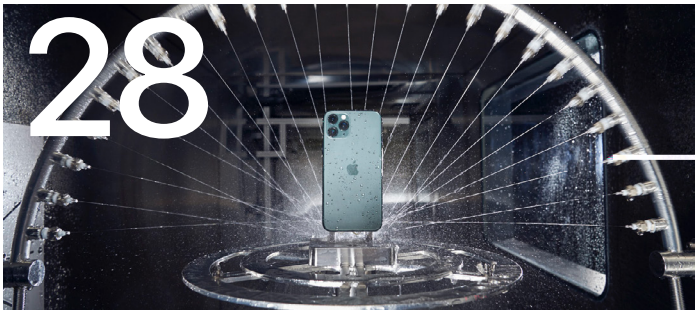
Environmental Progress Report.

Covering fiscal year 2019

Contents



Cover: An Apple-protected forest in Maine, United States.
Image Credit: EcoPhotography

Our year in review

The responsibility to protect our shared planet intersects every aspect of our lives. This year has offered humbling reminders that nature is bigger and more powerful than any one of us—and that our ability to solve worldwide challenges depends on historic innovation and collaboration.

That's why Apple has dedicated our resources—and our best thinking—to considering the environment in everything we do: the energy that powers our operations, the materials in our devices, the companies we do business with, and the health and safety of those who make and use our products.

We've led our industry in reducing our environmental footprint for years, but we know there is more to do. So we've set a groundbreaking new goal to further reduce our impact on the planet we all share: **By 2030, we're committing to total carbon neutrality**. We are already carbon neutral for our corporate emissions, including corporate travel—resulting from our use of 100 percent renewable electricity for our facilities and investing in high-quality projects that protect and restore forests, wetlands, and grasslands. And we're well on our way in our supply chain. But we're going further to cover our entire, end-to-end footprint. All the way down to the shipping that moves our products around the world, and the energy used to power our customers' devices.

But our journey is incomplete if the communities most impacted by environmental harms do not have a voice in our mission to address them. That's why a key component of our roadmap is an all-new Impact Accelerator for minority-owned businesses—so that our investments in renewable energy or carbon capture can help fight systemic barriers in our economy. That investment is part of our $100 million Racial Equity and Justice Initiative to expand opportunities for Black and Brown people in the areas of education, economic equality, and criminal justice reform.

This initiative will support not just our carbon goal but all of our ongoing environmental ambitions. Like our visionary goal of closing the loop on our supply chain and to one day no longer mine materials from the earth. Many of our products now contain higher percentages of recycled material than ever before, but we won't be content until that number hits 100 percent for all of our devices. Achieving this critical goal will also help us to further reduce our carbon footprint, and we're dedicating Apple's unmatched innovative capacity to get there.

Perhaps most importantly, we are channeling our learnings and influence to bring others along. We're committed to supporting smart policies around the world that better protect the planet and make transitioning to a low-carbon future more efficient. And we've helped dozens of Apple suppliers transition to using clean energy. They've built a powerful new competitive advantage that will set them apart in the years ahead. And those who are holding out should know that the clock is ticking. Our commitment to the planet means working with partners who share in our mission.

We hope the details in this Environmental Progress Report offer a model for others to copy. We are proud of what we've accomplished, but not so proud as to believe that these efforts alone are enough. In the urgent years ahead, we will all need to think differently and act urgently in order to build the safer, healthier, more equitable future we all know is possible. We're committed to doing our part.

Lisa Jackson

Vice President, Environment, Policy & Social Initiatives

Report highlights

Overall

$4.7B
green bonds

Apple remains the largest corporate issuer of green bonds, underscoring our strong commitment to the environment.

35% ↓
reduction of emissions

We've reduced Apple's overall carbon footprint by nearly 35 percent since our emissions peaked in 2015. And we've now committed to carbon neutrality by 2030.

UN Climate Neutral Now
Award

The United Nations recognized our achievements in reducing carbon emissions.

Operations

100% ↻
renewable electricity

We continue to use 100 percent renewable electricity at Apple stores, data centers, and offices across 44 countries.

70+
suppliers committed to clean energy

More than 70 suppliers have committed to 100 percent renewable electricity for Apple production.

CDP A
rating

For our work to reduce carbon emissions, we were recognized for the sixth consecutive year in CDP's Climate Change "A List."

Design

100% ↻
recycled rare earth elements in iPhone

The Taptic Engine in iPhone 11, iPhone 11 Pro, and iPhone 11 Pro Max is built from 100 percent recycled rare earth elements—a first for Apple and for any smartphone.[1]

40%
recycled content in MacBook Air

The 13-inch MacBook Air with Retina display, introduced in July 2019, contains over 40 percent recycled content.

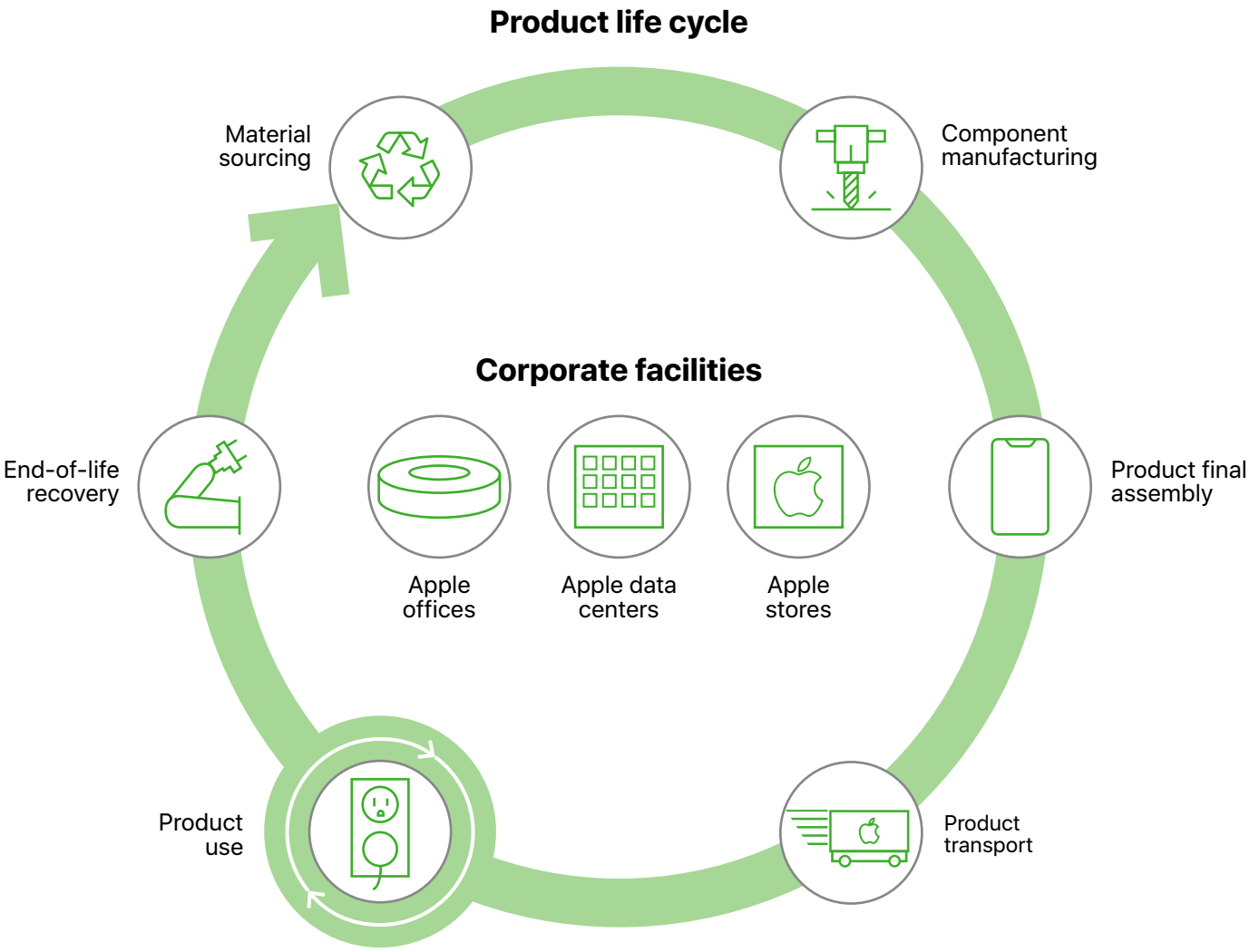
A+
Mind the Store

Apple was the only retailer to receive the top rating in the "Mind the Store" campaign for our work to eliminate harmful chemicals in products and packaging.

Our responsibility

Apple has a history of channeling innovation to address global challenges. That task has never been more urgent than now, with the existing threats of climate change and environmental degradation that our planet faces. We believe we can make the world's most iconic products—without depleting the earth's resources. That's why we take responsibility for the impact of our entire value chain, including the complete life cycle of our products, as well as our own facilities. This includes supporting the environmental innovation needed to help us meet our goals, and creating economic opportunities for minority-owned businesses and institutions that have been historically disadvantaged. By doing so, we hope to build pathways for others to reduce their footprint while addressing environmental impacts that disproportionately negatively affect communities of color.

Our value chain



Our environmental strategy

We focus our environmental work in areas where we believe we can make the biggest difference. Our strategy is informed by comprehensive data and input from external stakeholders. What we learn drives our mission: to make products without taking from the earth. Achieving this ambition requires focus and innovation in three key interconnected areas:

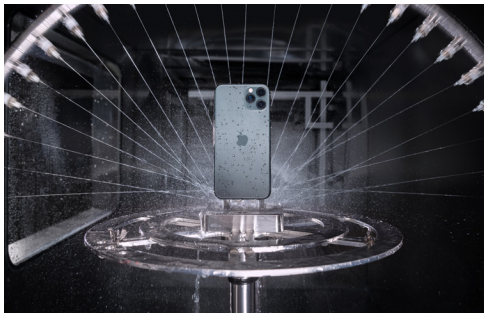
Climate change

We've set a goal to become carbon neutral across our entire footprint by 2030. We will get there by reducing our emissions by 75 percent compared to 2015, and then investing in carbon removal solutions for the remaining emissions.

- Low-carbon design ›
- Energy efficiency ›
- Renewable electricity ›
- Direct emissions abatement ›
- Carbon removal ›

Resources

We aim to make products and packaging using only recycled or renewable materials. At the same time, we're committed to stewarding water resources and sending zero waste to landfill.



- Materials ›
- Water stewardship ›
- Zero waste to landfill ›

Smarter chemistry

We maintain rigorous controls to ensure our products are safe for anyone who assembles, uses, or recycles them.

- Mapping and engagement ›
- Assessment ›
- Innovation ›

Our environmental vision

Our ambitious vision across our three focus areas outlines where we are headed and what we intend to achieve.

Climate change

We are proud to have reached 100 percent renewable electricity for Apple facilities, and carbon neutrality for Apple's corporate emissions, including business travel and employee commute. We are embarking on a new goal to become carbon neutral for our entire carbon footprint by 2030.

To get there, we will:

Transition our entire manufacturing supply chain to 100 percent renewable electricity by 2030.

Reduce emissions by 75 percent from 2015 levels by 2030.

Balance the remaining emissions with high-quality carbon removal projects.

Resources

We've progressed significantly toward making products and packaging using only recycled or renewable materials; stewarding water resources; and sending zero waste to landfill.

Our ambition is to:

Use only recycled and renewable materials in our products and packaging.

Eliminate plastics in our packaging by 2025.

Minimize use of freshwater resources in water-stressed locations.

Eliminate waste sent to landfill from our corporate facilities and our suppliers.

Smarter chemistry

For years, we've led the industry in eliminating potentially harmful chemicals from our products. We will continue to drive Smarter Chemistry to promote human and environmental health through leadership, transparency, and innovation.

More specifically, we will:

Drive 100 percent transparency of chemical use in our supply chain and products.

Minimize exposure to chemicals that could be harmful to human health or the environment.

Integrate Smarter Chemistry innovation into the way we build and design our products.

Climate Change.

Apple launched a first-of-its-kind China Clean Energy Fund to connect suppliers with renewable electricity projects. Our first fund investments included this 48-megawatt wind farm in Hunan province.

Highlights

We've achieved some significant milestones in our work to reduce emissions and accelerate climate solutions, through years of investments in emissions reduction programs.

Our 2019 comprehensive carbon footprint has shown a 35 percent absolute reduction since it peaked in 2015, even as product sales have increased. We've done this by focusing on energy efficiency, low-carbon design, and transitioning to 100 percent renewable electricity at all of our facilities worldwide—and working with our suppliers toward the same goal. To date, over 70 suppliers have committed to 100 percent clean energy for Apple production.

And we've been focused on reducing the carbon footprint of our products by transitioning to recycled and renewable materials in key components.

We know we all have to do more. Mitigating climate change is of vital importance. That's why we're accelerating and expanding our work and announcing that by 2030 we will reach carbon neutrality for our entire footprint. This includes emissions in our supply chain and across the product life cycle, from raw material extraction and processing, to manufacturing, and through to product use and end-of-life material recovery. We are also now carbon neutral for our own operations. There's never been more urgency to act, given the devastating threats of climate change, so we are sharing our progress and ambitions with the world to ask others to join us in eliminating carbon emissions.

35%

Progress toward zero

We reduced our comprehensive carbon footprint by 35 percent since its peak in 2015.

100% ↻

Renewable electricity at corporate facilities

We continued to source 100 percent renewable electricity at all offices, retail stores, and data centers, across 44 countries.

70+

Supply chain renewable energy

Over 70 suppliers have committed to 100 percent renewable electricity for Apple production, of which 2.7 gigawatts is operational today.

4.3M ↓

Low-carbon design

By increasing efficiency and using recycled and other low-carbon aluminum in our products, we have decreased our carbon footprint by 4.3 million metric tons in 2019.

73% ↓

Product energy use

In 11 years, we've reduced average product energy use by 73 percent.

—

Carbon neutral operations

Beginning April 2020, Apple is carbon neutral for our corporate emissions, investing in high-quality projects that protect and restore forests, wetlands, and grasslands.

Our approach

Climate change is a defining issue of our time, and the science clearly shows that we are at a pivotal moment. From shifting weather patterns that threaten food production, to widespread wildfires that devastate entire communities and ecosystems, the impacts of climate change are global in scope and unprecedented in scale. Without comprehensive and immediate action today, adapting to these impacts in the future will be more difficult and costly.

As a global business, we have a responsibility to our customers, employees, shareholders, and the world at large, to take strong, decisive action on climate change. That's why we recently announced our goal to be carbon neutral by 2030. This is 20 years ahead of the recommendations by the Intergovernmental Panel on Climate Change, which call for carbon neutrality as a planet by 2050.

To meet our goal, we've created a climate roadmap. By working with teams across the company, we've identified a broad portfolio of projects to reduce our emissions, which we will regularly update. We are leveraging Apple's USD$2.2 billion green bond issued in November 2019 to help meet this climate goal.

Our philosophy for achieving carbon neutrality follows these tenets:

Take complete accountability:
We take responsibility not only for our direct operations, but for the entire life cycle of our products. The responsibility extends from the production of raw materials through product manufacturing and shipping, to the energy used to power our facilities and our customers' devices, and recover materials at the end of their useful life.

Set ambitious targets:
We plan to reduce emissions by 75 percent by 2030, compared to 2015 levels, through product design and engineering, energy efficiency and renewable energy, and direct emissions abatement. Then for the remaining emissions, we will invest in carbon removal, like natural climate solutions that protect and restore ecosystems and play a vital role in removing carbon from our atmosphere.

Match solutions to sources:
We will address direct emissions through energy efficiency, emissions abatement, fuel switching, and carbon removal. And we will address emissions from electricity generation with renewable electricity. In this way, the solutions we create will match their sources, which, when scaled, is necessary to truly decarbonize our economy.

Make no compromises:
We don't believe there is an inherent trade-off between the environment and what is good for business. We intend to meet our carbon reduction goals without compromising on things like our design and performance, the durability of our products, or our bottom line. We believe that our carbon goal will challenge us to improve on all aspects of our business.

Pursue all solutions:
A successful approach means working across multiple solutions. We must concurrently deploy all the tools at our disposal, scaling proven solutions and enabling new ones.

Be open:
We are committed to transparency about our climate strategy, progress toward our reduction goal, as well as climate risk–related financial information. To this end, we report each year to CDP, a global disclosure nonprofit, which has aligned to the Taskforce on Climate-related Financial Disclosures (TCFD) recommendations. In addition, we're currently undertaking a climate-scenario analysis that will help us even better understand the physical and transitional effects of climate change.

Work together:
The best solutions are often found through collaboration. We plan to pursue partnerships and identify projects and financing models that help scale efficiency, renewables, and carbon removal beyond our footprint.

Our 10-year climate roadmap will leverage five pillars to decarbonize Apple's carbon footprint:

Low-carbon design ›

We will design products and manufacturing processes to be less carbon-intensive.

Energy efficiency ›

We will increase energy efficiency at our corporate facilities and in our supply chain.

Renewable electricity ›

We will maintain our use of 100 percent renewable electricity for our corporate facilities and transition our entire supply chain to 100 percent clean, renewable sources of electricity.

Direct emissions abatement ›

We will avoid direct greenhouse gas emissions through technological solutions or switching to non-fossil -based low-carbon fuels.

Carbon removal ›

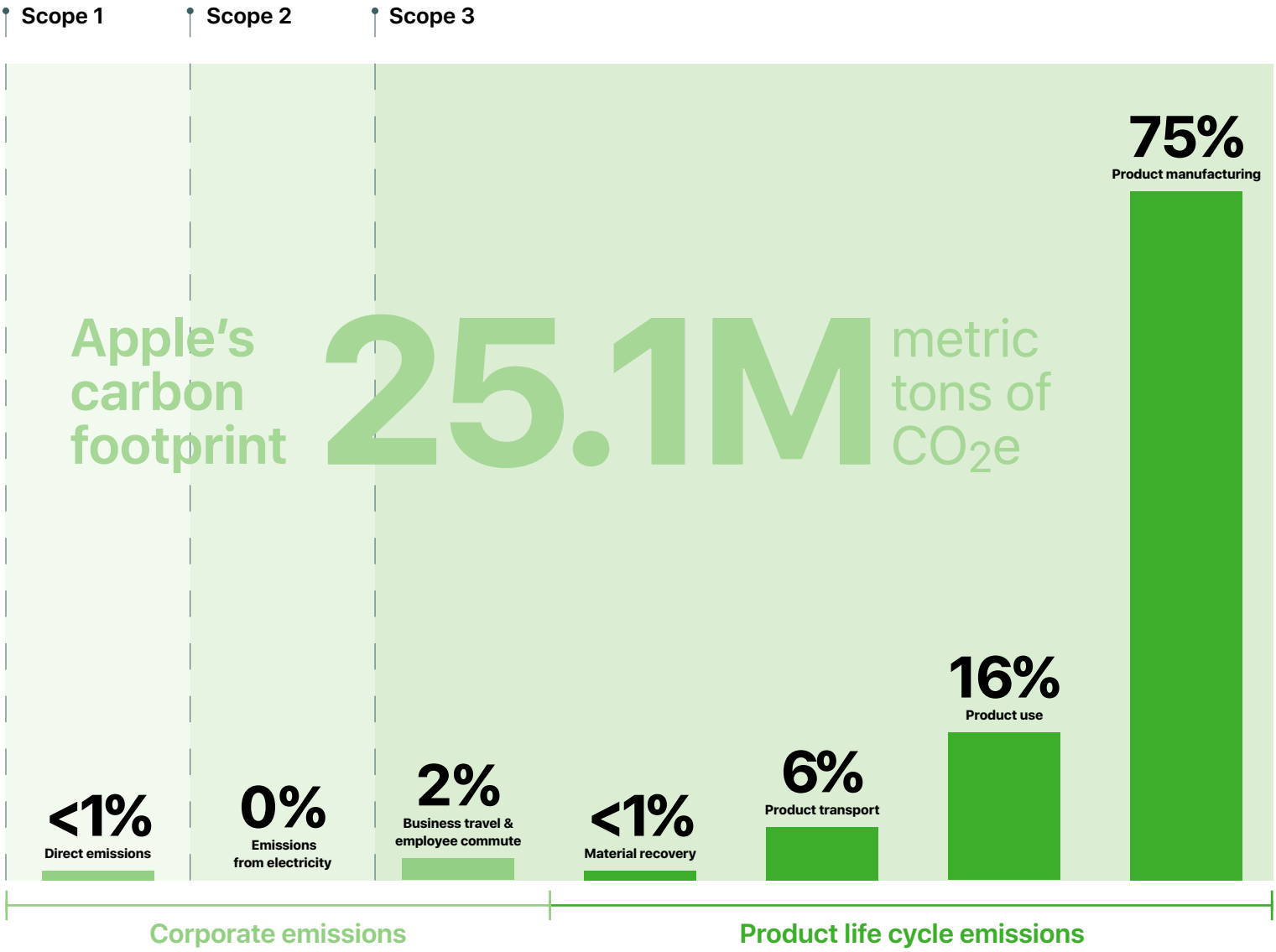
Working in parallel with our emissions reduction efforts, we will scale up investments in carbon removal projects, including nature-based solutions that protect and restore ecosystems around the world.

Climate change is real and we all share a responsibility to fight it. We will never waver, because we know that future generations depend on us."

Tim Cook, CEO

Apple's 2019 carbon footprint

Understanding our carbon footprint is essential to taking strong action to eliminate it. That's why we model it so comprehensively, taking responsibility for emissions across our entire value chain, including Apple's corporate operations, as well as across the product life cycle, from manufacturing (including material sourcing), use, transportation, and end-of-life material recovery. And each year, we use the results to adjust our climate roadmap, which lays out our plan to get to carbon neutral by 2030.



The WRI Greenhouse Gas Protocol defines the methodology for calculating carbon emissions.

Scope 1 emissions are those greenhouse gases resulting from fuel combustion from sources we own or operate—like vehicles or natural gas for heating.

Scope 2 emissions refer to those resulting from use of electricity. Renewable energy generates minimal Scope 2 emissions, whereas burning coal, oil, or natural gas to produce electricity releases carbon dioxide and other greenhouse gases into the atmosphere.

Scope 3 emissions refer to all other indirect emissions that occur in a company's value chain, including upstream and downstream activities.

Note: This graphic was edited on October 2020 to correct the percentage breakdowns of "product manufacturing" (previously 76%), "product use" (previously 14%), "product transport" (previously 5%), and "business travel & employee commute" (previously 3%). The total carbon footprint (25.1 million metric tons) and reported breakdowns on page 63 remain accurate.

Our past and future carbon footprint

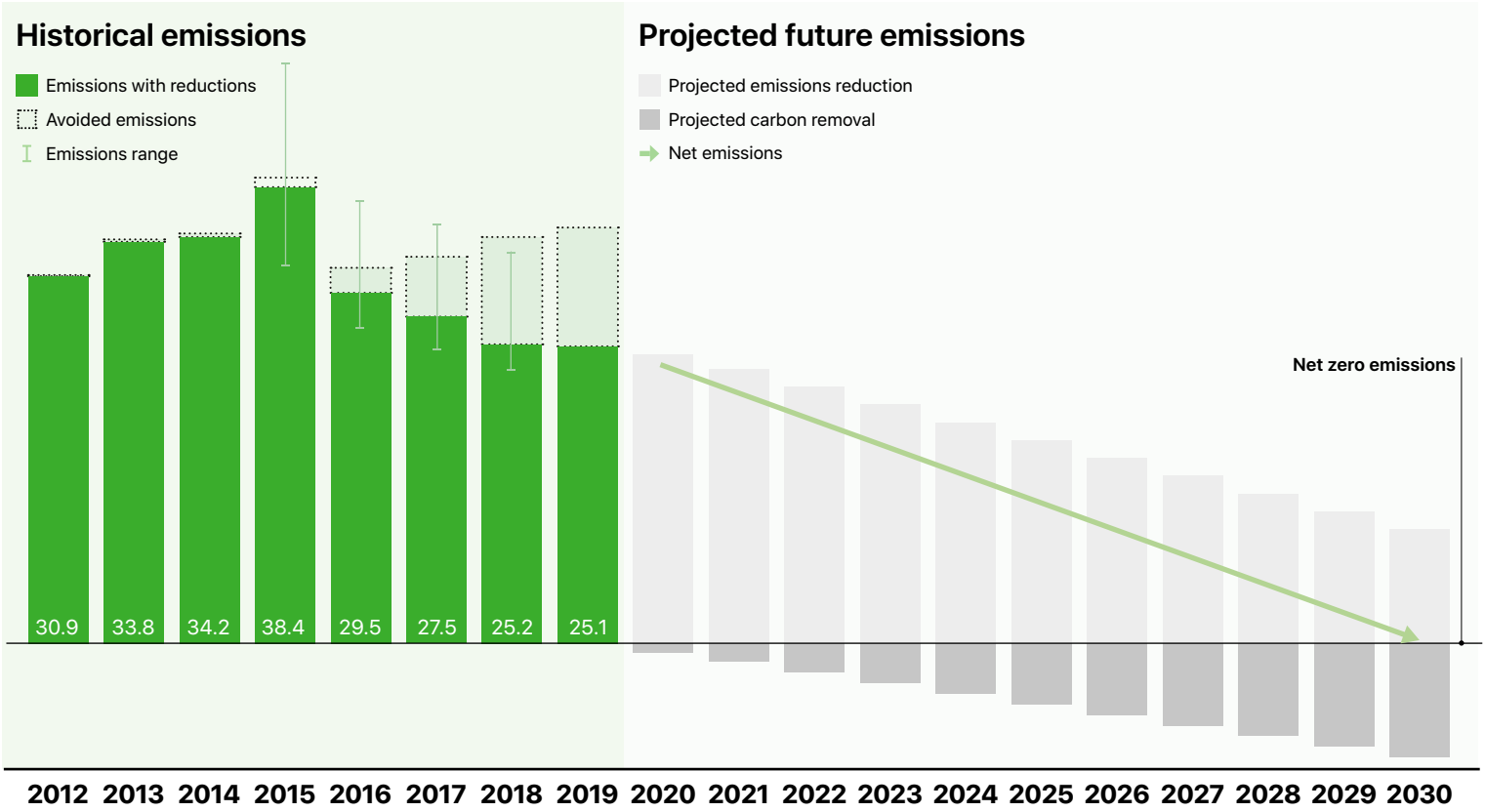
In fiscal year 2019, we reduced our comprehensive carbon footprint for the fourth consecutive year—down 35 percent compared to 2015, when Apple's carbon emissions peaked, even as net revenue increased by 11 percent over that same period. In the past year, we avoided over 10 million metric tons from our emissions reduction initiatives—like our Supplier Clean Energy Program, which lowered our footprint by 4.4 million metric tons.

