

Sustainability



To operate sustainably, TI invests in programs and sets performance improvement goals to operate efficiently, conserve natural resources and materials and reduce costs. In this section, we describe the management systems, policies, key strategies and programs that enable us to identify and evaluate ways to meet these goals. We make these efforts to protect human health and the environment; to maintain compliance with global laws and regulations; and to adhere to our ambitions, values, code of conduct and policies.

External recognition for sustainable business practices

- Dow Jones Sustainability Indices, “North America Component,” 13th year.
- 3BL Media, “100 Best Corporate Citizens,” 17th year.
- Fortune magazine, “World’s Most Admired Companies.”
- Barron’s “The 100 Most Sustainable U.S. Companies.”
- Euronext Vigeo, U.S. 50 (50 most advanced U.S. companies for corporate responsibility), sixth year.



ENVIRONMENTAL IMPACT

TI is committed to doing its part to reduce the environmental impact of our operations. Our company designs, manufactures, assembles and tests billions of integrated circuits each year. Globally, our operations require the use of raw materials, chemicals, energy and water. To responsibly conserve natural resources and protect the environment, we set voluntary reduction goals, invest in new abatement technologies, and reuse and recycle water when feasible. We also comply with laws and regulations in locations where we operate.

Air emissions

TI actively implements various projects and voluntarily sets site-specific chemical-reduction goals to keep air emissions below permitted limits. While reduction methods vary according to specific regulations, they generally include:

- Phasing out ozone-depleting substances in manufacturing support equipment.
- Using thermal oxidizers, catalysts and abatement systems such as filters, wet scrubbers and purifiers to reduce or remove pollutants before they are emitted.

- Improving building and equipment efficiency and ensuring that manufacturing tools optimize efficiency.
- Limiting the use of stationary combustion engines such as diesel generators.

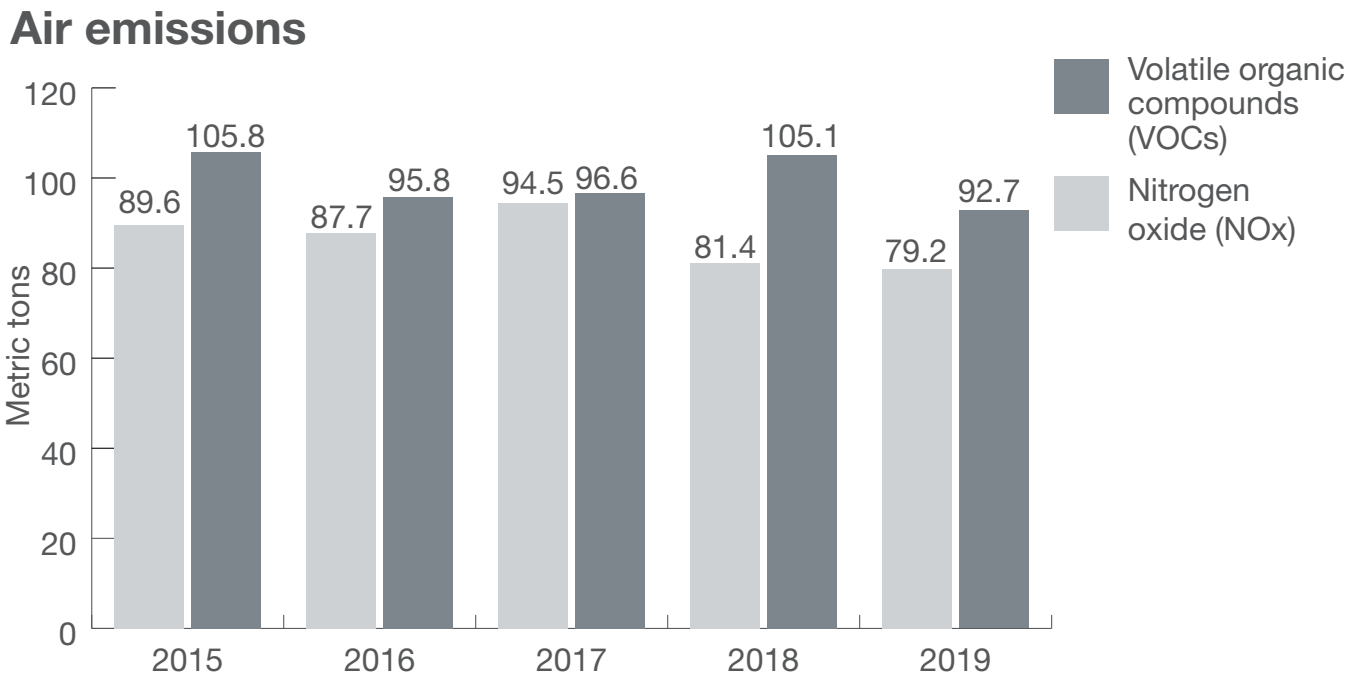
TI no longer uses the following Class I and Class II ozone-depleting substances in manufacturing:

- Class I compounds include fully halogenated chlorofluorocarbons, halons and substances that harm the ozone layer.
- Class II substances are known or expected to have harmful effects on the stratospheric ozone layer.

Regulations and reporting

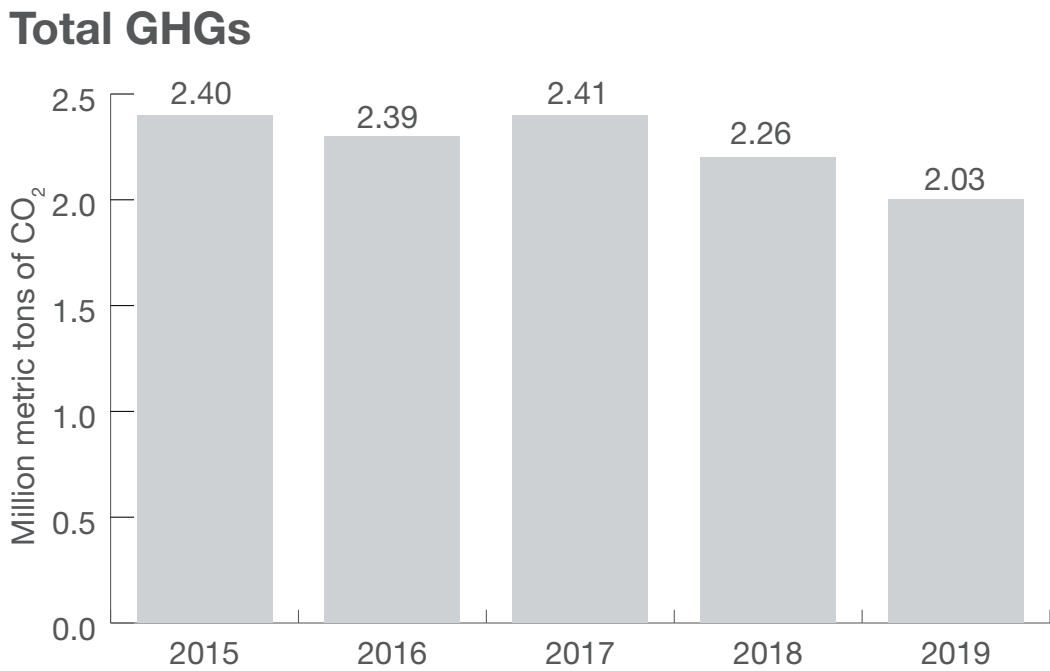
TI’s operations produce varying quantities of air emissions², some of which are subject to regulatory limits or are required to be calculated and reported, depending on the country, state, or municipality in which we operate.

In the U.S., TI produces relatively small quantities of air emissions that are regulated, such as volatile organic compounds, nitrous oxides, carbon monoxide, ozone, lead, sulfur dioxide and particulate matter. We report air emissions data to the U.S. Environmental Protection Agency (EPA) and state regulators. Chemical releases and pollution prevention activities also are reported to the EPA’s Toxic Release Inventory.



Greenhouse gases (GHGs)

We understand the importance of addressing and responding to climate change. Setting realistic GHG emission and energy-reduction goals and regularly assessing potential risks related to climate change that may affect the company over the long term makes TI more efficient and competitive.



² TI does not include nitrous oxide (N₂O) in its air emissions calculations because the company accounts for N₂O in its GHG emissions data.

Goal

We set a five-year goal in 2015 to reduce absolute Scope 1 and 2 GHG emissions by 15% by the end of 2020. By year-end 2019, absolute emissions were down 15.6% due to improved efficiency and our commitment to investing in projects that reduce emissions. We will continue to monitor our progress as manufacturing has increased in the first half of 2020. We will report the outcome in our 2020 Citizenship Report.

Types of GHGs and reduction strategies

TI focuses its GHG emission-reduction efforts on Scope 1 and 2 GHG emissions. We have not fully evaluated all relevant Scope 3 emissions due to complexities associated with our supply chain, number of employees, diversity of locations and broad distribution network.

• Scope 1

Direct GHG emissions that TI generates from its fabrication, assembly/test, and large design and sales locations. We mitigate these emissions by:

- Installing efficient manufacturing technologies.
- Eliminating nonessential fluorinated gases, using alternative gases and reusing gases.
- Installing thermal point-of-use abatement devices that treat the exhaust of gases used in semiconductor manufacturing.

• Scope 2

Indirect GHG emissions created by electricity, heat and steam that TI purchases for its manufacturing or other operations. We mitigate these emissions by:

- Optimizing the efficiency of our manufacturing systems, buildings and tools.
- Using renewable energy sources when feasible.

