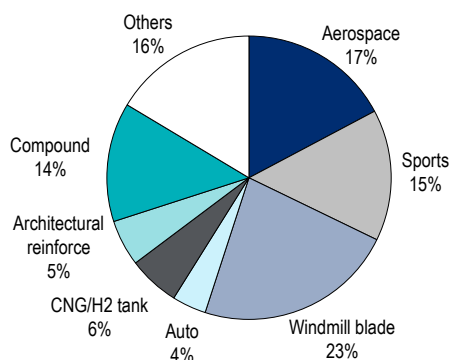
### Forecasting demand growth of 11% YoY in 2012

In 2011, we estimate the global carbon fiber market expanded 14% YoY to around 37,000MT, with the growth breakdown by application as follows: aircraft/aerospace up 16% to c6,300MT, general industrial up 25% to c25,000/MT, sport goods down 21% to c5,600MT. In 2012, we forecast the market will grow 11% to 41,000MT: +15% for aircraft/aerospace, +11% for general industrial, + 5% for sport goods.

### Wind turbine blades, aircraft, autos, pressure vessels to drive demand

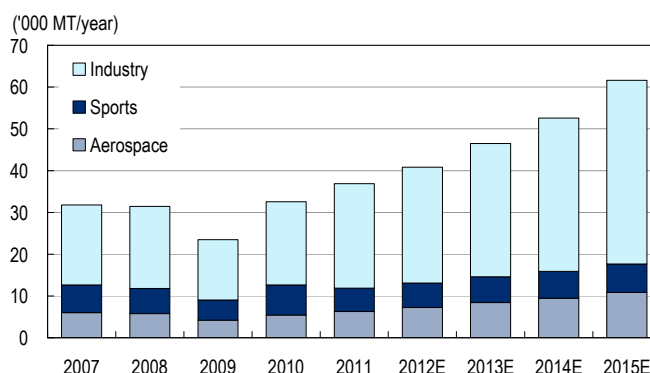
More specifically, we expect wind power generation to be the main driver of growth, followed by aircraft, sport goods, and compound-use carbon fiber. In the field of wind power generation, we expect P&J Windpower, the biggest player in emerging markets, to step up development and the ratio of carbon fiber used in turbine blades to increase as blade sizes expand. In the aerospace field, we forecast annual growth will remain at around 15% on an increase in demand for existing Boeing and Airbus models as well as an increase in the Boeing 787 build rate and the full-fledged start of Boeing 350 production from 2014 (see our October 11 report [Boeing Co. \(BA\) - In-Depth Backlog Analysis Adds Comfort to the Long Thesis](#)). In pressure vessels, we forecast sharp growth for CNG tankers.

Figure 25. Global carbon fiber demand by application (2011: 37,000MT)



Source: Company data, Citi Research estimates.

Figure 26. Global carbon fiber demand forecasts

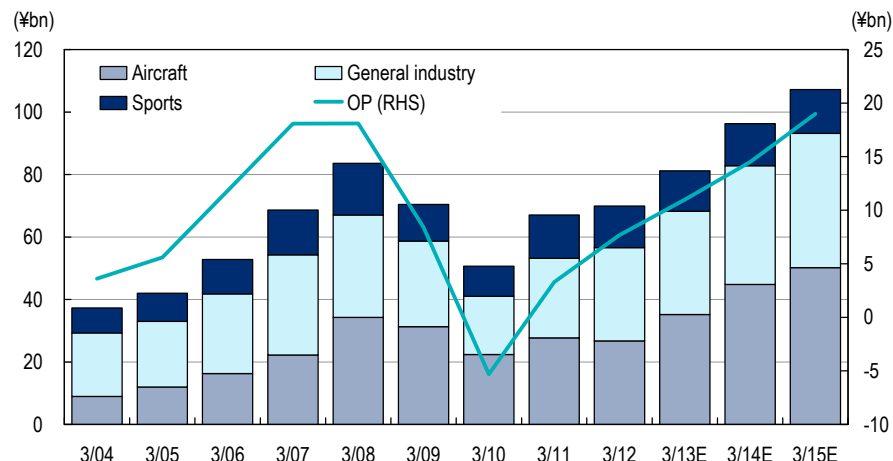


Source: Company data, Citi Research estimates and forecasts.

### Aircraft, mainly the Boeing 787, to be the main driver of carbon fiber earnings growth

Aircraft account for around 17% of global carbon fiber demand. For Toray, however, aircraft contributed 38% of carbon fiber sales in FY3/12, more than double the global weighting, and we forecast this ratio will climb to 47% in FY3/14, mainly because of an increase in the Boeing 787 build rate. We estimate Toray shipped carbon fiber for two and a half 787s a month in FY3/12 and that this will increase to nine 787s a month in FY3/14. We also forecast growth in shipments for general industrial applications, driven by CNG tankers in North America against the backdrop of the shale gas revolution, and rapidly rising demand in Asia. We expect Toray's new carbon fiber production base in South Korea to make a particularly large contribution to growth.