We also made several product design changes over the past five years, like sourcing aluminum made with hydroelectricity and increased recycled content, as well as improving efficiency—which together avoided another 4.3 million metric tons in 2019.

Measuring our footprint

We use a life cycle–based approach to measuring our comprehensive carbon footprint. We utilize as much Apple-specific data as possible, falling back on industry averages where original data isn't available. Because we're committed to accuracy and transparency, we're constantly refining our product life cycle assessment model and sources of data. For example, we recently obtained more accurate data for the amount of electricity used to manufacture a number of components like onboard electronics, bare boards and flexes, and various module assemblies. The net result was an increase in our 2019 carbon footprint.

If we used the same data and model as 2018, our 2019 carbon emissions would have been about 23 million metric tons, or a decrease of 7 percent. Each year, we obtain third-party verification of our comprehensive carbon footprint that validates the accuracy and robustness of our methodology (see Appendix C). We will continue to revisit and refine our carbon footprint moving forward to maximize its accuracy, and will adjust our climate roadmap as necessary.



Since 2015, we've reduced emissions by 35 percent. Building on this success, we recently announced our new goal to become carbon neutral by 2030, targeting an ambitious 75 percent reduction in emissions compared to 2015.

Note: Beginning this year, we've included a range for recently estimated emissions, to reflect the potential variances inherent to modeling product-related carbon emissions. Each year, we refine our methodology to ensure the accuracy of our estimates.

Low-carbon design

Apple makes hundreds of millions of products each year. Each product represents an opportunity to reduce our global carbon footprint—small changes can mean enormous results. We focus on design, like switching to low-carbon materials, improving manufacturing and material processes, and building energy efficiency into our products.

We utilize carbon data during the design and engineering processes to inform product decisions. We believe this holds tremendous opportunities for reducing our overall carbon footprint.

Material efficiency

Using less material is one of the most effective ways to reduce the carbon impact of our products. Material efficiency avoids energy-intensive processing and transportation of raw materials. While manufacturing scrap does typically get directed toward the recycled materials market, we believe it is still best not to create the waste in the first place. So we're exploring manufacturing processes that generate less material inefficiencies.

To this end, we've improved how we manufacture iPhone and Apple Watch. iPhone 11 Pro, for example, integrated a novel technique in the production of the steel band, reducing steel use by over 30 percent compared to traditional forging methods. The reduction in steel use resulted in a savings of over 1 kilogram of carbon dioxide equivalent (CO_2e) per iPhone.

We also reduced the amount of aluminum used to manufacture Apple Watch Series 5 by 50 percent using a hollow extrusion process. This utilization improvement, combined with 100 percent recycled content, reduced the carbon impact of the aluminum enclosure by 25 percent.

Improved manufacturing efficiencies, as well as use of recycled aluminum and aluminum smelted with hydroelectricity helped us reduce our 2019 carbon footprint by 4.3 million metric tons of CO_2e.

Low-carbon materials

Material selection is another way to reduce the carbon footprint of our products. Our strategy is to transition to materials manufactured using low-carbon energy and recycled content. We've prioritized materials and components that make up a large part of our carbon footprint.

One example is aluminum, which in 2015 represented 27 percent of our product manufacturing footprint. We started by prioritizing the use of aluminum that was smelted using hydroelectricity rather than fossil fuels like coal. We also reengineered our manufacturing process to reincorporate aluminum scrap. We then went even further to source 100 percent recycled aluminum, utilizing post-industrial aluminum waste generated during the manufacturing of Apple products. We're now selling four products with a 100 percent recycled aluminum enclosure. As a result of these initiatives, we've seen a 63 percent decrease in Apple's aluminum carbon footprint compared to 2015.

Use of 100 percent recycled aluminum in the enclosure of the MacBook Air with Retina display helped cut the product's carbon footprint by nearly half compared to the 2017 MacBook Air.

Product energy efficiency

Customer use of products represents 16 percent of our overall carbon footprint. Prioritizing the energy efficiency of these products can benefit both our customers and our carbon impact. So we set aggressive energy efficiency targets early in the design process. Some recent efficiency improvements include the use of software and power-efficient components that intelligently manage power consumption. And our latest MacBook computers now ship with power adapters that are over 89 percent efficient,[2] meaning that it takes less electricity to power the device. Apple products consistently rank among the high-performing products rated by ENERGY STAR—which was established to recognize the 25 percent most energy-efficient computers on the market. In 2019, 100 percent of our eligible products received an ENERGY STAR rating for superior energy efficiency.[3] As a result of these energy efficiency improvements, we've decreased the average product energy use across all major product lines by 73 percent since 2008.[4] And 100 percent of our eligible products received a Gold rating, the highest awarded, from EPEAT, an environmental rating system for electronic products, where energy efficiency is a highlighted feature.[5]

65% ↓

The 16-inch MacBook Pro consumes 65 percent less energy than the ENERGY STAR® energy efficiency requirement.

70¢

The Super Retina XDR display in iPhone 11 Pro is up to 15 percent more efficient, contributing to our largest leap ever in battery life. We estimate it costs only 70 cents a year to charge iPhone 11 Pro once a day.*

40% ↓

Pro Display XDR uses efficient backlight control to deliver outstanding brightness and contrast, while using 40 percent less energy than required by ENERGY STAR.

*Calculation assumes one full charge per day, using the U.S. Energy Information Administration average electricity cost in the U.S. for January 2020.

Energy efficiency

Simply put, the cleanest energy is the energy we don't use. And when we use less energy, we need less from clean sources. To increase energy efficiency at our offices, data centers, and retail stores, we start by designing buildings to optimize energy use.

For many existing buildings at our facilities and in our supply chain, we conduct energy efficiency audits to identify system improvements that could reduce energy use. And we even think about efficiency when shipping products to our customers too.

Working energy efficiently

Apple's energy efficiency program targets natural gas and electricity use at data centers, retail stores, offices, and R&D facilities located around the world. For existing buildings, we take a methodical approach, auditing building performance, and then deploying identified reduction measures. In Europe, since 2015, we've completed 81 energy audits of Apple facilities, across eight countries, and 49 in the past year.

Data centers are typically very energy-intensive. So we've deployed a number of energy efficiency technologies at these locations, such as evaporative cooling, airside economizers, and sophisticated cooling systems that optimize the sensitive temperature conditions at these facilities. An energy assessment of our data centers found they were performing, on average, about 60 percent better than the ASHRAE 90.4 baseline specific to data centers.

We've improved our energy tracking and benchmarking processes, enabling early detection of low-performing buildings, using data from utility meters that continuously track 15-minute electricity data and daily natural gas energy consumption.

We're now closely monitoring consumption from over 500 electricity and natural gas meters across 261 buildings in the U.S., and are in the process of incorporating occupancy and use data to improve accuracy and benchmarking.

We also integrate energy efficiency early in the design process when developing new offices or Apple stores, facilitating design that accommodates local conditions, from temperature and humidity to light. We have rolled out a store prototype at over 20 retail locations, designing in energy efficiency from the beginning, resulting in energy savings of 10 to 20 percent, compared to the industry-standard energy benchmark (ASHRAE 90.1). For our larger and more complex Flagship Stores, we have been able to affect the store design in more significant ways to maximize energy performance, resulting in anticipated energy savings of 20 to 40 percent, compared to the ASHRAE benchmark. And once a building is operational, we continue to monitor energy performance to ensure it is performing optimally.

In fiscal year 2019, our energy efficiency program avoided an additional 26.4 million kilowatt-hours and 194,500 therms per year from existing buildings and retrocommissioning, as well as new building design. Together, these initiatives avoid about 7500 metric tons of CO_2e per year.

18%

In fiscal year 2019, we implemented energy efficiency measures to over 6,400,000 square feet of new and existing buildings, resulting in 18 percent electricity savings—over 26.4 million kilowatt-hours saved per year.

A more energy-efficient supply chain

The energy our supply chain uses to manufacture products represents about three-quarters of Apple's comprehensive carbon footprint. Most of those emissions are from electricity use, so we prioritize supporting suppliers in becoming more energy efficient, and then moving them to clean, renewable energy sources.

Our Supplier Energy Efficiency Program aims to educate suppliers, identify initiatives to reduce energy use, and manage those projects to completion. While we've historically prioritized facilities with the highest energy use and potential for improvement, more recently, we've focused on supplier facilities by product line, like iPhone, which represents a significant percentage of Apple's manufacturing footprint.

To help suppliers reduce their energy use, we conduct energy audits and train suppliers to uncover opportunities for energy efficiency—like replacing outdated or inefficient heating, cooling, and lighting systems; repairing compressed air leaks; and recovering waste heat. The assessments provide suppliers with a cost-benefit analysis for implementing energy efficiency improvements. The number of facilities participating in our Supplier Energy Efficiency Program grew to 92 in 2019, an 8 percent increase over the previous year. In 2019, we avoided over 779,000 annualized metric tons of supply chain carbon emissions (CO_2e), a 67 percent improvement compared to 2018.

A focus on iPhone manufacturing

Because iPhone manufacturing represents a significant portion of Apple's manufacturing energy use, in 2018, we encouraged six facilities in China that perform the final assembly of iPhone to commit to an aggressive 20 percent energy reduction by the end of 2020, compared to the 2017 baseline year. This three-year initiative is ahead of schedule, having already achieved 16 percent more energy savings compared to the established 2017 baseline. In 2019, 21 percent of Apple's annual supply chain energy-related carbon savings resulted from this commitment alone. We are continuing to expand this product-driven strategy, with the addition of the final assembly sites for AirPods.

Supporting suppliers' energy investments

Access to capital often presents a significant barrier to suppliers seeking to implement the energy efficiency improvements identified in energy audits. In 2019, we collaborated with the U.S.-China Green Fund to accelerate engagement with the manufacturing sector through the creation of a special fund to initiate the investment of $100 million in supplier projects. The fund employs an innovative approach that provides both solution design and up-front capital investment for efficiency upgrade solutions. As savings are realized, the investment is recouped. This reduces the investment barrier for suppliers, while allowing them to realize energy savings achieved through upgraded equipment and management systems.

Product transportation

Our carbon footprint includes all the energy used for shipping our products to customers, retail stores, and distribution centers across the world. To reduce our carbon impact from shipping, we've focused on maximizing system efficiencies and prioritizing modes of transport with lower carbon impacts. And we're continuously improving our Transportation Management Systems to identify which shipments could use ground and ocean transport instead of air without compromising on-time delivery.

In addition to transportation efficiencies that reduce our carbon footprint, we continue to partner with our shipping suppliers to leverage fleet improvements, sustainable fuels, and supply chain efficiencies.

779,000+

Working with suppliers to reduce energy used to manufacture our products resulted in over 779,000 annualized metric tons of avoided carbon emissions in 2019.

Renewable electricity

The burning of coal, natural gas, and oil for electricity and heat is the largest single source of global greenhouse gas emissions.[6] By switching to renewable sources of electricity and investing in energy storage, we have a significant opportunity to reduce our impact on climate change and contribute to cleaner air for communities around the world where we operate.

Since 2018, we've generated or sourced 100 percent renewable electricity for all of Apple's global facilities, driving our scope 2 emissions from electricity to zero. And we estimate that in our manufacturing supply chain, which itself makes up 75 percent of Apple's overall carbon footprint, around 70 percent of emissions come from electricity. By investing in new renewable energy projects around the world and working with our suppliers to do the same, we aim not only to reduce Apple's footprint but to help decarbonize electricity grids around the world.

We and our suppliers select projects with the greatest potential for impact and projects with a clear carbon, ecological, and social benefit. In most cases, wind and solar solutions meet our criteria. For some energy projects, such as biomass and hydroelectric generation, we review the individual project to ensure that it delivers positive impact while minimizing harm. We also uphold stringent accountability standards to ensure that all clean energy can be verified.

Renewable electricity at Apple facilities

Apple occupies over a thousand offices, retail stores, data centers, and distribution centers across 44 countries. We've been sourcing the electricity used at these facilities from 100 percent renewable energy, prioritizing the creation of new renewable energy projects, instead of taking away existing renewable energy available to others through the purchase of market renewable energy credits (RECs). This has meant taking on direct project ownership, making equity investments in new projects, and entering into power purchase agreements. As of January 2020, around 83 percent of the renewable energy Apple sources comes from projects that Apple created, for a total of 1.2 gigawatts operational and another 350 megawatts under contract. And we aim to soon cover our entire electricity load with Apple-created projects. We define "Apple created" projects to include:

- **Direct ownership**
  [12 percent of Apple-created projects]
  Where feasible, we source renewable electricity by building our own projects, including solar, wind, biogas fuel cells, and low-impact hydro projects.
- **Equity investment**
  [4 percent of Apple-created projects]
  In some markets, we invest capital to become part owner of new solar PV or wind projects and match that renewable generation with our energy use.
- **Long-term renewable energy contracts**
  [84 percent of Apple-created projects]
  At other times, we sign long-term contracts for renewable electricity. These power purchase agreements and virtual power purchase agreements support new, local primarily solar PV and wind projects that meet our robust renewable energy–sourcing principles.

In the few remaining cases where we need more renewable energy than what's generated by our Apple-created projects, we directly purchase renewable energy through available utility green energy programs (about 10 percent of the total load). Renewable energy is also supplied by colocation facility vendors (2 percent of the total load).

When these options are not available, or projects are still coming online, we are willing to procure robust market RECs (about 5 percent of the total load). As a condition, these must be tied to recently constructed projects, Green-e Energy certified, where available, and come from the same power grid as the Apple facility they support. We apply the same rigor to these purchases as we do to our Apple-created renewables. See Appendix B for additional details on Apple's renewable energy solutions.

83%

About 83 percent of the renewable energy that Apple sources for our facilities are from Apple-created projects.

Progress beyond 100 percent

Having reached 100 percent renewable electricity for Apple's facilities worldwide, we've sought to enhance the impact of our renewable energy sourcing. We've done this through projects that deliver local community benefits, aggregation projects that democratize access to renewable electricity, storage solutions to maximize the use of renewable electricity, and by moving away from government-subsidized renewable energy projects.

Social impact

In 2019, we launched our Power for Impact program to promote renewable energy projects that deliver strong local community benefits. With funding from Apple, local communities and organizations gain access to cost-effective energy. At the same time, Apple retains the projects' environmental attributes, providing a win-win-win for the community, for our company, and for the environment. We are initially focusing on projects in developing economies in which Apple has small loads. Two projects we recently launched include a 100-kilowatt rooftop solar project at an educational facility for disadvantaged children in the Philippines, which will benefit from offsetting expensive local electricity costs; and adding a 50-kilowatt solar power system and a 260-kilowatt-hour battery to enable 24/7 electrification of an off-grid fishing community in Thailand.

Aggregation

We have continued to expand our aggregation efforts to bring together multiple buyers in single renewable energy transactions to attain economies of scale. This aims to assist companies in accessing cost-effective renewable energy that they might not be able to obtain on their own. In 2019, we assembled a group of four buyers and executed an aggregation contract with a 75-megawatt wind project in Texas. Our aggregation project in the Great Lakes region, completed in 2018, achieved commercial operation in 2019.

Energy storage

The continued advancement of wind and solar technology has enabled renewable energy to become the most cost-effective new source of electricity in many parts of the world. Despite the increase in the development of wind and solar power generation, the intermittent nature of the technology has prevented further market adoption and continued reliance on fossil fuel–powered grids. Cost-effective electricity storage, which could retain wind and solar power, has become the next critical frontier in renewable energy. Apple is working to advance both short- and long-term electricity storage options.

In 2019, we executed an agreement to deploy a utility-scale battery storage system at one of our solar-power projects. This system will allow us to deliver solar electricity to the grid when the electricity is most needed. For longer-term storage, we have been funding university research into biomethanation processes, in which biological organisms are harnessed to combine CO_2 in wastewater digesters with hydrogen to create methane, thereby storing renewable electricity as renewable natural gas.

Subsidy-free projects

While government subsidies have played an important role in increasing the availability and affordability of renewable electricity, we are now pursuing projects that do not receive any government subsidies, and therefore face no danger of competing claims for the renewable energy attributes. Our entirely subsidy-free 42-megawatt solar photovoltaic project in Denmark entered service in late 2019, in time to power our new Viborg data center with 100 percent renewable energy from its first day of operation. We are also actively supporting the evolution of the Chinese renewable market in its transition from subsidized Feed-in-Tariffs to non-subsidized grid-parity projects, as we pursue new projects to power our data centers under construction there.

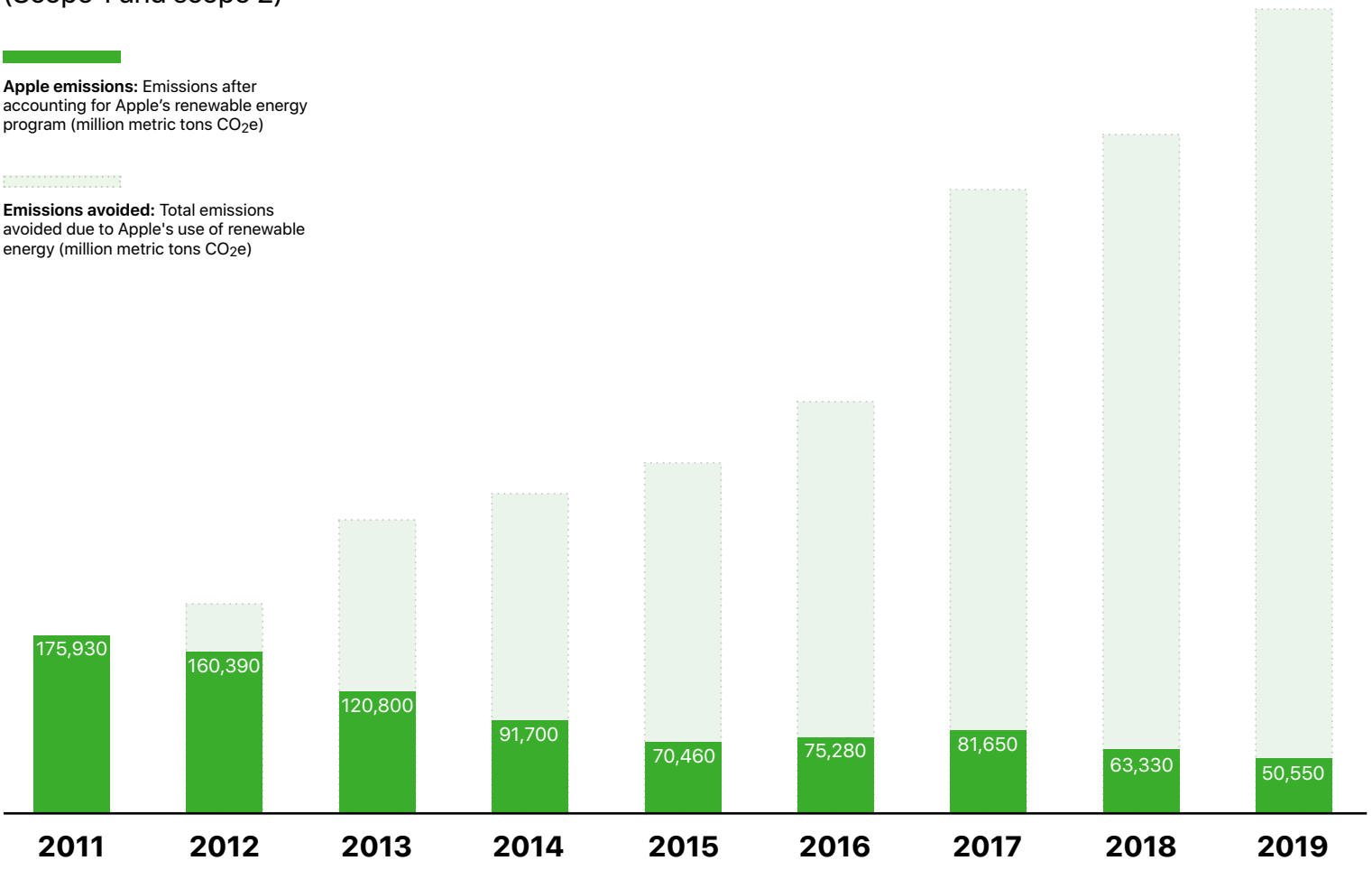
This 56-megawatt solar array supports renewable electricity use at our data center in Oregon.

We've already reduced emissions

Our transition to renewable energy has reduced our scope 1 and scope 2 emissions by 71 percent since 2011, preventing over 3.6 million metric tons of carbon from entering the atmosphere over that period—even as our energy use increased by more than 4 times in this same period.

That's equivalent to taking more than 791,000 cars off the road for one year.[7] For the first time, in 2019, Apple had zero scope 2 emissions from electricity. We now plan to tackle the remaining scope 1 emissions through energy efficiency, fuel switching, as well as carbon removal projects, in addition to purchasing carbon credits to offset their impact.

Apple's emissions since 2011
(Scope 1 and scope 2)



Renewable electricity at supplier facilities

Apple also takes responsibility for the carbon emissions associated with making our products—nearly half of our comprehensive carbon footprint comes from electricity used to manufacture our products. So, in addition to helping our suppliers reduce their energy use, we are helping them transition to 100 percent renewable electricity.

We launched the Supplier Clean Energy Program in October 2015 to advance those goals through our manufacturing supply chain. Since then, we have made strong progress toward our initial goal of bringing online 4 gigawatts of new clean energy by 2020. Building on that momentum, we recently set a new, even more ambitious goal: to transition our entire manufacturing supply chain to 100 percent renewable electricity by 2030.

We're proud of the progress our suppliers have made so far. As of June 2020, 71 manufacturing partners in 17 different countries have committed to 100 percent renewable energy for Apple production. And Apple itself has continued to invest directly in renewable energy projects to cover a portion of upstream emissions.

The Supplier Clean Energy Program now has 7.8 gigawatts of clean energy commitments, of which 2.7 gigawatts was operational in 2019. Once completed, these commitments will avoid over 14.3 million metric tons of CO_2e annually—the equivalent of taking more than 3 million cars off the road each year.[8] In fiscal year 2019, renewable energy already online generated 5.7 million megawatt-hours of clean energy across 17 countries, resulting in about 4.4 million metric tons of carbon emissions avoided within our supply chain.

Supplier commitments

As we continue transitioning our supply chain to clean energy, these 71 suppliers operating across 17 countries—including 28 new commitments in the past year—have committed globally to producing Apple products with 100 percent clean energy.

- II-VI Incorporated*
- 3M*
- Advanced International Multitech
- Amphenol*
- Arkema
- ASE Technology Holding*
- ATL*
- AT&S
- Avary Holding*
- Bemis Associates
- Biel Crystal (HK) Manufactory Ltd.
- BOE
- Boyd Corporation*
- BYD Electronic (International) Company Limited*
- Catcher Technology
- Compal Electronics
- Compeq*
- Corning Incorporated
- COSMO
- Cowell Optics Electronic Ltd.*
- Daesang*
- Dexerials Corporation*
- DSM Engineering Plastics
- ECCO Leather
- Fastway Creation
- Flex Ltd.*
- Goertek
- Golden Arrow
- Guangzhou Meadville Electronics*
- H.B. Fuller
- Henkel*
- Hon Hai Precision Industry
- Hutchinson Technology, Inc.*
- IBIDEN Co., LTD.
- Jabil
- Keiwa Incorporated*
- Kersen Science and Technology*
- Kunshan KIMD Co., Ltd.*
- LEALEA Enterprise
- Lens Technology
- Lingyi iTech*
- Lishen
- Luen Fung Group
- Luxshare-ICT
- Nidec
- Nitto Denko Corporation*
- OFILM*
- Pegatron
- Phone In Mag-Electronics*
- Primax Group
- Qorvo
- Quadrant
- Quanta Computer
- RRD
- RyPax
- SanHuan
- SDK
- Seiko Advance Ltd.*
- Shenghe Resource*
- SK hynix*
- Solvay
- Sony Semiconductor Solutions*
- STMicroelectronics
- Sunway Communication
- Sunwoda Electronic
- Suzhou Anjie Technology*
- Taiyo Holdings Co., Ltd.
- tesa SE
- TSMC
- Wistron
- Yuto

*Suppliers that have committed to 100 percent renewable energy since April 2019.