Scope 1 GHGs by type (metric tons of CO ₂ equivalent)	2015	2016	2017	2018	2019
Carbon dioxide (CO ₂)	75,848	74,862	73,680	76,723	78,571
Methane (CH ₄)	1,203	1,192	1,192	1,244	1,251
Nitrous oxide (N ₂ O)	21,274	20,808	20,939	24,509	23,512
Hydrofluorocarbons (HFCs)	41,646	36,367	42,060	39,976	36,553
Perfluorocarbons (PFCs)	810,687	819,753	870,984	855,646	697,120
Sulfur hexafluoride (SF ₆)	45,147	52,464	59,802	65,911	54,645
Nitrogen trifluoride (NF ₃)	89,817	71,501	92,999	93,539	74,927

• Scope 3

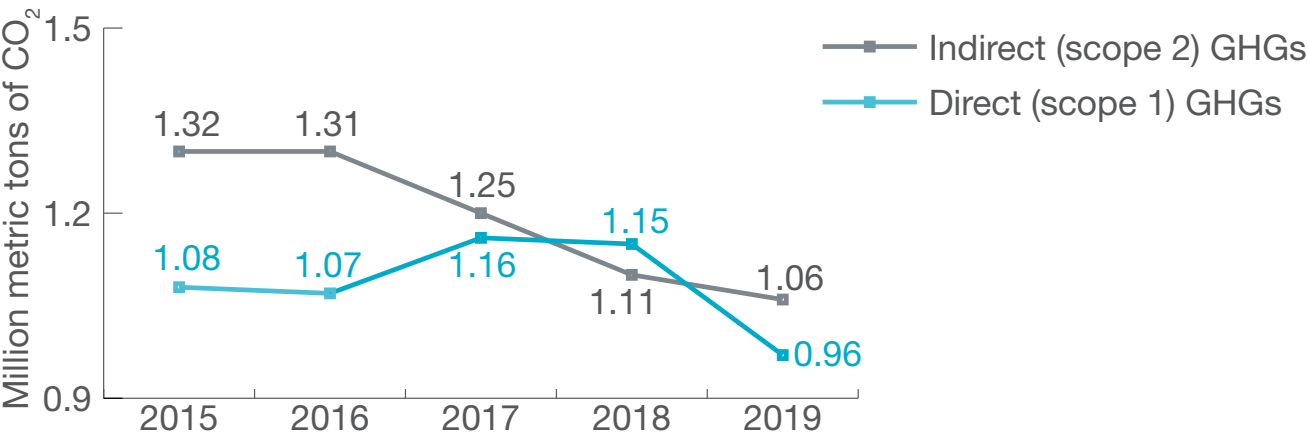
Indirect GHG emissions generated by our supply chain, employee travel and commuting, or our distribution network. We mitigate these emissions by:

- Offering video conferencing to limit business travel.
- Providing electric vehicle charging stations, on-campus shuttles and flexible work schedules, and subsidizing mass transit and carpooling at select sites.
- Shipping products in bulk and distributing from regional centers.

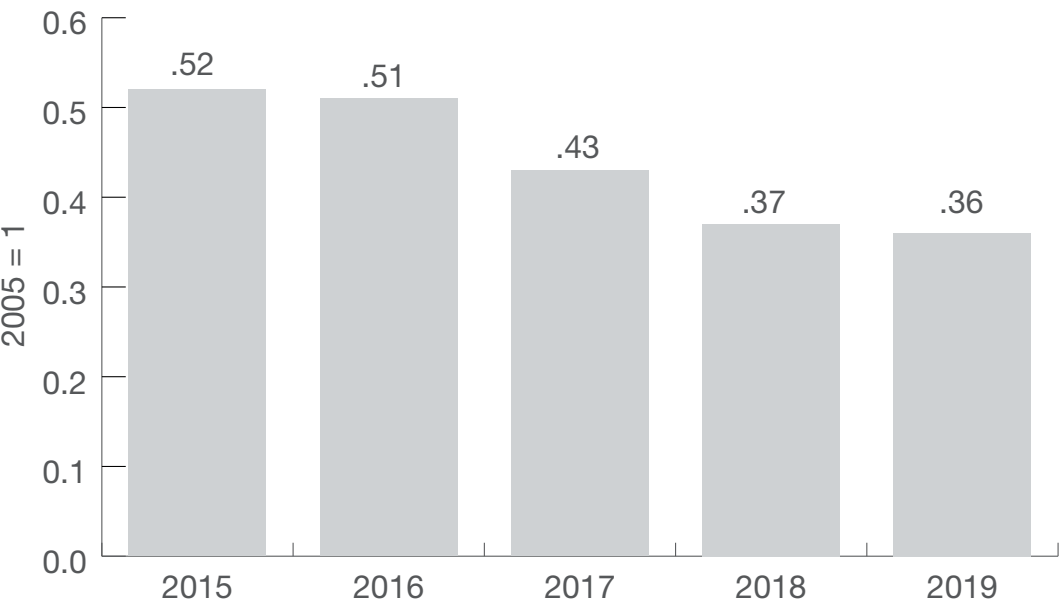
TI's carbon footprint

Advancement in the size of wafers (which yields more chips per wafer), the efficiency of semiconductor manufacturing machinery, and the reduction of chemicals have helped TI reduce normalized³ GHG emissions since 2005 – despite an increase in production. Changes in normalized GHG emissions per chip occur due to variations in chip production, improvements from manufacturing equipment upgrades and energy emissions improvements. In 2019, TI reduced total GHG emissions by more than 10%.

Indirect (scope 2) and Direct (scope 1) GHGs



Normalized GHG emissions per chip



³ Normalized data is a way to develop a baseline and track changes in a metric year over year.

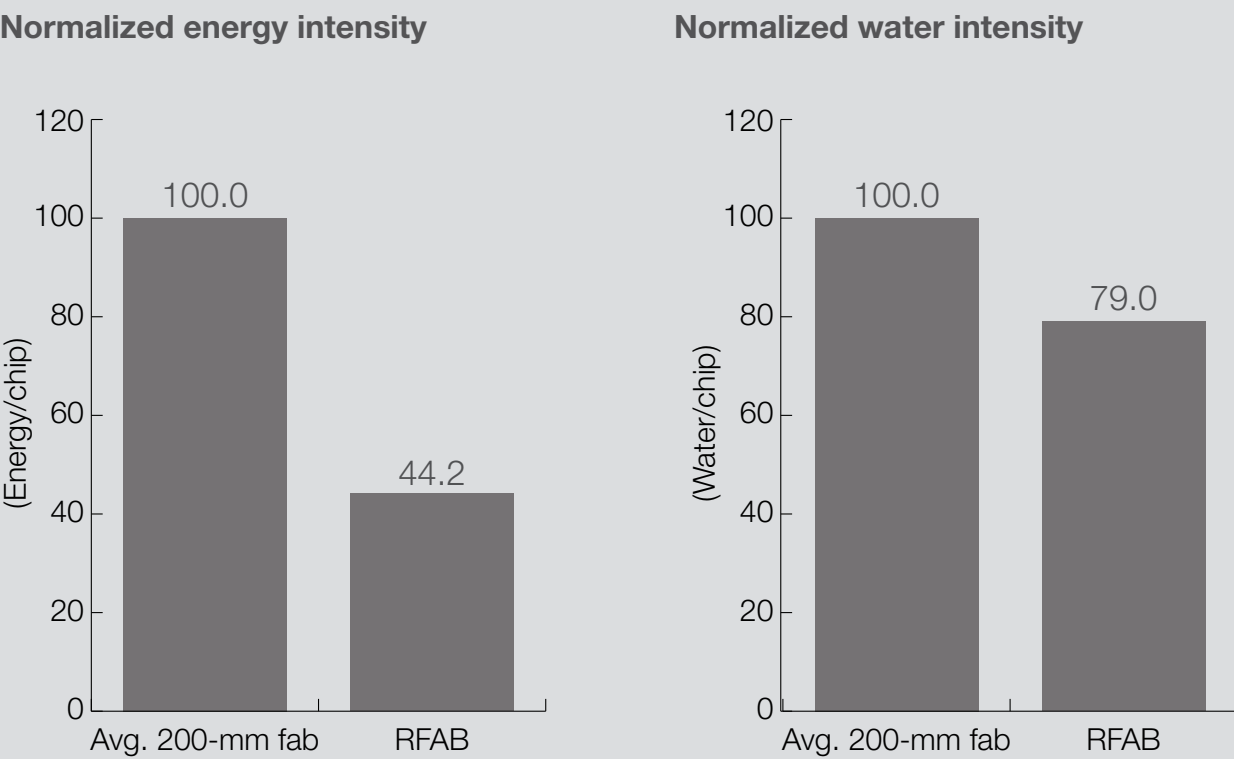
Driving efficiency in wafer production

TI continuously looks for ways to make its fabrication processes more efficient and cost-effective. We optimize older facilities by retrofitting lighting and upgrading equipment to reduce energy use and GHG emissions. We design new buildings to use fewer natural resources and electricity from the start, which reduces environmental impacts and operating costs.

Most of the GHGs that TI emits are fluorinated gases needed to produce silicon wafers and keep equipment clean. Our older 150- and 200-mm wafer fabrication plants use fluorine gases that generate more GHGs than modern factories. Our newer 300-mm fabs use a fluorinated gas that is a less potent GHG. Additionally, the larger 300-mm wafers produce more chips per wafer, which requires less water and energy and reduces production costs.

In the next few years, we plan to close two older manufacturing facilities – in Sherman, Texas, and Dallas, Texas – and we have construction underway on a new

300-mm advanced analog fabrication plant in Richardson, Texas. We expect that these changes will improve our environmental and financial performance. Moving production from 200 mm to the more efficient 300 mm reduces energy consumption per chip by approximately 56% and water consumption by about 21%.



