Product competitiveness

Create strong next-generation products

In the era of the Internet of Things (IoT), when a variety of objects can connect to the internet, semiconductor and flat panel display technologies support the expansion of new business models and lifestyles. In such circumstances, it is important to deliver high added-value and competitive products in a timely fashion in order to ensure continuous business expansion. Tokyo Electron engages in cutting-edge development to produce next-generation products featuring innovative technology. Furthermore, we are conscious of the importance of global environmental issues such as climate change and resource depletion and we strive to implement measures to reduce the environmental burden of our products. Through innovative technology and environmentally conscious products that will support the next generation, we contribute to the building of a sustainable society.

Priority themes

- Tackling technological innovation
- Environmental contribution of products

Relevant SDGs

- 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE — Industry, innovation and infrastructure
- 13 CLIMATE ACTION — Climate action

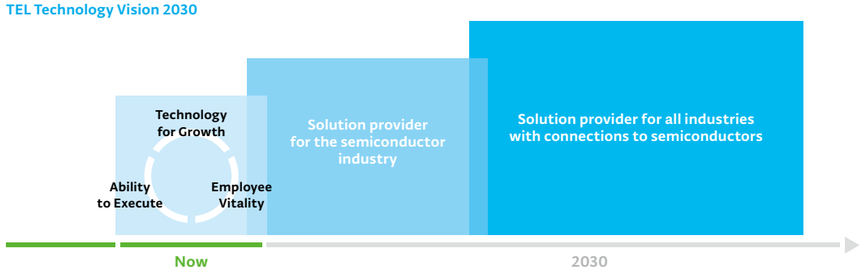
SUSTAINABLE DEVELOPMENT GOALS

Research and development

Research and development for the future

As lifestyles and business models undergo dramatic changes in the era of the Internet of Things (IoT), it is anticipated that the use of semiconductors will expand in all industries, and there will be demands for even more advanced technologies. As electronics become even familiar for people, semiconductors become a larger part of everyday life. Tokyo Electron (TEL) has settled on the TEL Technology Vision 2030 from a medium- to long-term perspective, and is holding lively discussions regarding technology for the future as well as its contribution.

TEL Technology Vision 2030



Development system

TEL has a system, which promotes technology development and technology innovation for the next generation, in collaboration with the Development & Production Division and business divisions to bring high-value-added products to market in a timely fashion. In fiscal year 2018, Tokyo Electron Technology Solutions was established, merging the factories in Yamanashi and Tohoku. As a result, resources relating to deposition technologies—one of our strengths—were centralized, and our process integration functions were strengthened. Also, in Tokyo Electron Miyagi, construction of a new R&D building has begun to accelerate the technology innovation of etch systems. We are creating one of the foremost development environments in the industry.

Intellectual property management

TEL's basic policy is to increase corporate revenues by supporting business through intellectual property (IP) protection. IP personnel are assigned at R&D/manufacturing facilities and at the headquarters. In order to boost competitiveness of TEL's products, they build IP portfolios that go well with technology and product strategies through assessment of R&D and marketing activities from various angles including R&D and marketing viewpoints.

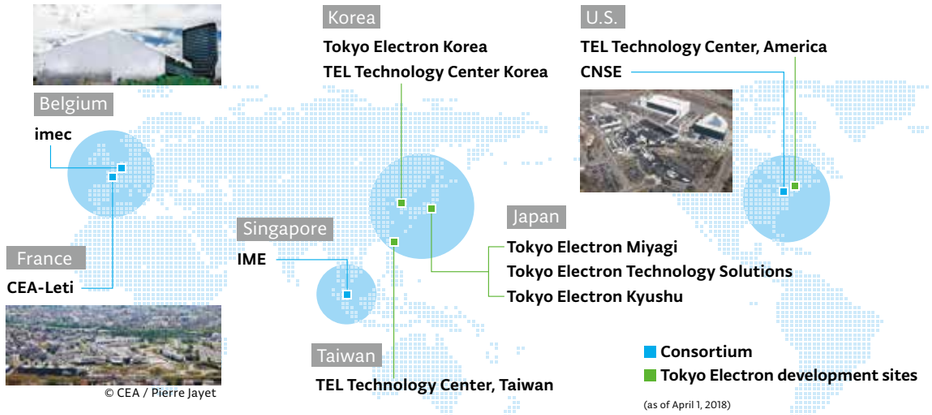
In fiscal year 2018, TEL introduced an integrated IT platform for managing TEL's worldwide intellectual properties. This platform is accessible from any employees involved in IP activities, and strongly supports worldwide R&D activities. We have maintained global patent application rates* around 70% in the last seven years. In 2017, we maintained high patent application success rates: 71.5% in Japan and 78.0% in the United States. To increase IP awareness, we continuously educate engineers, who are the foundation of TEL's R&D strategy; in total around 3,900 engineers have become inventors.

