



Special Feature: Dynamic Balance

Dynamic Balance

A dynamic balance spans Tosoh's manufacturing operations, overseas operations, and product portfolio. It underpins our business strategies—their development and implementation.

Dynamically Balanced Manufacturing Operations

Dynamic balance begins in our manufacturing operations. Integrated production processes are essential to Tosoh's competitiveness. Bottlenecks, inefficient processes, and insufficient or excess production volumes are counterproductive and therefore costly. Balancing the largest integrated production capacity in Asia for vinyl products is a massive but crucial undertaking encompassing electric power, electrolysis, ethylene dichloride (EDC), vinyl chloride monomer (VCM), and polyvinyl chloride (PVC) plants and a global sales network.

A snapshot of the intricate interplay of processes within [our manufacturing operations](#) reveals why a dynamic balance of synergies is so essential. Inexpensive electricity and steam generated by our advanced electric power plants allow us to cost-effectively produce chlorine, sodium hydroxide, and hydrogen through electrolysis. The chlorine is the core feedstock driving our vinyl chain and a key raw material for our production of methylene diphenyl diisocyanate (MDI). MDI, in turn, is a principal raw material for polyurethane production and is central to making our vinyl chain a vinyl isocyanate chain.

As a by-product, our MDI production process also generates hydrogen chloride, which is recycled into our VCM production in Japan. The synergies between our VCM and MDI operations enable us to manufacture these products at significantly lower costs than our competitors. MDI manufacturing, meanwhile, also benefits from the low-cost hydrogen produced through electrolysis. We employ that hydrogen in making aniline, another important element for MDI production.

Balancing the making of each raw material and end product ensures a cost-competitive and stable internal supply for our operations. And that, in turn, guarantees a cost-competitive and stable external supply for our customers' needs at home and abroad.

Dynamically Balanced Overseas Operations

The dynamic balance that characterizes our manufacturing operations extends throughout our overseas operations. This ensures that the cascade of intermediate and end products from our vinyl isocyanate chain continues to flow.

When you manufacture as much as a million metric tons of a single product annually, it is important to ensure dependable consumption. All of the product, in other words, must be consumed. The dynamic balance of processes along the vinyl isocyanate chain is so interdependently linked that if one product suffers an interruption the chain is broken and the balance lost.

In our chlor-alkali business, for example, we have set up a [network](#) of PVC manufacturing and sales subsidiaries. They are strategically positioned throughout Southeast Asia and in China to ensure that their core chlor-alkali products are consumed and that the vinyl isocyanate chain and its flow of products thereby remain intact.

We furnish these subsidiaries, moreover, with raw materials at prices unaffected by availability or other fluctuations in international markets. The resulting control that this gives them over their product prices is designed to help them succeed and contributes to stable earnings for the Tosoh Group as a whole.

Here again, the balance is dynamic and vital to our success. Tosoh reaps a myriad of benefits when a product travels all the way through the manufacturing chain to a sale by a group subsidiary. Such is the beauty of balance that it also grants control.