Creating a better world through semiconductors

Smart grids, enabled by TI technology, are reducing costs, saving energy, and improving how energy demand is monitored and managed, thus reducing GHG emissions. Utilities can use smart electrical meters to adjust thermostats; appliance usage; and heating, ventilation and air-conditioning settings in homes and businesses to avoid rolling brownouts or charging peak rates. Customers who use TI's GHG-reducing technologies include electricity providers, distributors, manufacturers of white goods (appliances) and the transportation industry.

Biodiversity

Our worldwide semiconductor design, manufacturing, assembly and test sites are located in industrial areas, inner-city areas and suburban areas, as well as areas surrounded by agricultural farmlands. We adhere to rigorous air emission, water and wastewater goals and requirements to manage our impact on biodiversity near our sites. We contribute to biodiversity by planting indigenous trees where we have sites and participating in community cleanup events in locations around the world.

For example, when two large storms affected TI's North Texas campuses in 2019, the company acted quickly to plant new trees. Teams planted more than 600 vitex, crape myrtle, chinkapin oak, pond cypress and live oak trees at our Dallas site, replacing more than 250 mature native trees we lost. Not only will these trees make our campuses beautiful for years to come, but they will help reduce GHGs, improve air quality and control soil erosion in areas where natural storm runoff occurs after it rains.

Monitoring potential risks

TI faces potential regulatory and physical risks associated with climate change. Currently, we do not believe that these risks have the potential to generate a substantive change in our business operations, revenue or expenditures. However, to ensure that we react appropriately and maintain our commitment to environmental stewardship, we closely track:

- Global trends in environmental and energy policy.
- Changes in regulations that may apply to TI or its suppliers. We work with industry associations to provide context and perspective on the potential impact of legislative and regulatory proposals.
- Extreme weather events such as typhoons, hurricanes and droughts. In any natural or human-caused disaster, our priorities are to protect our people, assets, revenue and reputation.

Regulations, compliance and reporting

We comply with GHG regulations that vary by country, state and municipality, and report emissions to relevant agencies. We are required to report U.S. GHG emissions to the EPA to comply with its mandatory reporting requirements. The EPA requires the semiconductor industry (among other industries) to measure and report annual fluorinated GHG emissions (such as sulfur hexafluoride, perfluorocarbons and hydrochlorofluorocarbons) as well as GHG emissions from combustion sources.

We also voluntarily report our GHG data to the World Semiconductor Council (as part of the U.S. industry report), the CDP (formerly the Carbon Disclosure Project), the S&P Global Assessment, in addition to this report.

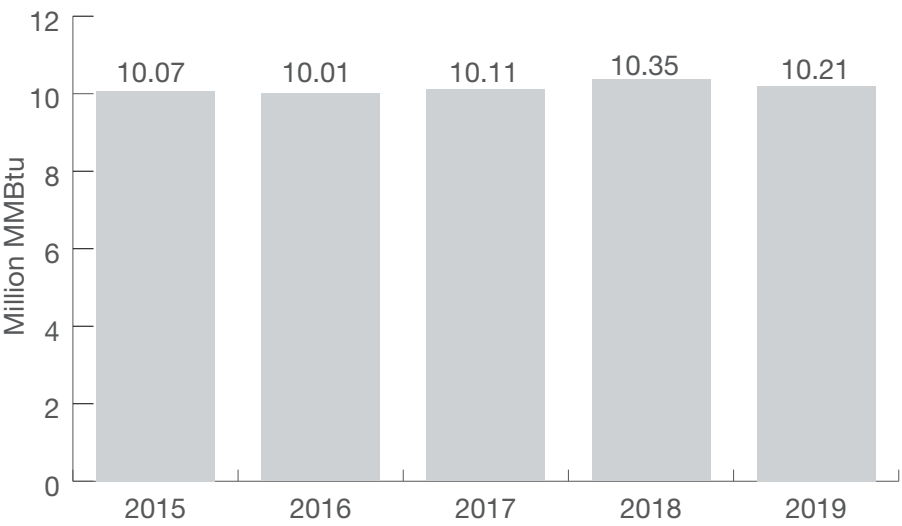
Energy use

Reducing our overall energy consumption is a focus in our global operations, both in our manufacturing and design sites. Our sites are required to set annual energy reduction goals to lower costs and emit fewer GHGs.

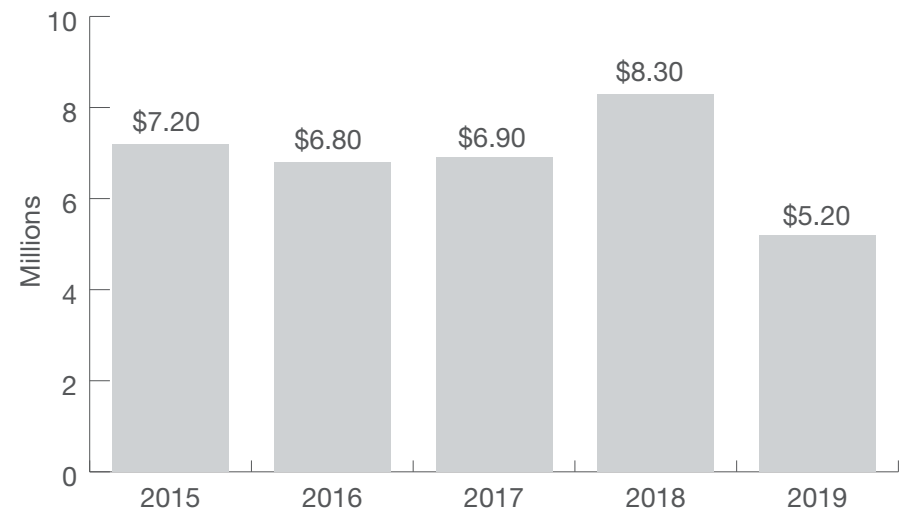
Our manufacturing operations account for about 90% of our total energy use and are the focal point for our global energy strategy, which includes:

- Securing reliable, affordable and renewable energy supplies.
- Building and retrofitting buildings and factories to optimize efficiency and using more efficient equipment.
- Designing and manufacturing semiconductor products that enable energy-efficient electronics, and investing in R&D to further reduce energy consumption. We also stack chips vertically in our product packaging, which reduces motherboard space and total energy and cooling costs in our customers’ end products.

Total energy use



Energy utility cost savings

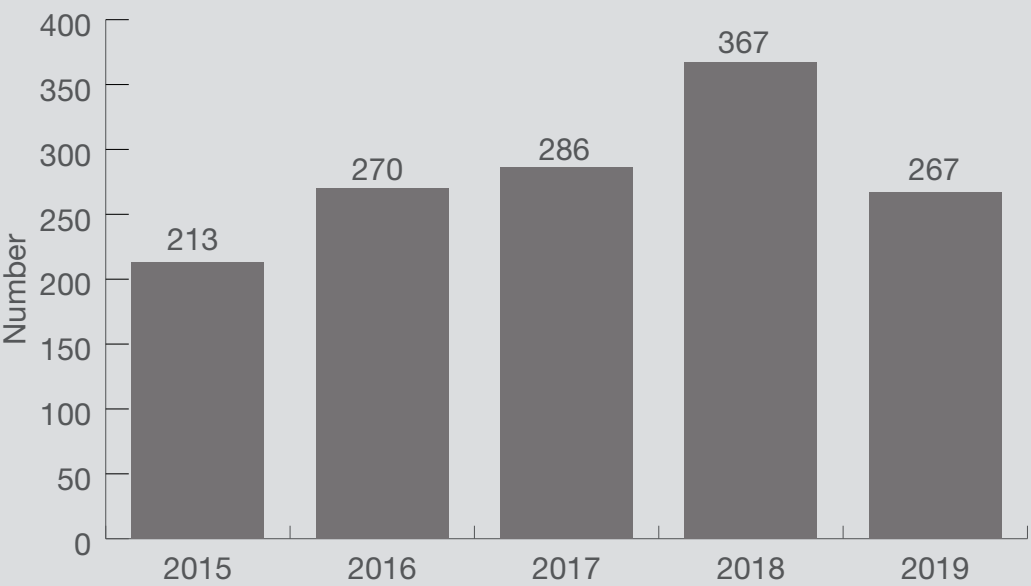


Energy use by type (million million British thermal units)	2015	2016	2017	2018	2019
Savings (MMBtu)	283,234	321,177	285,556	254,121	251,198
Energy use (total MMBtu)	10,070,708	10,017,419	10,116,022	10,357,182	10,216,767
Indirect energy use (total)	8,620,386	8,588,300	8,691,304	8,875,461	8,749,565
Electricity	8,567,814	8,534,080	8,635,917	8,823,520	8,701,606
District heating	52,572	54,220	55,387	51,941	47,959
Direct energy use (total)	1,450,322	1,429,119	1,424,718	1,481,721	1,467,202
Natural gas	1,259,187	1,245,657	1,244,765	1,298,268	1,285,129
Fuel oil (No. 6)	73,179	72,243	192,216	12,795	12,435
Diesel	50,201	46,842	40,000	44,655	33,158
Propane	65,166	61,790	1,180,646	123,407	133,858
Gasoline	2,589	2,586	2,667	2,596	2,622

\$34.4 million in utility cost savings since 2015

Each year, we implement more than 200 efficiency projects that reduce our GHGs and collectively save an average of more than \$6.5 million in energy costs. Since 2015, TI has conserved 1,395,286 million British thermal units (MMBtu) of energy – the equivalent of powering more than 37,000 homes for a year. During that same time, we implemented more than 1,400 efficiency projects that saved \$34.4 million in utility costs.