* Global patent application rates: Percentage of invention applications filed in multiple countries

Collaborating with consortiums

Along with enhancing its own research and development capabilities, TEL is also engaged in the development of cutting-edge technologies in collaboration with international and domestic consortiums.

In the U.S. state of New York, we have participated in the Albany NanoTech megaplex since its establishment in 2003. Here, global device manufacturers and makers of semiconductor production equipment have participated to build a comprehensive semiconductor production line, where we can verify integrated process development and its effectiveness. Taking advantage of an environment close to the actual device manufacturing, we also conduct joint research projects aimed at resolving specific issues faced by customers. Based in a world-class development environment, our team of more than 100 engineers are advancing efficient development, committed to researching next-generation semiconductor production equipment and processes directly linked to business.



Tackling technological innovation

Integrating logic and memory

In this era of IoT, data centers are processing massive amounts of data such as in information and image analysis, and as the increasing power consumption of semiconductor devices proves to be an issue, attention is being drawn to neuromorphic devices inspired by the neural circuits of humans. Computers in data centers consume power in the order of several tens of kilowatts, but the human brain consumes only about 20W when doing the same processing. Similarly, whereas the operating frequency[1] of today's semiconductor devices is 5 GHz, the human brain runs at just several tens of hertz. Neuromorphic devices use synaptic connections[2] to integrate the processing function and the memory function, which had previously been divided between logic and memory of a conventional microprocessor. This enables a higher degree of information processing with less power consumption like the human brain.

Leveraging its strengths in deposition technologies and pattern technologies, Tokyo Electron (TEL) has initiated research efforts into new materials needed for next-generation computing, such as neuromorphic devices, quantum computers, as well as manufacturing processes for utilizing these materials.

1 Operating frequency (or clock speed): The number of signals per second to adjust the pace of processing of multiple electronic circuits. Indicates the processing performance of the computer. The higher the frequency, the more power is consumed.

2 Synaptic connection: A junction formed between neurons (cells making up the nervous system of an animal) regarded as having an important role in learning and memory.

Use of AI technologies

TEL is promoting the use of AI[1] in order to achieve more efficient and stable equipment operation. In addition to strengthening the training of experts in machine learning, such as through study programs at overseas universities, in 2017, we established a division responsible for technological innovation utilizing AI, as well as a division responsible for planning the interdivisional use of data. Thus, we are putting in place an organizational structure that promotes planning, marketing and development activities on a company-wide basis.

With this structure, we are driving our efforts using AI to analyze the vast amounts of data coming out of our equipment, to help us predict and control the condition of the equipment. By monitoring the operating status of our semiconductor production equipment in real time via the internet, and using AI to analyze that data, we target to meet the demands of our customers, namely, maintaining equipment performance, achieving wafer process uniformity, and avoiding unexpected downtime.

1 AI: Artificial Intelligence

Addressing advancements in display

Flat panel display (FPD) has evolved along with advancements in liquid crystal technology to a high resolution that cannot be identified by the human retina. In recent years, there has been greater adoption, particularly for smartphones, of organic EL display, which can produce a brighter screen with less power. These advancements have been supported by technology for forming minute electronic circuits on glass substrates, for which our equipment is widely used in the etch process.

TEL adopted the industry's first high-density plasma generation technology, known as ICP,[2] and developed PICP™[3] that advanced this technology further. PICP™ creates even more uniform plasma compared with conventional ICP, enabling fine etch and achieving formation of a uniform fine circuit over the whole substrate. In addition, this technology provides stable quality, improved productivity, and extends the replacement cycle of consumable parts, thus reducing environmental burden.