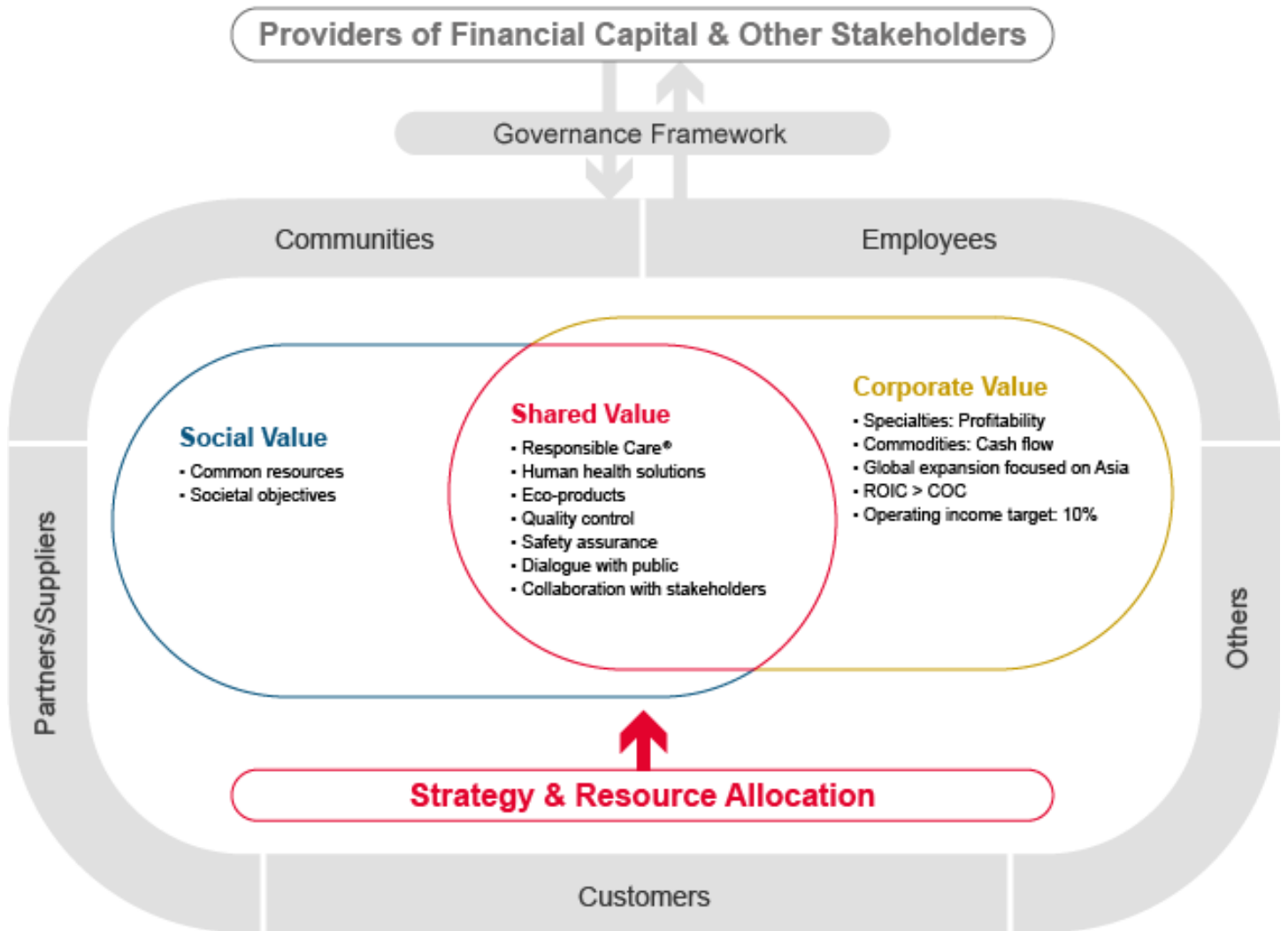
Dynamically Balanced Product Portfolio

Tosoh's introduction of specialty products to its product portfolio sprang from its need to counteract the cyclicity of its commodity operations amid the leapfrogging of demand and capacity. The company targets highly profitable niche specialty material markets where the opportunity exists to get in on the ground floor of emerging markets or where it has a technological advantage to ensure the dynamic balance of its product portfolio.

Originally, our strategic mix of specialties and commodities was meant only to mitigate downturns in commodity markets. The role of specialties in our operations has, of course, expanded, but their buffering capability remains valid and was amply demonstrated in fiscal 2014.

The Chlor-alkali Group, which accounts for many of our commodities products, contributed 37.1% of our consolidated net sales in fiscal 2014 but only 9.3% of our operating income. The Specialty Group, conversely, produced 46.2% of operating income on only 19.9% of net sales. The dynamic balance that supports our dual commodities and specialties strategy thus remains sound—sales of specialties continue to counteract downturns in commodities and to increase our profitability.

Creating Shared Value





Special Feature: Opportunities and Risks

Opportunities and Risks

Beyond ensuring stable cash flow and profitability, Tosoh's dual commodities and specialties strategy also hedges risks. Those risks include prices for crude oil and naphtha, which are essential fuels and raw materials for our commodity operations; trends in domestic and global economies and markets; disruptions to supply chains; and regulations on environmental protection. The diversity of Tosoh specialty products serving the world's semiconductor, consumer electronics, pharmaceutical, bioscience, automotive, and health care industries offers a degree of stability against such risks.