Apple's role

Apple envisions a world where renewable energy is cost-effective, reliable, and widely available to all. As we work with suppliers to grow their use of clean energy, we look for ways to achieve those broader goals as well:

Demonstrating leadership in our suppliers' markets

The transition to renewable energy can require complicated deal structures across many regions with diverse market designs and regulatory requirements. Apple seeks to break down that complexity for our suppliers by sharing what we've learned from our investments in renewable energy—often in challenging markets. For example, we've helped to develop nearly 500 megawatts of solar and wind projects in China and Japan to address upstream emissions in our supply chain.

Connecting suppliers to high-quality projects

We develop new tools for our suppliers to help execute on their renewable energy goals. In many markets where we operate, companies have limited options to access clean energy. To break down that barrier, we created the China Clean Energy Fund, which enables Apple and our suppliers to invest in clean energy projects totaling more than 1 gigawatt of renewable energy in China. We also connect suppliers with opportunities to buy renewable energy directly from project developers and utilities as those models emerge around the globe.

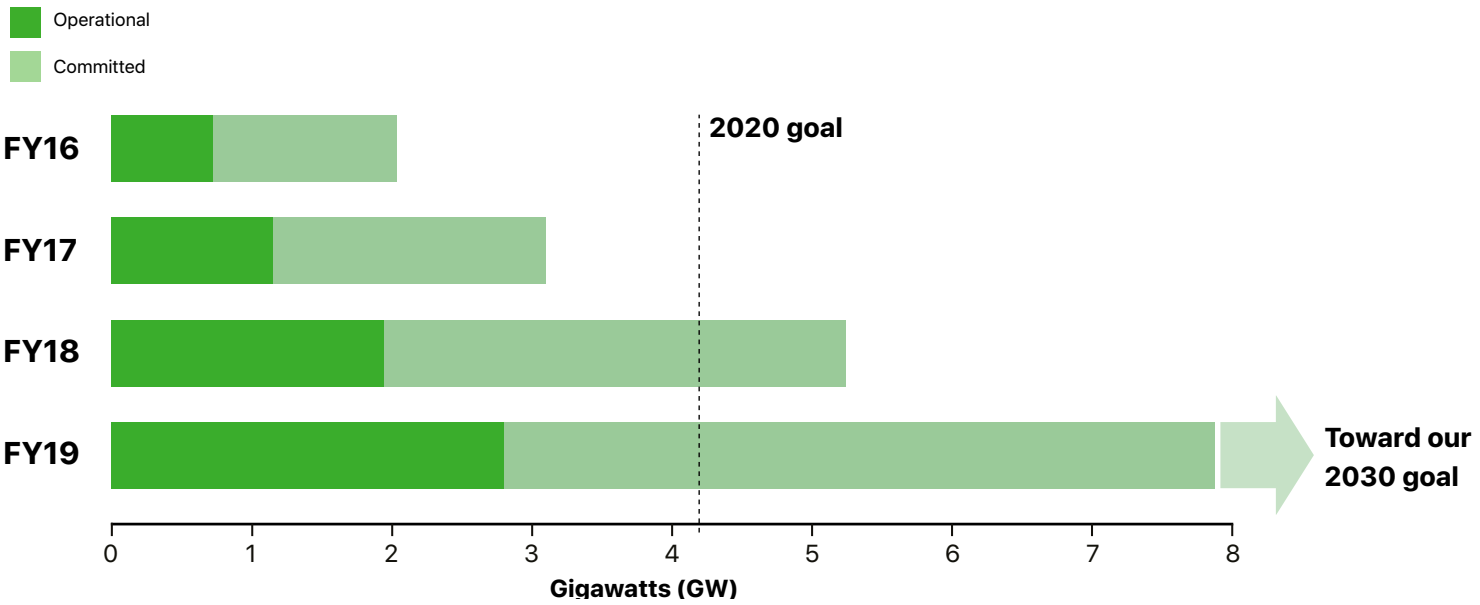
Building clean energy champions

We leverage our own experience and bring in leading experts to help our supplier partners plot their transitions to renewable energy. Following on the success of our Supplier Clean Energy Portal, which offers training and tools for suppliers switching to clean energy, in 2019, Apple hosted our first in-person training for over 30 suppliers in China. The intensive, two-day training equipped suppliers with the market insights, policy analysis, and tools needed to drive renewable energy solutions—within Apple's supply chain and beyond.

Advocating for strong policy

Suppliers often face regulatory barriers to cost-effective renewable energy options. Clean energy technology offers tremendous benefits to our suppliers, to electricity grids, and to countries. We believe that when policymakers fully value these benefits, clean energy becomes more cost-competitive than fossil fuel energy. So we actively support policies that create cost-effective renewable energy markets, and we work closely with suppliers and other climate-leading companies to engage local, regional, and national governments. This encourages the development of country-specific policies that support scalable renewable energy solutions, with an impact far beyond Apple's supply chain.

Supply chain clean energy progress



To ensure that our program achieves the greatest positive impact, we require that all supplier clean energy projects meet stringent social and environmental standards. The data above reflects only those projects that meet our strict standards and include only clean energy generated or sourced since Apple's engagement. Operational data is based on our last annual supplier energy survey for fiscal year 2019. Commitments are current as of June 2020.

Located in Dao County in Hunan, China, the Concord Jing Tang wind farm was developed by Concord New Energy Group and produces 48 megawatts of clean energy.

China Clean Energy Fund

In 2018, we created a first-of-its-kind investment fund in China to connect suppliers with renewable electricity sources. The fund, which will include nearly $300 million from 10 initial suppliers and Apple, will invest in and develop clean energy projects totaling more than 1 gigawatt of renewable electricity in China and will enable suppliers to meet their renewable electricity commitments.

Since 2015, we've been engaging with manufacturing partners through our Supplier Clean Energy Program to help them transition to using 100 percent renewable electricity for Apple production. While supplier response has been tremendous—71 suppliers in just five years have made commitments—we've found that oftentimes, suppliers do not have many options for purchasing cost-effective renewable electricity in their market. So we worked with our partners to innovate a solution to this problem, creating the China Clean Energy Fund.

By virtue of its size and scale, the China Clean Energy Fund gives its participants the advantage of greater purchasing power and the ability to attain more attractive and diverse clean energy solutions. The China Clean Energy Fund will be managed through a third party, DWS Group, which specializes in sustainable investments and will also invest in the fund.

In September 2019, we announced the first renewable energy investment by the fund: two 48-megawatt wind farms in Hunan province and a 38-megawatt wind farm in Hubei province.

These massive wind turbines will help to displace polluting fossil fuels, helping to clean the air, and provide a timely solution for suppliers seeking to cut emissions and fight climate change.

The wind farms in Hunan and Hubei provinces also support their local economies and governments, helping each province reach mandated renewable energy goals. In Dao County, which is classified a state poverty county, the revenues from the construction and running of Concord Jing Tang and Concord Shen Zhang Tang farms also provide important sources of income.

The China Clean Energy Fund offers a timely solution for suppliers seeking to act now and make a material contribution to the climate crisis. However, the need for such a fund underscores the importance of strong climate policies that enable a diverse set of cost-effective solutions for anyone to choose from, like direct renewable energy procurement. In the meantime, we hope the fund can serve as a global model to help other companies transition to 100 percent clean electricity.

Direct emissions abatement

In instances where we cannot reduce the demand for a specific process or material, we tackle emissions reduction through technological improvements. This could mean point-of-use abatement, altering a process to significantly reduce the associated emissions, or switching fuels to a low-carbon source.

Aluminum smelting

Aluminum is a key material in many of Apple's products, and, for more than 130 years, it has been produced through a carbon-intensive smelting process. In May 2018, aluminum manufacturers Alcoa Corporation and Rio Tinto Aluminum announced Elysis: a joint venture to commercialize patented technology that eliminates direct greenhouse gas emissions from the traditional smelting process. This is a revolutionary advancement in the manufacturing of one of the world's most widely used metals.

As part of Apple's commitment to reducing the environmental impact of our products through innovation, we helped accelerate the development of this technology. And Apple has partnered with both aluminum companies, and the governments of Canada and Quebec, to collectively invest a combined $144 million in future research and development. In December 2019, we announced we had bought the first-ever commercial batch of carbon-free aluminum resulting from this joint venture. This aluminum is currently being used in the manufacturing of the 16-inch MacBook Pro.

Lowering fluorinated greenhouse gas emissions

Fluorinated gases, such as sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3), are key chemicals used in the manufacturing of integrated circuit (IC) chips and display panels. These gases have high global warming potentials when emitted to the atmosphere as fluorinated greenhouse gas (F-GHG).

Since 2018, we have partnered with our IC and display suppliers to better understand F-GHG emissions related to the manufacturing of Apple products and to evaluate emission reduction strategies. We encourage our suppliers to reduce the F-GHG emissions by implementing reduction strategies recognized by international and industry standards.[9]

In 2019, we worked with key display panel suppliers to establish baseline emissions and implement reduction strategies. To date, our key display suppliers have reduced F-GHG emissions by more than 242,000 annualized metric tons CO_2e.

Employee commute

Even as we shrink the carbon footprint of Apple's facilities, we're continuing to look for ways to reduce carbon emissions from employee commuting. We enable telecommuting for roles that can accommodate it to avoid emissions from commuting. For example, our At Home Advisor program provides AppleCare customer service by Apple employees working from their homes. This program avoided nearly 22,000 metric tons of CO_2e emissions in fiscal year 2019—equal to 11 percent of our employee commute footprint. We also offer our U.S. employees a transit subsidy of up to $100 per month, and we grew our bus commute program in Santa Clara Valley and China to reduce the use of single-occupancy vehicles. At all of our campuses in the U.S., we offer a total of more than 2300 EV charging stations, which help our employees transition to electric vehicles. Further, we offer campus bicycles and a dedicated bus commute program to facilitate employee commute through mass transit, which we estimate avoided over 6000 metric tons in fiscal year 2019.

Carbon removal

The Intergovernmental Panel on Climate Change is unequivocal in calling for carbon removal as essential to limiting global warming to 1.5 degrees celsius. Natural climate solutions effectively remove carbon from the atmosphere, while further benefiting people and the planet, by protecting and restoring important ecosystems and natural habitats.

Apple has protected and restored forests, wetlands, and grasslands since 2015. Through our work with The Conservation Fund and the World Wildlife Fund, we have protected and improved the management of over 1 million acres of forests in China and the U.S. In 2018 and 2019, we partnered with Conservation International to protect and restore a vital mangrove ecosystem in Colombia and savanna in Kenya. Starting in 2020, we plan to scale up our ambition to remove atmospheric CO_2 by creating a first-of-its-kind fund that will invest in the restoration and protection of forests and natural ecosystems globally. By investing in nature-based carbon removal projects, this fund aims to cover residual emissions that we believe are not otherwise avoidable. And we will continue to explore other ways to sequester carbon, as technologies become available.

Carbon neutrality for corporate emissions

We recognize the urgency of tackling our contribution to climate change. So, in addition to aggressively reducing our carbon footprint, beginning April 2020, Apple is carbon neutral for our corporate emissions, which include business travel, employee commute, and direct emissions from corporate facilities, by investing in high-quality projects that protect and restore forests, wetlands, and grasslands. These include direct emissions, like from use of natural gas (scope 1 emissions) as well as emissions from our global employees' commutes to work and business travel (scope 3 emissions), which are difficult to avoid today. We've also partnered with Conservation International to identify projects that will protect and restore forests, wetlands, and grasslands, as projects from our fund come online.

Our carbon solutions fund

Forests, wetlands, and grasslands are nature's best tool to remove carbon from the atmosphere. When we look at the portfolio of solutions that will be required to become carbon neutral—not only for Apple but for the entire planet—we know nature-based solutions will play a critical role. To help drive additional capital into these essential climate solutions, Apple is creating a fund in partnership with Conservation International that will invest in the restoration and protection of forests and natural ecosystems globally. We're aiming to remove 1 to 2 million metric tons of carbon dioxide per year in the short term, and scaling this up over time. By investing in these projects, we aim to address residual emissions that are not otherwise avoidable today.

This approach is more than buying carbon credits—it is an investment in nature that provides meaningful returns for both the planet and the people who invest in it. Over time, we hope others will join us in this venture to ensure the health and livelihood of these key ecosystems.

Protecting mangroves in Colombia

In 2018, we partnered with Conservation International and regional partners—INVEMAR Research Institute and CVS (Corporación autónoma regional del Valle del Sinú)—to protect and restore a 27,000-acre mangrove forest in Colombia, which is expected to sequester 1 million metric tons of CO_2 over the project's lifetime. These mangroves not only protect the coasts and help support the livelihood of those communities where they grow, they also can store up to 10 times more carbon than forests on land.

This is because mangroves store significant amounts of carbon in the soil below the waterline, in addition to storing carbon in their roots, leaves, and branches like other trees. Our project with Conservation International is the first "blue carbon" methodology to rigorously value the entire mangrove system—trees and soil—for its climate mitigation value both above and below the waterline. We hope this effort will encourage the protection of threatened mangrove ecosystems globally as important resources in the fight against climate change.

Conserving savannas in Kenya

In another partnership with Conservation International, we are restoring degraded savannas in the Chyulu Hills region of Kenya, an area between three national parks in Kenya and just across the border from Kilimanjaro National Park in Tanzania.

Savanna restoration at scale has the potential to remove a significant amount of carbon from the atmosphere. But because the landscape has become degraded through unsustainable land use, the soils are unable to sequester carbon, and are instead releasing carbon dioxide back to the atmosphere. In addition, these degraded lands can no longer fully support the grazing and economic needs of the communities in the area: Across the Chyulu Hills, overgrazing has left Maasai herders without enough food for their livestock. The habitat is so degraded that elephants and other wildlife also struggle to find sufficient food. In the past, a restoration project in an area like this might have focused on replanting grass and trees. But in partnership with Conservation International, we are testing a new approach. We are working with local partners, including the Maasai Wilderness Conservation Trust and the Big Life Foundation, to enable the landscape to rebound on its own. Instead of simply replanting—which may not be a sustainable solution—we are testing social interventions to promote regrowth.

For example, we are working with Maasai herders to implement planned grazing practices and governance systems which, in combination with savanna reseeding, can catalyze restoration at the landscape scale.

The initiative is designed to scale beyond the Chyulu Hills region. There are approximately 900 million hectares of degraded rangeland and natural savannas across Africa, which could adopt this approach—potentially removing billions of tons of carbon from the atmosphere each year, while also benefiting local communities and wildlife.

We're protecting and restoring 27,000 acres of mangrove forest in Colombia. These mangroves support the livelihood of those communities where they grow.

Tim Cook recently accepted the Ceres 30 Years of Impact Award for Apple's bold sustainability leadership and actions.

Lending our voice to climate advocacy

Last year, inspiring and powerful voices challenged the global community to confront the crisis of climate change. This advocacy reframed how many see the challenge. The scientific community has laid out a clear path to mitigating the impacts of climate change by reducing emissions—and provided stark warnings for the consequences of inaction. In addition to strong actions by businesses and individuals, we need strong government policies that support a just climate transition.

Apple sees this as the foundation of our actions on the environment. It also drives our climate advocacy and guides how we pursue global cooperation.

As governments tackle climate change, we believe three actions are central to creating strong climate policy:

1. **Set strong targets based on science.** Policymakers should set national or regional targets that prevent warming of more than 1.5 degrees celsius. Key components of meeting these targets should include a price on carbon and parallel participation in international policy negotiation.
2. **Create sector specific policies.** Limiting warming to 1.5 degrees celsius will require action throughout all parts of the economy. Governments should create sector specific policies to support the transition in difficult to decarbonize sectors or in sectors that require investments in major infrastructure.
3. **Support a green economy for all.** Climate policies should have positive, long-term fiscal impacts and support the development of the new green economy, with job opportunities focused on advancing clean innovation.

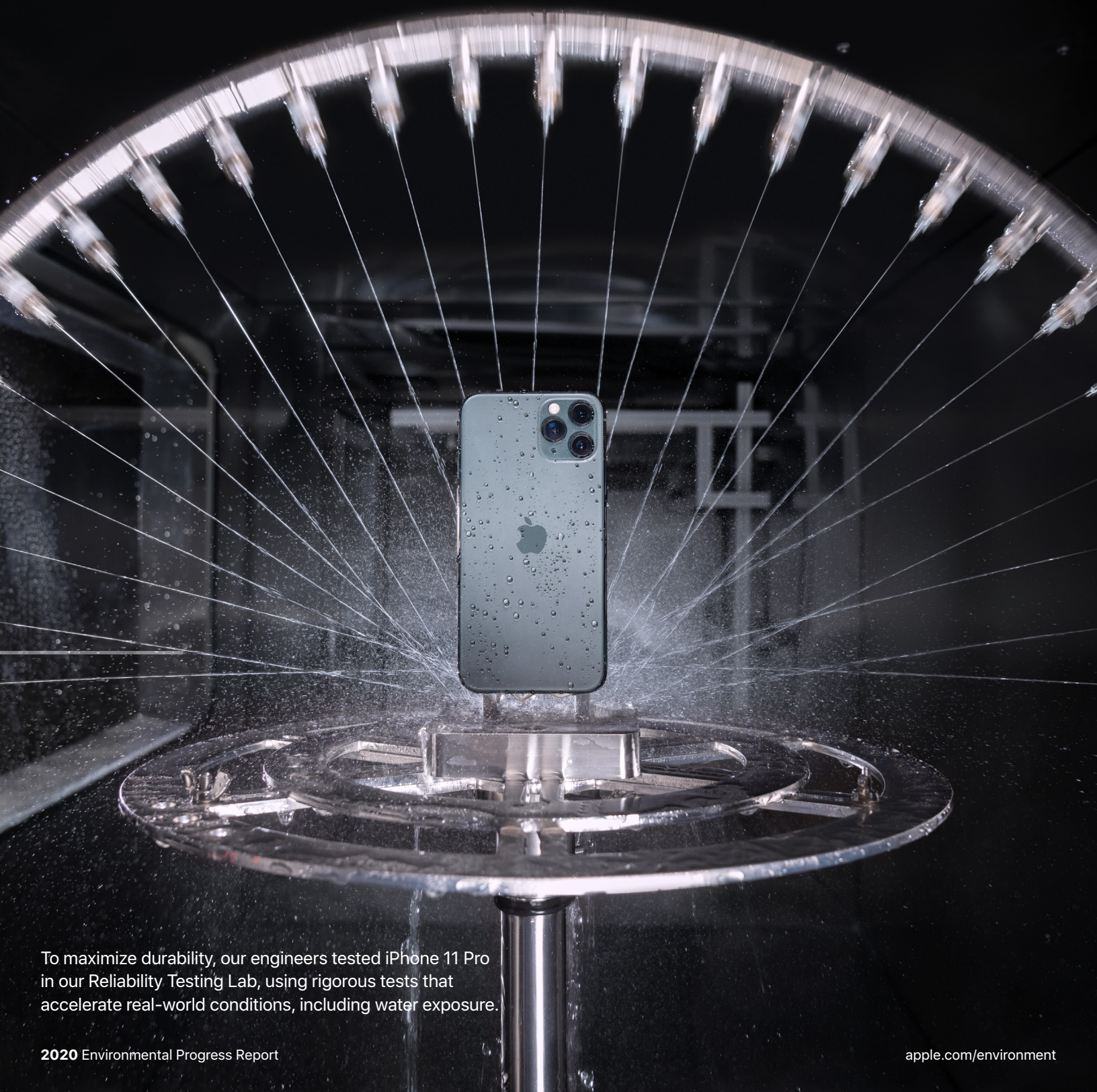
We have spoken clearly and unambiguously: across different forums, in public statements and closed-door discussions, and through our actions. Whether making known our support for the United States upholding its obligations under the 2015 Paris Agreement or backing a price on carbon, we're pursuing strong policies that promote decarbonizing our economy. And in November 2019, Apple issued about USD$2.2 billion in green bonds dedicated to projects that will reduce our carbon footprint.

We've also lent our voice to make an immediate impact on policy. In the United States, we submitted comments urging the Federal Energy Regulatory Commission not to finalize a rule that would subsidize fossil fuels, which would limit the ability of renewables to compete in the electricity market.

In countries where we and our suppliers operate, we're pursuing policies that will enable the development of cost-effective renewable energy. In Korea and Vietnam, we sat with policymakers to advocate for energy market reform, including allowing businesses to purchase power directly from renewable power plants. We've held roundtables with companies and NGOs to identify possible solutions to some of the challenges for creating renewable energy projects in Korea, Singapore, and Taiwan. And we've undertaken similar efforts in Japan, where we have joined other companies to formally encourage the Japanese government to promote corporate renewable energy use.

Effective policies that support the decarbonization of the global economy are essential to tackling the climate crisis. Our plan to reach carbon neutrality can help show what is possible and reduce risks for others, but will not be sufficient without policy action. We will continue to lend our voice, joining with others to advocate for collective action and strong climate positive policies.

Resources.



To maximize durability, our engineers tested iPhone 11 Pro in our Reliability Testing Lab, using rigorous tests that accelerate real-world conditions, including water exposure.

Highlights

Every day at Apple, we're working to do more with less. Our designers and engineers build products not only to perform well now, but also to last for years to come.

Our robots, Daisy and Dave, disassemble devices to recover the important materials our products rely on. Our teams closely monitor and manage the waste we and our suppliers generate—as we make progress toward our goal of eliminating waste sent to landfill.

We live in a world of finite resources. We're not only taking steps to conserve, we're pushing through technical, economic, and policy barriers to bring solutions to scale. We've made meaningful progress, and there's much more work to be done.

Recycled rare earth elements

iPhone 11, iPhone 11 Pro, and iPhone 11 Pro Max each launched with 100 percent recycled rare earth elements in the Taptic Engine.[1]

Recycled tin

We expanded our use of 100 percent recycled tin in the solder on main logic boards to 23 products, including Phone 11, iPhone 11 Pro, iPhone 11 Pro Max, iPad (7th generation), and the 16-inch MacBook Pro.

Recycled aluminum

All aluminum enclosures for new iPad, iPhone, Apple Watch, and Mac products released in 2019 were made with either 100 percent recycled or low-carbon primary aluminum.

Recycled tungsten

About 22 percent of the tungsten used in products shipped in 2019 came from recycled sources.

Recycled plastics

We introduced more than 100 components with an average of 46 percent recycled plastic across products released in 2019.

Our newest disassembly robot

Named "Dave," it disassembles modules like the Taptic Engine to enable recovery of materials like rare earth elements, steel, and tungsten.

58%

Better packaging

We've reduced plastics in our packaging by 58 percent in four years.

11M

Refurbished devices

More than 11 million devices were sent by Apple to be refurbished for new users in 2019, a 42 percent increase from the previous year.

Zero waste

All final assembly sites for iPhone, iPad, Mac, Apple Watch, AirPods, HomePod, and Apple TV have been certified as UL Zero Waste to Landfill.[10]

Our approach

Businesses like Apple cannot operate without the earth's resources. So we focus on responsibly sourcing the materials in our products, and minimizing the water our processes rely on and the waste we generate.

We aim to create products made with only recycled and renewable materials. To make this monumental shift, we are identifying new sources of materials, building new supply chains to mobilize them, and creating new designs to leverage them. And we continually look for new ways to build our products that reduce the amount of material needed overall. By extending the life of our products, we help make the most of the materials used to make them. We design for durability, provide software updates and repair support, and refurbish devices for new users. Once products reach end-of-life, we work with recycling partners to recover the most materials we can from them.

We're also working hard to design the recycling technologies of the future. That way, recovered materials can be the raw materials of the next product.

Water plays a central role in how we build, support, and recycle the products we make. That's why we are working to optimize and reduce the overall amount of water our operations use, leveraging alternative and recycled water sources, and carefully managing any water discharge. We are also developing processes to both drive down the amount of waste we create and avoid sending it to landfills, particularly items that can be reused.

This important work extends to our facilities and our suppliers—each plays an integral role in our business and in meeting our conservation goals.

These efforts to conserve resources are also interconnected with our other priorities. By using recycled materials, for example, we've lowered product carbon footprints. And by using safer materials in our designs, we've made the materials in our products safer and easier to recover and recycle.

Within resources, we focus on three main areas of impact:

Materials ›

Transition to only recycled or renewable materials in our products and packaging, and maximize material efficiency, product longevity, and recovery.

Water stewardship ›

Reduce freshwater use, improve the quality of water we discharge, and demonstrate leadership by protecting shared water resources.