Figure 27. Toray: Carbon fiber business sale and OP by application



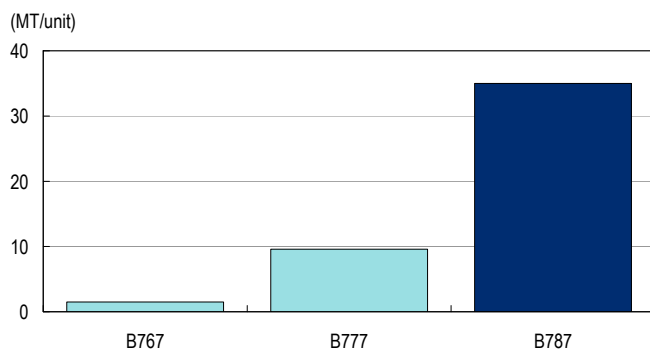
Source: Company data, Citi Research.

## Aerospace

### Carbon fiber usage per aircraft increasing

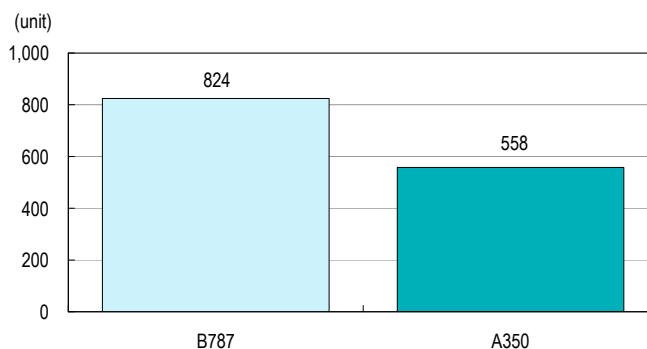
The ratio of carbon fiber used in aircraft is increasing to meet the need for improved fuel efficiency. In the Boeing 767, the fuselage, wings, tail, and other major structural parts are all made of aluminum. Carbon fiber reinforced plastic (CFRP) is only used for wing flaps and constitutes around 3% of the structural materials. In contrast, in the 787, around 50% of structural parts materials are carbon fiber.

Figure 28. Carbon fiber composite volume in key Boeing aircraft



Source: Company data, Citi Research

Figure 29. Order backlog for key Boeing and Airbus mid-size aircraft (as of August 2012)



Source: Japan Aircraft Development Corporation, Citi Research

### Extremely close relationship with Boeing

Toray and Boeing have a long relationship. Toray began supplying carbon fiber to Boeing in 1975 and in 1989 it began supplying carbon fiber for fuselages, wings, and other primary structural parts. Toray materials used in the 767 and 777 were highly praised, and in April 2006 Toray concluded an exclusive agreement to supply carbon fiber composites for the 787. The agreement spans 16 years until 2021 and is worth around \$6bn. Toray is supplying unidirectional carbon fiber prepreg for the main wings and tail, and carbon fiber fabric prepreg for the fuselage. The material used for the large main wings can reduce weight by 20%-30% compared with previously used material. Not only do Toray's materials reduce weight, but their high

strength allows larger aircraft interiors and window sizes and their high corrosion resistance allows the humidity level in the aircraft to be increased, thereby facilitating a significant improvement in the comfort of aircraft design. Boeing says it is hurrying to develop a successor to the 777, and in a media release issued on October 4 Vice President Randy Tinseth commented that composite materials are being considered for the aircraft body. We forecast the trend toward using carbon fiber composite for aircraft bodies will gather pace moving forward.

**Airbus: targeting prepreg supply and advancing the development of CFRP engine parts**

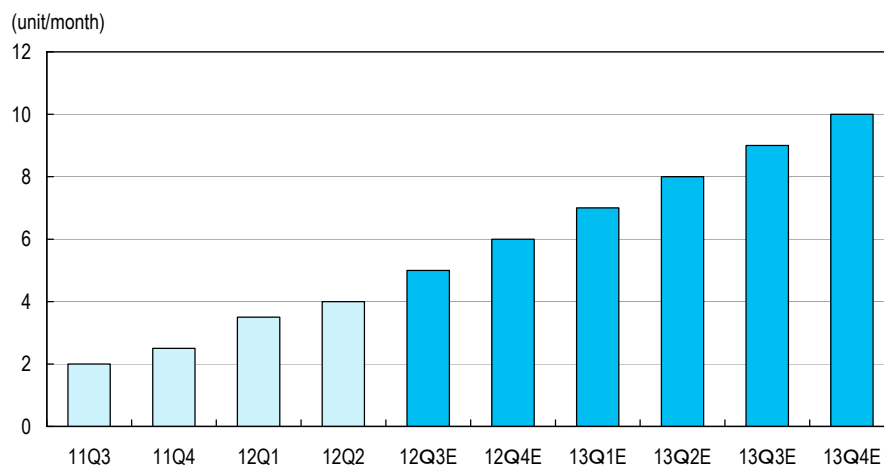
To date, Toray has mainly supplied carbon fiber to Airbus indirectly in the form of prepreg to Hexel and other materials suppliers, but we believe there is significant potential to increase composite business with Airbus. In April 2010, Toray concluded a long-term contract (15 years to 2025) to supply carbon fiber prepreg to EADS and Airbus. We forecast a huge jump in demand, driven by the mid-size Airbus 350 WXB and other next-generation aircraft, which are expected to significantly increase the use of CFRP for wings, the fuselage, and other body parts. In addition, Toray is participating in programs to develop small and mid-size aircraft for emerging markets and progressing with the development of CFRP engine parts.