Our specialty products, though, have outgrown being merely a risk hedge. They represent an opportunity as a platform for Tosoh's business expansion. So we are determined to hold to our dual commodities and specialties strategy. It grants us the flexibility to adjust quickly to movements in our markets. And its dynamic balance allows us to take business risks and to view dire business circumstances with confidence.

The Tosoh Group's horizontal sharing of technologies can lead to solutions that can be commercialized. Adjusting the production mixes of our products enables us to reduce our exposure in weak markets and to capitalize on opportunities in rising markets. Increasingly strict environmental regulations also represent an opportunity to sell technological solutions to industry. The list goes on, but the bottom line is that we possess numerous means to reduce risk and attain sustainable growth.



Special Feature: Sustainable Growth

Sustainable Growth

Our chemical commodities and our high-tech growth specialties propel our sustainable growth. The 37.1% of consolidated net sales generated by the Chlor-alkali Group in fiscal 2014—without the contribution of the Petrochemical Group's commodities—supplied the essential cash flow needed to cover the fixed costs and other expenses necessary for Tosoh to remain a going concern. This is as important to our customers as it is to us. Manufacturers around the world count on Tosoh to support their operations with stable supplies of raw materials. We fulfill that responsibility globally while remaining focused on market movements.

Our high-tech growth specialties, meanwhile, feature a long-standing tradition of frontier technology research. We develop the results first for highly profitable niche markets and later for substantially larger markets. This keeps us in tune with progress in contemporary industry and abreast of future industries. In this sense, our high-tech specialties are the growth drivers that lead the way in our pursuit of sustainable growth.

High-silica zeolites (HSZ) are a top Tosoh high-tech growth driver. These molecular sieves and their superior thermal stability, catalytic, and adsorption properties serve numerous purposes in the manufacturing and environmental industries. The short list includes petroleum refining catalysts; petrochemical catalysts; adsorbents of volatile organic compounds (VOCs); and catalyst material for automobile exhaust system catalytic converters. Soaring demand compelled Tosoh to double HSZ production capacity in 2009, substantially increase it again in 2013, and schedule another doubling of it for 2014.

The popularity of Tosoh's yttria-stabilized zirconia (YSZ) stems from a technological breakthrough that solved the characteristic brittleness of ceramics. Commonly known as ceramic steel, YSZ has high strength and wear resistance, flexibility, a long life, and heat-insulating properties and is basically chemically inert—a manufacturer's dream material.

YSZ's uses go beyond industry. It also is used in consumer goods and dental materials because of its natural beauty and soft texture. Amid soaring demand, Tosoh expanded YSZ production capacity 50% in 2009 and another 20% in 2012. YSZ appears poised for further growth following Tosoh's April 2014 announcement of its development of a nanocrystalline, ultra-degradation-resistant zirconia that is far superior to conventional products.

In the biosciences, Tosoh's Toyopearl is a longtime top seller in the separation media market, populated by pharmaceutical, food product, and bioscience companies. Toyopearl appeals to customers through its high quality, performance, and grades of packing materials for chromatography methods too numerous to mention.

Tosoh's Toyopearl portfolio helps purify virtually any protein, peptide, enzyme, nucleic acid, antibiotic, or small molecule. And Tosoh's global network of technical support services only adds to Toyopearl's appeal. Driving demand is the biopharmaceutical industry's global expansion and emphasis on biosimilar molecule development and antibody drug purification. And meeting demand depends heavily on efficient operations.



Special Feature: Efficiency

Efficiency

Efficiency and innovation fine-tune Tosoh's dynamic balance and thereby keep the company competitive and profitable. Global competition and growing economies compel Tosoh to reinvent and reengineer its processes and methodologies to heighten efficiency and productivity.

Our manufacturing and R&D operations work to improve our integrated vinyl isocyanate chain operations. We recently, for example, converted our MDI operations to a low-cost production process to stay apace of growing competition. We also are developing a piperazine (PIP) synthesis method to expand the potential of our ethyleneamine production line to raw materials for heavy metal chelating agents and reactive triethylenediamine (TEDA). And our recently expanded Toyopearl production capacity depends on new purification processes to broaden its targeted markets.

