

Society will experience a communications revolution due to the introduction of 5G next-generation communication standard, while the coming age of IoT linking everyday objects will see the advancement of big data processing by AI, together with diversifying services which use it, and semiconductors and FPD plays a central role in these developments. It is important that Tokyo Electron (TEL) promotes leading-edge research and development to meet various demands for technological innovation, and provides equipment and services to meet expanding applications. TEL strives to preserve the global environment by recognizing environmental impact throughout the value chain, and offering products that are conscious of reducing this impact. The company will contribute to the further development of industry and society through the timely creation of high added-value and competitive next-generation products.

Medium-term goals (1)

Create strong next-generation products

Priority themes, Main activities:



Tackling technological innovation

R&D

R&D for the future, front-loading, collaboration with consortia, IP management

Tackling technological innovation

Integrating analog and digital, leveraging AI technology, responding to developments in display

Environmental contribution of products

Products that contribute to a sustainable society, initiatives concerning environmental laws and regulations related to products



Environmental contribution of products

SDGs initiatives

- Aim to build a more sustainable society by promoting further innovation through innovative technology
- Contribute to the reduction of environmental impact on a global level by providing products and services that are conscious of the environment



Industry, innovation and infrastructure



Climate action

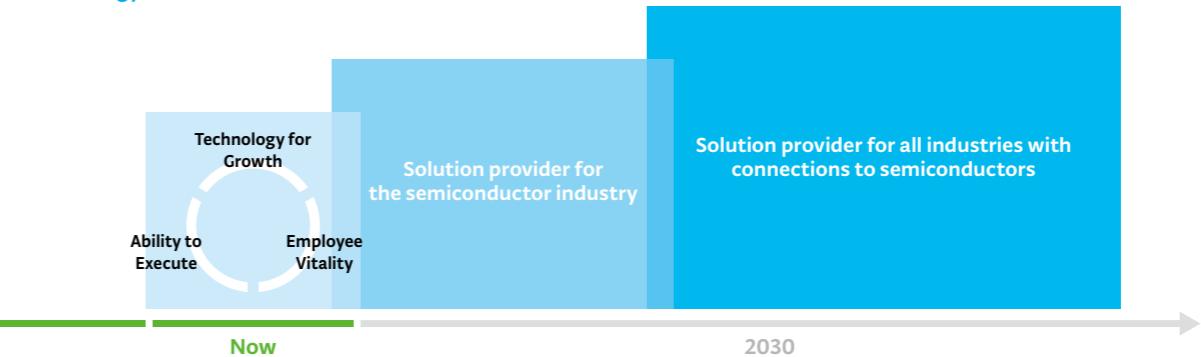
SUSTAINABLE DEVELOPMENT GOALS

Research and development

Research and development for the future

As lifestyles and business models undergo dramatic changes in the era of the 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. In readiness, Tokyo Electron (TEL) formulated and released the TEL Technology Vision 2030. TEL is continuously engaged in rigorous debate regarding technology for the future and TEL's contribution, and is actively communicating the results of this within the company.

TEL Technology Vision 2030

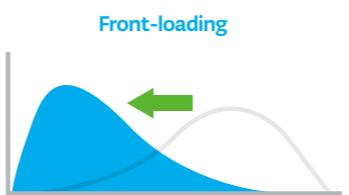


Development system

TEL attaches weight to promoting technology development and technology innovation for the next generations, and has built a system in which its Development & Production Divisions collaborate with Business Divisions to bring high-value-added products into the market in a timely fashion. In 2018, TEL established the Corporate Innovation Division, which strives to further strengthen process integration capabilities maximizing TEL's strengths in deposition and etching technologies, based on its wide lineup of semiconductor production equipment. Under this new structure, TEL has been accelerating technological innovation as well as cross-functional development.

Front-loading

TEL is focusing on front-loading, investing resources (including technology, personnel, and money) in the early processes of product development. The company shares its technology roadmap with customers who aim for next-generation and next-next-generation research and development and beyond, and is engaged in development of the various technologies required for its realization. TEL proposes its unique technologies to promote on-site collaboration for early introduction of evaluation units at customers' plants and research and development laboratories, aiming for acceleration and maximum efficiency of technology development and conversion to mass production equipment.