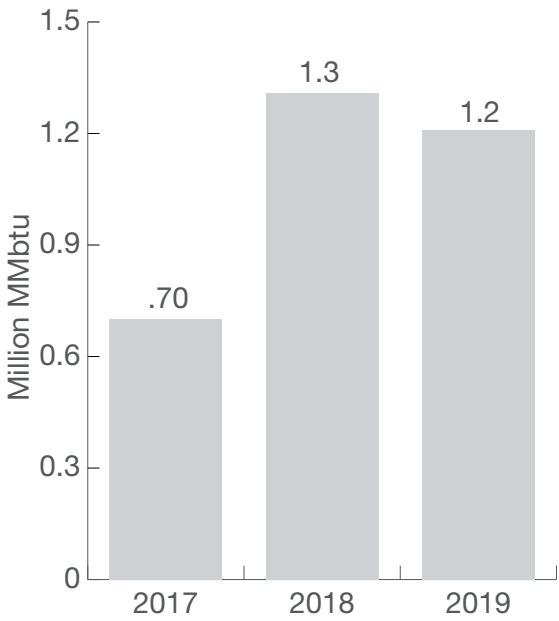
Energy conservation projects



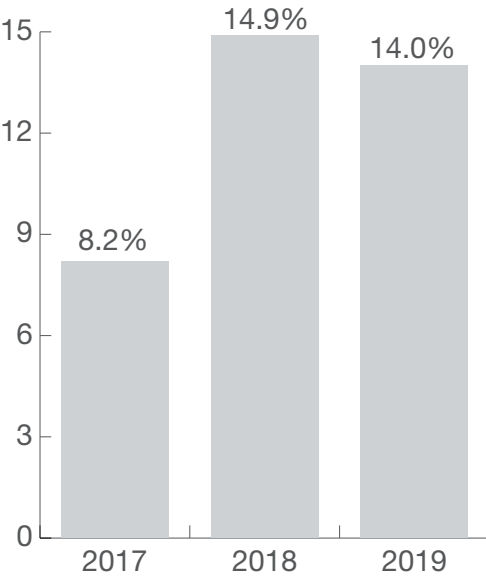
Renewable energy

TI secures reliable and affordable energy supplies, which includes renewable⁴ resources where available and cost-effective. We use direct contractual arrangements for renewables that play a role in reducing our energy consumption in some locations, and we continue to actively look for opportunities to invest in more renewables as they make sense for our business. In 2019, TI’s use of renewable energy declined slightly as off-site renewable power that supplies two of our sites experienced severe weather disruptions. Conventional grid energy supplied these sites until the renewable power came back online.

Renewable energy use



Percent of renewable electrical energy used



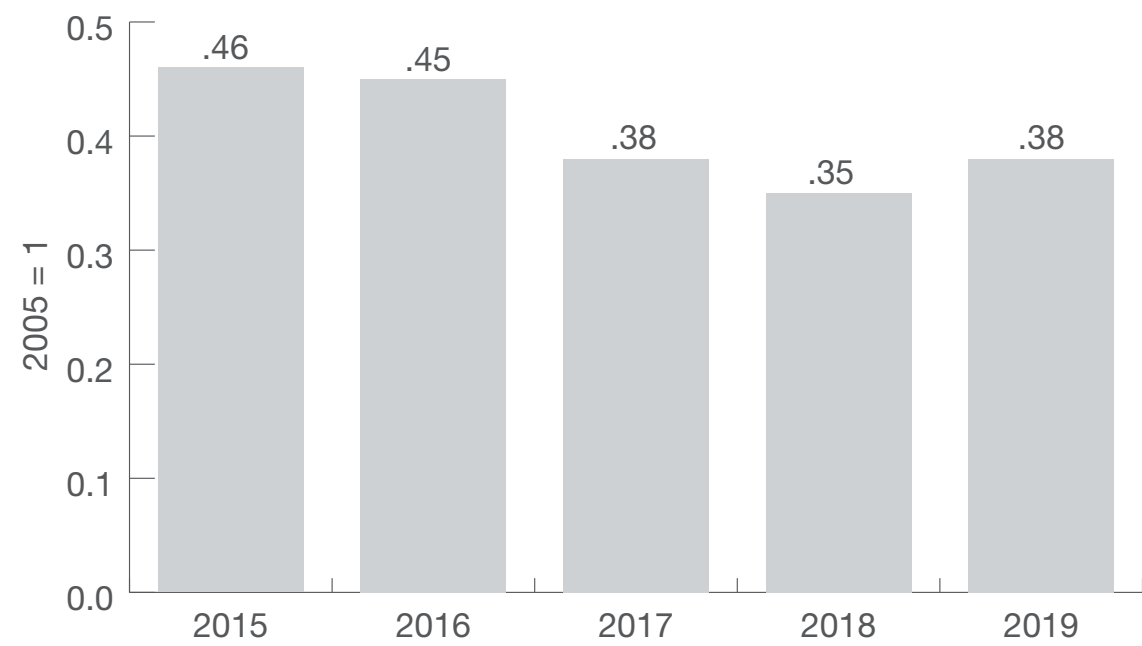
⁴ No global standard exists for calculating renewable energy that includes power purchased from mixed-generation suppliers or the grid in the geographic regions in which we operate. We stopped attempting to estimate the renewable energy portion of purchased mixed-generation power after 2014 and will not report this incidental renewable energy use until there is a consistent standard or we receive more accurate information from suppliers. The data reported in 2017, 2018 and 2019 are for the portion of the energy supplied in a traceable way via a contract or government-managed tracking system.

Energy intensity

We measure energy intensity to assess the overall efficiency of our manufacturing processes. Energy use refers to the total energy used, which depends on production. Energy intensity is an attempt to normalize usage by looking at energy per unit of output (by dividing our total energy use by our total production).⁵

Since 2005, we have reduced per-chip energy intensity⁶ from 1.0 to 0.38 globally – a reduction of 62%. In the U.S., we have reduced energy intensity by 36.5% since 2010 in our quest to achieve the U.S. Department of Energy’s Better Buildings, Better Plants program goal to reduce energy levels at manufacturing sites by 50% by 2020.

Normalized energy per chip



Compliance and reporting

The countries where we operate require our compliance with applicable energy use and building codes. We voluntarily report our energy consumption data to the CDP and in this report each year.

Water and wastewater management

Water is an essential part of manufacturing semiconductors, which is why we use it responsibly and efficiently. Conserving water and protecting water quality enables us to reduce costs, comply with regulations, ensure long-term availability and preserve this natural resource.

How we manage

TI’s water conservation and protection strategies include investing in reduction, recycling and reuse projects, and restricting, reducing

Water sources total and by type (million gallons)	2015	2016	2017	2018	2019
Total gallons	6,837	6,724	6,657	6,812	6,356
Municipal	4,493	4,275	4,207	4,360	4,294
Reused	1,986	2,092	2,032	2,016	1,690
Well	320	356	395	401	372
Rain ⁷	37	22	23	35	0

and monitoring chemicals that have the potential to affect water quality. As a requirement of our environmental, safety and health (ESH) management system, which is certified to ISO 14001, each of our sites evaluate water risks – such as availability, quality and groundwater impacts – in an annual assessment.

Specific actions we take to conserve water globally include:

- Installing water recirculation units on thermal processing equipment to reduce the use of city water.
- Controlling water alkalinity (pH) in cooling towers to prevent calcium buildup and scaling, saving money and consuming less water to flush mineral-concentrated water.
- Implementing tool optimization and water-purification plant projects that conserve water.
- Maximizing the amount of condensate and microfiltration water directed to cooling towers.
- Reusing water with high salt/mineral content (produced as a byproduct of our ultra-pure water system) for toilet flushing.
- Reusing water in our central utility plant cooling towers to reduce the amount of water we need from lakes, groundwater or other natural sources.

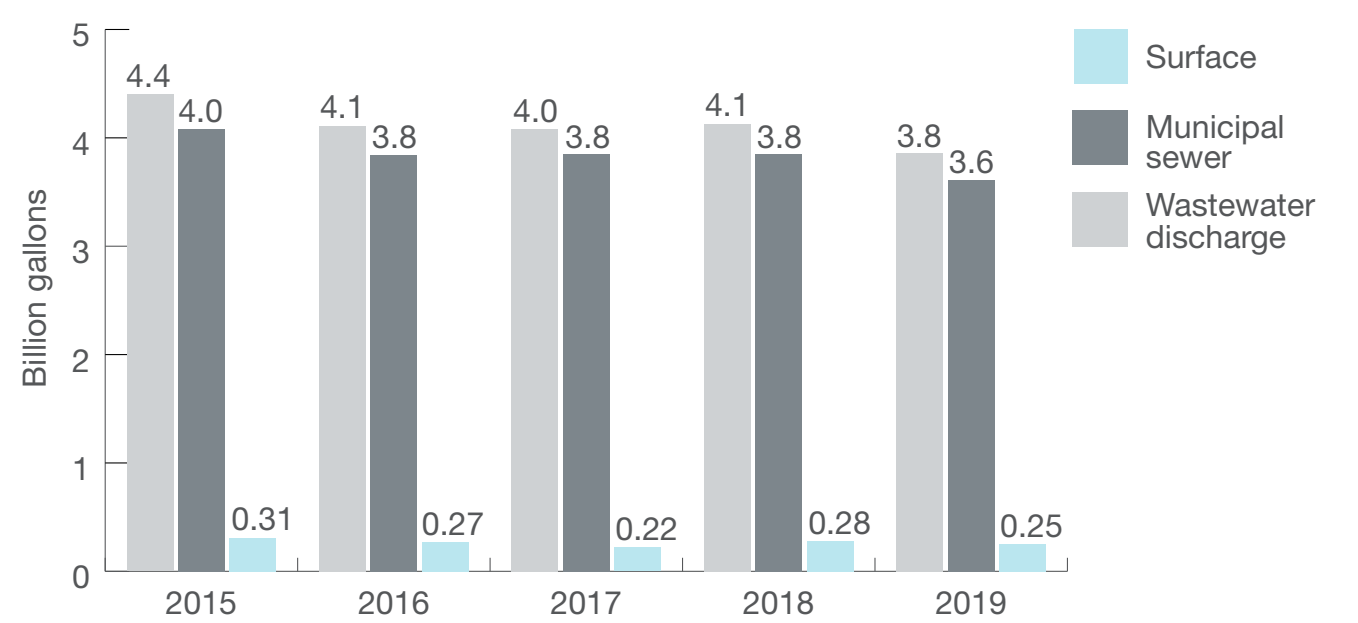
Most of the wastewater generated by TI is treated on-site to reduce contaminants. We collect any wastewater sludge containing solvents, concentrated metals and acid solutions and dispose of them off-site per regulatory requirements. In some cases, we send these compounds to reclamation facilities for their reuse by other industries.