Zero waste to landfill ›

Minimize overall waste generated and eliminate waste sent to landfill from manufacturing facilities as well as corporate offices, data centers, and retail stores.

Materials

With linear supply chains, new raw materials are continually extracted from the earth and materials from old products are not always recovered. We envision a future where our devices are made with materials that follow a circular supply chain model—using only recycled and renewable sources—eliminating our reliance on mining.

Because we make hundreds of millions of products each year, we can have a significant positive influence. As we tackle the regulatory, design, and operational challenges of creating circular supply chains, we're also breaking down barriers for others to follow.

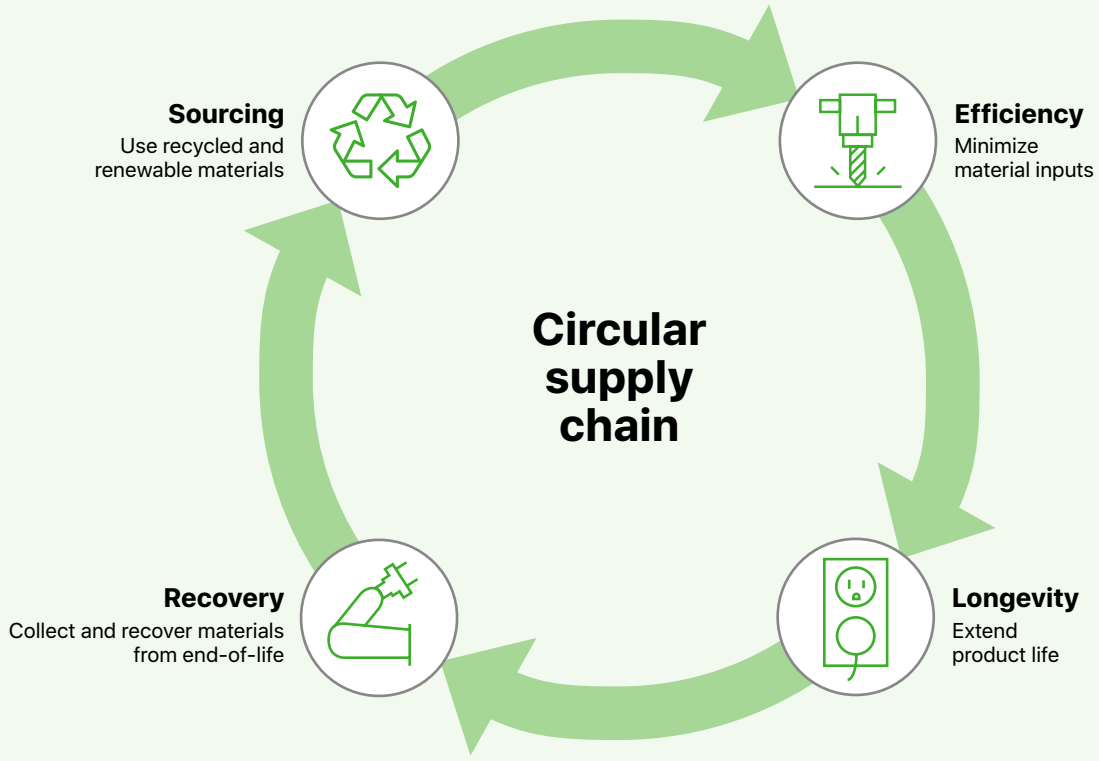
We're using three different levers to reduce our impact and achieve circularity:

Sourcing and efficiency: Finding solutions to source recycled and renewable materials for our products and packaging, and using these materials more efficiently. And we source materials responsibly, whether from virgin, recycled, or renewable sources.

Product longevity: Making the most of the materials we use through designing long-lasting products. We design durable hardware, leverage software to extend functionality, support a broad network of repair providers, and refurbish devices for their next user.

Product end-of-life: Enhancing product collection and reuse, and innovating in recycling, so we and others can start using old devices as the raw material sources of the future.

How we define a circular supply chain



Sourcing and efficiency

In 2017, we announced our goal to one day use only recycled and renewable materials for our products and packaging—demonstrating our commitment to conserve the world's resources. By using materials from recycled sources, we aim to end our reliance on mining.

And we focus on renewable materials from biological sources—such as wood fiber from trees—that are responsibly managed to continually produce without depleting the earth's resources. As we switch to sources like these, we work to use materials in the most environmentally efficient way possible to reduce our overall demand.

We're making steady progress toward our goal. Based on supplier reports, 10 percent of the total material we shipped in products in 2019 came from either recycled or renewable sources, one-third of which has been confirmed through third-party certifications. And because certain materials have a high percentage of recycled content on average in the industry—like steel—the actual amount could be much higher. Four products launched in 2019 were made of 17 percent or more recycled and renewable content, led by MacBook Air with Retina display with more than 40 percent recycled content.

There is still much progress to be made, so we continue to responsibly source materials by conducting due diligence in our supply chain; considering the human rights impact on surrounding communities; and fostering the same opportunities as we do in other parts of Apple's supply chain.

We didn't start with the materials that were easiest for transitioning to recycled and renewable sources, but with those with which we would achieve the most significant impact. We extensively analyzed the environmental, social, and supply impacts associated with 45 elements and raw materials, creating full Material Impact Profiles (PDF) for each. These profiles informed our prioritization of 14 materials. The priority materials are significant not only for their impacts, but also because of how much we use. Overall, they represented nearly 90 percent of the total mass shipped by Apple in fiscal year 2019.

Aluminum	Plastics
Cobalt	Rare earth elements
Copper	Steel
Glass	Tantalum
Gold	Tin
Lithium	Tungsten
Paper	Zinc

We've put a lot of thought into the new sources we want to use. We've created a recycled and renewable material specification that aligns with international standards and guides our suppliers as they source materials. And in many cases, we ask our suppliers to take the additional step to get third-party certifications. For materials that can come from either recycled or virgin sources, certification confirms the recycled content.[11] For renewable materials, certifications help us confirm that the biological source the materials come from, like working forests, can continually produce without depleting the earth's resources. Our goal is for suppliers to own these certifications, so the materials aren't exclusive to Apple, and are available to others.

In just the two years the program has been active, we've already seen a significant impact. More partners involved in secondary markets are willing to join us, and manufacturers in our supply chain are more responsive. While we are starting with our material use, our aim is much broader: to be a part of a world in which recycled and renewable materials are available and preferred by everyone. That's why we aim to break down barriers for others as well, by working on components commonly used in our industry, by pursuing recycled alternatives at prices competitive with virgin material, and by engaging policymakers to improve global policies that enable the use of recycled content.

Apple is committed to setting the highest standards for responsible sourcing of the materials used in our products.

Read our 2020 Supplier Responsibility Report (PDF).

Creating a circular supply chain for rare earth elements

Three years ago, a team of eight from Apple's environmental, engineering, and procurement groups arrived at one of our suppliers in China on a mission. Could they find a way to recover, recycle, and reuse key materials that enable our technology?

Many of our greatest innovations rely on a small number of earth's elements. This is particularly true of our Taptic Engine, which enables tactile feedback from the user interface on iPhone and Apple Watch devices. The magnets inside these engines account for one of the largest concentrations of rare earth elements within our iPhone devices. However, the processes involved in mining these materials are both labor-intensive and carry environmental impacts.

The challenge was clear: Could we create a circular supply chain for rare earth elements?

Success would require innovation in several areas: processes to manufacture magnets made with 100 percent recycled rare earth elements that could perform at the high level our products demand; the ability to recover and recycle rare earth elements; and a pathway to achieve all of this at scale. To our knowledge, this had never been done.

We started by investigating deep within our supply chain—to businesses operating far beyond the direct visibility of most original equipment manufacturers. It was there that our team made a surprising discovery. Not only was a recycler collecting the scrap generated by rare earth magnet manufacturers, but they had developed a process to recycle this material for reuse.

Apple then partnered with a magnet manufacturer willing to try something new: create a magnet with 100 percent recycled rare earth elements.

While many magnets contained small percentages of recycled rare earth elements already—often without final manufacturers even knowing—no one had used recycled rare earth elements exclusively. Our material scientists analyzed our newly manufactured magnets to better understand their performance. Then we put these magnets through our rigorous performance tests—and they passed.

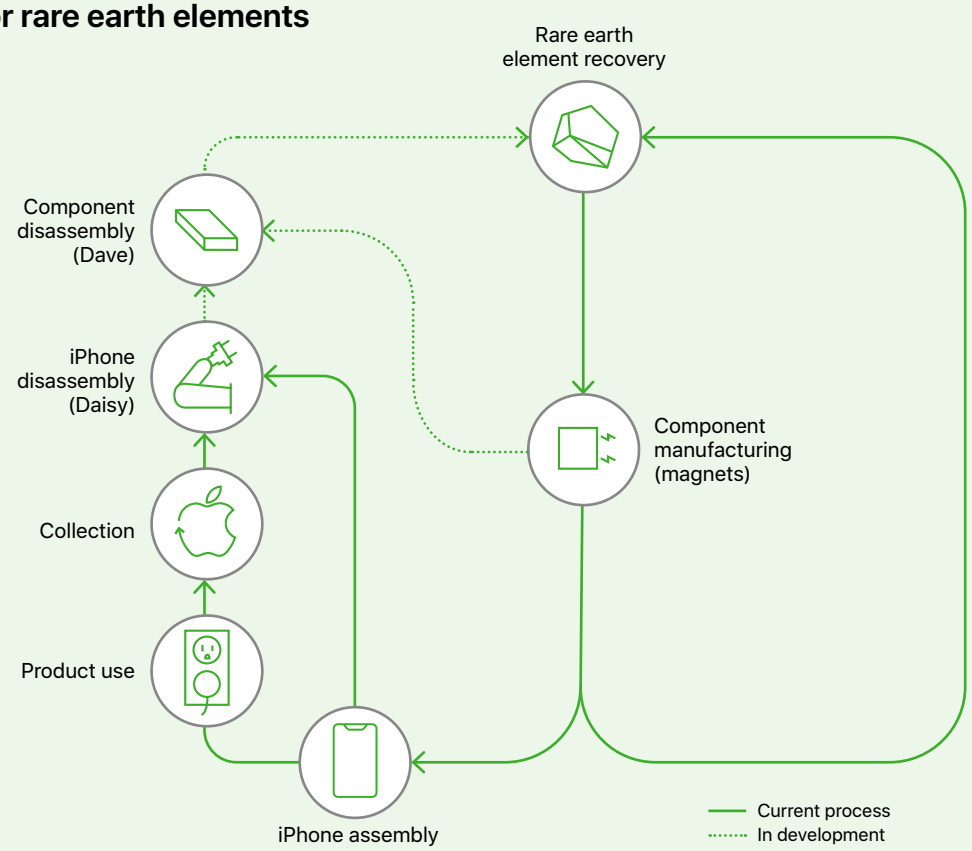
But building a high-performing magnet was not our only task. We also had to create an entire new supply chain solely for recycled material. This meant connecting each of the players—the recycler, magnet manufacturers, component manufacturers, and final assembly suppliers. And we created a way to trace the third-party certified recycled material through each node in the supply chain.

With the help of all our partners, we were able to bring our pilot to scale—and released our iPhone 11, iPhone 11 Pro, and iPhone 11 Pro Max with 100 percent recycled rare earth elements in the Taptic Engine.[1] Since last fall, we've also expanded the use of 100 percent recycled rare earth magnets to the AirPods Pro Wireless Charging Case.

However, creating a fully circular supply chain also means recovering rare earth elements from manufacturing scrap and products at end-of-life. That's why we focus on recycling innovations as well. While our disassembly robot, Daisy, can take apart iPhone devices into distinct components, our newest disassembly robot, Dave, takes the next step—disassembling the Taptic Engine to recover the rare earth magnets inside. We've begun deploying Dave robots so that our specialty recyclers can recover recycled rare earth elements along with other key materials like tungsten and steel.

The challenges of creating a circular supply chain for rare earth elements aren't only technical. We're also working with policymakers to address restrictions on the movement of electronic waste. Our goal is to enable the movement of end-of-life materials to best-in-class recyclers without compromising necessary safeguards that ensure responsible waste disposal. We hope regulations can evolve to enable circular supply chains while still protecting people around the world. Our ambition, for ourselves and our industry, is to achieve a future where we can create all of our products entirely from recycled and renewable materials.

Circular supply chain for rare earth elements



Progress by material

We face many challenges as we work to transition materials to recycled and renewable sources. And though we have much to do, we've also made meaningful progress.

Key challenges to creating circular supply chains:

Regulatory barriers
Certain regulations—even when originally intended to create environmental protections—inadvertently inhibit the ability to recover materials from scrap, end-of-life products, and parts for use in new products.

Contamination
The manner in which materials recovered for recycling can impact the composition of the material, reducing its purity and usability.

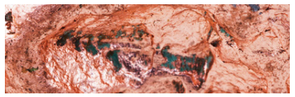
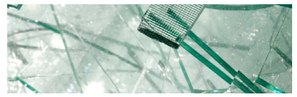
Technical properties
Recycled or renewable material may have unique technical properties that need to be accounted for in product design.

Availability
End-of-life products and industrial sources of scrap for recycling may not be readily available, constraining the supply of recycled material. And the production of renewable material is sometimes limited.

Supply chains
Recycled or renewable content may not be easily accessible on the market, requiring the development of new supply chains.

Transparency
Information about the source of materials—whether mined, recycled, or renewable—may not be readily available.

Scale
Identifying and mobilizing high-quality recycled or renewable materials to scale use across our products.

Material	Aluminum	Cobalt	Copper	Glass	Gold	Lithium	Paper
							
Where it's used	Enclosures, batteries	Batteries	Main logic boards, flexible circuit boards, enclosure, wireless charging, and power adapters	Displays, enclosure	Main logic boards, flexible circuit boards, camera modules	Batteries	Packaging
Key challenges	Regulatory barriers Contamination Technical properties Scale	Regulatory barriers Availability Supply chains Scale	Regulatory barriers Technical properties Supply chains	Contamination Technical properties Availability Scale	Regulatory barriers Transparency	Regulatory barriers Availability Supply chains	Technical properties
Progress	We first addressed technical barriers to using recycled aluminum, and are now working to mobilize supply of high-quality recycled content in order to scale our use across products. **Creating a new alloy:** Aluminum accumulates impurities as it is recycled, so we designed our own 100 percent recycled aluminum alloy that can accommodate impurities while maintaining the finish and durability we require of our enclosures. And this alloy can be recycled indefinitely while maintaining its properties. Based on supplier reports, 28 percent of the aluminum shipped in our products in 2019 came from recycled sources—10 percent of which has already been third-party certified. We've used 100 percent recycled aluminum in the enclosures of iPad (7th generation), Apple Watch Series 5, MacBook Air with Retina display, and Mac mini. We're sourcing this recycled aluminum from Apple's manufacturing scrap, from post-industrial sources, and from iPhone enclosures recovered from Daisy, our disassembly robot.	Newly available supply of recycled material has enabled us to significantly increase our use of recycled cobalt. **Expanding use:** We started by building a supply chain with our manufacturing scrap and cobalt recovered from end-of-life iPhone devices disassembled by Daisy. Lithium-ion battery recycling has since expanded dramatically, making far more recycled cobalt available on the market. As a result, we've secured a new supply of recycled cobalt for use in future products.	As we test different recycled copper sources for use in our products, we're also reducing the amount we need to build our products. **Making new foils with less copper:** We're partnering with our suppliers to develop new manufacturing processes that use less copper. For example, we reduced by one-third the copper thickness of select foils needed to create a printed circuit board (PCB). And since PCBs are used across electronics, we are helping the industry use less copper, starting with our suppliers. **Using recycled content:** We've begun using 100 percent recycled copper in one of the foils of our PCBs, which is now being shipped with iPhone 11. And we're continuing to test the use of recycled copper sources across our applications. **Mining material from old devices:** Our old devices represent another source of recycled copper, and our specialty recycler is now recovering copper from iPhone components disassembled by Daisy.	Glass is very sensitive to impurities, so we are focused on minimizing scrap in our glass production and maximizing the purity of recycled scrap. **Finding opportunities for reuse:** We're digging deep in our supply chain to identify opportunities to recycle scrap. At the sites where our glass is strengthened and cut, we are collecting scrap and analyzing its properties and material composition. With this information, we are exploring opportunities to reincorporate this scrap into new glass melts.	As we reduce the amount of gold we need, we are working to improve transparency in gold supply chains so that material can be traced to the recycled source. **Reducing use:** We re-evaluated the plating for the printed circuit board of iPhone 11 Pro and iPhone 11 Pro Max, reducing the amount of the board covered with gold plating by 27 percent. **Enhancing transparency:** While gold is recovered at high rates from products at end-of-life, virgin and recycled sources are mixed by the time they get to market. We are working with upstream gold refiners to identify and track recycled gold to its source—improving traceability both in our supply chain and in the broader industry. **Finding creative recycled sources:** We've begun using flexible circuits manufactured using gold salts recovered from 100 percent recycled gold waste. Our old devices represent another source of recycled gold, and our specialty recycler is now recovering gold from iPhone components disassembled by Daisy.	Technology exists to recycle lithium from batteries and is rapidly becoming more economically viable. We are working to identify new sources of recycled lithium and test their performance in our applications. We also continue to search for and partner with recyclers who can recover lithium at high rates from our end-of-life products, so that we can contribute recycled material back to the market.	We've maintained our circular supply chain for paper, by sourcing from recycled and renewable sources and by creating as much responsibly sourced fiber as we are using. **Sourcing responsibly:** 100 percent of the wood fiber in our packaging comes from recycled sources or responsibly managed forests.[12] **Regrowing forests:** We're protecting or creating enough responsibly managed forests to cover all the wood fiber we use in our packaging. This helps us ensure we are not taking away from, but instead growing the world's supply. **Enhancing recyclability:** All the retail boxes for our products can be recycled at standard paper recycling facilities. And we are continuing to transition internal packaging trays to model fiber or other fiber-based solutions to enhance recyclability even further.

Progress by material continued

Key challenges to creating circular supply chains:

Regulatory barriers
Certain regulations—even when originally intended to create environmental protections—inadvertently inhibit the ability to recover materials from scrap, end-of-life products, and parts for use in new products.

Contamination
The manner in which materials recovered for recycling can impact the composition of the material, reducing its purity and usability.

Technical properties
Recycled or renewable material may have unique technical properties that need to be accounted for in product design.

Availability
End-of-life products and industrial sources of scrap for recycling may not be readily available, constraining the supply of recycled material. And the production of renewable material is sometimes limited.

Supply chains
Recycled or renewable content may not be easily accessible on the market, requiring the development of new supply chains.

Transparency
Information about the source of materials—whether mined, recycled, or renewable—may not be readily available.

Scale
Identifying and mobilizing high-quality recycled or renewable materials to scale use across our products.

Material	Plastics	Rare earth elements	Steel	Tantalum	Tin	Tungsten	Zinc
							
Where it's used	Enclosures, speakers, keyboards, and many other components	Magnets in speakers, receivers, Taptic Engine, cameras, and enclosures	Enclosures, cases, screws, structural components, and other small parts	Capacitors	Main logic boards, flexible circuit boards	Taptic Engine	Power adapters, main logic boards
Key challenges	Regulatory barriers Contamination Technical properties Transparency	Regulatory barriers Supply chains Scale	Regulatory barriers Contamination Technical properties	Regulatory barriers Availability	Regulatory barriers Scale	Regulatory barriers Technical properties	Technical properties Supply chains
Progress	Though plastics typically lose performance with mechanical recycling cycles, we've continued to advance the performance we can achieve with recycled plastics across applications. **Scaling recycled content:** In products released in 2019, we introduced more than 100 parts with an average of 46 percent recycled plastic content. This includes recycled materials with advanced capabilities: in partnership with our suppliers, we've developed a plastic with over 35 percent recycled content that offers the advanced acoustic properties needed for speakers. We've also introduced plastics with the strength and resilience needed for protective cases—made with about 40 percent recycled content. **Switching to bio-based sources:** We've introduced plastic made from bio-based content rather than fossil fuels on 38 components in 2019. And while this is an important step, we continue to pursue certifications as we transition to renewable materials.	By investigating deep into our supply chain, we identified sources of recycled rare earth elements, proved that 100 percent recycled content could be used in our magnets, and continue to scale across our products. **Using 100 percent recycled rare earth magnets:** Last fall, we released iPhone 11, iPhone 11 Pro, and iPhone 11 Pro Max with 100 percent recycled rare earth elements in the Taptic Engine.[1] And we've since expanded to other products, releasing the AirPods Pro Wireless Charging Case with 100 percent recycled rare earth elements in the magnets. **Designing new technologies for recovery:** We've created a new disassembly robot, Dave, to extract rare earth magnets from Apple Watch and iPhone components. This enables our recycling partner to recover high-purity rare earth elements and other important materials.	Stainless steel is highly recyclable and often recycled. Our challenge is to optimize our material efficiency and identify high-purity recycled sources. **Reducing use:** We've implemented a new process that allows us to reduce the amount of steel needed to make the iPhone 11 Pro and iPhone 11 Pro Max enclosure—enhancing material efficiency by 30 percent compared to traditional methods. **Mobilizing high-quality supply:** We've also enhanced the collection of our high-quality steel scrap for use in future products, and we continue testing recycled steel to ensure we can use it while still maintaining performance.	The market for recycled tantalum exists since it is a valuable and highly recovered material. Our challenge is to build new supply chains to source 100 percent recycled content at the scale needed for our products. And because tantalum is not often recovered from electronics at end-of-life, we are continuing to pursue recycling innovations.	**Expanding use:** We've released 23 products with 100 percent recycled tin in the solder of their main logic boards, including iPhone 11, iPhone 11 Pro, and iPhone 11 Pro Max, as well as iPad (7th generation) and the 16-inch MacBook Pro. We continue to scale our use, expanding to accessories like the 18W Power Adapter and the AirPods Pro Wireless Charging Case. In total, 15 percent of the tin shipped in our products in 2019 came from recycled sources. **Mining material from old devices:** We've begun shipping end-of-life iPhone components from Daisy to specialty recyclers that will recover tin, which is often lost in traditional electronic waste recycling.	Tungsten is used in many industries where it is highly recovered at end-of-life, but this isn't the case in our industry. Our challenge is to prove we can use high concentrations of recycled content—up to 100 percent in any single application—while maintaining performance and recover it at end-of-life. **Introducing recycled content:** More than 22 percent of the tungsten in products shipped in 2019 came from recycled sources. And we are currently identifying and rigorously testing the use of recycled content across more of our products. **Designing new technologies for recovery:** Our new disassembly robot, Dave, can extract tungsten from iPhone and Apple Watch components, so our recycling partner can recover high-quality tungsten from end-of-life devices.	Because zinc can accumulate impurities during recycling, we are searching for new, high-purity sources of supply for our manufacturers. And we continue to rigorously test recycled material, to make sure we can use recycled sources without compromising product performance.

Product and accessory environmental features

iPhone 11

100%
recycled rare earth elements
in the Taptic Engine, a first for a smartphone

100%
recycled tin
in the solder of the main logic board

30% or more
recycled plastic
in 4 components

AirPods Pro

100%
recycled rare earth elements
in the magnets of the wireless charging case

100%
recycled tin
in the solder of the main logic board of the wireless charging case

35% or more
recycled or bio-based
plastic in 4 components in AirPods Pro

iPad (7th generation)

100%
recycled aluminum
in the enclosure

100%
recycled tin
in the solder of the main logic board

70% or more
recycled plastic
in 3 components

Improving our packaging and protecting forests

At Apple, we're focused on creating groundbreaking product experiences. From the moment a customer opens the box and holds the product in their hands for the first time.

Last year, those who purchased our newly designed Mac Pro encountered another design innovation: packaging that was made almost entirely out of fiber.[13] This honeycomb-shaped design made primarily from recycled fiber was the work of our packaging engineering team. It embodies our goal to eliminate plastics by 2025, increase our use of recycled and renewable materials, and enhance the recyclability of our packaging.

With Mac Pro, our packaging designers set out to tackle a unique challenge. How do we replace the plastic foam typically used to protect our Mac devices with a fiber-based alternative? Plastic foam is both lightweight and resilient as packing material, but it also contributes to waste.

A fiber alternative not only could be sourced from recycled content, but could also be recycled by the consumer. But fiber had yet to show durability characteristics comparable to foam: the ability to spring and release multiple times to absorb the G-forces from the bumps on drops experienced in transit. Teams got creative and took inspiration from the world around them, including the design of motorcycle suspension systems. Through iterative cycles of design and testing, the packaging engineering team fabricated a fiber-based design that could withstand the rigors of shipping. Most importantly, once the packaging had outlived its use, it could be more easily recycled.

We're continuing to make progress toward eliminating plastics in packaging across all products. Since 2015, we've reduced our plastic used in our packaging by 58 percent. The launch of iPhone 7 marked our first device with majority-fiber packaging. This involved replacing two plastic trays that protected the iPhone and accessories with a single one crafted from molded fiber, as well as creating a paper origami-style alternative to the plastic packaging around the EarPods. We've since carried those innovations over to all of our iPhone and iPad devices, most recently iPad mini. And our new 16-inch MacBook Pro comes packed with an internal paper tube in the box wall structure designed for cushioning—an innovation that allowed us to cut the plastic used by 83 percent.