- Sharing of multi-generation technology roadmap with customers
- Promotion of early engagement
- Maximization of yield for customer devices and equipment operating rate from early stages of mass production, and also reduction of environmental impact
- Promotion of improvement in work efficiency and per person productivity, and further increase in investments into human resources and development

- Business deployment utilizing the industry's largest number of products delivered (69,000 units)
- TELeMetrics™ remote maintenance
- Predictive maintenance using machine learning

Intellectual property management

In its intellectual property-related activities, TEL's basic policy is to contribute to increased corporate revenues by supporting business activities through appropriate protection of intellectual property (IP). IP personnel assigned at R&D/manufacturing sites and headquarters assess each project from various angles including R&D and marketing perspectives, building IP portfolios aligned with technology and product strategies in an effort to boost competitiveness. In 2018, in order to uphold the company's worldwide advantage in the IP field, TEL maintained a global patent application rate* of approximately 70% for the eighth consecutive year, and achieved high patent approval rates (83% in Japan and 85% in the United States). TEL is also increasing patent application in China in line with changes in market circumstances.

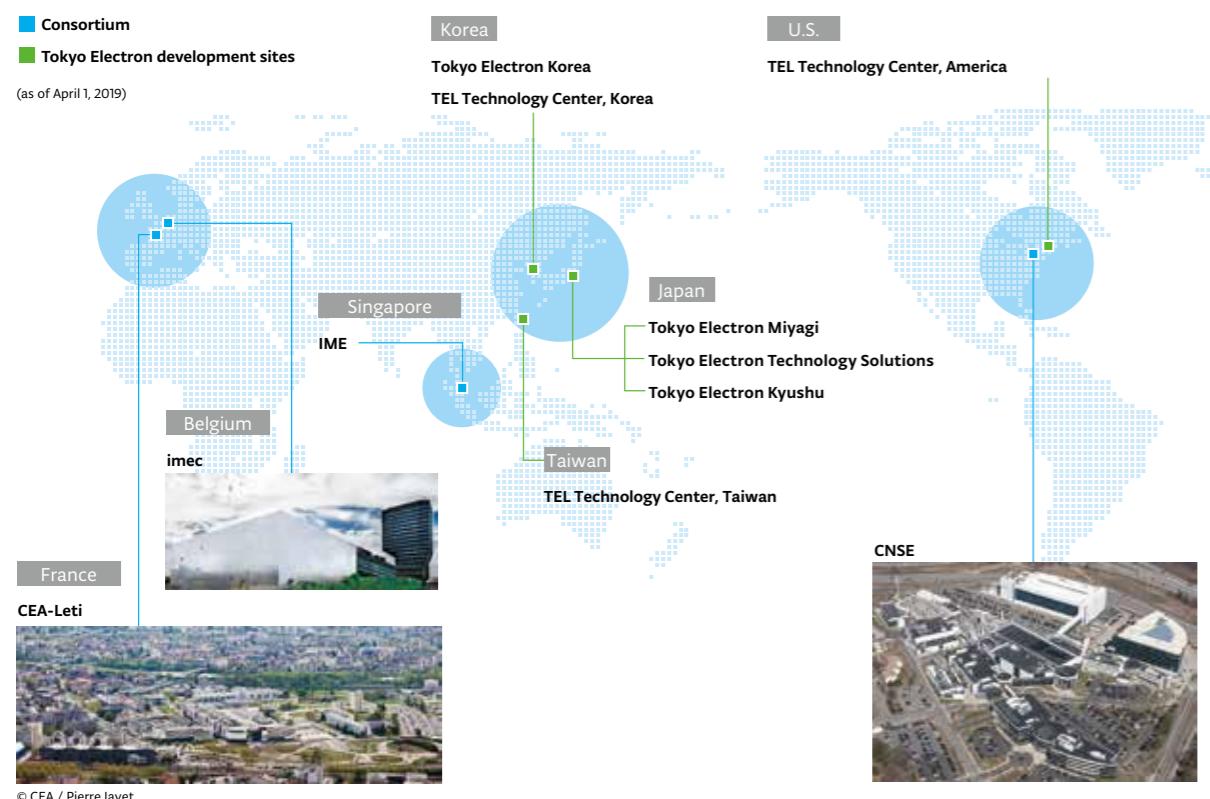
To increase IP awareness, TEL continuously educates its engineers, who are the foundation of TEL's R&D strategy, and in total around 4,200 engineers have become inventors. Additionally, because TEL often handles highly confidential information including technological information of its customers and collaborative partners, the company also focuses on confidential information management education.