Debottlenecking production by improving processes often represents an inexpensive alternative to adding production capacity. Our decision to debottleneck our proprietary oxychlorination process at the Nanyo Complex added 200,000 metric tons of VCM production capacity. And our debottlenecking of CSM production in 2012 raised CSM production capacity by 1,000 metric tons, or more than 10%.

Technology is helping us deal with rising naphtha costs through feedstock diversification. We've enabled our crackers to employ heavier naphtha grades, improved the recovery efficiency for spent C4 and C5 fractions, and switched to butane and propane to enhance the flexibility of feedstock selection.

Sometimes, we work externally to develop production technology to keep us competitive. The n-BiTAC electrolyzers that we developed jointly with Chlorine Engineers Co., Ltd., have almost doubled production in our electrolysis plants since 1990. Yet we've still managed to reduce their energy calorie units 9%.

Labor productivity is crucial to production efficiency. Tosoh focuses on training and occupational safety and health. Training takes place on-site and through classes and Internet courses with an eye to each employee's abilities and career development.

Our Responsible Care (RC) program has in place many systems to monitor and improve safety methods and enhance employee safety awareness. Incidents or accidents are thoroughly investigated and analyzed to prevent repeats.

We also protect the physical and mental health of our employees with awareness and checkup and health monitoring programs. We especially watch employees with specific health concerns. Accidents and lost workdays because of sickness have a greater impact on labor productivity than lost workdays due to safety-related lost time incidents and accidents. Much of what we do to ensure productivity and efficiency overall results from our ability to innovate.



Special Feature: Innovation

Innovation

Innovation is as important to competitive strength and profitability as efficiency. At Tosoh, innovation springs mostly from the creative solutions provided by Tosoh's research and development (R&D) operations. Those solutions, so much the stock and trade of all businesses, keep the Tosoh Group's production and marketing at the top of their games.

The Specialty Group, for example, innovates based on the creative solutions furnished by our R&D personnel. It develops and improves technologies that support a steady stream of materials and products for the electronics, bioscience, and environmental conservation fields.

Rotary sputtering targets for the electronics industry are a prime example of the trend-setting technologies that Tosoh is developing. They are, at 70% to 80% efficiency, some 2.5 times more efficient than planar sputtering targets. Rotary sputtering targets also offer longer life and greater productivity. Tosoh was one of the first companies to develop and introduce rotary sputtering targets and so was well prepared for the wave of touch panels and other devices from the electronics industry that are the biggest applications for rotary sputtering targets.

Our R&D and innovation in the biosciences have the benefit of putting our products into the hands of people who make a difference. Examples include the many compact models of diagnostic equipment that we've developed to aid in the diagnosis and care of infectious and lifestyle diseases, including diabetes and high blood cholesterol. Innovation also is reflected in our joint research project on the frontier of bioscience with a university in Japan. That project seeks to develop a reagent for the detection and monitoring of a peptide to advance a cancer peptide therapy that involves creating a "cancer vaccine."

TS-300, our piperazine heavy metal treatment agent for incinerator fly ash, is an example of creative R&D in environmental conservation. It is specifically designed based on the latest trends in garbage treatment and incineration, such as increased melting treatments. The result: TS-300 features enhanced safety and functionality.

R&D for the Chlor-alkali Group is a search for innovative technologies to improve the productivity and quality of the processes and products of Tosoh's vinyl isocyanate chain. In fact, R&D by Tosoh and NPU is crucial to NPU's recovery. It supports NPU's enhanced cost-efficiencies, shift to higher-value-added products, and improved quality and thus higher price structure.

Petrochemical Group R&D revolves around reengineering cracker operations to raise output and improving and developing polymers and related technologies. Observing market trends opens opportunities for customization. A sharp decline, for example, in the C4 fraction production of butadiene and aromatic products, such as benzene, because of the switch to natural gas feedstock for crackers has opened a market for catalysts for the organic syntheses of these chemicals.

Also noteworthy is our R&D on the industrial-scale palladium-catalyzed cross-coupling production process used in the manufacture of liquid crystal display (LCD) and organic light-emitting diode (OLED) materials and pharmaceutical intermediaries. Tosoh enlisted the joint winner of the 2010 Nobel Prize in Chemistry, Emeritus Professor Akira Suzuki, of Hokkaido University, to help it commercialize its innovative process.