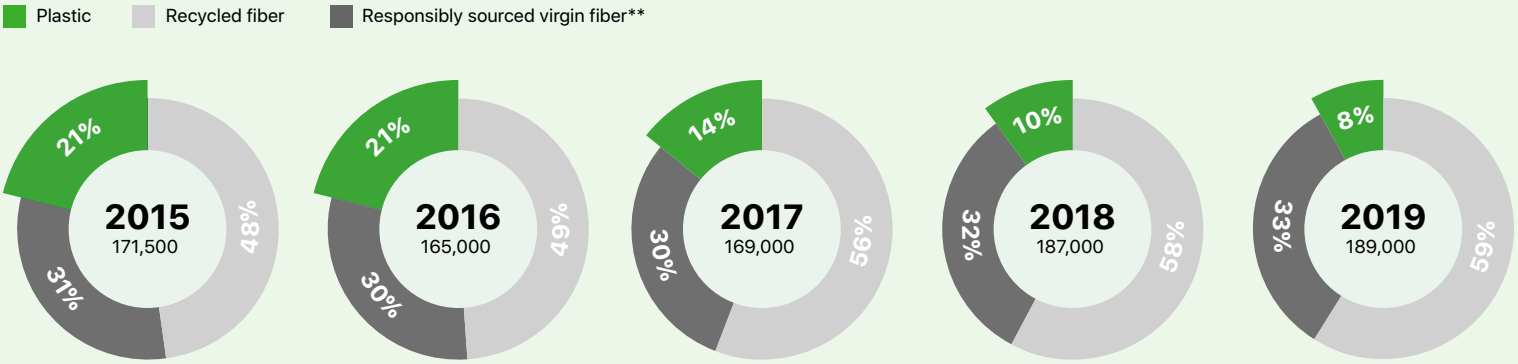
And as we transition to primarily fiber-based packaging, we make sure the fiber is responsibly sourced as well. Again in 2019, 100 percent of the wood fiber in our packaging came from recycled sources or responsibly managed forests.[12]

We've also taken direct steps to support the responsible production of wood fiber. Through our partnerships with The Conservation Fund and the World Wildlife Fund, we have improved the management of more than 1 million acres of working forests in the United States and China. For the fourth year in a row, the responsibly produced fiber from forests we've helped to protect equals the amount of the virgin paper we use in all of our packaging.[14] We continue to invest in the protection and restoration of forests to deliver both a carbon benefit and increase the availability of responsible forestry products to the world.

For more information, read our white paper on Apple's Paper and Packaging Strategy (PDF).

Packaging fiber and plastic footprint* (metric tons)

We've reduced plastic in our packaging by 58 percent in the past four years. And since 2017, 100 percent of the virgin wood fiber used in our packaging has come from responsible sources.



* These data include the materials used in our packaging. Fiber used at our corporate facilities represents less than 1 percent of our overall fiber use.

** Since 2017, all of the virgin wood fiber used in our packaging has come from responsible sources. Responsible sourcing of wood fiber is defined in Apple's Sustainable Fiber Specification (PDF). We consider wood fibers to include bamboo.

Product longevity

Our products are built to play a vital role in the daily lives of our customers. We also design each device to make the most of the resources we use to create them. That is why we build our products to withstand what life might throw at them, we offer new features and functionality with each software update, and we provide access to high-quality repair.

Each of these goals comes with challenges. We take a holistic approach that optimizes for longevity and is adapted to the way each device will be used. And the results are clear: iPhone holds its value longer than other smartphones. Long-lasting products are not only good for the planet, they're also good for our customers. Having a product that lasts is important to our customers, and we believe that it makes customers more likely to choose Apple in the future.

Durability is a principle of good design

Durability is central to the Apple product design. We aim to create devices that endure the rigors of everyday use. And we seek to reduce the need for maintenance and repairs. Our designs are optimized for this. The engineers in our Reliability Testing Lab assess each design decision—from materials to components, to final product and packaging—for real-world performance.

Our teams start with in-depth user studies. They look closely at repetitive actions and interactions: picking up and setting down a device, repeated use of an individual key, and what might scratch a device inside a handbag or pocket. What we learn through these studies drives our design decisions, which vary depending on how the product will be used.

iPhone longevity journey

iPhone (1st generation) 2007

iPhone 11 Pro 2019

	iPhone (1st generation) 2007	**iPhone 11 Pro** 2019
Durability		
Water resistant*	–	✓
Dust resistant	–	✓
Spill resistant**	–	✓
Repairable onsite* **		
Display	–	✓
Battery	–	✓
Speaker	–	✓
Haptics	–	✓
Rear camera	–	✓
SIM tray	✓	✓

* iPhone 11 Pro and iPhone 11 Pro Max are splash, water, and dust resistant and were tested under controlled laboratory conditions with a rating of IP68 under IEC standard 60529 (maximum depth of 4 meters up to 30 minutes). Splash, water, and dust resistance are not permanent conditions and resistance might decrease as a result of normal wear. Do not attempt to charge a wet iPhone; refer to the user guide for cleaning and drying instructions. Liquid damage not covered under warranty.

** For select common liquids.

*** Includes repairs performed in retail stores, Apple Authorized Service Providers, and mail-in locations.

For example, customers may use their iPad devices in many different venues—whether at home, on a subway, or in a park. So we created the durable unibody construction. And our users run, swim, and bike with their Apple Watch, so we optimized our Apple Watch designs for water and sweat resistance.

In our Reliability Testing Lab, we subject our product prototypes to rigorous testing to ensure our designs achieve our goals. Our engineers re-create and accelerate real-world settings, including using a chamber to simulate UV exposure and corrosive seaside conditions like "Salt Fog." Other tests shock, drop, and tumble products, going to extremes beyond the impulses and contact that a device might experience during typical use. And our team has developed more than 100 proprietary tests that exceed industry standards. Thousands of prototypes are evaluated, and all the results are shared directly with the design teams to inform how each product is built.

iPhone 11 illustrates some of the choices we've made to help devices withstand the conditions our customers subject them to. It was designed to take spills from ordinary liquids, and to be water, dust, and splash resistant (rated IP68 under IEC standard 60529).

Accessible, reliable, and high-quality repairs give products new purpose

We aim to avoid the need for repair in the first place. But when a repair is needed, there should be safe, dependable options available to bring a device back to its best possible performance.

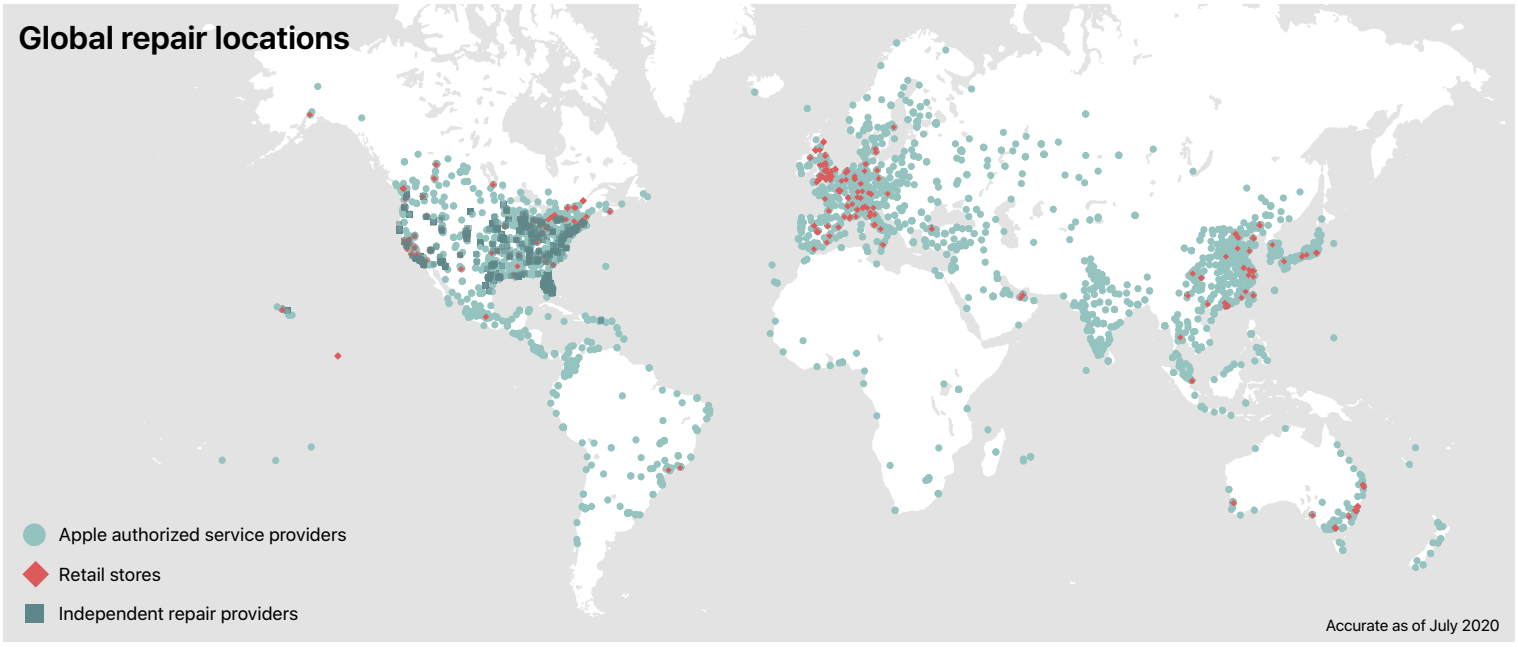
Our more than 5000 Apple Store and Apple Authorized Service Provider (AASP) locations offer repair services to customers both in-person and by mail. And we've trained more than 265,000 technicians to help service and support our products, continually certifying our retail employees and channel partners in tools and techniques to repair devices, and avoid unnecessary service or part replacement.

We have recently made significant improvements in expanding customer access to repair services. Through the launch of our Independent Provider Repair program, we are providing independent repair businesses—large or small—with the same genuine parts, tools, training, repair manuals and diagnostics as AASPs. There is no cost to join the program, training is free, and genuine parts are offered at the same cost as to AASPs. In the U.S., 700 locations across all 50 states are already participating in the program, and we've also expanded the program to Europe and Canada as well.

We've also broadened the reach of Apple authorized service repair. Through a partnership with Best Buy, we added 1,000 more AASP locations in 2019, tripling the number of U.S. AASP locations compared to three years ago. These programs mean it's easier than ever for our customers to access the service and support they need.

We've also made design choices so that products are easier to repair. Mac Pro, for example, was created with an aluminum housing that offers 360 degrees of access, and a dual-sided logic board that allows for components to be easily added or removed. For our iPhone devices, we've utilized stretch release adhesives, which securely hold the battery during use yet can be swiftly debonded by service partners to install replacements.

There's still work to be done. But we continue to make progress along this journey. And we do this because making repairs more convenient and reliable is directly aligned with our goal of creating long-lasting products that maximize the resources we use.



Ongoing software support extends the life of each device

We continually upgrade our operating systems to include powerful features like Dark Mode, and support for advanced augmented reality, as well as essential updates that enhance security and privacy features. We make these freely and widely available. That way, the latest features and security updates reach more users, whether they're using the latest Apple device or an earlier model. This also means our community of app developers can design for our newest operating systems and reach more users.

Our customers value this approach. We see this clearly in the adoption rates of our operating systems. By January 2020, we already had 70 percent of all users running iOS 13.[15] iPad users showed a similar preference for software updates—with 57 percent on the most recent release of iPadOS. And for iPad devices introduced in the last four years, 79 percent were running our latest major version of iPadOS.[15]

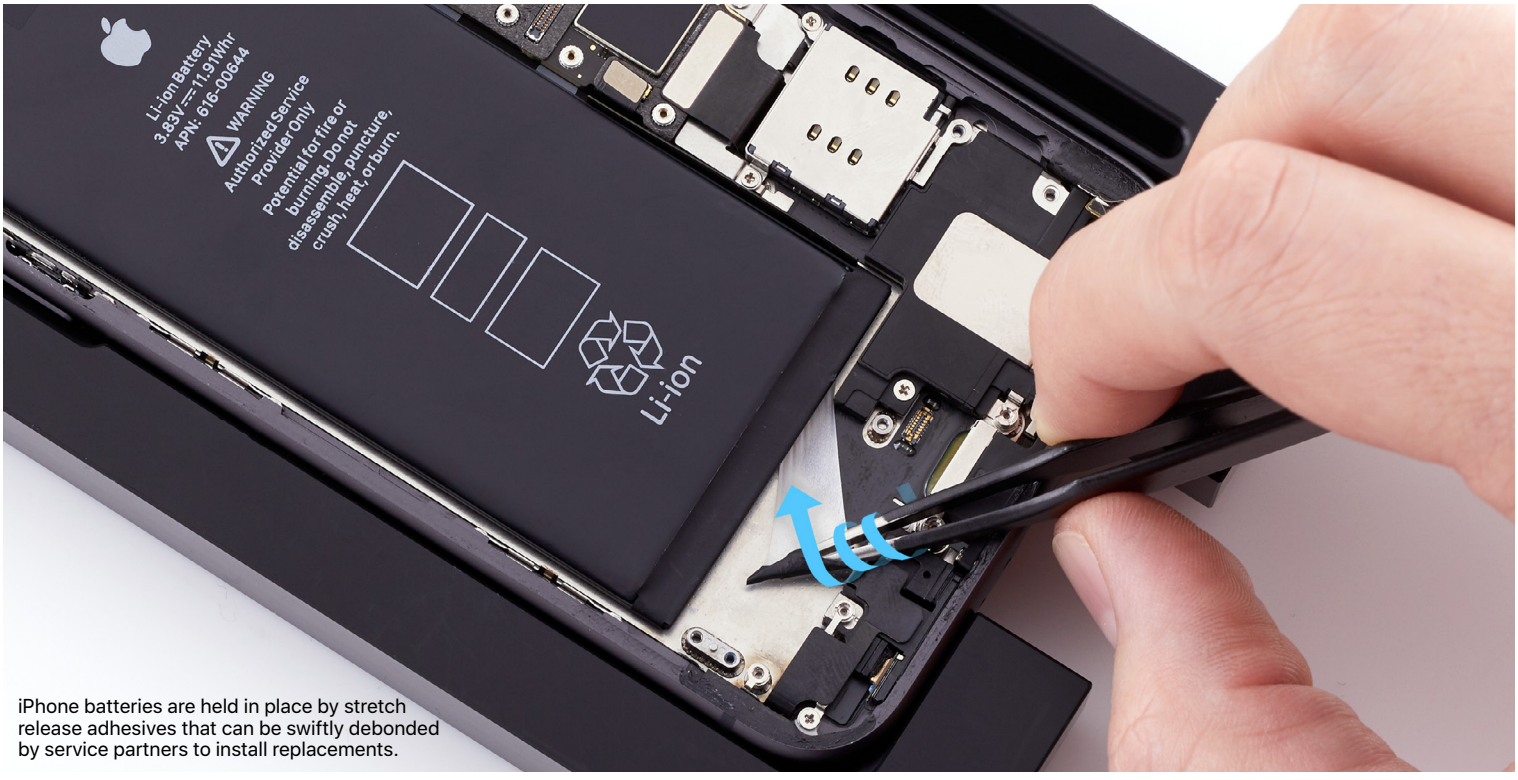
By designing both the hardware and software, we can optimize our operating systems to support the broadest range of products and help our customers get more out of the devices they already own. iOS 13, for example, is compatible with devices going back to 2015. There's an important balance we try to strike with each new update: to deliver the latest technologies our new hardware enables while being inclusive to prior generations of devices. This includes 2019 updates to macOS and iPadOS, which support devices from 2012 and 2014, respectively. Each new software update is validated and optimized for each model of our devices, so that when we release an update, we maintain our high levels of performance.

Refurbishing devices for second and third owners

We collect and refurbish used devices through Apple Trade In, our iPhone Upgrade Program, AppleCare, and, inside Apple, our Hardware Reuse Program for employees. Altogether, we refurbished 11.1 million devices for new users in 2019, representing a 42 percent increase from 2018.

That isn't simply a statistic to us. Each refurbished device represents a smarter and more environmentally efficient use of the resources and materials we rely on to build our products. And it further demonstrates that our products possess the high level of durability and desirability required to be embraced by second and third owners.

Our Apple Trade In program allows customers in 25 countries to walk into an Apple Store or go online to trade in their devices. Through the iPhone Upgrade Program, customers return their existing devices before upgrading to the latest model. These devices are refurbished and passed on to a new user. We also collect and refurbish devices through AppleCare and our employee Hardware Reuse Program. For devices at the end of their life, we'll recycle each free of charge. The success of these programs belongs to our customers. Their efforts identify the value of our products and help get the most from each device, and from the resources inside.



iPhone batteries are held in place by stretch release adhesives that can be swiftly debonded by service partners to install replacements.

Product end-of-life

What happens to Apple products once they reach end-of-life is our responsibility. When a device can no longer function as originally intended, its parts and accessories may still have more to give. So we recover these and get creative about the ways we can best reuse them. And for the parts that cannot be reused, we are designing new technologies to unlock the useful materials inside them. By effectively reusing and recycling products, we can all help keep the world's resources in use.

Reuse is our first choice

When a device as a whole no longer functions, we first aim to recover and reuse the parts inside that still work. One of the simplest ways to reuse a part is in another device. Recovered parts that are refurbished and tested to our stringent standards can be used as replacement parts for devices being repaired. This keeps quality parts in use while also reducing the number of spare parts we need to build.

We also find creative ways to use accessories in new applications. For example, we piloted a program to collect and ship recovered Apple cables and power adapters to manufacturing sites in Texas and Brazil, where they will be used to power production lines. This both extends the life of existing cables and reduces the need for new ones, for cost savings and an environmental win.

For other reuse programs, we've gotten even more creative. In many end-of-life devices, we've found integrated circuits that still deliver industry-leading processing, memory, and storage capabilities. We realized our developers could use these devices instead of new ones as they design and test apps and software—from developing the latest iOS to enhancing machine learning and artificial intelligence. We've piloted a program deploying thousands of end-of-life devices—including iPhone, iPad, Mac mini, and Apple Watch—for use by developers at our R&D sites and data centers. All these devices continue to perform in the most high-value form possible, before finally being recycled for raw materials.

We have much more progress to make. But across our company, we are building systems to help promote creative thinking and the collaboration needed for more reuse opportunities like these.

Recycling innovations unlock more key resources

Recycling represents the final, essential piece of creating circular supply chains. But the recycling industry faces significant challenges, from very diverse streams of waste to low margins on some materials. That's why we're partnering with recyclers, academic institutions, and other stakeholders to make sure materials are recovered in the highest quantities with the technologies available now, and to invent the recycling capabilities of the future.

Offering the best recycling available now

We aim to make recycling as accessible as possible to our customers. That's why we offer and participate in product take-back and recycling collection programs for 99 percent of the countries where we sell products. In total, these programs directed 47,000 metric tons of e-waste to recycling globally in 2019.

We've set up systems for collecting and recycling Apple products from iMac Pro to Apple Card. As new Apple products are developed, we create recycling programs for these too. We also care about how our devices get recycled. We hold our recycling partners to high standards for environment, health, safety, and security. In 2019, we conducted more than 60 audits globally on issues relating to environment, health, and safety—and we performed additional audits relating to security. We also look beyond our own recycling activities. In 2019, we supported U.S. nonprofit The Recycling Partnership's creation of educational guides to promote proper disposal of e-waste and lithium-ion batteries. These guides will be made freely available to local governments to encourage better recycling in communities across the United States.

Improving disassembly

Traditional recycling technology can recover certain valuable materials—like gold and cobalt—at very high rates. However, often these recycling techniques—like shredding to separate materials quickly—mean certain materials get lost in the process or downcycled for use in lower-quality applications. That's why we are working to take our products apart with the same intention that we put them together.

Our Material Recovery Lab (MRL) in Austin, Texas, is the center of our work to enhance recycling technology. At the MRL, both Apple engineers and interns from colleges and universities develop tools and methods to improve the way our recyclers process our devices. For example, at our MRL, we've invented a semiautomated jig for even more efficient AirPods disassembly. We rigorously test these tools before deploying them across recycling networks.

Another area of our work focuses on designing the automation that can revolutionize the way our devices are taken apart.

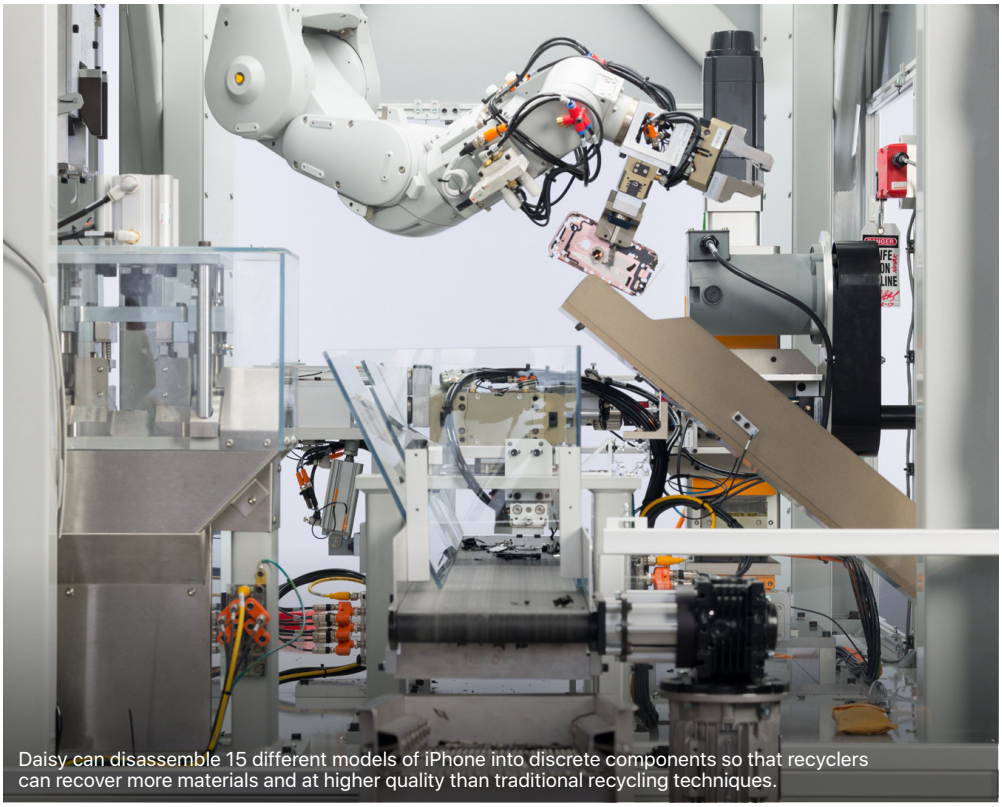
Our iPhone disassembly robot, Daisy, continues to work hard at the MRL in Austin as well as at our site in the Netherlands. Daisy can separate the individual components of 15 different models of iPhone so that recyclers can recover more important materials and at a higher quality than traditional recycling technologies. Daisy receives iPhone devices from our AppleCare and Trade In programs as well as from partner programs with Best Buy in the U.S. and KPN in the Netherlands. Modules from Daisy are already making their way to recyclers. And the results are impressive: A recycler recovered the same amount of copper and gold from 1.4 metric tons of Daisy modules as can be extracted from more than 150 metric tons of mined ore.

While Daisy can disassemble devices into components, select components require additional disassembly to enable material recovery. So we invented Dave, our newest disassembly robot, to take apart individual components. So far, Dave can disassemble the Taptic Engine for greater recovery of materials like rare earth elements, tungsten, and steel.

By processing 800 modules an hour, just one single Dave robot can go a long way for a recycler. Dave is being deployed at one of our key recycling partners, who is part of the circular supply chain for the recycled rare earth elements we use in our iPhone magnets today.

Creating the next generation of recycling

Our third recycling initiative focuses on what the future of recycling could be—with technology that allows recyclers to process high volumes of diverse and increasingly complex electronic waste. In a partnership with Carnegie Mellon University, we're applying machine learning to help address part of this recycling challenge. Researchers are developing methods to train automated systems to sort waste in real-time and learn as they go—so the technology can evolve as waste streams do. Any software created from this joint initiative will be open-sourced to help better support e-waste recycling around the world.