*
Global patent application rate:
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. With bases including the United States, Belgium, and Singapore, TEL collaborates with device manufacturers worldwide and with global research institutes to promote research into next-generation semiconductor production technology. From 2018, TEL is participating in a global research hub developing next-generation AI hardware. In this consortium, TEL is mainly responsible for development that raises the added value of software, such as advanced control software, in addition to manufacturing technology for chips designed for AI computing.



Tackling technological innovation

Integrating analog and digital

In this era of IoT, when a multitude of devices can connect to the internet, semiconductors are required to process massive amounts of data quickly and efficiently. At the same time, progress is taking place in the development of neuromorphic devices, inspired by human neural circuits. Computers used in data centers that use conventional architecture consume tens of kilowatts of power, while the human brain uses only about 20 W. Similarly, whereas the operating frequency¹ of today's semiconductor devices is 5 GHz, the human brain is believed to run at just several tens of hertz. Neuromorphic devices utilize synaptic connections² based on analog devices to replace the processing and memory functions, which had previously been only divided between the digital logic and memory of a conventional microprocessor. The aim is to achieve a higher degree of information processing with low power consumption. Furthermore, the development of neuromorphic devices requires an approach of integrating analog to digital. In addition to conventional pursuit of circuit miniaturization, development is underway of semiconductors that mimic human neural circuits, including resistive analog neuro device,³ nonvolatile resistive random access memory⁴ and so on. Leveraging its strengths in deposition and patterning technologies, TEL has initiated research efforts into new materials needed for semiconductors that will be the core of next-generation computing, such as neuromorphic devices, quantum computers beyond that, 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 connections: A junction formed between neurons (cells making up the nervous system of an animal) regarded as having an important role in learning and memory.

³ Resistive analog neuro device: Electronic devices capable of continuously changing resistance

⁴ Nonvolatile resistive random access memory: Random access memory that uses nonvolatile resistance transformers

Using AI technologies

TEL is promoting the use of AI and striving to achieve highly stable equipment operation and greater efficiency in development activities. By monitoring the operating status of semiconductor production equipment in real-time, and using AI to analyze that data, TEL aims to improve equipment operation efficiency such as maintenance of equipment performance, achieving wafer process uniformity, and avoiding unexpected downtime. TEL's specialized AI department, launched in 2017, plays a key role in the development of algorithms and other projects to use AI to analyze the vast volumes of data output from equipment. From 2018, the company has held AI workshops, aiming to share the latest technology trends and to boost internal collaboration, to achieve more efficient development activities.

Addressing advancements in display

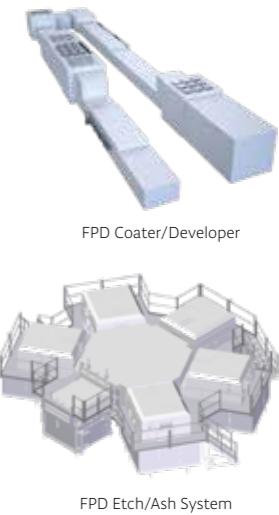
Displays used in personal computers, televisions, and mobile devices have been constantly evolving, growing in size and resolution. Furthermore, in recent years, progress has also been made in the adoption of organic EL that is self-luminous and that offers superior contrast. Such cutting-edge display production is supported by photolithography technology to create minute electronic circuits on glass substrate. TEL develops, manufactures, and sells FPD coater/developer equipment and FPD dry etch system. In 2017, TEL launched a product compatible with production of the world's largest glass substrate, the Generation 10.5 substrate (2,940 mm x 3,370 mm).

FPD coaters/developers can coat and develop a light-sensitive material known as a photoresist with extreme uniformity. The air floating coater unit, which was developed independently by TEL and which was the world's first to be used in mass production by TEL, simultaneously realizes stable glass substrate transfer, greater productivity, and improved uniformity.

The FPD dry etch system etches various thin-film materials using a photoresist-drawn pattern as a mask. Important here is uniform processing in the surface of glass substrates, which are becoming increasingly bigger. TEL has independently developed plasma source for large substrates. By assessing and proposing processes suited to various film types and processing patterns, the company is contributing to the mass production of high-quality displays.

In the field of organic EL displays, which are now being adopted for smartphones and large-screen televisions, TEL is striving to provide new technologies for developing even higher resolution and improved productivity for organic EL displays, under the joint development of inkjet printing equipment with a partner company.