In the future, it is expected that demands on the display market will progressively increase for features such as high definition, low power consumption, Free Form,[4] Flexible[5] and Touch UI[6] on the display market. Therefore even finer circuit formation is essential to achieve these. TEL will make significant contributions to the future advancement and development of displays by enabling production of fine, uniform circuits required for leading-edge displays.

2 ICP: Inductively Coupled Plasma

3 PICP™: Planar Inductively Coupled Plasma™, which describes the creation of extremely uniform high density plasma on a panel substrate

4 Free Form: Non-rectangular shaped display

5 Flexible: Bendable and freely deformable display

6 Touch UI: Touch User Interface is a computer-pointing technology based upon the sense of touch

Betelex™

Impressio™

Executive message

The semiconductor and FPD industry is evolving more and more with the dawning era of the Internet of Things (IoT). In response, we will create customer value, developing competitive new technologies and products at a rate faster than the industry evolves.

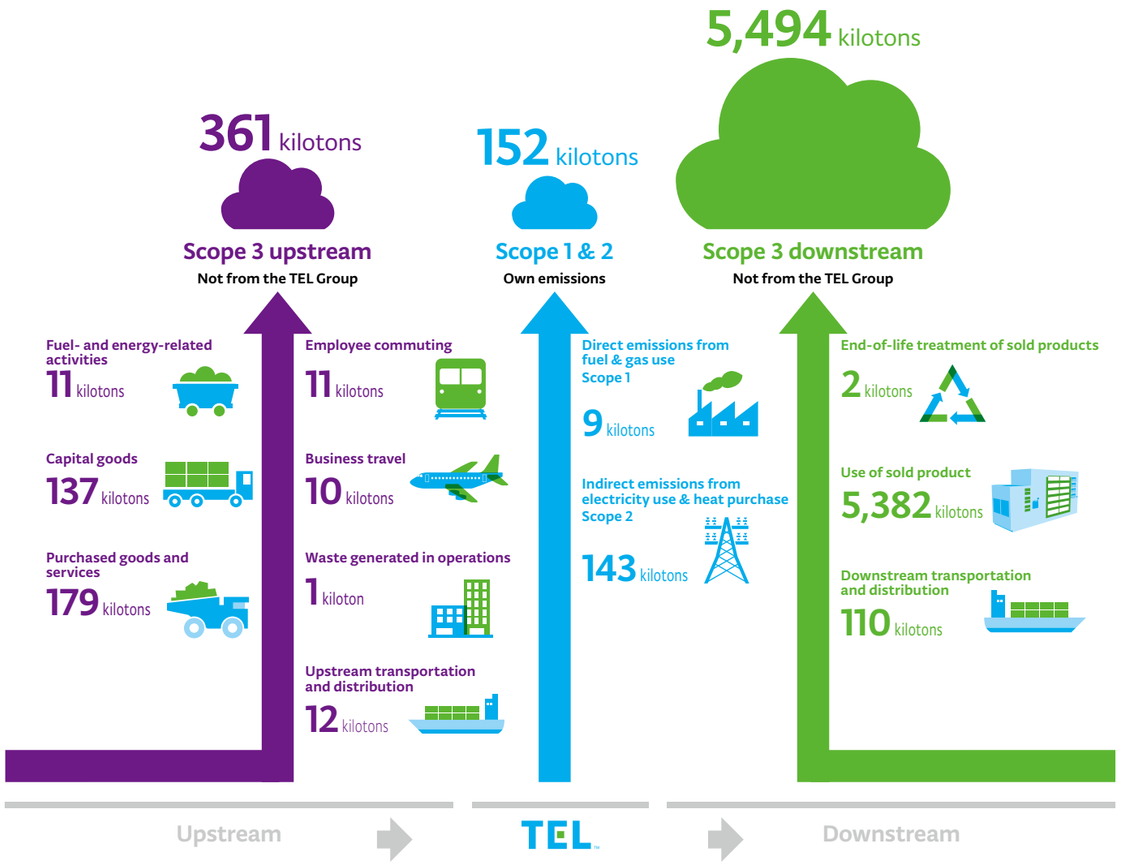
We will continue our efforts to create new value by combining and integrating our various technologies with those of universities, business partners and other external parties. With challenges though comes failure. Our view is that constructive failure hails future success. We believe that repeated challenges revitalize the organization, nurture human resources and produce innovative technologies and products, which in turn, will help create value for customers in the future.