Water sources

Our water sources include surface water from local municipal supplies, collected rainwater and groundwater. Our water footprint comprises three types of water:

- Nonmanufacturing – used in restrooms, irrigation, drinking fountains and cafeterias.
- Manufacturing – used to rinse wafers after chemical processing or for other fabrication processes.
- Manufacturing support – used in exhaust abatement and cooling systems.

Wastewater discharges total and by type



Reuse and recycling

We reuse water in other processes where possible, such as cooling towers, scrubbers and irrigation. For example, many of our cooling towers reuse water from the manufacturing process to reduce or eliminate the amount of city water they need to operate.

TI reused more than a quarter of the water used on-site in 2019.

⁵ Changes in normalized energy per chip occur due to variations in chip production, improvements from manufacturing equipment upgrades and energy emissions improvements.
⁶ Primary energy consumed per pattern produced by our U.S. manufacturing facilities, normalized for 80% loadings and compared to a 2010 baseline. Primary energy is energy content found in natural sources that has not been subject to any conversion or transformation process. Adjusted for startup and closure of facilities.
⁷ In 2019, we elected to not report rain water collection as the total was not directly measured. Previously reported values were estimates based on regional rainfall data and capture area.

Water quality

Our water management standard establishes minimum expectations for water, wastewater, and stormwater quality and management. All TI wastewater treatment plants are permitted where required to meet applicable regulatory requirements and ensure that discharges meet local, state and/or country-level wastewater discharge requirements.

Regulations require the restriction or removal of substances such as metals, toxic organic compounds, nitrates and sulfides from water before discharge. TI also has internal standards, programs and procedures in place to ensure that stormwater runoff at all sites complies with local and national discharge requirements.

We conduct periodic water sampling to ensure that we are operating within our permit limits. We take additional precautions at sites in Malaysia, the Philippines and Japan because treated wastewater discharges directly into a body of water in these countries instead of to a municipal treatment facility.

Water availability

We monitor future water availability issues for all sites, specifically those in North America and Asia. We also work with country, regional and local agencies; suppliers; and local water utility management and operations teams to discuss emerging risks and possible mitigation plans. For example, at our Texas sites, which make up the largest concentration of our operations, we engage with the Texas Water Development Board and participate in its water use survey activities. This engagement enables us to help shape the community’s water supply in the future, and prepare our operations for future water availability issues or changes to our water management strategy.

Reporting

Each year, we voluntarily report our water footprint to the CDP and in this report. We compile the data that we report from quantities billed by municipal suppliers as well as our own production metrics.

TI Chengdu recognized for water conservation

The Chengdu City Water Conservation Office and Sichuan Housing and Urban-Rural Bureau recognized TI’s fabrication site in Chengdu, China, for its water conservation practices, which have saved millions of gallons each year. TI ESH personnel in Chengdu set annual reduction goals and monitor water use daily to prevent fluctuations. They also implemented water projects to curtail use or recycle water, including:

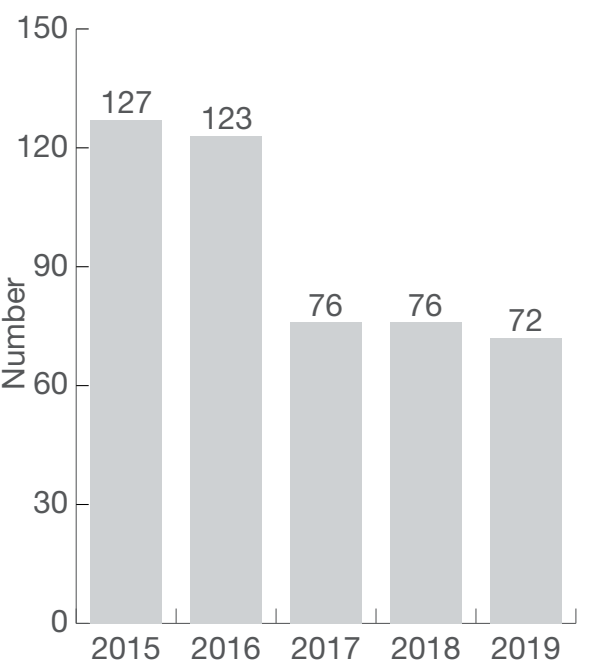
- A pure water ultrafiltration concentrated water recovery device that reprocesses concentrated water from the original ultrapure water system, saving an estimated 5 million gallons annually.
- An instrument-sampling water recovery system that saves about 2.6 million gallons of water annually.
- A pure water reverse-osmosis concentrated water recovery device that recycles concentrated water, recovering about 50% of it for reuse.
- An ultrafiltration recovery device that recycles treated wastewater, saving about 14.3 million gallons per year.

TI’s water conservation efforts

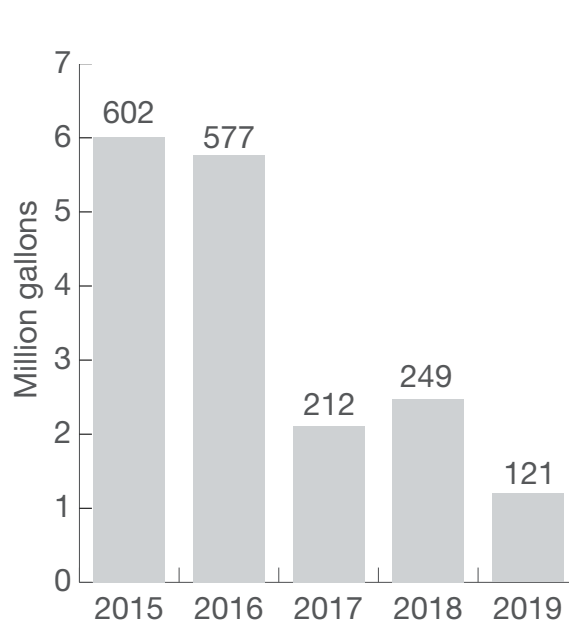
Since 2015, TI has implemented 474 conservation projects that saved \$11.5 million in utility costs and more than 33.3 billion gallons of water – enough to fill more than 55,000 Olympic-sized swimming pools. Previously completed efficiency projects have enabled TI to reap continued water utility savings.⁸

In 2019, overall water use was down due to fabricating fewer semiconductors, which resulted in a slight increase in our per-chip water use. We also set a goal to reduce water use by 2.2% in 2019, which we exceeded by conserving 2.5%.