Going forward, TEL will develop and deploy new technologies that contribute to the advancement and expansion of displays.



Product competitiveness

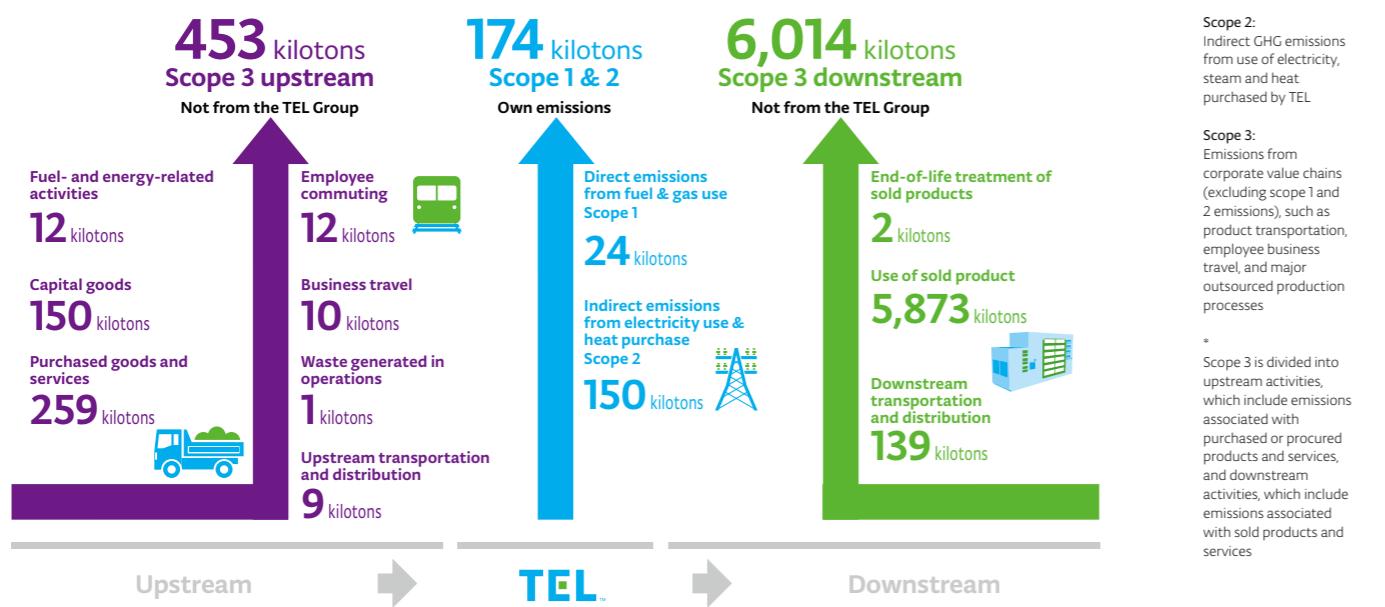
Environmental contribution of products

Environmental risks and opportunities

The various issues related to the environment have an impact on our daily lives and on the business activities of companies. Physical risks, such as rising average global temperatures, strong winds, disasters, and water shortages caused by climate change and abnormal weather, heighten the risks to businesses, such as damage to assets, increased operating costs, and impacts on the supply chain. In terms of legal risks, tougher environmental laws and regulations require action at business sites and with products. At the same time, promoting environmental initiatives leads to more opportunities to provide outstanding environmentally friendly products, reductions in operating costs, and further improvements in corporate value. Based on the requirements of ISO 14001, Tokyo Electron (TEL) identified and analyzed internal and external issues in relation to the environment, namely, its relationship with the climate, air quality, and water quality. TEL also identified the environmental needs and expectations of customers, suppliers, governments, and employees, as well as the company's compliance obligations. From this information, TEL has set the following as its risks and opportunities to address: (1) environmental management by reducing the environmental impact of its business activities, (2) compliance with applicable laws, and (3) enhancing product competitiveness with the environmental contribution of products.

CO₂ emissions across the value chain

TEL recognizes environmental impact throughout the value chain, and develops business activities that are conscious of reducing this impact. TEL aims to resolve environmental problems through leading technology and reliable services, in line with its environmental slogan "Technology for Eco Life."