**Figure 30. Carbon fiber usage by major aircraft type**

Model	Boeing 767	Airbus A320	Boeing 777	Airbus A330	Airbus A380	Boeing 787	Airbus A350XWB
Launch year	1982	1987	1995	1998	2007	2011	2014E
Structural material	Secondary structure	Primary/secondary structure	Primary/secondary structure	Secondary structure	Primary/secondary structure	Primary/secondary structure	Primary/secondary structure
CFRP consumption (MT)	1.5	1.5	10	7	35	35	Not decided
Products supplied by Toray	CF, fabric	CF	CF, prepreg	CF	CF	CF, prepreg	Working on prepreg approval

Source: Company data, Citi Research estimates.

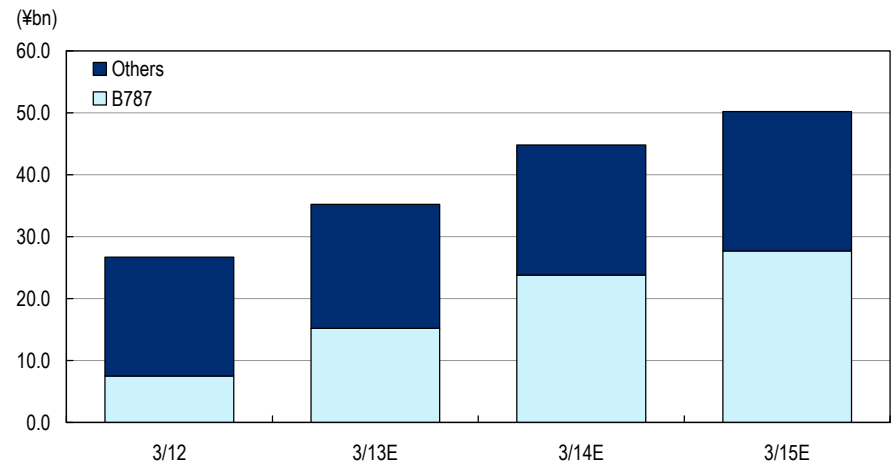
**Figure 31. Boeing 787 build rate: Growth to 10 aircraft per quarter by end-2013**



Note: Calendar year-end basis.

Source: Company data, Citi Research estimates and forecasts.

Figure 32. Toray: Aviation-application carbon fiber sales forecasts



Source: Citi Research.

## General industrial applications

### High-pressure vessel applications

**Shale gas revolution poised to trigger major growth in most important application area**

Within Toray's general industrial application carbon fiber business, high-pressure vessels are the applications that generate the highest sales, and we consider this an important area, with exceptionally large room for growth moving forward, thanks to the shale gas revolution. We estimate that annual global demand for high-pressure vessel application carbon fiber stood at around 2,000MT in 2011. However, we expect annual demand to increase some 50% YoY to roughly 3,000MT in 2012. CNG tank applications account for a sizeable share of high-pressure vessel-related demand. Diffusion of gas-powered vehicles, which has already occurred in Argentina and Brazil, is rising in places like North America, Indonesia, Thailand, and South Korea spurred by a drop in natural gas prices thanks to the shale gas revolution, and also because gas vehicles emit 10%-20% less CO<sub>2</sub> and substantially less nitrogen oxides and other pollutants than gas-powered vehicles.

**From a safety perspective, use of carbon fiber likely to expand**

However, carbon fiber is currently used in only a tiny 1%-2% of total CNG tank production. We understand that most CNG tanks are made of steel or glass fiber reinforced plastic, but we see substantial potential for carbon fiber as an alternative, given its lightweight and corrosion-resistant properties. Following a CNG tank-related bus explosion in South Korea, in the interest of safety, carbon fiber-manufactured CNG tanks became compulsory there. We expect Toray's new South Korean carbon fiber facilities to operate at full tilt and establish an effective monopoly on supply there.

**Rapid growth in shale gas transportation applications**

Recently, too, the sharp increase in shale gas extraction volumes in the US has triggered growth in demand for carbon fiber used in shale gas transportation trailers. With shale gas mining sites dispersed across the country, investment considerations mean transportation by trailer is more common than by pipeline distribution. To efficiently transport huge quantities of natural gas, vessel capacity is important, and in this case we see a strong need for carbon fiber composite materials, which are both ultra-lightweight and thin. We believe that in general, vessels are constructed of an inner resin or aluminum liner and an outer wrap of fibrous material. We also foresee growth in CNG storage-related demand. Toray expects an increase in CNG tank and transportation demand and higher carbon fiber usage rates to trigger a high 27% or so rise in annual high-pressure vessel carbon fiber demand in the 10 years to 2020.