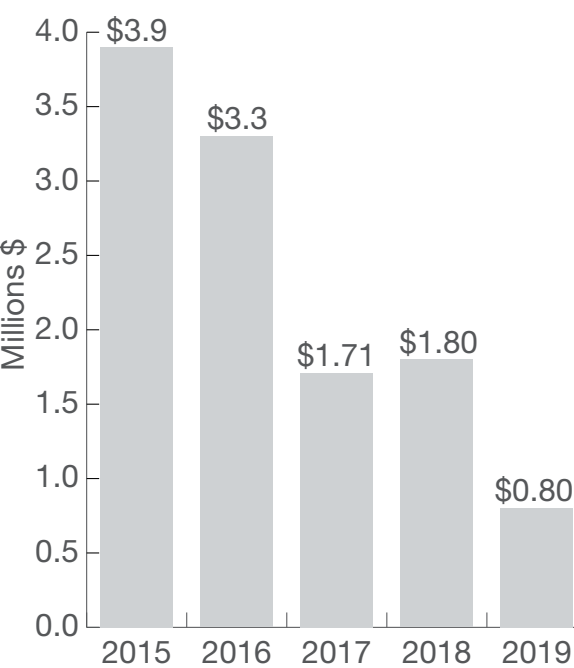
Conservation projects



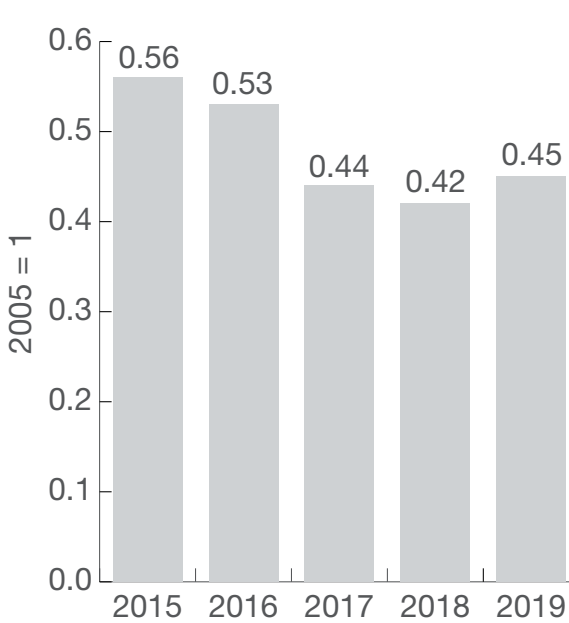
Savings from conservation projects



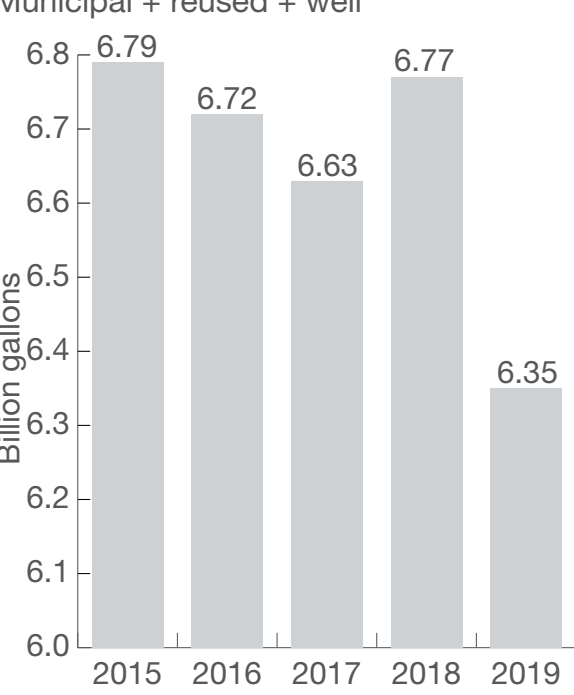
Water utility savings



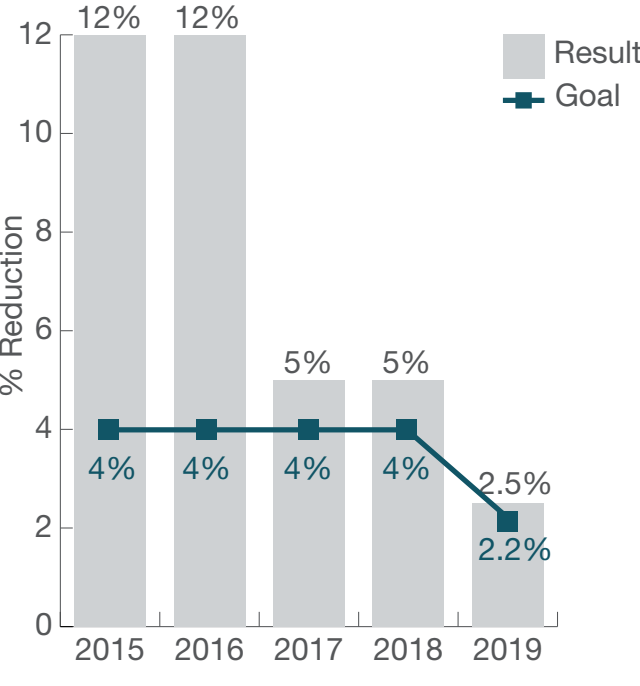
Normalized water use per chip



Water consumption



Water use



⁸ To calculate water use, we compile data from quantities billed by municipal suppliers as well as our production metrics. We also measure effluent rates and volumes and analyze industrial wastewater and stormwater samples using standard methodologies set by the EPA.

Water use	2018	2019
Change in water storage (megaliters) ⁹	0	0
Water withdrawal (total megaliters)	18,155	17,664
Surface ¹⁰	132	0
Ground ¹⁰	1,517	1,409
Sea	0	0
Produced	0	0
Third party	16,506	16,255
Fresh (≤1,000 mg/L total dissolved solids)	18,155	17,664
Other (≤1,000 mg/L total dissolved solids)	0	0
Water withdrawal in water-stressed regions (total megaliters)	3,352	2,674
Surface ¹⁰	0	0
Ground ¹⁰	40	44
Sea	0	0
Produced	0	0
Third party	3,312	2,630
Fresh (≤1,000 mg/L total dissolved solids) ¹⁰	3,352	2,674
Other (≤1,000 mg/L total dissolved solids) ¹⁰	0	0
Water discharge (total megaliters)	15,643	14,617
Surface ¹⁰	1,068	953
Ground ¹⁰	0	0
Sea	0	0
Third party	14,575	13,664
Fresh (≤1,000 mg/L total dissolved solids) ¹¹	Unknown	Unknown
Other (≤1,000 mg/L total dissolved solids) ¹¹	Unknown	Unknown
Water discharge (water-stressed areas, megaliters)	2,860	2,278
Fresh (≤1,000 mg/L total dissolved solids) ¹¹	Unknown	Unknown
Other (≤1,000 mg/L total dissolved solids) ¹¹	Unknown	Unknown
Water consumption (total megaliters) ¹²	2,512	3,047
Water consumption (water-stressed areas) ¹²	491	396

⁹ There is a small amount of water storage (relative to overall usage) in facilities systems, but the year-over-year change is not significant.

¹⁰ This does not include once-through cooling water, which is pumped from on-site wells at our Freising, Germany, site and used only for heat rejection. This water returns to the original aquifer. Collected rainwater is used for irrigation and not reported as part of our water use totals, except for a small quantity reported on the rain source line for our Richardson, Texas, fabrication facility before 2019.

¹¹ TI does not monitor total dissolved solids continuously at all sites.

¹² Calculated as water withdrawn minus water discharged.

A new metering technology helps make every drop count

TI technologies can help conserve one of our most precious resources – water. According to the EPA, household leaks waste about 900 billion gallons of water each year in the U.S. Ultrasonic technology enabled by TI products gives water meters the ability to locate leaks as small as one drop every few seconds, enabling early detection and reducing water waste.

Cities from Austin, Texas, to Antwerp, Belgium are installing high-tech smart water meters that give consumers the information they need to find leaks and conserve water, while helping utilities identify infrastructure leaks in aging pipes and broken water mains. TI’s advanced flow metering microcontroller, the MSP430FR6043, significantly improves accuracy while reducing overall cost and power consumption.



Environmetal safety and health

Our Environmental, Safety and Health (EHS) team is responsible for:

- Operational decisions and investments to control potential environmental impacts and maintain a safe and healthy working environment.
- Conserving natural resources.
- Assessing and reducing ESH risks.
- Driving continuous improvement.
- Meeting or exceeding compliance obligations.
- Setting site-specific conservation and efficiency goals and initiatives, and tracking and reporting these goals to senior leaders quarterly.

Our ESH management system contains rigorous programs, policies, personnel, controls, processes and measurement tools that are based on industry best practices and international standards. This system helps us mitigate ESH risks, improve our performance, fulfill compliance obligations and achieve our objectives.

All TI sites meet the certification requirements set by International Organization for Standardization (ISO) 14001 environmental management system criteria, as well as those set by ISO 45001 for the management of occupational health and safety.

Additionally:

- To guide our efforts to operate sustainably, we require employees and supplemental contractors at all manufacturing and assembly/ test sites to adhere to our [ESH Policy and Principles](#) as well as to applicable regulatory requirements.
- Our [Living our values – TI’s Ambitions, Values and Code of Conduct](#) includes sections on protecting human health and the environment.
- TI and its suppliers are expected to comply with the [Responsible Business Alliance \(RBA\) Code of Conduct](#), which contains ESH standards.

Our ESH policy is available in multiple languages:
[English](#) | [Traditional Chinese](#) | [Simplified Chinese](#) | [Japanese](#)
| [Malay](#) | [Spanish](#) | [German](#) | [Korean](#)



RESPONSIBLE MANUFACTURING AND DISTRIBUTION

We design and manufacture products that help solve some of the world's toughest challenges and create a better world. Sustainable technology design and production is an opportunity for our company and our customers to help dozens of industries make their products safer; smarter; and more affordable, energy-efficient and reliable, all while consuming less power.

Semiconductors

About 80% of our wafers are manufactured in-house, at 14 manufacturing sites across eight countries. We have complemented our manufacturing capability by forming strong partnerships with external foundries and subcontractors so that we can scale production to meet customer demand. This flexibility enables us to help ensure continuity of supply for the approximately 100,000 customers we support.

One of our competitive advantages is our large and robust manufacturing footprint, and our shift from 150- to 200-mm wafer production to more advanced and cost-effective 300-mm technology. Making 300-mm wafers enables the production of more chips per wafer while reducing manufacturing costs, resource consumption and environmental impacts.

Quality

Having in-house manufacturing capability enables us to more closely control the quality of our products by monitoring and regulating the materials we purchase for product development as well as the fabrication process itself. Our [Quality System Manual](#) describes our management process and systems, quality policies, and procedures so that we can quickly address and resolve quality-related issues. Our quality standards maintain compliance with numerous quality specifications and the latest industry standards.

Reliability

The average life span of a semiconductor used under normal circumstances is 10 to 15 years. Our reliability testing includes [stress and temperature tests](#), during which we apply heat, vibration and other factors that accelerate potential failure mechanisms. These tests help us identify the root cause of such failures and improve the design of integrated circuits before selling them to our customers. Our product designs, processes, products and packages must also meet industry [reliability](#) standards before release.

We regularly make changes to comply with industry standards.

We also routinely evaluate customer quality data, develop quality improvement plans and conduct quarterly internal quality audits to make sure that our products are long-lasting.

We continue to sell our products until our inventory is depleted or technological or efficiency updates are warranted. To discontinue a particular product, three conditions must simultaneously exist:

- The product has had no sales for the last five years (seven years for automotive or high-reliability products).
- Has been in production for at least 10 years.
- There is no current customer demand.