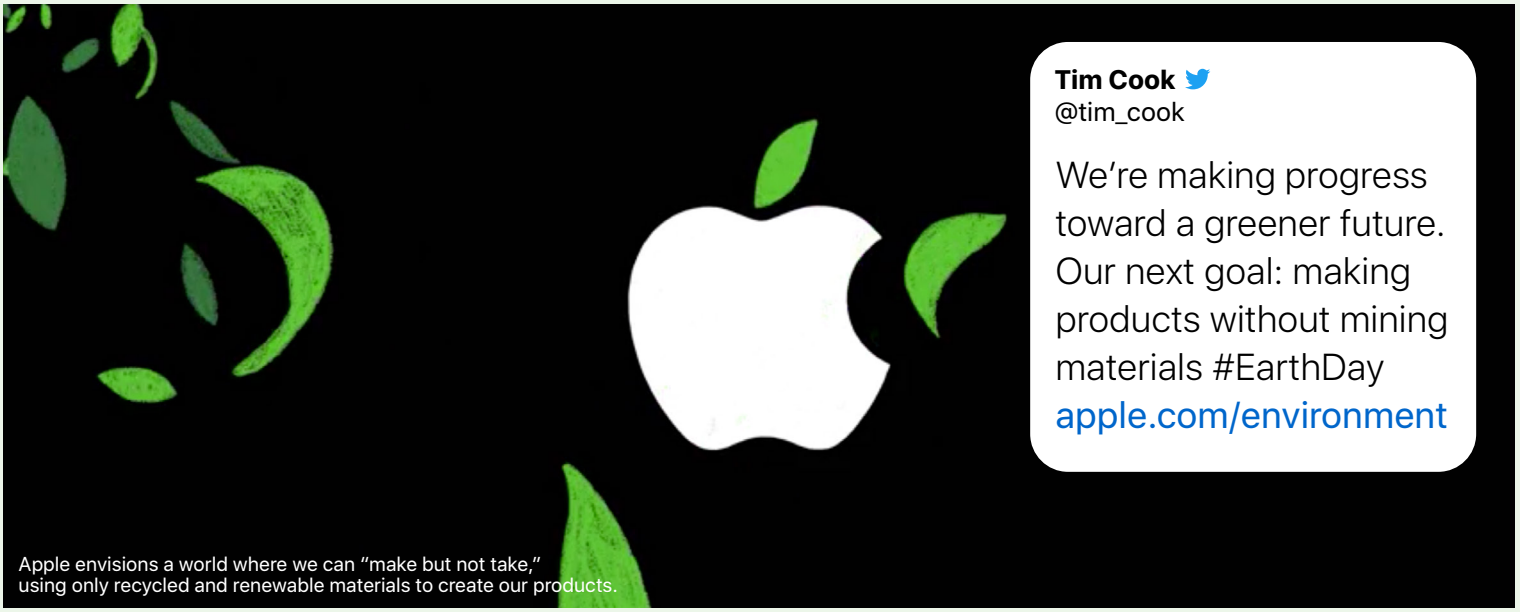
Daisy can disassemble 15 different models of iPhone into discrete components so that recyclers can recover more materials and at higher quality than traditional recycling techniques.

We recycled 47,000 metric tons of e-waste in 2019

Apple and our recycling partners are focused on:

- Maximizing material recover rates
- Protecting privacy
- Maintaining standards for environment, health, safety, and security

Learn how to trade in or recycle your device ›



Apple envisions a world where we can "make but not take," using only recycled and renewable materials to create our products.

Advocating for policies that enable resource recovery

Apple envisions a world where we can make products without taking from the earth, using only recycled and renewable materials in our products.

We've made significant progress toward our goal—like using 100 percent recycled aluminum in the enclosure of our 2019 MacBook Air with Retina display and Mac mini devices, and using 100 percent recycled rare earth elements in the Taptic Engine of iPhone 11, iPhone 11 Pro, and iPhone 11 Pro Max.[1] To further our progress, we're looking to increase the use of scrap materials recovered from our supply chain and from end-of-life products to make new products.

In pursuing that goal, we've learned that there are some significant obstacles to building circular supply chains—those that collect, process, and reintroduce secondary materials from manufacturing scrap and products at the end of their useful lives. One set of obstacles are actually policies that were written to address the negative impacts of waste, but now have the unintended consequence of limiting the movement of materials for recovery and reuse. Waste shipment regulations offer important protections to people and the environment around the world. They were created to respond to the dumping of waste in particularly vulnerable communities. We believe there's an important opportunity to strengthen these regulations to maintain and improve these protections while enabling new, clean economies based on circular movement of materials. Retooling these regulations can make circular supply chains more competitive with traditional linear supply chains—by responsibly fostering recycled material supply flexibility and competition.

We've learned that we need to level the playing field for circular supply chains if we want recovered materials to replace primary materials in manufactured goods at scale. It turns out that in many cases, it is easier to move materials newly mined from the earth around global supply chains than it is to move materials for recycling. For example, bauxite rocks—roughly 20 to 25 percent of which will turn into aluminum and which require mining, crushing, chemical processing, and smelting—move more easily than iPhone enclosures separated by Daisy and containing 95 percent already smelted aluminum. This means that responsible recycled material supply chains are often harder to establish and cost more to operate, even though they can have much lower environmental impacts. It also means that recoverable materials are often diverted to less responsible or lower-quality recycling or disposal pathways.

As we've expanded our collection of materials from our disassembly robot, Daisy, we've sought to redirect this material back into our supply chain. In the process, we learned that it can sometimes take years to secure the necessary approvals to ship components recovered from Daisy. This is because policies can treat these materials the same as hazardous waste headed for landfill, even though they are destined for a responsible material recovery operation. There is an opportunity to strengthen policy to encourage the recovery of material for reuse in manufacturing, and to improve the economics of activities that can reduce the waste burden to begin with. Without this policy innovation, circular supply chains will remain niche projects, unable to truly scale in a way that competes with dynamic, global, and linear supply chains.

Protections surrounding the movement of hazardous waste are paramount. Recovering resources for reuse is paramount. We are obligated to innovate in determining how to do both simultaneously. Thinking of waste as a resource requires a paradigm change and a collaborative approach between NGOs, industries, and governments around the world. We are eager to continue to collaborate with others in pursuit of these opportunities.

Water stewardship

We give a lot of thought to how we use water at Apple. That's in part because we work in communities around the world that relate differently to this precious resource—whether in a water abundant environment like Cork, Ireland, or regions that experience water scarcity like Mesa, Arizona.

Our operations use water in many different ways, from our relatively low-impact retail stores to our data centers and suppliers' manufacturing facilities, which rely more heavily on water. And, as climate change impacts global water resources, we're experiencing the effects across different environments.

This helps us see water in a global context. It's the most fundamental resource to life on this planet. And it is also essential to our growth as a company. To use water responsibly requires different approaches for different contexts. And because it is a resource shared by many, our efforts go beyond our own immediate business needs and into the communities where we work to care for, replenish, and share freshwater resources.

Our impact drives our efforts

The first step in developing our water strategy is to understand how we use it. The scarcity of freshwater impacts communities around the world—and this drives the urgency around our effort to use this resource more efficiently. Our corporate facilities utilize water for construction, sanitation, and climate control. During the manufacturing process, our suppliers process and clean our products with water.

We continually examine our usage in each of these contexts. We look beyond our local footprint to the impact on the region, our supply chain, and global resources. We rely on globally recognized tools—including the Aqueduct tool from the World Resources Institute and the World Wildlife Fund's Water Risk Filter—and our knowledge of local conditions to help us evaluate water risks in the communities where we work.

Rigorous measurement is an essential part of this process. We look at the patterns of usage at our retail stores, corporate facilities, and data centers, and engage our suppliers in measuring their water use. We engage beyond our direct suppliers, going deeper into our supply chain. This allows us to prioritize the manufacturers of modules that involve a water-intensive production process or those that create wastewater that needs to be rigorously managed. And this analysis informs our business decisions and allows us to develop a cohesive water engagement strategy.

We're able to match our most urgent efforts with the areas in greatest need. We continue to direct our attention to Apple locations in Maiden, North Carolina, Mesa, Arizona, and in California's Santa Clara Valley, areas of elevated water risk, which also account for more than half of our facilities-based water use.

Among our suppliers, we have identified more than 100 top sites where we are providing onsite tools, training, and water engineering to reduce our usage.

This poses a continuous challenge—which we're committed to addressing. Our strategy on improving water use at our facilities and suppliers remains consistent:

- Using water efficiently to reduce overall consumption.
- Expanding use of alternative water sources.
- Discharging water responsibly.
- Enhancing our water stewardship to keep watersheds healthy for all who rely on them.

We're focused on progress. At Apple facilities, we work to design for and optimize our use of water. With our suppliers, we work from established baseline assessments to drive technical support for water-saving measures—and monitor performance throughout the year against our goals. This work doesn't happen in isolation. The efforts we undertake with our suppliers build capacity to better manage water use in key regions around the world.

Efficiency reduces our impact

Our business relies on access to safe, reliable water sources, whether to keep our facilities and data centers cool, to nurture our green spaces, or to manufacture our products. We know that we need to minimize the amount of water we use. And we are looking for ways to be more efficient—changing our processes, technologies, and, most important, behavior.

Last year, our facilities used 1.3 billion gallons of water. Our use of recycled water increased by 68 percent and our use of freshwater (excluding temporary water uses) increased by 9 percent. Temporary water use decreased due to fewer construction activities. Overall, we're working to improve our water efficiency through the use of low-flow fixtures, advanced cooling technologies, and a new landscaping program at our global facilities that employs sensors to optimize water use. These efforts are important to us because we recognize the size of our footprint and the potential it has to impact the communities where we work. In water-stressed regions, this work is particularly urgent.

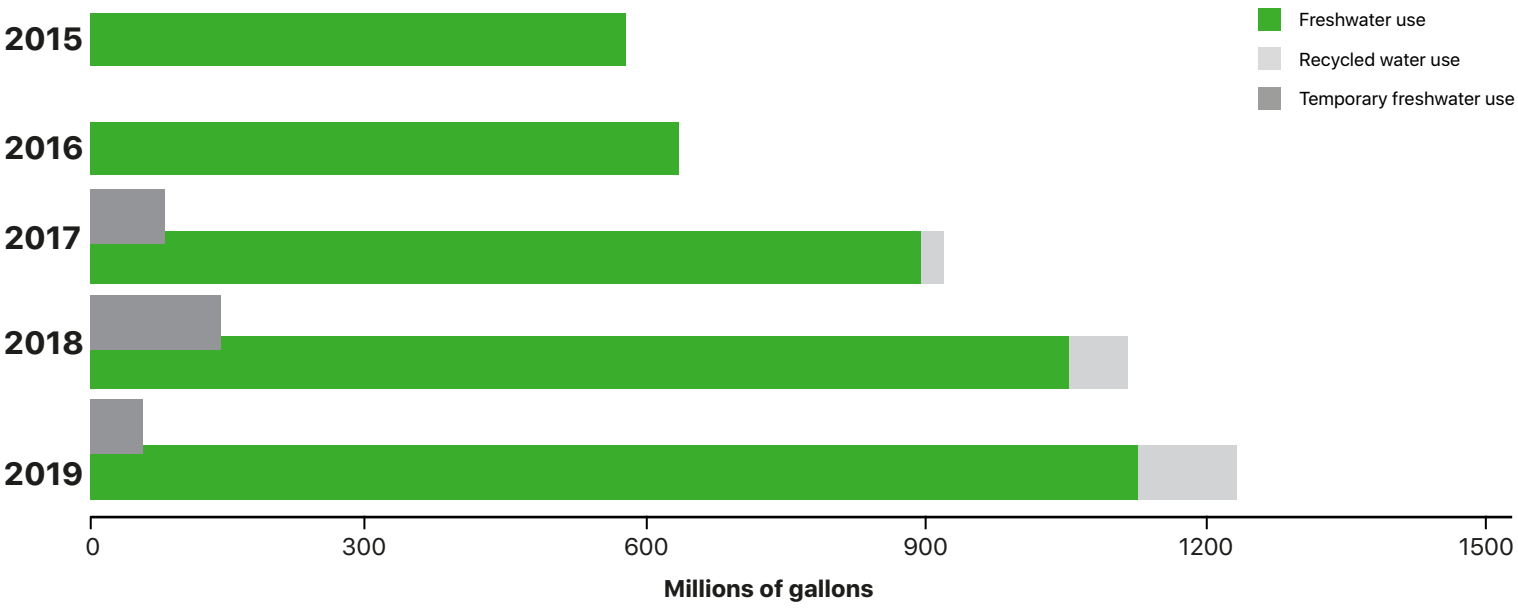
This is why we focused on our Mesa, Arizona, data center last year. Located in the Lower Colorado River Basin, a region that has endured both a 20-year drought and historic overallocation of water resources, our Mesa facility provided an opportunity to make a significant impact by finding ways to more efficiently use water.

We approached this challenge from several directions. First, we made improvements to our infrastructure onsite to reduce our water usage. This involved consolidating our existing cooling equipment and deactivating cooling towers that were not needed. Next, we separated the pipes containing recirculating water with those that contain water for evaporation. This reduced the amount of water we needed to store to clean and refill the system. Finally, we adjusted the operating plan of the chiller plant to require less cooling. Together, these activities are expected to save 14 million gallons of water per year.

While we focus first on the water Apple uses directly, we know that the water our suppliers use to make our products is significant too. Our supplier Clean Water program provides both the assessment tools and technical guidance our partners need to make improvements. Suppliers have taken a range of approaches, from employee education to optimizing the rinsing processes used in manufacturing, to updating equipment to include smart water feeding and usage monitors. We've even worked with a supplier at the outset of a manufacturing site design to make recommendations on water-conscious equipment and wastewater reclamation systems. In 2019, the 136 suppliers participating in our program directly contributed to saving more than 9.3 billion gallons of freshwater, for a total of 30.5 billion gallons since the launch of the program.

Water use at corporate facilities

We track our corporate water use for our data centers, retail stores, and corporate offices.



Note: We began separating out temporary water use in 2017 to capture water use for activities like dust control for new construction and the establishment of mature, drought-tolerant trees in landscaping. Beginning in fiscal year 2017, our boundary expanded to include more than 150 million gallons of water used annually at distribution centers and colocated data centers.

Alternative water sources preserve freshwater

Challenging problems demand creative solutions. This is the case when it comes to conserving freshwater sources. Different uses of water require different qualities, from salinity to levels of pH. We've looked across our operations to match water quality to its ultimate use. And to seek out and identify opportunities to utilize alternative water sources from recycled and reclaimed water to captured rainwater.

In 2019, we increased our use of recycled water 68 percent, from 63 million gallons to 106 million gallons. Our corporate facilities in the Santa Clara Valley and Elk Grove, California; Singapore; India; and Taiwan; as well as two of our three largest colocated data centers contributed to this increase. At our new Apple Park and Wolfe campus, new recycled water systems came online, replacing 11 million gallons of potable freshwater with recycled water. That's only the beginning. We expect that number to continue to grow. In India, onsite water treatment and reuse provided water for irrigation, toilet flushing, and cooling, boosting our reuse rate to 100 percent. We've also rolled out these efforts at retail locations. Our new retail location in Washington, D.C., for example, incorporates a rainwater harvesting system, which collects up to 25,000 gallons of water, cutting our reliance on potable freshwater.

We've looked beyond our facilities, to our suppliers, to find other opportunities to conserve freshwater. In some cases, making minor changes to how we work can have a much larger impact on both our water usage and the amount of wastewater our suppliers generate. For example, we've implemented a countercurrent washing technique to rinse components with the same efficiency, while using much less water. One China-based supplier developed a recycling system using electrolysis to remove copper from a water mixture following a micro-etching process. That approach enables the supplier to reuse 53 percent of the local water they rely on, far exceeding the national standard. On average, suppliers in our Clean Water program have achieved a 40 percent wastewater reuse rate.

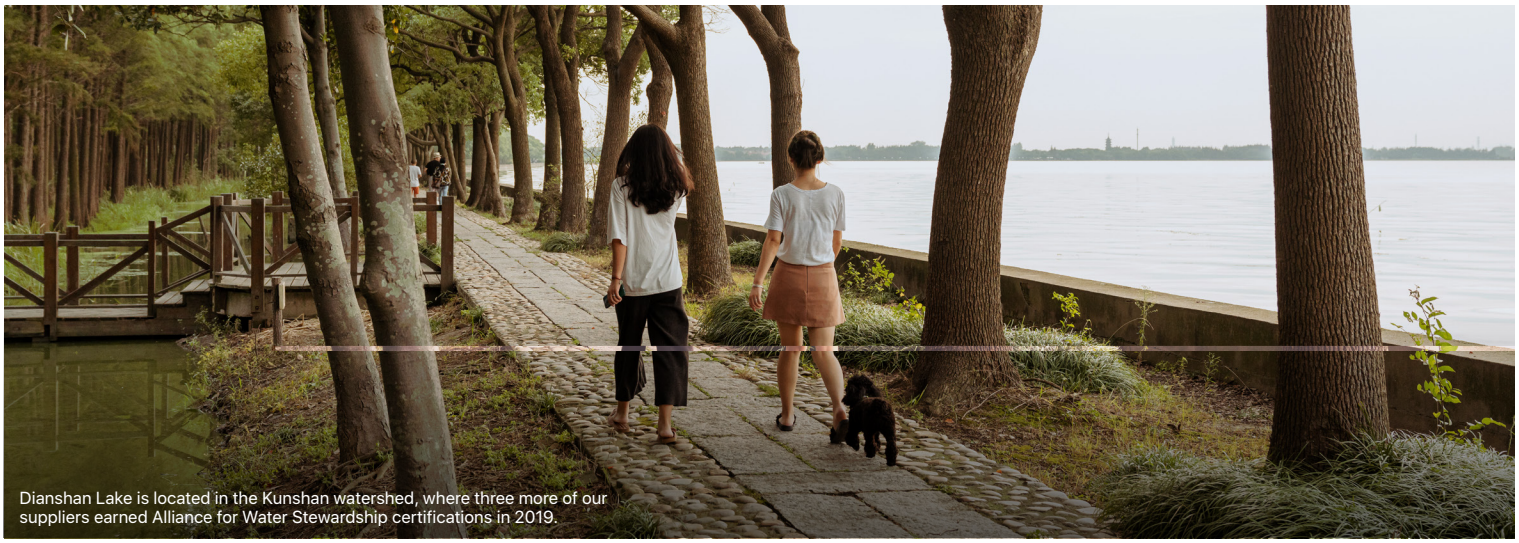
Stewardship expands beyond our footprint

We're committed to protecting the communities where we work. That's why we ensure each of our facilities complies with all local regulations. And that each of our suppliers adheres to our Apple Supplier Code of Conduct (PDF), which sets high standards for wastewater discharge.

However, we go far beyond compliance and are working toward water stewardship, which means using water even more responsibly, in a socially beneficial, environmentally sound, and economically sustainable manner. That's because the watersheds we rely on should be healthy and accessible to the communities where we work and our suppliers operate.

We've expanded our work with the Alliance for Water Stewardship, investing in their work to raise awareness throughout the Asia-Pacific region on this issue, to build tools and training for the AWS certification process, and to increase support for our suppliers working to be certified. Last year, three of our supplier sites earned platinum AWS certifications, bringing the total number of Apple supplier sites certified by AWS to five. Others are following suit. The Kunshan watershed, where many electronics manufacturers operate, is now home to the most AWS certified sites in the world.

This provides us the opportunity to talk to others about local water risks. We are hosting discussions between brands, NGOs, local regulators, and government representatives to raise awareness around the business risks associated with water risks. In 2019, we engaged more than 100 stakeholders in events held across China.



Dianshan Lake is located in the Kunshan watershed, where three more of our suppliers earned Alliance for Water Stewardship certifications in 2019.

Apple helped create an aquifer storage and recovery system in Prineville, Oregon, where one of Apple's data centers is located.

Building a partnership in Prineville, Oregon

Each week, a truck from a local farm pulls up to the gate of Apple's data center in Prineville, Oregon. There, an Apple employee loads something unexpected: food scraps, single-use paper towels and cups, and other compostable materials generated onsite.

The local janitorial staff set up a system to collect this waste and, in April 2019, Apple partnered with Bluestone Natural Farms to use the material. Instead of bringing these scraps to a local landfill, Bluestone Natural Farms composts the nearly 5000 pounds of organic and compostable waste Prineville generates per year into rich organic material for use on the farm.

This partnership is just one piece of a much larger effort Apple is undertaking here: to not only reduce our local impact, but also collaborate with the community to enhance the well-being of local ecosystems. The Prineville data center has become part of the landscape in this community, where farmers, ranchers, and mill operators have built the local economy in the surrounding valleys over many generations. Set on a 367-acre plateau in this high-desert town in Central Oregon, the center employs 100 people in a community of 10,000. Now Apple is working with local stakeholders to ensure the area's natural beauty and resources are available for generations to come.

A central component of this is water stewardship. Prineville has been recognized nationally for its Crooked River Wetlands project, an innovative wastewater treatment system, which Apple supported.

The project models the effectiveness of partnering with a private enterprise in creating public works projects that can benefit the environment and deliver cost-savings to the community. Now the Crooked River Wetlands Complex also serves as a community space—Apple has worked with the Crook County Rotary Foundation to fund an accessibility project to encourage neighbors to take advantage of this 120-acre habitat.

We have also partnered with the City of Prineville on another innovation: a 180-million-gallon aquifer storage and recovery system that holds water throughout the year for use in peak demand months. This system uses natural underground spaces for cost-effective storage, helping mitigate seasonal impacts and future climate-related risks of water shortages.

Our partnership extends beyond our environmental efforts. A data center internship pilot program draws candidates exclusively from Oregon State University–Cascades and Central Community College in Prineville. And our outreach includes volunteer events to clean up Ochoco Creek and a back-to-school movie night to promote healthy eating habits. A community like Prineville offers an important lesson in Apple's environmental mission. Small efforts, undertaken by each one of us, can yield greater results.

Zero waste to landfill

The work we're doing to rethink how we use materials isn't limited to our products. We take a comprehensive view of what we consume as a company—from coffee cups to shipping palettes. When we think of the use of these items circularly—finding ways to reuse and recycle—we better serve our ultimate goal of keeping waste out of landfills.

Transitioning to zero waste to landfill at facilities

In 2018, we launched our commitment to send zero waste to landfill for our offices, retail stores, and data centers. That commitment aims to eliminate waste sent to landfills from these sites. We've started our journey toward that goal, but there's work to be done. Across our global locations, the amount of municipal solid waste we generated increased from 53,000 metric tons to 58,000 metric tons, reflecting an overall growth in our business.[16] And the rate of municipal solid waste that we diverted to be recycled or composted remained about the same at 66 percent.[17] To address our waste footprint, we are focusing on our major campuses and data centers in the U.S. as well as our global retail stores.

This work begins by first understanding what we throw away. In some cases, we've installed remote waste monitoring systems to accurately measure waste generation and contamination.

For an even more in-depth look, our teams have put on gloves to conduct waste audits, manually looking through what is thrown away. This data collection helped us discover an important fact: We were overestimating waste. Before we optimized waste measurements from our monitoring system, our estimates assumed that bins were full each time they were emptied, leading us to overestimate waste by as much as 50 percent. We also found that products often ended up in the wrong bins. We used this information to better target our efforts and raise employee awareness.

We also prevent waste by closely managing what comes to our sites. We've amended construction contracts, for example, to include waste reporting and diversion requirements. This helps us minimize the amount of waste each project generates. For landscaping work, we require that trimmings be mulched and reused onsite to ensure that compostable waste does not end up in a landfill. At our data centers, we are working with our suppliers to consolidate and, if necessary, redesign packaging to be 100 percent recyclable or reusable. We've recently begun to roll out a similar packaging standard at our retail sites as well.

We've also worked on enhancing how we recycle and reuse materials. At our Nevada data center, a new scrap metal and cardboard collection program diverted an additional 10 percent of materials from landfills. Our Prineville, Oregon, data center eliminated more than 5000 pieces of single-use dishes and utensils in the first four months of our reusable dishware program. These and other efforts—including an office recycling program that captures paper, batteries, and beverage containers—helped increase our diversion rates between 2 percent and 10 percent at our data centers.

Our zero waste effort extends to our retail stores. We recycle paper, plastic, aluminum, and cardboard in all of our retail stores worldwide, and have partnered with local vendors to collect compost in more than 70 stores across North America.

Hazardous waste generated at Apple facilities is another challenge we're actively addressing. We've made significant progress in ensuring that these waste streams are managed responsibly. We audit our Transportation, Storage, and Disposal Facilities (TSDFs) regularly, ensuring that the locations where we send this waste to be treated, recycled, or incinerated operate within the strict standards for environment, health, safety, and waste management protocols. If a facility falls short, we send our waste to another approved facility that can meet our standards.

Supporting supplier progress toward zero waste to landfill

We continue to engage our manufacturing partners through our supplier Zero Waste program, which launched in 2015 with the objective to divert 100 percent of their waste from landfills. The program provides supplier facilities with onsite support to reduce, recycle, and reuse materials, as well as tools and expert guidance in sustainable waste management. In 2019, participating supplier facilities increased by more than 50 percent, with 155 engaged in our Zero Waste program overall. These locations diverted 322,000 metric tons of waste from landfill during the year, bringing the total over the lifetime of the program to 1.3 million metric tons—enough to fill over 100,000 garbage trucks.[18]

We've prioritized these efforts around the suppliers with the most significant waste streams: the final assembly suppliers who put together the parts and modules for our products. And we're seeing meaningful results. All iPhone, iPad, Mac, Apple Watch, AirPods, and HomePod final assembly sites have been certified as UL Zero Waste to Landfill facilities for the second year in a row.[19] And all Apple TV final assembly sites received certification in 2019. We're now expanding this work to engage our sub-assembly suppliers, where the waste streams are far more complex and require new, creative solutions.