Yoshifumi Tahara
Senior Vice President and General Manager, Development & Production 4th Division

Environmental contribution of products

CO_2 emissions across the value chain

Tokyo Electron (TEL) believes it is important to recognize environmental impact throughout the value chain in conducting its business activities. We aim to resolve environmental problems through leading technology and reliable services, in line with our environmental slogan "Technology for Eco Life."



Scope 1: Direct GHG emissions from use of fuel and gas owned or controlled by TEL

Scope 2: Indirect GHG emissions from use of electricity, steam and heat purchased by TEL

Scope 3: Emissions from corporate value chains (excluding scope 1 and 2 emissions), such as product transportation, employee business travel, and major outsourced production processes

* Scope 3 is divided into upstream activities, which include emissions associated with purchased or procured products and services, and downstream activities, which include emissions associated with sold products and services

The total of Scope 1 and Scope 2 of the TEL Group is 152 kilotons, while Scope 3 accounts for a total of 5,855 kilotons, which is approximately 97% of the total. We believe that it is particularly important to develop products with low CO_2 emissions during operation, as CO_2 emissions from the use of products sold amount to 5,382 kilotons, which is 90% of the overall total.

Products that contribute to a sustainable society

Of the total CO_2 emissions from the TEL value chain, emissions arising from product use account for 90% of our total CO_2 emissions. For this reason, we have made it a key corporate objective to promote environmentally friendly product design, and lower the energy consumption of our products.

In fiscal year 2015, we established a goal to reduce energy and pure water consumption by 10% by fiscal year 2019, using fiscal year 2014 consumption as the baseline. To achieve this goal, we are working to reduce energy use and improve overall throughput. As a result, we achieved the goal for one model in fiscal year 2016 and three models in fiscal year 2017 ahead of schedule. Moreover, even after achieving the goal, we have maintained our efforts for these models. For instance, in fiscal year 2017 we achieved our 10% reduction goal for the Precio™ XL test system. Then in fiscal year 2018, by switching to energy-efficient motors, we were able to reduce power consumption per wafer by a further 20%. In addition, in fiscal year 2018, the percentage of sales from energy-saving models based on in-house standards was 92.8% of total product sales.

To further reduce the overall environmental impact of our products, we must examine our primary equipment, peripherals, associated facilities, and management at our customers' factories. Going forward, it will become increasingly important to improve the operational efficiency of our equipment and encourage overall energy-efficient operations at our customers' factories.

Power consumption reduction rate*

20% reduction

* Test System Precio™ XL power consumption per wafer

Percentage of energy-saving model* sales in total sales

92.8%

* Based on in-house standards

Initiatives for product environmental laws and regulations

In order to comply with each country's environmental laws and regulations pertaining to products, TEL proactively collects information and takes appropriate action as required. An example of our efforts for EU REACH[1] regulations is that we investigate the presence of any substances of very high concern (SVHC) in articles, and disclose information appropriately. As for efforts for GHS[2] requirements, we provide safety data sheets (SDS) when selling chemical goods.

In fiscal year 2018, we established a new environmental IT system, making it possible to share information more efficiently with our supply chain. In addition, we have also continued to offer "web based training for Product Environment Compliance" to all employees, providing a description of the frequently revised environmental laws and regulations and product compliance. We also provide suppliers with information on the relevant environmental laws and regulations. We had no violations of environmental laws and regulations during fiscal year 2018.

We will continue to rapidly monitor each country's environmental laws and regulations, and strive to take appropriate action.

1 EU REACH: An EU regulation pertaining to the registration, evaluation, authorisation, and restriction of chemicals

2 GHS: Globally Harmonized System of classification and labelling of chemicals

Logistics initiatives

URL www.tel.com/csr/environment/product/

As logistics regulations have become more stringent in recent years and the demand for a lower impact on the environment rises, TEL has been promoting modal shifts[3] and other activities designed to reduce the environmental burden of its logistics.

3 Modal shift: Switch of transportation means from truck or aircraft to one that has a lower impact on the environment, such as rail or ships