### Automotive applications

**Highest growth potential**

Global demand for carbon fiber used in automotive applications was roughly 1,200MT in 2011, but we regard this as probably the category with the greatest growth potential. BMW plans to use carbon fiber reinforced plastic (CFRP) bodies in the i3 Mega City Vehicle all-electric vehicle that is plans to release next year. The i3 is expected to be the first semi-mass produced vehicle to make use of CFRP. Some sections of the media put the price tag of the i3 at around ¥5mn. If the price of a BMW brand vehicle can be kept to this level while using CFRP as a structural material, then we think CFRP would look appealing to others. Moreover, BMW's i8 plug-in hybrid is expected to combine an aluminum alloy chassis with a CFRP cabin. Elsewhere, Toray has teamed up with Daimler to supply CFRP parts to Mercedes-Benz.

**Full-scale expansion from 2015**

With regulations governing emissions set to become more stringent, we expect carbon fiber to be adopted for the mass production of electric and hybrid vehicles around 2015 and enter into a full-fledged growth phase. Aluminum is increasingly being used to achieve lighter weight vehicles, but CFRP is still some 30% lighter

than aluminum and so to achieve truly lightweight vehicles we consider the use of CFRP a must. Toray is targeting full-scale adoption in the luxury car market, which accounts for some 5% of the overall market. Toray expects annual growth of some 30% in the automotive carbon fiber market in the 10 years through 2020.

**High processing costs the greatest bottleneck**

In reality, the hurdles to using carbon fiber in mass-produced vehicles are lofty. High processing costs are probably the greatest obstacle and in that regard shortening production times is an important issue. Throughput time for standard mass-produced vehicles is said to be around one minute and work to bring processing times closer to that level is ongoing. In aircraft production, an autoclave method is used to cure and consolidate prepreg layers, but this requires production time of several hours. Accordingly, to speed up the process, Toray has developed an innovative high-cycle resin transfer CFRP molding process, whereby thermoset resin is injected into a mold that contains a carbon fiber pre-form to form CFRP. So far, it has cut processing time to 10 minutes and is aiming to shorten times further to five minutes. To cut production times still further, Toray is pushing ahead with technological developments, producing, for instance, thermoplastics with improved elasticity.

**Starting with adoption for parts**

Price is also a hurdle to the adoption of carbon fiber auto parts, but there are also parts that can facilitate a reduction in part numbers through design changes. In fact, carbon fiber propshafts dispense with the need for the fasteners required in traditional steel propshafts and thus reduce part numbers by over 90%. Accordingly, the number of parts has been successfully reduced without resulting in any inferiority versus steel propshafts. In addition, a clear reduction in weight has been achieved, as propshaft weights have been largely halved to around 5kg from 10kg for some vehicles. We believe this will be hugely appealing to auto parts makers, who are pushing to shed every gram possible, and we anticipate that these parts will be adopted in more and more vehicles.

**Beginning with outer panels**

Toray is starting with outer panels like the engine hood and the trunk lid, where forms are relatively straightforward and the results from lightweighting are impressive. The strategy is to aim for the expansion in the areas where carbon fiber is adopted, with the final targets being bodies, floors, and side frames. Strength is required in frames, so we think one option would be for Toray to offer thermoset CFRP in combination with thermoplastic CFRP for materials and components such as external sheets and engine covers. The field of automotive applications is exceptionally wide-ranging, so Toray plans to aggressively push alliances with automakers and auto parts makers.

**TAK likely to become core base on its overwhelming cost competitiveness**

Toray plans to start mass production of carbon fiber at TAK in South Korea from the start of 2013; we think that compared with Japan, costs are about 30% lower, given factors such as capex sums and South Korean electricity charges. We forecast that TAK will become a core base for production for auto applications, on further cost reductions stemming from end-to-end production starting with precursor and the pursuit of economies of scale.

**Windpower applications**

**Lots of demand but an intensely competitive field**

We understand that in 2011, demand for carbon fiber for wind power applications surged by approximately 40% to 8,400MT/year (including large tow). We forecast that demand will grow further for windpower, as nuclear power policies are revised around the world in the wake of the accident at Fukushima Daiichi. Blades are being enlarged to improve power generation efficiency and the substitution of traditional metal and glass fiber blades with carbon fiber ones from the perspectives of lightweighting and strength is gradually moving ahead. For blades with a diameter



of 50m, we believe the standard is to use approximately 3MT/unit (when there are three blades) of carbon fiber. For large facilities with diameters of 120m or more, we estimate that 10MT/unit or more of carbon fiber is used. The number of offshore windpower projects is rising, due to the problem of noise and so as to obtain stable and strong windpower. We see the demand for carbon fiber here rising, from the perspectives of large-sizing, anti-corrosive properties, and enhanced durability. Toray is focusing efforts on the development of lightweight blades that can generate electricity even at low wind speeds, aiming to differentiate itself from the competition, and lobbying potential customers to adopt them. However, competition is fierce in the windpower arena, in part because it is possible to use large tow. As a consequence, Toray plans to respond selectively to demand, emphasizing profitability.

### Ultrabook and tablet applications

An area where lightweighting needs are acute

We expect growth in carbon fiber for IT equipment cases, in particular in the tablet PC field where lightweighting is key. Toray has more than 20 years of experience with notebook PCs and its carbon fiber is used in high-end models from Sony and Lenovo. Moving forward, we expect the user base to broaden. Recently, NEC has adopted Toray carbon fiber for the back cover of its 7-inch tablet, the Medias Tab UL N-08D, rendering it some 30% lighter than rival products. We hope to see Toray leverage ties with key customers nurtured by the electronics and IT business and increase adoption of its carbon fiber for the mainstay models of major manufacturers.