We're helping our suppliers reduce disposable materials onsite, enhance their diversion rates, and find reusable and recyclable alternatives. For example, we helped create a Recyclable Protective Film (RPF) that protects products during manufacturing and can be recycled after use. In 2019, the use of the film became a requirement for new iPhone final assembly and is also available on the open market for others. We've also encouraged the use of reusable plastic trays at our final assembly sites. We made this simple and more cost-effective by connecting multiple suppliers with a single vendor to collect and clean trays for reuse. And the high volume of reusable trays made them more economical than using new ones. As a result, more than 6 million trays are being used and reused, saving our suppliers significant cost and reducing the amount of waste generated. In another initiative, we've helped our suppliers assess their shipping materials, identifying a 25 percent thinner shrink-wrap to secure products on shipping pallets. Through these and other efforts, we're pursuing every opportunity to meet our zero waste goal and transform the way business is done.

We've helped participating suppliers transition to reusable rather than disposable plastic trays at our final assembly sites—one of the many small innovations that add up in our Zero Waste program.

Our facilities embody our environmental commitment, with features designed to lighten their environmental impact. Apple Carnegie Library in Washington, D.C., for example, features a rainwater capture system that collects up to 25,000 gallons of water, reducing freshwater use.

Reflecting our values in our green buildings

Whether a retail store, data center, or office, our facilities reflect the vision and values of Apple: the idea that the creativity and collaboration that define our company intersect with our responsibility to preserve the environment.

Our efforts also acknowledge the impact that built environments have on our planet. That's why we've prioritized the environment in our building design, utilizing industry-recognized green building certification wherever possible. To date, more than 50 of our sites have received LEED (Leadership in Energy and Environmental Design) or BREEAM (Building Research Establishment Environmental Assessment Method) certifications. And in total, we're bringing online more than 13.8 million square feet of green building space worldwide.

Opened in 2017, Apple Park remains one of the largest LEED platinum–certified office buildings in North America. Our facilities feature many groundbreaking innovations, from the world's largest natural ventilation system to highly efficient hydronic radiant heating and cooling. Our ongoing challenge is ensuring that each of these performs efficiently and to their potential—not only to make the most of our precious resources but to uphold our values.

Our approach extends far beyond our Apple Park headquarters. The nearby Wolfe Campus, which provides more than 700,000 square feet of corporate office space, has also received LEED platinum certification. Features like smart LED lighting and high-efficiency water-cooled chillers drive the site's efficient energy usage. Low-flow fixtures and an irrigation system that uses 90 percent recycled water help to optimize water consumption across this site.

At our data centers, we continue to pursue opportunities to use less water in cooling systems and optimize energy use. This allows our data centers to continue to perform more efficiently, on average, about 60 percent better than the ASHRAE 90.4 baseline specific to data centers.

Our environmental focus also extends to retail spaces. Energy-efficiency teams engage early in the process of developing our flagship stores, modeling and optimizing energy use that accounts for the local climate, from temperature and humidity to light. At Apple Carnegie Library in Washington, D.C., we've designed a rainwater capture system to reduce the store's reliance on freshwater resources. We have a new store design that uses 10 percent less energy than the industry-standard energy benchmark (ASHRAE 90.1), which we have rolled out at 20 new locations. We're committed to using sustainable materials for our in-store furniture while also reusing and repurposing fixtures.

For each novel challenge we face in building and operating green spaces at Apple, there is an opportunity to learn more and apply our knowledge to working more efficiently.

Smarter Chemistry.

We test all our products, and place special attention on materials that come in skin contact. In our nickel leach testing on the Apple Watch Sport Band, we place components in jars of artificial sweat to ensure the nickel, a potential allergen, stays where it belongs—in the product.

Highlights

Each Apple product results from an intentional design process that prioritizes the safety of our materials and manufacturing processes. We continually work to create innovative products that also meet our high standards of safety.

Safer products make for more sustainable products—their materials can be more readily recycled without concern for future exposure to harmful chemicals. This supports our efforts to eliminate waste and move toward circular sourcing for our products. In 2019, Apple was the only company to receive an A+ rating from Mind the Store, an external campaign that evaluates the largest retailers in North America on how they ensure the chemical safety of their products and packaging. This reflects our ongoing commitment to providing safe products for our customers, manufacturing partners, recyclers, and the environment.

900+

Chemical information providers

Over 900 Apple supply chain partners are providing chemical information through our industry-leading Full Material Disclosure Portal.

45,000+

Chemical information collection

We have collected and validated chemical information for more than 45,000 parts.

1100+

Raw materials

We've created direct relationships with more than 90 raw material suppliers, enabling us to collect the chemical composition of over 1100 raw materials.

100%

Safer Cleaners program

We've enrolled 100 percent of supplier final assembly sites in our Safer Cleaners program, representing over 900 metric tons of cleaners used each year by more than 87,000 workers.

100+

Chemicals Management Program

Over 100 supplier facilities are participating in our Chemicals Management Program that evaluates the safety of chemicals used in our manufacturing process.

A+

Rating

The Mind the Store campaign, by the NGO Safer Chemicals, Healthy Families, gave Apple an A+ rating for our work to eliminate harmful chemicals in products and packaging.

Our approach

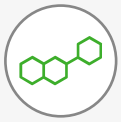
Safer materials make for safer products—and a better world. This belief has driven our efforts to remove harmful chemicals from our products—and from the processes of designing, making, using, and recycling them.

Apple has taken on a leadership role with our approach to smarter chemistry, pushing advancements within the scientific community, our industry, and among regulators. This is a priority because we know that our efforts can have a broad impact beyond our customers. Our work continues each year, not only to ensure that harmful chemicals stay out of our products, but also to expand our knowledge of the chemicals our suppliers use to make our products.

We must understand the chemical composition of each material used in Apple products to ensure they meet our strict standards—so we are working to collect and track comprehensive chemical composition information for each one. We also examine our manufacturing processes to monitor the chemicals our manufacturing partners use. This information helps us evaluate compliance with the Apple Regulated Substances Specification (RSS)—the global chemical restrictions we set for the materials in our products and the process chemicals used to manufacture products.

The RSS standard exceeds what is required by regulations, based on industry best practices and Apple's own research. We also assess the safety of unregulated substances, to ensure we have all the information about the potential risks and hazards of materials used in products and by our suppliers. This empowers us to make changes when we need to, by finding safer alternatives to help protect our manufacturing partners and our customers—and the planet.

Our Smarter Chemistry strategy focuses on three main areas:



Mapping and engagement ›

Engage our supply chain partners to build a comprehensive inventory of chemicals that make up the materials used in our products.

Assessment ›

Assess the health and environmental risks the chemicals in product materials may pose.

Innovation ›

Exceed requirements by innovating safer alternatives and improving how we manage potential risks of chemicals.

Mapping and engagement

We regularly engage our supply chain partners to ensure they understand and support our commitment to safer chemistry. From there, we begin to collect information from our suppliers on the chemical composition of the materials used in our products.

Which chemicals do our suppliers use to make our products? How do they impact our manufacturing partners, customers, and the planet? How do the chemicals used impact the quality of materials that could be recovered and recycled into new products?

These questions are fundamental to our smarter chemistry work. Yet finding the answers requires a global effort. To do this, we've undertaken an enormous project: cataloging the materials in tens of thousands of parts in our products. This is a shared project that draws in not only our suppliers but the suppliers they work with. Through this broad cooperation, we're mapping the chemical composition of the materials used in our products, as well as the process chemicals used in the manufacturing process—like cleaners and degreasers. Our toxicology team relies upon this data to perform toxicological assessments for safety.

This is not standard practice for our industry. Many electronics manufacturers do not have an understanding of the composition of materials in their products. Without the composition, they have few means to understand the toxicological risks associated with each chemical. And oftentimes this information is claimed as either confidential or a trade secret by the supplier. Even when the data is readily available, most brands lack the means to collect, process, and make decisions based on that information.

Cataloging all the chemicals used to make our products

Our Full Material Disclosure program, launched in 2016 as a sort of human-genome project for the materials we use, continues to expand our understanding of the chemicals within each material in our products—including the materials used in very small quantities like inks, adhesives, and coatings. We're navigating this enormous challenge with our manufacturing partners, whom we require to disclose proprietary information to assist this process. We've established an advanced system that simplifies the process of collecting data from suppliers.

This helped us create an industry-leading level of transparency across our supply chain. After collecting the data, we go a step further than many other companies by carefully validating material composition information with the raw material manufacturers.

We prioritize the collection of chemical composition for materials associated with the most significant risks—whether through the level of usage or the amount of human exposure. We have collected detailed chemical information on more than 82 percent, on average, of product mass for iPhone, iPad, and Mac products we released in fiscal year 2019, which equates to tens of thousands of parts and assemblies.

For some products, like the 21.5-inch iMac with Retina 4K display, we've collected detailed chemical information for over 94 percent of the product, by mass. For those materials that come under prolonged skin contact and require qualification from our biocompatibility team, we have collected 100 percent of the chemical information. There is still much to be done. Our work will be complete when we understand the chemical composition of every material used in our products—and even then, we will be continuing to update the mapping for newly introduced products and even changes that occur in the manufacturing process.

Mapping process chemicals at supplier facilities

We care about the health and safety of the people who make our products. Requiring a safe and healthy work environment is core to our Code and Standards, and fundamental to protecting the people in our supply chain. As part of our broad engagement with suppliers, we established the Chemicals Management Program in 2015 to closely examine the chemicals used in our manufacturing processes at final assembly facilities. In 2017, we created an inventory of these substances.

Since then, we have worked closely with our suppliers not only to catalog each chemical used in our final assembly facilities but also to assess safety measures in place, from training to personal protective equipment to ventilation. This process has yielded clear results. We've taken steps to develop safer materials—while working on controls and protocols to minimize harmful exposure.

We've started requiring suppliers to disclose chemical safety information to Apple. This industry-leading initiative enables us to more deeply understand the scope and volume of chemicals used in our supply chain, including process chemicals.

We also developed a standardized process through which suppliers share information about the specific chemicals they use, what the chemicals are used for, and the measures taken to protect their employees. We use this information to better understand potential risks to workers. The rollout of this tool expanded in 2019 to include 80 participating facilities.

Learning with our suppliers

Our engagement with suppliers goes even deeper. We regularly conduct in-person, in-region training in native languages to educate suppliers on our RSS, Full Material Disclosure program, and Chemicals Management Program, as well as inform suppliers about evolving regulations. To date, we've conducted training sessions in China, Korea, and Japan, and have reached more than a thousand suppliers across our supply chain—from final assembly to raw material vendors. These engagements enable us to build trust, have an open dialogue, and answer nuanced questions that help us collectively reach our goals.

We've enrolled all our Supplier Final Assembly sites in our Safer Cleaners program, representing over 900,000 metric tons of cleaners used each year by over 87,000 workers.

Assessment

We want to ensure that our products are safe. To accomplish this, we test and evaluate the chemicals in our products to understand the concentrations of chemicals and evaluate compliance with the RSS. Toxicologists review the test results to evaluate safety. Finally, we take the added step of having toxicologists review the chemical formulation of each material that may come in prolonged contact with the skin. Only materials that pass these reviews are acceptable for use in Apple products.

By setting conservative restrictions, testing for chemicals of concern, and conducting toxicology evaluations, Apple prioritizes the safety of our customers and those who make our products.

Our very own list of restricted chemicals

The introduction of the RSS in 2002 established our own restrictions on harmful chemicals in our products and manufacturing processes. We derive these restrictions from leading standards, recommendations from toxicologists and dermatologists, international laws and directives, and Apple policies. And we pay special attention to materials that will be in prolonged skin contact.

Apple created a new Restricted Chemicals for Wearables (RCW) specification in 2015, restricting potentially harmful substances in wearable devices, as consumer exposure is greatest in this category of products, and regulatory limits in general are not available or may not be sufficiently protective for materials in prolonged skin contact.

The RCW has additional restrictions on potentially harmful substances, with a key focus on skin irritants and sensitizers. Skin irritants and sensitizers were in focus because customer skin reactions are the most commonly reported health issue for wearable products, such as jewelry. These additional requirements are specific to materials that come into prolonged skin contact, including natural and synthetic fibers and polymers, coatings, ink, leather, plastics, adhesives, metals, and ceramics.

Our chemical restrictions are distributed to material suppliers and we have contractual requirements in place to obligate compliance. Nevertheless, compliance is not assumed. All materials that will be in prolonged skin contact undergo material characterization testing to evaluate compliance with the RCW.

We publish Apple's restrictions on harmful chemicals in the Apple Regulated Substances Specification (PDF) and in Apple's Restricted Chemicals for Wearables (PDF) paper.

Assessing the effects of chemicals on human and environmental health

More than a decade ago, Apple set up the Environmental Testing Lab—and with it, a team of chemists tasked with testing our products, identifying potentially harmful chemicals, and monitoring compliance with the RSS. The lab has continually expanded since its 2006 opening to accommodate the advanced equipment required for chemical analysis—it is now 30 times its original footprint. We continue to expand the technological capabilities of this lab, recently adding a new high-resolution mass spectrometer and more sophisticated preparation equipment.

With the information collected from the Environmental Testing Lab and the Full Material Disclosure and chemical mapping programs, we can then generate comprehensive assessments. This includes GreenScreen®, which considers 18 criteria to help us understand the chemicals' effects on health and on the environment. We also have in-house, board-certified toxicologists who use lab testing and computer modeling to create toxicological profiles that previously didn't exist. Only materials that pass our rigorous review process are accepted for our products.

We're also focused on protecting the people who make our products. The RSS establishes a safety standard on chemical usage that our suppliers are required to uphold. We also require that our suppliers provide us with chemical test reports to prove that the chemicals their facilities use comply with the RSS. In 2019, we assessed over 1200 new materials through a combination of tests, formulation reviews, and quantitative and qualitative exposure assessments to proactively eliminate risks to people and the environment.

The Nitrogen bath is used to break down components—like the Apple Watch Sport Band—to test them for compliance with Apple Regulated Substances Specification.

Innovation

The identification and assessment of the chemical compositions of materials help inform how we take action to keep harmful chemicals out of our products.

In some cases, this means integrating toxicology into the design process so that we can prevent harmful chemicals from entering the product in the first place. In other cases, we find a safer substitute to potentially harmful chemicals. We're also expanding our engagement with suppliers to improve how chemicals are managed. And we monitor customer feedback and make adjustments as necessary. This work is never done. Rather, we are constantly improving on the information we collect to keep safe those who make, use, and recycle our products.

Integrating toxicology into product design

A great deal of care and research goes into choosing materials for Apple products to ensure manufacturing workers, customers, and recyclers can use and handle Apple products safely. And the best way to keep harmful chemicals out of our products is not to use them in the first place. So we consider the toxicological profile of materials as part of Apple's material selection process during new product development.

Materials characterization testing is an essential step in the process to evaluate compliance to the RSS and to uncover any potentially harmful substances that are present but not expressly listed in the specification. Toxicologists use the testing results to conduct risk assessments for material selection.

While this evaluation is costly, labor-intensive, and requires resources not usually found in the electronics industry, it is the most essential step to objectively and comprehensively evaluate safety. Characterizing materials without knowing the full composition requires a battery of testing for substances of concern combined with supplier statements. Higher-quality assessments can be completed if the full chemical composition is known in advance. This is why we work with raw material manufacturers to collect the proprietary chemical composition of their materials.

> "Apple is playing a leading role in driving the development of safer chemicals and less toxic electronics through global supply chains."
>
> **Mike Schade**
> Mind the Store Campaign Director for Safer Chemicals, Healthy Families

Innovating alternatives to harmful substances

We're not only evaluating the chemicals that go into our products and those used to manufacture them, but also developing alternatives that help reduce and remove substances we've determined to be potentially harmful. Sometimes this requires innovation. If a safer alternative doesn't exist, we work with our suppliers to create one. Developing chemistries that meet both our rigorous performance and safety standards takes time and effort.

We spent four years on research and development to create an alternative to PVC and phthalates, which are used in the manufacture of power cords and headphone cables. Apple worked with multiple material suppliers and tested dozens of different formulations until the right combination of performance and safety was achieved with lower toxicological and ecological risk than PVC. Apple then worked with dozens of safety agencies around the world to create new pathways to certify the alternative materials. This innovation, and others we're currently working toward, exemplify Apple's commitment.

We've been actively working on safer products since the late 1990s. Our efforts have steadily identified and removed harmful chemicals: PVC and phthalates used in power cords and data cables, lead used in display glass and solder, mercury in displays and arsenic in glass, and brominated flame retardants.[20] We've done so by developing alternatives from energy-efficient and mercury-free LEDs and OLEDs, to safer metal hydroxides and phosphorus compounds on enclosures, cables, circuit boards, and connectors. Or, as we did with beryllium-copper connectors and springs, we designed them out of our products.

Inventing ways to replace bad substances with good ones

PVC and phthalates

Replaced with safer thermoplastic elastomers.[21] Both are still used by other companies in power cords and headphone cables.

Brominated flame retardants (BFRs)

Eliminated from thousands of parts such as enclosures, cables, circuit boards, and connectors in 2008. We use safer metal hydroxides and phosphorus compounds in their place.[22]

Mercury

Eliminated in 2009. We use energy-efficient, mercury-free LEDs and OLEDs instead of mercury-based fluorescent lamps in all our displays.

Lead

Phased out of display glass and solder in 2006.[23]

Arsenic

Eliminated from display glass since 2008. Arsenic was traditionally used in glass.[24]

Beryllium

Eliminated from all new product designs. Beryllium is found in copper alloys used to make connectors and springs.

Keeping circular supply chains free of harmful chemicals

As Apple and other manufacturers transition to circular material supply chains, the role of green chemistry has taken on new importance. It's becoming even more essential to make sure that materials returning to the supply chain do so free of harmful substances. A circular material supply chain means that materials from products are recovered and reused, minimizing the strain on natural resources. There is a tremendous risk of introducing harmful chemicals into this loop. And in some cases, materials cannot be recycled because of their history of containing harmful chemicals.

When we source recycled materials from our own products, we know the chemical composition of the materials used. And we have the assurance that the materials are safe for use in our products. In instances where we source content from the recycled materials market, the chemical composition is not only unknown but also difficult to trace. So we take the extra step to analyze the chemical composition of these materials to evaluate whether they comply with Apple's RSS. Through our work, we want to ensure that materials can be recycled at end-of-life, without posing a threat to the health of people or the environment.

Managing chemicals at supplier facilities

Putting people first when it comes to chemicals management requires strict adherence to safety processes and the transparent sharing of information with supplier employees about the chemicals they are using. In the RSS, we provide clear instructions to suppliers on banned substances. But rather than stop at simply banning chemicals, we are working to provide guidance on how to select safer alternatives from the start.

The first focus of our safer alternatives effort has been cleaners and degreasers, which are the most used final assembly process chemicals in our supply chain by volume. Since 2017, utilizing rigorous methodologies such as GreenScreen, SciveraLENS Screened Chemistry, and EPA Safer Choice, we have been developing a list of safer cleaners and degreasers for use at final assembly sites.

Since the inception of this effort, all supplier final assembly sites have utilized only these safer alternatives.

In 2019, we began scaling the adoption of safer cleaners and degreasers beyond Apple's supply chain. We started by tackling the lack of a comprehensive industry-wide standard for defining safer cleaners. We worked with Clean Production Action, an independent, third-party organization, to create criteria that can be used across the electronics industry to assess safer cleaners. This enables chemical manufacturers and suppliers to have the cleaners and degreasers they use assessed at hundreds of testing laboratories around the world using a common framework. Our safer cleaners criteria were also reviewed and approved by the Apple Green Chemistry Advisory Board, a group of the world's leading toxicologists, researchers, and academics focused on integrating green chemistry into Apple's products and supply chain.

Later in 2020, these criteria will be shared openly with others to encourage the adoption of safer alternatives and industry standards that can be adopted globally across sectors.

Gathering stakeholders around green chemistry

We seek out insights and ideas from those who share our commitment to removing toxins.

So we formed our own Green Chemistry Advisory Board, made up of some of the world's leading toxicologists, researchers, and academics. We regularly convene this advisory board to discuss the latest developments in the field of green chemistry, and obtain input on our strategy.

The advisory board has helped us identify innovative ways to minimize or eliminate toxins from our supply chain.

We also want to engage with the industry more broadly to help drive transparency of chemicals used in manufacturing. Apple serves on the board of the Clean Electronics Production Network (CEPN), which Apple helped found. It is a multi-stakeholder Innovation Network to address complex workplace health and safety challenges in the electronics supply chain. The network is facilitated by the Center for Sustainability Solutions at Green America, a leading environmental advocacy organization whose members include civil society organizations and government agencies.

> "Apple has been a leader in meeting society's demand for better stewardship of chemicals over the life cycle of their products. For the past five years, the Green Chemistry Advisory Board has worked with Apple's own experts to help push the company to avoid the use of inherently toxic substances and to recover materials for next-generation products."

Dr. Lauren Heine and Professor Dele Ogunseitan
Apple Green Chemistry Advisory Board

Appendix.

Appendix A

Apple's environmental data

Greenhouse gas emissions

		Fiscal year				
		2019	2018	2017	2016	2015
Corporate facilities emissions (CO_2e)	**Scope 1**					
	Natural gas, diesel, propane[1]	38,720	39,990	34,560	27,000	19,360
	Fleet vehicles	6,950	11,110	8,300	7,370	8,740
	Process emissions[2]	4,870	3,490	2,540	-	-
	Scope 2 (market-based)[3]					
	Electricity	0	8,730	36,250	41,000	42,460
	Scope 3[4]					
	Business travel[5]	325,500	337,340	121,000	117,550	139,940
	Employee commute[6]	194,660	183,160	172,440	186,360	172,970
Product life cycle emissions (CO_2e)[7]	Manufacturing (purchased goods and services)	18,900,000	18,500,000	21,100,000	22,800,000	29,600,000
	Product transportation (upstream and downstream)	1,400,000	1,300,000	1,200,000	1,200,000	1,300,000
	Product use (use of sold products)	4,100,000	4,700,000	4,700,000	4,900,000	6,600,000
	End-of-life treatment	60,000	50,000	100,000	300,000	500,000
Total comprehensive carbon footprint[8]		**25,100,000**	**25,200,000**	**27,500,000**	**29,500,000**	**38,400,000**

[1] Starting in fiscal year 2016, scope 1 emissions capture diesel use in emergency back-up generators and propane gas use in corporate offices.
[2] Emissions from R&D processes. Data reported beginning in 2017.
[3] The building operations and cooling emissions (PUE) associated with our colocated data facilities are beyond our operational control and therefore these emissions are not included in our report.
[4] In fiscal year 2017, we started calculating scope 3 emissions not listed above. In fiscal year 2019, these include electricity transmission and distribution losses (54,000 metric tons CO_2e) and life cycle emissions associated with renewable energy (77,000 metric tons CO_2e).
[5] We are constantly revisiting our methodology to hold ourselves to high accountability standards. So in fiscal year 2018, we changed how we calculate emissions from business travel in order to better account for classes of service in air travel. As a result of this change, our scope 3 transportation emissions increased by 77 percent between 2017 and 2018. Without the methodology change, these emissions would have increased by 14 percent, which reflects the growth in our business.
[6] We adjusted our methodology for fiscal year 2017 to take into account Apple's "At Home Advisors" program, where employees work remotely.
[7] Because we're committed to accuracy and transparency, we're constantly refining our product life cycle assessment model and sources of data. For example, we recently obtained more accurate data for the amount of electricity used to manufacture a number of components like onboard electronics, bare boards and flexes, and various module assemblies. The net result was an increase in our 2019 carbon footprint. When using the same data and model as 2018, we find our carbon emissions in 2019 would have been about 23 million metric tons, or a decrease of 7 percent.
[8] Due to rounding, our total comprehensive carbon footprint is not always the sum of the subtotals disclosed above.

Notes: For data on previous years, please reference past Environmental Responsibility Reports, available at apple.com/environment. Dash indicates data that are not available.