The total of Scope 1 and Scope 2 of the TEL Group is 174 kilotons, while Scope 3 accounts for a total of 6,467 kilotons, which is approximately 97% of the total. TEL believes that it is particularly important to develop products with low CO₂ emissions during operation, as CO₂ emissions from the use of products sold amount to 5,873 kilotons, which is 88% of the overall total.

Medium- and long-term environmental goals

Medium-term goals (2030)

Equipment	Facilities
30% ↓ Reduce per-wafer CO ₂ emission (as compared with 2013)	20% ↓ Total CO ₂ emissions (as compared with 2018) 1% ↓ Reduce year-over-year energy consumption at each factory and office (per-unit basis, annual goal)

Long-term goal (2050)

As a leading corporation in environmental management, Tokyo Electron works actively to conserve the global environment. We strive to contribute to the development of a dream-inspiring society by proactively promoting the reduction of environmental burden of both our products and facilities, and at the same time, providing evolutionary manufacturing technologies that effectively reduce the power consumption of electronic products.

Products that contribute to a sustainable society

Of the total CO₂ emissions from the value chain of TEL, emissions arising from product use account for 88% of its total CO₂ emissions. For this reason, TEL has made it a key corporate objective to promote environmentally friendly product design, and lower the energy consumption of its products. In fiscal year 2015, the company 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, the company has worked to reduce energy use and improve overall throughput. As a result, in addition to achieving the goal for four models prior to fiscal year 2019, TEL achieved its goal for a further four models in the target fiscal year of 2019.¹ Specifically, the company aimed for improved efficiency in Tactras™ Vigus™, plasma etch system for 300 mm wafer processing that offers high reliability and high productivity, managing to reduce energy consumption per wafer by 12%. In addition, the company also achieved above-target energy-saving results for the EXPEDIUSTM series batch cleaning system, NS300Z scrubber system, and CELLESTAT™ series surface preparation system, including improved throughput and wafer-process optimization. From fiscal year 2020, TEL has set the new medium-term goal of "30% reduction by fiscal year 2031 in comparison with fiscal year 2014 for the key models of each business unit (30% or more reduction in CO₂ emissions when compared with equipment shipped in fiscal year 2014)." With this goal, the company endeavors to address not only energy and water as done conventionally, but also use of process gas and chemical substances, to reduce product footprint, volume, and weight, and the frequency of parts maintenance, while increasing the lifespan, and shortening the launch time of equipment, in order to incorporate its contribution to CO₂ reduction.

¹ Based on TEL's specific usage conditions

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 its efforts for EU REACH² regulations is that the company investigates the presence of any substances of very high concern (SVHC) in articles, and disclose information appropriately. As for efforts for GHS³ requirements, TEL provides safety data sheets (SDS)⁴ when selling chemical goods. In fiscal year 2019, the company partially revised the environmental IT system introduced in fiscal year 2018 in order to continue to share information more efficiently with its supply chain. In addition, TEL has 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. The company also provides suppliers with information on the relevant environmental laws and regulations.

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

Biodiversity

In carrying out its business activities, the TEL Group has a not insignificant impact on biodiversity, and yet without the benefits yielded from biodiversity, the company could not sustain its activities. In recognition of this, the Group will develop a framework for promoting initiatives in an effort to conserve biodiversity.

URL <https://www.tel.com/csr/environment/office/>

Green procurement

TEL promotes green procurement, prioritizing the purchase of environmentally friendly parts, products and materials.

URL <https://www.tel.com/csr/environment/green-procurement/>

Logistics initiatives

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 shifts⁵ and other activities designed to reduce the environmental burden of its logistics.

URL <https://www.tel.com/csr/environment/product/>

Environmental communication

TEL's environmental policy requires that, based on a shared understanding with a broad range of stakeholders, the company promotes cooperative partnerships with them, and it takes appropriate steps to live up to their expectations. In promoting initiatives for the environment, TEL will maintain close communication with all its stakeholders.

URL <https://www.tel.com/csr/environment/office/>

² EU REACH: An EU regulation pertaining to the registration, evaluation, authorisation, and restriction of chemicals

³ GHS: Globally Harmonized System of classification and labeling of chemicals

⁴ SDS: Safety Data Sheet (for chemical substances, etc.)

⁵ Modal shift: Efforts to transform the means of transportation. Refers to switching the means of transportation from truck or aircraft to ones with a lower environmental impact, such as rail or ship.