### Transmission cable core material applications

Toray has a monopoly

We are also optimistic about expansion in core materials for electricity transmission cables. Significant lightweighting is possible versus extant steel and stainless steel materials. This makes it possible to increase the amount of aluminum, which is the electricity transmitting layer, and thereby increase the volume of electricity that can be supplied. Moreover, carbon fiber is distinguished by its low thermal elasticity and high strength, so it is possible to extend the distance between pylons. Toray says the adoption of carbon fiber is progressing in the BRICs, where the increase in demand for electricity is startling, especially in Brazil and India. We see Toray products as becoming the de facto standard and the company is working to push the spread of carbon fiber with even greater vigor.

### Offshore oilfield extraction applications

Pushing development ahead of peers

In offshore oilfield applications, we think it is possible that carbon fiber will be used for not only drilling risers and tethers but also for platforms themselves. Some are of the view that this could lead to the creation of vast demand for carbon fiber of the order of several thousand tons per rig. Toray is pushing joint development with the oil majors and we anticipate growth in carbon fiber adoption in this field in the long run.

## Electronics and IT-related products

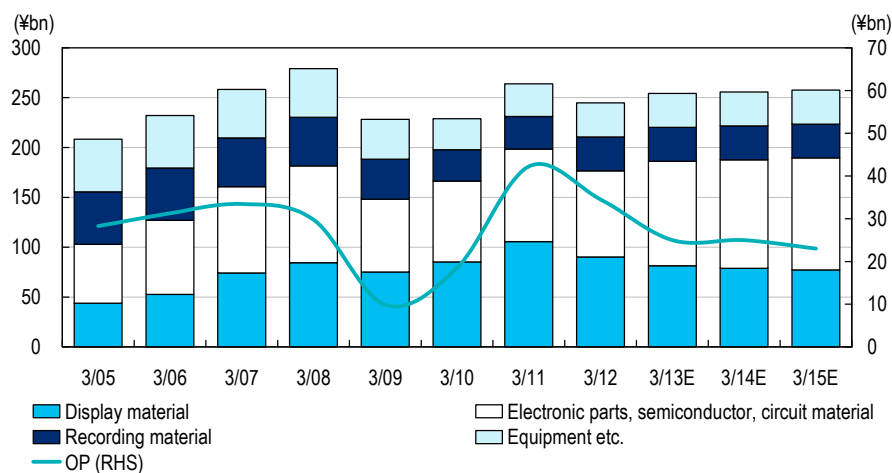
### FY3/13 earnings levels look sustainable

We expect OP from the IT-related products segment to fall 28% YoY in FY3/13, to ¥25bn, equating to about 25% of companywide OP. We assume an operating margin around 10%. The equity market is taking into account the risk of declines in shipments of PDP materials, but these have already fallen off significantly to account for a much reduced proportion of the company's sales, and we think the risk of further earnings deterioration as a result is limited. In addition, assuming 5%–7% annual growth in the market by surface area due to the expanding size of panels in the mainstay demand field of LCDs, we think the shift to higher-value-added materials used in touch panels and color filters for smartphones and tablets, the introduction of new products, and comprehensive cost reductions will allow Toray to sustain its present earnings levels for the time being.

### With its superior film formation technologies, the company has substantial gearing to FPD-related materials

Toray is very competitive in display and circuit materials, and it also produces equipment like slit coaters. In particular, in addition to film formation of PET and polyimide films using its superior film stretching technologies, Toray has strengths in film processing technologies including coating and deposition. The company has also become competitive in paste and coating materials developed via its high-polymer and organic synthesis technologies. The electronics and IT-related products segment comprises four businesses: display materials (32% of sales); electronic component/semiconductor/circuitry materials (41%), recording materials (13%), and equipment, etc. (13%). A number of the components and materials it produces are difficult to categorize, but we think the biggest field of applications is FPD-related products, which directly accounts for about 50% of sales based on our FY3/13 estimates. We expect continued growth in uses such as ceramic capacitors, recording materials, semiconductors, and lithium-ion batteries.

Figure 33. Toray: IT-related product subsegment sales and profit trends



Source: Company data, Citi Research.