We notify customers of pending discontinued products so that they can determine whether they wish to purchase and store them for future use.

End-of-life disposal

We give customers detailed information about the substances used in our components so that they can make informed decisions about end-of-life disposal. Customers can incorporate our component compliance data into their product assessments because they are ultimately responsible for managing any social or environmental impacts that result from the useful life and disposal of end products, such as cellphones or computers. This data is available through our [material content tool](#).

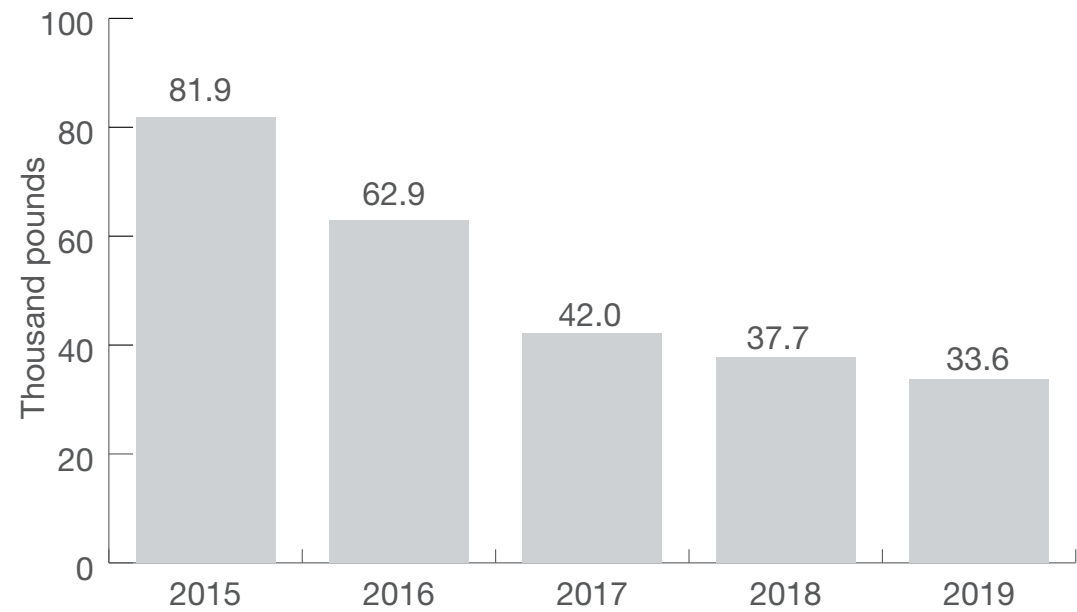
Education technology

We outsource the manufacturing of our [education technology calculator products](#), which are used by educators and students worldwide. We develop these products with concern for their environmental impact, including the type of materials used in their design, packaging and waste, as well as the products' life cycle. We also require suppliers and contractors to comply with applicable ESH and quality laws and regulations, as well as our own standards, to ensure the responsible manufacturing of our handheld graphing calculators.

Reducing waste in Education Technology products

We reduce waste by designing Education Technology products with flash technology, which enables consumers to download software applications, extending the products’ life span and long-term value. We also design our calculators to withstand years of classroom use. We continue to recycle more electronic waste and have diverted 258,367 pounds from landfills since 2015.

Waste generated from Education Technology products



Packing and shipping

TI is committed to packing and distributing all of its products in the most environmentally responsible way.

In Japan, we use the Multipak packing system, which enables customers to return the entire box and shipping materials to a third party that certifies the packing for reuse. If the materials do not pass inspection, they are recycled.

Packing

We pack our products efficiently to assure timely distribution to customers and compliance with international shipping regulations. For example, we:

- Pack large quantities of products into each shipment to eliminate multiple deliveries.
- Increase packing density to move actual weights closer to charged dimensional weights.
- Eliminate heavy and expensive custom-cut foam, nonrecyclable foam, and foam and cardboard waste.
- Reuse packing materials that protect products during shipment.

Shipping

We strategically place our distribution centers in regions close to customers in order to accelerate delivery times, be more efficient, and facilitate product deliveries in the event of a natural or human-caused disaster. We work with our customers to determine when they need our products so that we ship at the right time and in bulk when possible. This practice enables us to ship mutually agreed-upon low-priority freight when space becomes available on more affordable shipping options.



MATERIALS MANAGEMENT

TI makes every effort to purchase only what is necessary to run its business and to recycle, reuse or sell scrap and waste materials such as shipping materials or chemicals.

We apply a three-step approach to material management:

Step 1: Examine what we need.

Most of the materials we need are used to fabricate semiconductors and are present in our final products. When purchasing materials, we consider the resulting waste and whether an opportunity exists to reuse existing materials or purchase recycled materials or environmentally friendly items instead.

Step 2: Reuse what we can.

We reuse materials by:

- Recovering metals from solids, liquids and sludge.
- Repurposing and reselling used process chemicals, chemical containers and older manufacturing equipment.
- Reusing wafer carriers and food service tableware.
- Donating wafer fabrication shoes to local nonprofits.

Step 3: Recycle what is allowed.

Our recyclable material comes primarily from our offices and manufacturing sites and is managed and regulated differently depending on local requirements.

TI strives for zero wasted resources at all of its sites, and believes in responsibly managing material use and disposal. We do this by reusing, recycling or reselling materials we no longer need (such as scrap material) and items that can be reused or resold (such as some chemicals). This practice helps protect the environment and reduce the amount of material sent to landfills.

We also educate our employees about the importance of doing their part to reduce waste. Depending on the site, ESH personnel may spearhead recycling drives, promote the composting of food scraps or encourage other waste management practices. While our programs and infrastructure vary by location, our commitment to zero waste remains the same.

Screening materials

We screen all incoming materials and chemicals before incorporating them into our semiconductor manufacturing processes to comply with both regulatory and customer requirements. In addition to any ESH controls required for their use, we incorporate restrictions and standards related to chemicals in our contracts with suppliers.

If concerns about a chemical or other material arise during our screening process, we elevate the matter to an internal chemical and material review board staffed by experts throughout the

company. If we believe that a chemical or material is necessary for manufacturing but still raises concerns, our manufacturing leaders review the issue and, if necessary, authorize additional time and resources to seek a safer alternative or implement more stringent use controls.

Stringent management of chemicals required for manufacturing

Producing world-class semiconductors involves the use of hazardous and nonhazardous chemicals and gases, which is why we have stringent controls in place. We also continually assess the potential ESH impacts of these materials as new scientific information becomes available and new regulations go into effect.

We are committed to identifying and using the safest, lowest-risk materials in our operations and have strict standards and protocols for purchasing, tracking the use of and disposing surplus waste chemicals. We push these standards up our supply chain and restrict our suppliers from using certain chemicals and materials. [Click here](#) for a list of chemicals and materials TI restricts.

The European Union (EU), China and other governments have stringent laws and regulations for product content and have banned some chemicals altogether.

Our product management systems control the materials used in our products and we make that data and information available to our customers so that their end products remain compliant with applicable standards. Key laws and regulations include:

- **Restriction of Hazardous Substances Directive ([RoHS](#))**
TI provides information that enables customers to prove that their products containing TI parts are RoHS-compliant.
- **Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals ([REACH](#))**
We make information available to customers regarding REACH “substances of very high concern” as they relate to our products.
- **China Management Methods for Controlling Pollution by Electronic Information Products ([China RoHS](#))**
Although our components are not subject to China RoHS, our shipping labels do contain analytical data and bill-of-materials information to help our customers maintain compliance.

Managing industrial waste

Regulatory authorities in each of TI’s operating regions classify industrial waste (primarily chemicals) originating from manufacturing operations. Where possible, we use high-pressure water instead of chemicals in certain cleanup applications or replace chemicals with environmentally benign substitutes.

When we must use chemicals, we carefully manage their transport, distribution, use and disposal. We do this by training personnel on hazards and proper chemical use, storage and disposal. We also use ventilation controls, abatement systems, leak detectors and appropriate treatment technologies.

Lead

Long before laws and regulations sought to phase out the use of lead in various products, TI led the industry in developing lead (Pb)-free alternatives. Although most customers have shifted to using Pb-free products, we continue to manufacture a few that contain lead for those who require it. These products are usually outside the scope of RoHS requirements.

Brominated and chlorinated flame retardants

One of the challenges facing TI and the electronics industry is how to reduce or eliminate the use of brominated flame retardants (BFRs) and chlorinated flame retardants (CFRs), which are integral to semiconductor packaging materials. While BFRs and CFRs contained in products pose no risk as sold, their improper or unsafe disposal is of concern. We removed these materials from 90% to 95% of our products during the conversion to Pb-free and RoHS compliance before they became an industry concern.

Our Pb-free and RoHS-compliant devices also meet globally defined restrictions in the Global Automotive Declarable Substance List and the International Electrotechnical Commission 62474 database (formerly the Joint Industry Guide, JIG-101). Our products listed as green go beyond these types of regulatory requirement lists and include compliance with low-halogen efforts.

What does green mean to TI?

We define green to mean “Pb-free; RoHS-compliant; and free of chlorine, bromine and antimony trioxide-based flame retardants.” More than 90% of the semiconductor products we ship are considered green and meet low-halogen industry requirements. For more information, see our [Our Halogens, Chlorine and Bromine: Concentration in TI’s Green Devices document](#) and our [Eco-Info website](#).