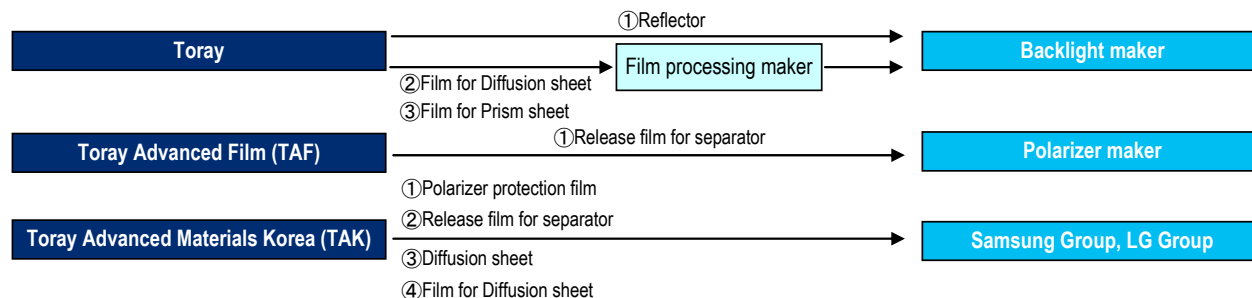
## Display materials

### Shift to higher-value-added and cost-cutting progress

PET films account for about 65% of sales in the display materials subsegment. Toray has a global market share of around 30%. Principal competitors include DuPont Teijin Films, Mitsubishi Chemicals, SKC, Toyobo, and Kolon. Toray has an especially high market share in protective films and release films for major Japanese and South Korean makers of polarizing film, reflecting the superior surface precision and other technologies that are required. The company also produces reflective films and diffusion films for backlights, among other products.

Toray's edges include not only superior base films, but aggressive advances in downstream areas such as high-performance film processing products. Recent sluggishness in LCD TV demand and stepped-up competition due to supply growth have made conditions tougher, prompting the company to respond by expanding sales through TAK in South Korea to take advantage of its cost-competitiveness, and to shift production of materials for prism sheets and microlenses from Japan to China, as it pursues comprehensive cost reductions.

Figure 34. Toray: LCD polyester film supply chain



Source: Company data, Citi Research.

#### Great potential for touchscreen applications

One area where we see the greatest latent growth potential is base films for ITO films used in touchscreens; Toray commands more than 50% of this market. Because of requirements for products that are thin, strong, highly heat-resistant, and help control interference, this is an area where it is easy to find ways to add value. We understand that film-type (glass + film + film, GFF) panels are to be used in the new, smaller Apple iPad scheduled to be announced in October, and we think the success of this product will be important to understanding potential trends for film-based touchscreens in the future.

#### Expansion in color filters for smartphone applications

Color filters account for about 15% of sales in the display materials segment. Toray is focusing on smaller filters, and we think its main customers include Japan Display and AUO. Shipments to Japan Display for G5.5 displays used chiefly in high-end smartphones are set to increase. Looking forward, we anticipate stable volumes and prices, particularly in high-value-added products, supporting earnings.

### Electronic component/semiconductor/circuitry materials

#### Dominant share of market for release films for ceramic capacitors

PET films, and particularly release films for ceramic capacitors, account for about a third of Toray's sales in the electronic component, semiconductor, and circuitry materials business. The company has a dominant market share in this field; we understand major customers include SEMCO and Murata. With growing needs for thinner, flatter, and smoother surfaces, especially in smartphone and tablet PC applications, conditions are ripe for the company to further develop its advantages.

#### Strong ties with Samsung Electronics

Other major products in this area include mounting materials for LCD driver IC and other semiconductor devices. On top of the company's solid relationship with Samsung Electronics, Toray can boast a wide range of products from upstream to downstream. In CoF devices, the supply chain comprises input polyimide film produced by DuPont Teijin, with double-layer ion plating for CoF tape applied at Toray Advanced Film and TAK, and circuitry produced at Toray's STEMCO JV with Samsung. While there has been a supply glut, some competitors have pulled out of

the business, and LCD panel operating rates have been trending up, leading us to anticipate recovery in earnings related to circuitry-products.

**Subsidiary for lithium-ion battery separator business**

In January 2012, Toray made Toray Tonen Specialty Separator, which handles lithium-ion battery separators, into a wholly owned subsidiary. The subsidiary currently ranks third in this field, behind Asahi Kasei and US-based Celgard, with an estimated global market share around 15%. From the latter half of 2012, operations on a new line in South Korea with capacity of 40mn m<sup>2</sup>/year came on-stream, bringing total annual capacity in Japan and South Korea to 130mn m<sup>2</sup>. We expect the company to expand shipments to major South Korean customers like Samsung SDI and LG Chem. Toray uses wet production processes at present, and focuses mainly on consumer-use battery applications, but it is working to bring dry-produced separators that it developed to market, to make maximum use of its strength in film technologies and to win new customers in the market for automotive applications.

**Expectations of growth in polyimide coating materials on new products**

In semiconductor-related materials, Toray holds the top share of the global market for positive polyimide coating materials with about 40%. Competitors in the field include Sumitomo Bakelite, Asahi Kasei, and others. Toray is answering rising needs for low-temperature processes by developing and marketing low-temperature curing materials. We expect its sales to expand more rapidly than the overall market going forward.

## Water treatment business

**High-performance membranes distinguish Toray from peers; aims to lower costs by establishing local footholds**

Toray's water treatment business is strengthened by a complete product line-up that spans the entire spectrum of high-performance water treatment membranes. Each of its five product types—membrane bioreactors (MBRs), micro-filtration (MF) membranes, ultra-filtration (UF) membranes, nano-filtration (NF) membranes, and reverse osmosis (RO) membranes— offer industry-leading performance. We estimate that Toray commands a leading 30% or so share of the global market for RO membranes, where technological requirements are particularly high. The desalination plants of the Middle-East and Asia are increasingly using water treatment membranes that consume less energy than previous evaporation methods and thus offer greater cost-saving benefits. We think this trend will boost growth in demand for RO membranes, where Toray's advantages are easily asserted. Leveraging its nanotechnology strengths, Toray, has for instance successfully managed to increase removal rates for the hazardous substance boron to almost 100% by controlling the pore structure of the membrane surface on a sub-nanometer scale, and orders are consequently building up. Going forward, Toray aims to develop its water treatment business as a long-term growth driver. To that end, it intends to step up JV production in China to drive down costs, minimize forex effects and tap into local demand. In addition, by commercializing the water-treatment business at TAK in South Korea, Toray aims to win new orders and steadily capture replacement demand there.

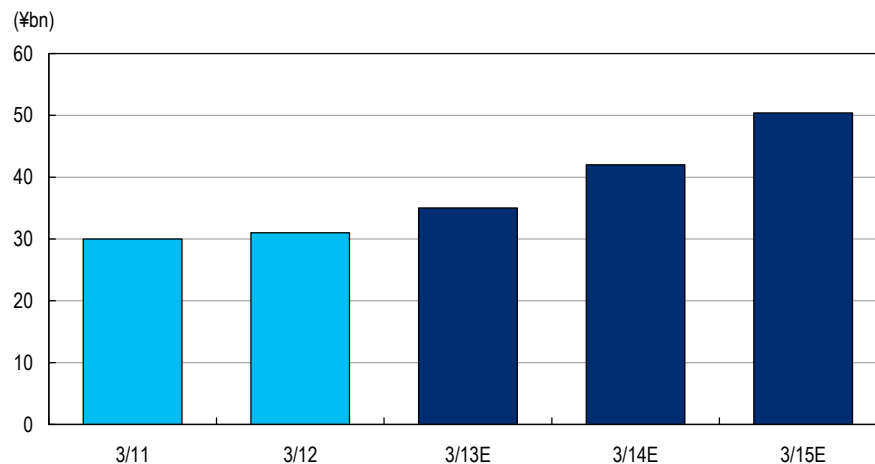
Figure 35. Leading water treatment equipment makers

Company	Country	Reverse osmosis	Nano-filtration	Ultra-filtration	Micro-filtration	Membrane bioreactors
<b>Toray</b>	<b>Japan</b>	◎	○	○	○	○
Nitto Denko	Japan	◎ (Hydranautics)	◎ (Hydranautics)	○ (Hydranautics)	○ (Hydranautics)	○
Mitsubishi Rayon	Japan				○	○
Toyobo	Japan	○		○	△	
Daicel Chemical	Japan	○		○		
Asahi Kasei	Japan			○	◎	○
Kubota	Japan					◎
Dow	US	◎ (Filmtec)	◎ (Filmtec)		○ (Omex)	○ (Omex)
Koch	US	◎ (UOP)	△ (UOP)	○ (Abcor)	○ (Abcor)	○ (Puron)
General Electric	US	○ (Osmonics)	○ (Osmonics)	◎ (Zenon)		◎ (Zenon)
Siemens	Germany				◎ (Memcor)	○ (Memcor)
Norit	Netherlands			◎ (X-Flow)		
Woongjin Chemical	South Korea	○ (Saehan)	○ (Saehan)			
Motimo	China			○	○	○
Vontron	China	○	○			

Note: ◎ : Has market-leading products, ○ : Has products on the market, △ : Has products under development.

Source: Company data, Citi Research.

Figure 36. Toray: Water-treatment business sales



Source: Citi Research estimates and forecasts.

Figure 37. Toray RO membrane customers: Desalination plants

Country	Location	Water production capacity (m <sup>3</sup> /d)	Year opened
Algeria	Magtaa	500,000	2012
Singapore	Tuas II	318,500	2013
Bahrain	Al Dur	218,000	2011
Algeria	Hamma	200,000	2008
Saudi Arabia	Shuaibah	150,000	2009
Trinidad & Tobago	Point Lisas	136,000	2002
Singapore	Tuas	136,000	2005
UAE	Fujairah 2	136,000	2010
Kuwait	Shuwaikh	136,000	2010
Israel	Palmachim	124,270	2007

Source: Company data, Citi Research.

Figure 38. Toray RO membrane customers: Waste-water recovery plants

Country	Location	Water production capacity (m <sup>3</sup> /d)	Year opened
Kuwait	Sulaibiya	320,000	2005
Singapore	Changi	228,000	2009
China	Ningxia	78,000	2008
Australia	Luggage Point	66,000	2008
Australia	Western Sydney	57,000	2010
China	Tianjin TEDA	30,000	2006
China	Dongguan	25,000	2005
Singapore	Seletar	24,000	2004
China	Tianjin Dongjiao	12,000	2008
South Africa	Lethabo	11,350	2003

Source: Company data, Citi Research.