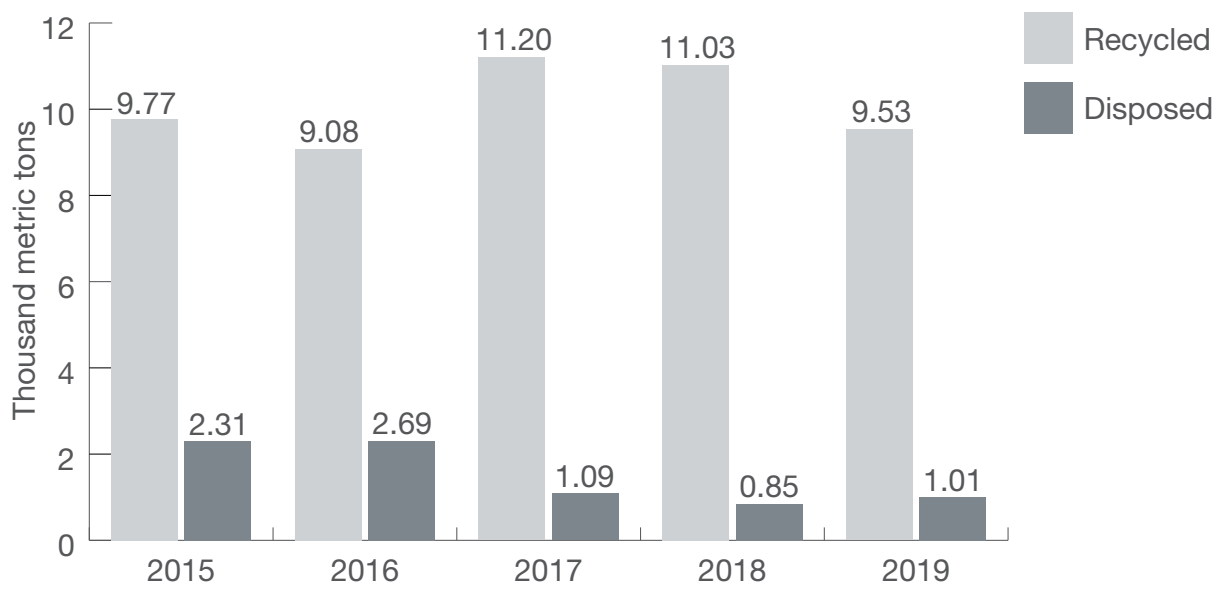
Nanomaterials

We continually work within the industry to assess the types of nanosized chemicals and substances that we can use in our products. We are actively involved with research groups to evaluate the use of nanomaterials for specific functions, such as catalysts, lubricants, paints or coatings. Currently, we only embed nanoscale features and structures within select semiconductors. We are working with industry partners to study these materials further to understand potential ESH impacts better, and to ensure that our management systems provide appropriate controls and protections should they be necessary.

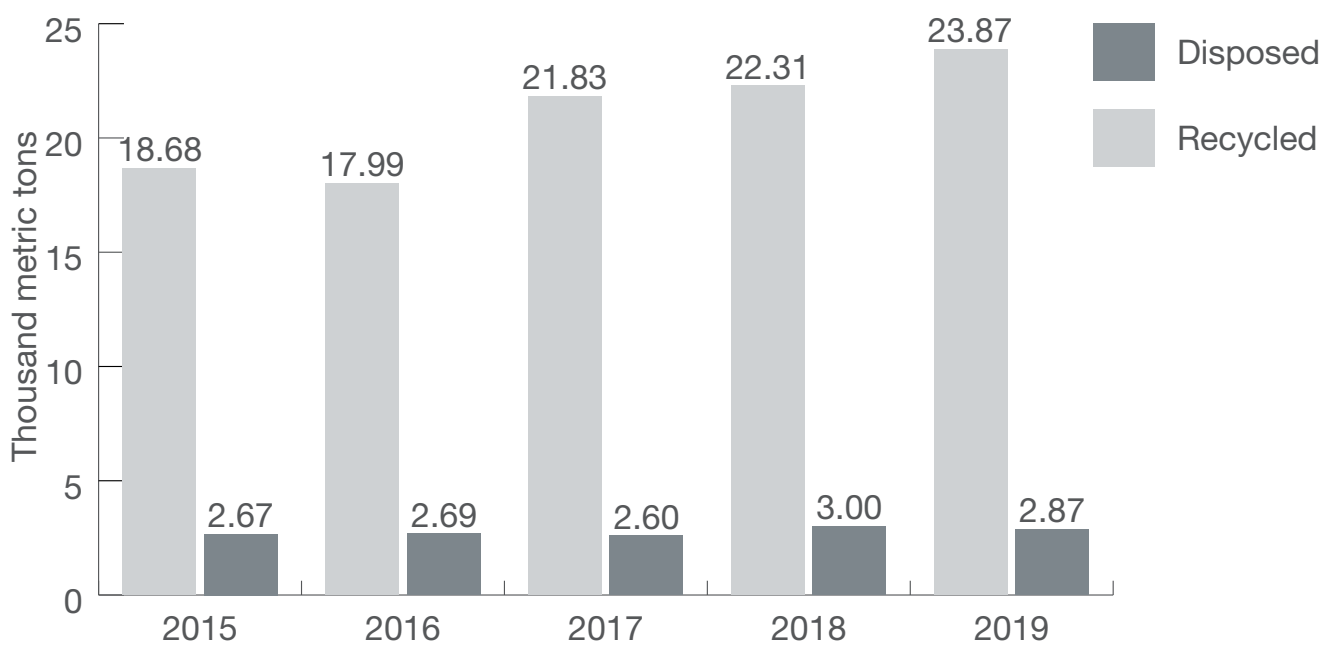
TI’s material use

In 2019, TI generated fewer tons of waste overall, although our waste-per-chip increased due to lower wafer production. We generated slightly more hazardous waste, consisting primarily of process chemicals, which we sell for reuse in other industries. We were unable to sell a portion of this waste, so we disposed it in accordance with hazardous waste regulations.

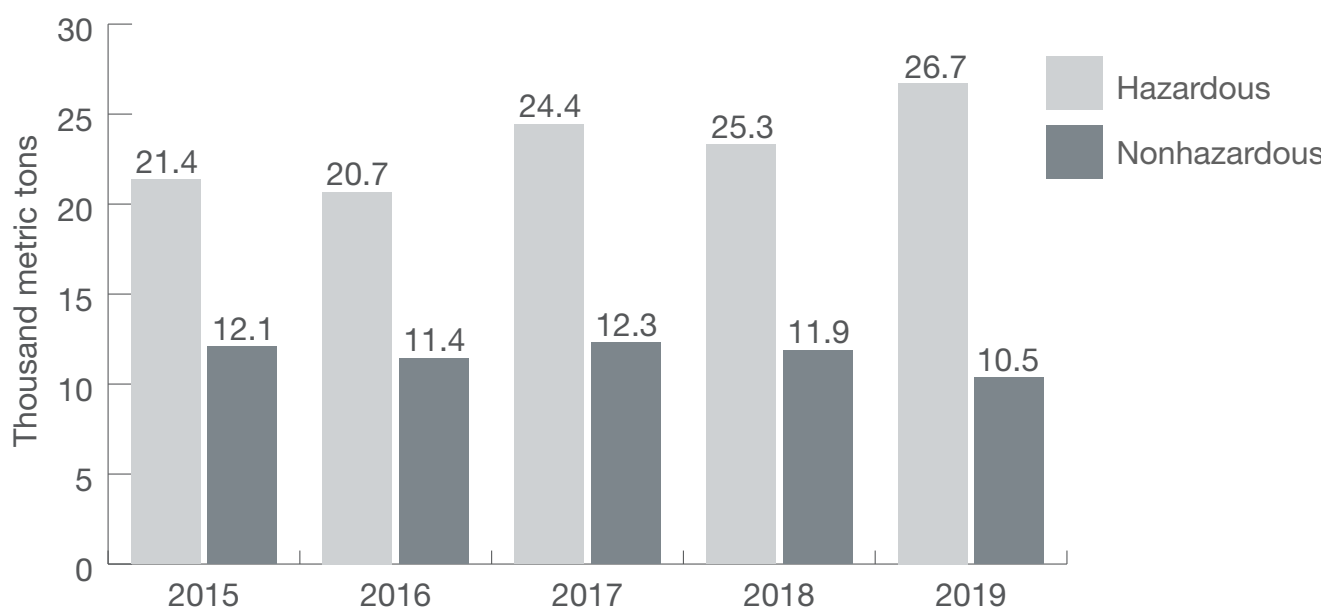
Nonhazardous waste



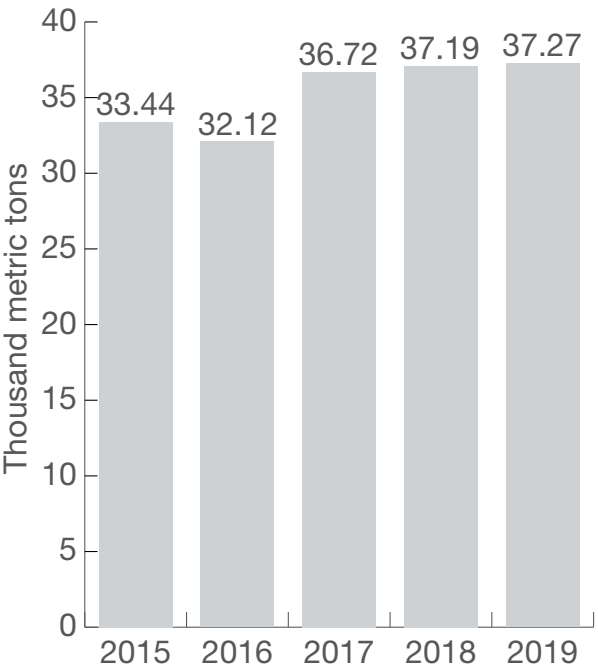
Hazardous waste



Waste by type



Waste generated



Normalized waste use per chip