## Toray Industries

### Investment strategy

We rate the shares of Toray Buy (1), with a ¥580 target price. In fibers and textiles, the main earnings driver, the prospects are in sight for further volume expansion in woven products. Also, the build rate for the Boeing 787 is a key factor in Toray's share price, and we expect it to rise. LCDs are on a recovery trajectory, and growth in new demand for products such as touchscreen films and separator films for capacitors used in smartphones is positive. Furthermore, fuel consumption restrictions are likely to accelerate the trend toward lighter-weight vehicles, and we therefore expect growth in demand for carbon fiber for automotive applications.

### Valuation

We reference the following factors in setting our target price for Toray. (1) Historical average valuations: Over the last five years, the shares have traded on an average PER of 19x and an average EV/EBITDA multiple of 8x (excluding outliers). (2) Sum-of-the-parts: Referencing industry PERs and other metrics, we set fair value target PERs at 18x for fibers and textiles, 13x for plastics and chemicals, 12x for electronics and IT-related products, 18x for carbon fiber and composite materials, 15x for environment and engineering, and 14x for life science and other businesses. Weighting these by OP, we arrive at a companywide target PER of 15x (on our FY3/13 forecasts). (3) Earnings momentum: Carbon fiber earnings are recovering and we expect high earnings levels to be maintained in fibers. Referencing historical valuations and our SoTP approach, we think an FY3/13E PER of 16x is reasonable, and we set a target price of ¥580.

### Risks

We believe risks to our target price include the following: 1) the demand environment, input costs, and other factors diverging from our assumptions for the fiber & textiles and plastics segment; 2) demand and price volatility for displays and semiconductors affecting electronics & IT products segment earnings; and 3) changes in demand trends and supply capacity expansion causing the carbon fiber supply-demand balance to diverge from our assumption.

## Appendix A-1

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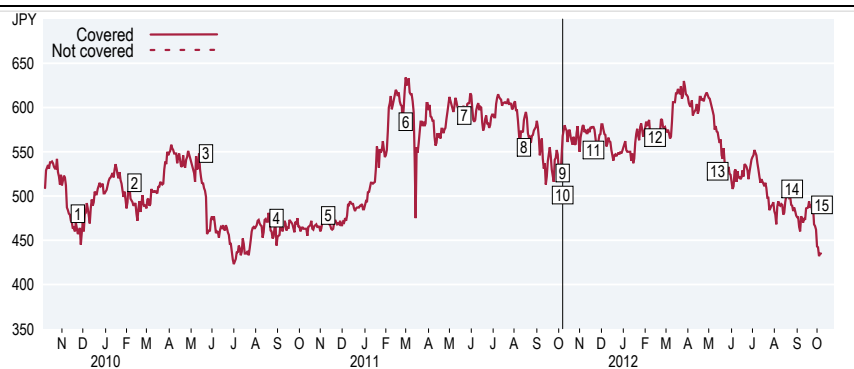
## IMPORTANT DISCLOSURES

### Toray Industries (3402)

#### Ratings and Target Price History Fundamental Research

Analyst: Atsushi Ikeda

Covered since December 22 2009



Date	Rating	Target Price	Closing Price
1 24-Nov-09	2M	*500	457
2 11-Feb-10	2M	*530	489
3 24-May-10	2M	*510	499
4 31-Aug-10	2M	*520	444
5 11-Nov-10	2M	*530	470

\* Indicates change

Date	Rating	Target Price	Closing Price
6 1-Mar-11	*1M	*750	634
7 23-May-11	1M	*770	599
8 14-Aug-11	1M	*700	572
9 7-Oct-11	Stock rating system changed		
10 7-Oct-11	*1	700	568

Date	Rating	Target Price	Closing Price
11 21-Nov-11	1	*660	578
12 15-Feb-12	1	*680	573
13 14-May-12	1	*690	572
14 27-Aug-12	1	*630	489
15 8-Oct-12	1	*580	435

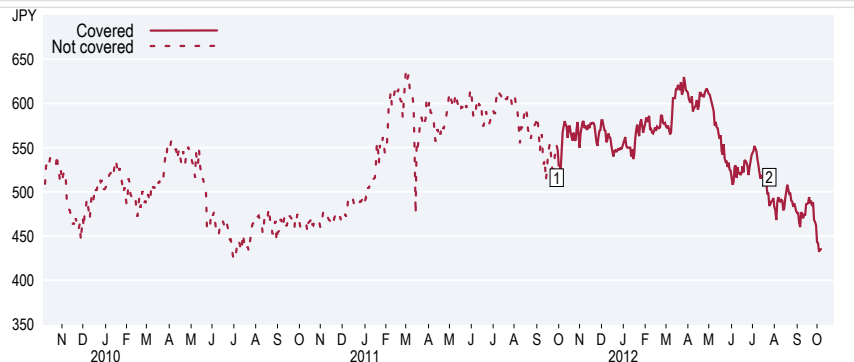
Rating/target price changes above reflect Eastern Standard Time

### Toray Industries (3402)

#### Ratings and Target Price History Best Ideas Research Relative Call (3 Month)

Analyst: Atsushi Ikeda

Covered since December 22 2009



Date	Rating	Target Price	Closing Price
1 29-Sep-11	*ADD MP	-	552

\* Indicates change

Date	Rating	Target Price	Closing Price
2 25-Jul-12	*REM MP	-	484

Rating/target price changes above reflect Eastern Standard Time

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