Apple's life cycle assessment methodology

Apple uses five steps when conducting a product life cycle assessment:

1. To model the manufacturing phase, we use part-by-part measurements of the entire product along with data on part production. The measurements help us accurately determine the size and weight of the components and materials in the product, while data on manufacturing processes and yield loss during production allows us to account for the impact of manufacturing. The LCA includes accessories, packaging, and units that are repaired and replaced through AppleCare.
2. To model customer use, we measure the power consumed by a product while it is running in a simulated scenario. Daily usage patterns are specific to each product and are a mixture of actual and modeled customer use data. For the purposes of our assessment, years of use, which are based on first owners, are modeled to be four years for macOS and tvOS devices and three years for iOS and watchOS devices. Most Apple products last longer and are passed along, resold, or returned to Apple by the first owner for others to use. More information on our product energy use is provided in our Product Environmental Reports.
3. To model transportation, we use data collected on shipments of single products and multipack units by land, sea, and air. We account for transporting materials between manufacturing sites; transporting products from manufacturing sites to regional distribution hubs; transporting products from regional distribution hubs to individual customers; and transporting products from final customers to recycling facilities.
4. To model recycling, we use material composition data on our products and cover the treatment steps carried out by the recycler to obtain metal, plastic, and glass material streams. Subsequent processing and remelting steps are not included, as these are considered stages of production and not end-of-life processing.
5. After we collect data about production, use, transport, and recycling, we combine it with detailed greenhouse gas emission data. This emission data is based on a combination of Apple-specific and industry-average datasets for material production, manufacturing processes, electricity generation, and transportation. Renewable energy used in the supply chain, initiated by suppliers independently or through the Apple Supplier Clean Energy Program, are also accounted for. Combining product-specific data with emission data in our LCA tool allows us to compile detailed results for greenhouse gas emissions as they relate to the product. The data and modeling approaches are checked for quality and accuracy by the Fraunhofer Institute in Germany. There is inherent uncertainty in modeling carbon emissions due primarily to data limitations. For the top component contributors to Apple's carbon emissions, Apple addresses this uncertainty by developing detailed process-based environmental models with Apple-specific parameters. For the remaining elements of Apple's carbon footprint, we rely on industry-average data and assumptions.

Energy

			Fiscal year				
		Unit	**2019**	**2018**	**2017**	**2016**	**2015**
Corporate facilities energy use[1]	**Electricity**	million kWh	2,427	2,182	1,832	1,420	996
	U.S.	million kWh	2,075	1,830	1,536	1,157	831
	International	million kWh	351	351	296	262	166
	Natural gas	MWh	190,260	189,280	165,330	132,970	105,940
	Biogas	MWh	217,140	226,660	193,280	152,650	143,660
	Propane liquid	MWh	280	280	280	280	70
	Gasoline	MWh	23,950	37,740	31,310	29,200	-
	Diesel (other)	MWh	16,450	20,270	20,670	9,920	-
	Diesel (mobile combustion)	MWh	2,520	4,540	690	460	-
Energy efficiency[2]	**Corporate facilities**						
	Electricity savings	kWh/year	208,645,080	113,203,780	69,989,660	55,288,800	37,875,000
	Fuel savings	mmBTU/year	277,120	254,140	245,340	222,850	167,670
	Supplier facilities[3]						
	Electricity savings	kWh/year	943,890,280	798,932,140	473,519,660	159,113,130	38,815,530
	Fuel savings	mmBTU/year	25,120	25,120	5,620	-	-
Renewable electricity	**Corporate facilities**						
	Renewable energy use	MWh	2,430	2,170	1,770	1,350	920
	% Renewable energy[4]	percent	100%	99%	97%	96%	93%
	Scope 2 emissions avoided[5]	metric tons CO_2e	899,000	690,000	589,000	541,000	336,000
	Supplier facilities						
	Renewable energy capacity (operational)	GW	2.7	1.9	1.2	0.7	-
	Renewable energy capacity (committed)	GW	5.1	3.3	2	1.3	-
	Renewable energy use	MWh	5,700,000	4,100,000	1,900,000	200,000	-

[1] Select historical breakdowns are not available for 2015.

[2] Because energy efficiency measures have lasting benefits, energy efficiency savings are calculated cumulatively since 2012. All efficiency measures are retired based on their effective useful lifetime as documented by the California Energy Commission.

[3] Supplier energy savings are calculated on a calendar year basis.

[4] We calculate our progress toward 100 percent renewable energy on a calendar year basis. Beginning January 1, 2018, 100 percent of the electricity we use to power our global facilities is sourced from renewable energy.

[5] We have adjusted previous years' avoided emissions to remove double counting biogas emissions.

Notes: For data on previous years, please reference past Environmental Responsibility Reports, available at apple.com/environment. Dash indicates data that are not available.

Resources

			Fiscal year				
		Unit	2019	2018	2017	2016	2015
Water	**Corporate facilities**						
	Total[1]	million gallons	1,318	1,258	1,000	630	573
	Freshwater[2]	million gallons	1,151	1,055	896	-	-
	Recycled water	million gallons	106	63	24	-	-
	Water for temporary uses[3]	million gallons	60	140	80	-	
	Supply chain						
	Freshwater saved	million gallons	9,300	7,600	5,100	3,800	-
Waste	**Corporate facilities[4]**						
	Landfill diversion rate	percent	66%	67%	71%	64%	62%
	Landfilled (municipal solid waste)	pounds	38,317,120	32,372,890	31,595,200	21,618,850	13,110,880
	Recycled	pounds	72,338,130	66,380,630	68,509,300	28,198,560	19,599,570
	Composted	pounds	10,882,120	10,397,430	14,567,500	13,737,320	3,006,170
	Hazardous waste	pounds	6,096,590	6,277,790	3,342,700	2,287,320	1,002,300
	Waste to energy[5]	pounds	1,129,080	1,105,140	645,000	-	-
	Supply chain						
	Waste diverted from landfill[6]	pounds	322,000	375,000	351,000	200,000	74,000
Product packaging footprint	**Total packaging**	metric tons	189,000	187,000	169,000	165,000	171,500
	Recycled fiber	percent	59%	58%	56%	49%	48%
	Responsibly sourced virgin fiber[7]	percent	33%	32%	30%	30%	31%
	Plastic	percent	8%	10%	14%	21%	21%

[1] Beginning in fiscal year 2017, our boundary expanded to include more than 150 million gallons of water used annually at distribution centers and colocated data centers.

[2] Freshwater includes rainwater capture and use.

[3] We began separating out temporary water use in 2017 to capture water use for activities like dust control for new construction and the establishment of mature, drought-tolerant trees in landscaping.

[4] Beginning in fiscal year 2017, we're including waste from Apple's distribution centers. Total does not include construction and demolition waste nor electronic waste. We're refining our methodology for collecting this data and plan to include it in future years. We have also re-stated the total for 2018 without these categories of waste.

[5] Beginning in fiscal year 2017, waste processed in "Waste to energy" facilities is reported separately.

[6] Calculated on a calendar year basis.

[7] Since 2017, all of the virgin wood fiber used in our packaging has come from responsible sources. Responsible sourcing of wood fiber is defined in Apple's Sustainable Fiber Specification. We consider wood fibers to include bamboo.

Notes: For data on previous years, please reference past Environmental Responsibility Reports, available at apple.com/environment. Dash indicates data that are not available.

Normalizing factors*

	Fiscal year				
	2019	2018	2017	2016	2015
Revenue (in millions)	$260,174	$265,595	$229,234	$215,639	$233,715
Number of employees	137,000	132,000	123,000	116,000	110,000

* As reported in Apple's Form 10-K Annual Report filed with the SEC.

Appendix B

Facilities renewable energy supplement

Use of renewable energy at our facilities has been a central component of our emissions reduction strategy since 2011. We've learned a lot about how best to secure renewable energy, which has helped us educate suppliers and expand our renewable energy efforts into our supply chain. This appendix summarizes the types of renewable energy solutions we've deployed, and details how we implement renewable energy at our data centers—our largest energy loads.

How we procure renewable energy

Since launching our renewable energy program in 2011, we have implemented a number of solutions to procure renewable energy. Our strategy has evolved over time to create the most positive impact.

Ownership and PURPA:
In 2011, Apple's 100 percent equity ownership of our Maiden solar arrays was the first time a non-energy commercial company built its own utility-scale solar PV project. We used a 1978 federal law called the Public Utility Regulatory Policies Act (PURPA) to structure the project. We then applied this same structure to two more large solar PV and biogas fuel cell projects in North Carolina and two micro-hydro projects in Oregon. This was a landmark moment in corporate renewable energy development and led to an increased use of PURPA in these states.

Direct Access:
Since 2012, in California and Oregon, we've used a program called Direct Access to bypass the default electricity generation offered by the utilities servicing our data centers in those states. Instead, we contracted directly with independent power producers who could supply 100 percent renewable electricity. After initially buying from existing, third-party owned projects, we're now procuring renewable energy from projects we created: The Solar Star II and Montague Wind projects deliver renewables to our Oregon data center, and the California Flats solar project to our data center, offices, and retail stores in California.

Green Rider:
In 2013, we opened a new data center in Reno, Nevada. With no PURPA or Direct Access options in Nevada, we worked directly with the local utility, NV Energy, to create a whole new regulatory structure. The "Nevada Green Rider" enables us to secure a long-term, fixed-price contract for renewable electricity from a new solar PV project built for us, but managed by the utility. We've used this partnership to create four solar projects totaling 320 megawatts.

Equity investment:
In 2014, we invested in two 20-megawatt solar PV projects in Sichuan, China, to support all of our in-country retail stores, corporate offices, and data storage facilities. This project represented the first time a commercial company created a new large-scale project in China for its own use. We've since replicated this model many times for Apple's supply chain.

Portfolio solutions:
In 2015 and 2016, we adapted to land scarcity constraints in Singapore and Japan by contracting for solar PV on 800 rooftops in Singapore and 300 in Japan. We adapted our approach in each country to fit local partnerships and regulatory structures: We signed a long-term agreement similar to a power purchase agreement in Singapore and made an equity investment in Japan. These projects offer us long-term flexibility as our load grows.

Renewable microgrid:
Since 2017, we've been powering Apple Park with 100 percent renewable energy—about 75 percent of which is generated onsite and managed by a microgrid. The onsite generation comes from 14 megawatts of rooftop solar PV and 4 megawatts of baseload biogas fuel cells. Any additional energy required is drawn by Direct Access from the California Flats solar project in nearby Monterey County. The microgrid system with battery storage manages the renewable energy generation and the building's energy use; optimizes demand management, load shifting, and frequency regulation services; and ensures uninterrupted energy reliability against local grid outages.

Facilities renewable energy projects

To reach 100 percent renewable electricity for Apple's own facilities, Apple has helped to create 1230 MW of renewable energy around the world, with another 349 MW in development (contracted)—for a total of 1579 megawatts. The projects listed to the right represent Apple-created renewable energy projects supporting Apple facilities' electricity use and contributing to cleaner grids around the world. Operational projects apply a mix of clean energy technology including wind (25.5 percent), solar (73.1 percent), micro-hydro (0.3 percent), and biogas fuel cells (1.1 percent).

This table represents all operational renewable energy projects that Apple has helped create.

Location	Renewable energy technology	Size (MW)
Australia	PV	0.5
Brazil	Wind	0.5
China	PV	40
Denmark	PV	42
France	PV	<0.1
India	PV	2
Israel	PV	5
Japan	PV	12
Mexico	Wind	0.8
Singapore	PV	34
Taiwan	PV	1
Turkey	PV	4
USA (AZ)	PV	54
USA (CA)	Fuel Cell	4
USA (CA)	PV	146
USA (IL)	Wind	112
USA (NC)	Fuel Cell	10
USA (NC)	PV	163
USA (NV)	PV	270
USA (OR)	Micro-hydro	3
USA (OR)	PV	125
USA (OR)	Wind	200
USA (TX)	PV	1
	Total	**1,230**

Note: Data current as of March 2020.

Fiscal year 2019 energy and carbon footprint (corporate facilities)

The chart below provides a detailed breakdown of fiscal year 2019 energy use, which we used to calculate our greenhouse gas emissions.

Location	Scope 1			Scope 2		
	Total gas (mmBTU)	**Renewable biogas** (mmBTU)	**Scope 1 emissions** (metric tons (CO_2e)	**Electricity** (million kWh)	**Renewable electricity** (million kWh)	**Scope 2 emissions** (metric tons (CO_2e)
Corporate	**797,483**	**244,969**	**29,367**	**658**	**658**	**0**
Cupertino, CA	699,878	244,969	24,176	314	314	0
Elk Grove, CA	12,098	-	643	16	16	0
Austin, TX	7,404	-	393	57	57	0
Other USA	29,251	-	1,558	94	94	0
Cork, Ireland	14,673	-	779	16	16	0
Singapore	611	-	32	18	18	0
China	3,538	-	188	32	32	0
Other international	30,030	-	1,598	111	111	0
Data centers	**496,939**	**495,946**	**80**	**1,565**	**1,565**	**0**
Maiden, NC	495,946	495,946	27	321	321	0
Mesa, AZ	446	-	24	163	163	0
Newark, CA	-	-	-	108	108	0
Prineville, OR	547	-	29	254	254	0
Reno, NV	-	-	-	374	374	0
Viborg, Denmark	-	-	-	6	6	0
Colocation facilities (USA)*	N/A	N/A	N/A	275	275	0
Colocation facilities (International)*	N/A	N/A	N/A	64	64	0
Retail stores	**87,918**	**0**	**4,670**	**203**	**203**	**0**
Domestic (USA)	55,342	-	2,939	99	99	0
International	32,576	-	1,731	104	104	0
Total	**1,382,340**	**740,915**	**34,117**	**2,426**	**2,426**	**0**

'-' data are not tracked.

N/A = Gas use at colocation facilities are considered outside of Apple's operational control.

* We've updated our fiscal year 2016 colocation facilities footprint to reflect more accurately Apple's operational boundaries. Per the WRI Greenhouse Gas Protocol, we've removed electricity use associated with colocation facility cooling and building operations. This energy use, however, is still covered by renewable energy.

A focus on data centers

We used over 1.5 billion kWh of electricity in fiscal year 2019 to power our data centers and colocation facilities around the world, representing over 60 percent of our scope 1 and 2 emissions. We're proud that 100 percent of that electricity came from clean, renewable sources including solar, wind, biogas fuel cells, and low-impact hydro power. To cover our needs, we build our own renewable power projects and work with utilities to purchase clean energy from locally obtained resources.

We're staying at 100 percent even as Apple's data center presence continues to grow.

We now operate five data centers, and several more are being developed. These data centers are spread across North America, Europe, and Asia. Each has unique design features that conserve energy and reflect the climate, as well as other aspects, of its location.

Solar + Biogas Fuel Cells

Maiden, North Carolina

100 percent renewable since opening June 2010

Between 2011 and 2015, we installed 68 megawatts of Apple-created projects: two 20-megawatt solar projects, an 18-megawatt solar project, and 10 megawatts of biogas fuel cells. We then partnered with the local utility, Duke Energy, to help build five solar projects through its Green Source Rider program. These solar projects came online beginning in 2015 and were Duke Energy's first Green Source Rider projects to become operational. We worked with Duke Energy for several years to develop this green energy tariff option, which allowed Apple and Duke Energy to work together to develop new renewable energy projects. The five Green Source Rider projects have a combined capacity of 20 megawatts. In 2017, we made long-term commitments to five more solar projects in North Carolina, for an additional 86 megawatts of clean energy. In fiscal year 2019, the Maiden data center was supported by projects that generated 321 million kWh of renewable energy, which is equivalent to the energy used by nearly 24,000 homes in North Carolina for a year.*

Energy efficiency measures we've implemented at our Maiden data centers include use of outside air cooling through a waterside economizer during night and cool-weather hours, which, along with water storage, allows the chillers to be idle 75 percent of the time.

Maiden, North Carolina: Grid mix vs. Apple-sourced renewable energy

Electricity use in fiscal year 2019: 321 million kWh

Default grid mix (Duke Energy)		Apple actual renewable energy use	
Natural gas/fuel oil	34%	Apple's solar projects	64%
Coal	31%	Apple's biogas fuel cells	18%
Nuclear	33%	Duke Green Source Rider (100 percent solar)	12%
Renewable	2%	NC GreenPower (100 percent solar)	6%
2019 default emissions (metric tons CO_2e/year)	**138,129**	**2019 effective emissions** (metric tons CO_2e/year)	**0**
www.sustainabilityreport.duke-energy.com/introduction/duke-energy-at-a-glance		Actual fiscal year 2019 energy data	

* Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2018 data: www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Wind + Solar + Low-Impact Hydro

Prineville, Oregon

100 percent renewable since opening May 2012

To support our Prineville data center, we signed a 200-megawatt power purchase agreement for a new Oregon wind farm, the Montague Wind Power Facility, which entered commercial operation at the end of 2019. It's our largest project to date, producing over 560 million kWh of clean, renewable energy a year.

This is in addition to our power purchase agreement for the 56-megawatt Solar Star Oregon II project located just a few miles from our data center. This solar PV project, which came online and began supporting the data center in 2017, produces 140 million kWh of renewable energy per year. To strengthen the connection between Apple and these projects, we use Oregon's Direct Access program to supply the renewable energy from these projects directly to our data center.

Also supporting the data center are two micro-hydro projects that harness the power of water flowing through local irrigation canals that have been operating for over 60 years. These micro-hydro projects generate about 7 to 10 million kWh of renewable energy a year. To supplement these projects, we executed a long-term purchase agreement for all environmental attributes from a 50-megawatt portfolio of six solar projects in Oregon.

In fiscal year 2019, the Prineville data center was supported by projects that generated 254 million kWh of renewable energy, which is equivalent to the energy used by over 23,000 homes in Oregon for a year.*

Our Prineville data center takes advantage of the cool and dry climate by cooling its servers with outside air whenever possible. Indirect evaporative cooling is enabled when the outside air temperature gets too high to cool the servers with outside air alone.

Prineville, Oregon: Grid mix vs. Apple-sourced renewable energy

Electricity use in fiscal year 2019: 254 million kWh

Default grid mix (Pacific Power)		**Apple actual renewable energy use**	
Coal	59%	Apple's micro-hydro projects	1%
Natural gas	11%	Oregon solar (via Direct Access)	53%
Unspecified	10%	Apple's solar projects	46%
Renewable	20%		
2019 default emissions (metric tons CO_2e/year)	**178,755**	**2019 effective emissions** (metric tons CO_2e/year)	**0**
www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/rates-regulation/oregon/tariffs/OR_LabelingInsert_LrgBiz.pdf		Actual fiscal year 2019 energy data	

* Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2018 data: www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Solar

Reno, Nevada

100 percent renewable since opening December 2012

Unlike competitive energy markets where we've located some of our data centers, the regulated electricity supply in Nevada did not offer a simple solution for us to create new renewable energy projects dedicated to our data center. So, in 2013, we created a partnership with the local utility, NV Energy, to develop the Fort Churchill Solar project. Apple designed, financed, and constructed the project, and NV Energy operates it and directs all the renewable energy it produces to our data center. The Fort Churchill Solar project uses a photovoltaic panel with curved mirrors that concentrate sunlight. The 20-megawatt array has an annual production capacity of over 43 million kWh.

To facilitate further renewable development in Nevada, Apple worked with NV Energy and the Nevada utility commission to create a green energy option open to all commercial customers, called the Nevada Green Rider, that does not require the customer to fund project development up-front. Thanks to this new option, in 2015 we announced our second Nevada solar project, the 50-megawatt Boulder Solar II project. This project came online in 2017, producing about 137 million kWh of renewable energy per year. We have used the Nevada Green Rider two more times, first for the 200-megawatt Techren Solar II project. Apple's largest solar project to date, it is estimated to produce over 540 million kWh per year and came online in late 2019.

Next was the 50-megawatt Turquoise Nevada project, estimated to produce 110 million kWh per year and come online in 2020.

In fiscal year 2019, the Reno data center was supported by projects that generated 374 million kWh of renewable energy, which is equivalent to the energy used by nearly 33,000 homes in Nevada for a year.*

Like in Prineville, our Reno data center takes advantage of the mild climate by cooling its servers with outside air whenever possible. When the outside air is too warm to cool the servers alone, it draws from indirect evaporative cooling.

Reno, Nevada: Grid mix vs. Apple-sourced renewable energy

Electricity use in fiscal year 2019: 374 million kWh

Default grid mix (NV Energy—North)		**Apple actual renewable energy use**	
Natural gas	58%	Apple's solar projects (via the Nevada Green Rider program)	81%
Coal	16%	Apple's solar projects	19%
Large hydro	8%		
Other	2%		
Renewable	16%		
2019 default emissions (metric tons CO_2e/year)	**112,440**	**2019 effective emissions** (metric tons CO_2e/year)	**0**
www.nvenergy.com/publish/content/dam/ nvenergy/bill_inserts/2019/01_jan/power-content-insert-south-2019-01_03_31.pdf		Actual fiscal year 2019 energy data	

* Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2018 data: www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Solar

Newark, California

100 percent renewable since January 2013

Our data center in Newark, California, is powered by 100 percent renewable energy. We hit this milestone in January 2013, when we began serving the data center with energy sourced primarily from California wind power.

We acquired this energy directly from the wholesale market through California's Direct Access program.

In 2017, Apple's 130-megawatt California Flats solar project in nearby Monterey County came online, and now we use Direct Access to supply power from that project directly to our data center as well as other Apple facilities in California.

In fiscal year 2019, the Newark data center was supported by projects that generated 108 million kWh of renewable energy, which is equivalent to the energy used by nearly 17,000 homes in California for a year.*

Newark California: Grid mix vs. Apple-sourced renewable energy
Electricity use in fiscal year 2019: 108 million kWh

Default grid mix (Pacific Gas & Electric)		**Apple actual renewable energy use**	
Natural gas	15%	Bundled solar (via Direct Access)	97%
Nuclear	34%	Apple's solar project	3%
Large hydro	13%		
Renewable	39%		
2019 default emissions (metric tons CO_2e/year)	**10,314**	**2019 effective emissions** (metric tons CO_2e/year)	**0**
www.pge.com/pge_global/common/pdfs/your-account/your-bill/understand-your-bill/bill-inserts/2019/1019-Power-Content-Label.pdf		Actual fiscal year 2019 energy data	

Note: The figures above may not sum to 100 percent due to rounding.

* Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2018 data: www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Solar

Mesa, Arizona

100 percent renewable since opening March 2017*

Our global command data center in Mesa, Arizona, came online in 2016. To support this facility, we partnered with the local utility, the Salt River Project (SRP), to build the 50-megawatt Bonnybrooke solar project, which became operational in December 2016. This project produces over 147 million kWh of clean, renewable energy a year, which roughly matches the energy used by the data center.

As the Mesa Data Center grew, it became apparent that we needed additional sources of renewable energy to maintain our 100 percent renewable electricity goal.

We began to explore onsite solar options at the data center and determined that we could provide valuable shaded parking that paid for itself through energy bill reductions while adding to our renewable energy portfolio. The resulting PV facility includes five elevated parking canopies and three ground mounted arrays, for a total generating capacity of 4.67 MW. The onsite PV system began commercial operation in February 2019 and is expected to generate 9000 MWh per year.

In addition, we began working with SRP to develop a customer renewable energy program in 2017, resulting in their Sustainable Energy Initiative, launched in 2019, to provide a diverse mix of commercial electric customers with new renewable energy at an affordable price. Under this program, Apple has executed an agreement with SRP to purchase a portion of the output of their proposed 100 MW Central Line PV Facility, expected to begin operations in 2021.

In fiscal year 2019, the Mesa data center was supported by 163 million kWh of renewable energy, which is equivalent to the energy used by over 13,000 Arizona homes.**

Mesa, Arizona: Grid mix vs. Apple-sourced renewable energy

Electricity use in fiscal year 2019: 163 million kWh

Default grid mix (Salt River Project)		**Apple actual renewable energy use**	
Coal	53%	Apple's solar project	100%
Nuclear	17%		
Natural gas/other	10%		
Sustainable	17%		
Other	3%		
2019 default emissions (metric tons CO_2e/year)	**77,139**	**2019 effective emissions** (metric tons CO_2e/year)	**0**
www.srpnet.com/about/stations/pdfx/2018irp.pdf		Actual fiscal year 2019 energy data	

* Apple took operational control of the building in October 2015 and converted it to a data center that began servicing customers in March 2017: www.srpnet.com/about/stations/pdfx/2018irp.pdf.

** Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2018 data: www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Denmark

We're currently completing construction of a new data center in Viborg, Denmark. It will run on 100 percent renewable energy from its first day of operations. The data center's construction phase was powered with 100 percent wind energy from a local renewable energy retailer in Denmark. We have long-term supply contracts with Danish renewable projects that will scale up as our data center loads grow. Our Northern Jutland PV project achieved commercial operation in late 2019, will meet all of the data center's near-term energy needs, and at 42 megawatts, is one of Denmark's largest solar power plants.

The power system design at the data center is based on a resilient substation that eliminates the need for backup diesel generators. This reduces the carbon footprint of the data center and completely eliminates the need for large diesel fuel storage systems and diesel engine emissions that would impact the local community.

China

We have two new data centers in development in China, one in Guizhou Province, the other in Inner Mongolia. Both will be supplied with 100 percent renewable energy.

Air quality

Data centers often rely on diesel-powered emergency generators to provide a backup source of power in case of electrical outages. Emergency generators must be exercised periodically to ensure their operational reliability. These preventative maintenance activities as well as emergency operations during power outages consume significant quantities of diesel fuel and result in air pollutant emissions. As a source of air pollutant emissions, the emergency generators at Apple's data centers are operated under air permits issued by regulatory agencies. These permits require monitoring, testing, inspection, and reporting at regular intervals. We've voluntarily installed emissions control systems on our emergency generators to reduce emissions of nitrogen oxides and particulates. And we're standardizing our approach to preventative maintenance activities to minimize annual testing hours.

To further reduce air emissions at our data centers, we're finding innovative ways to minimize the use of diesel-powered emergency generators. In Denmark, we've deployed a new substation design, in conjunction with the local utility, with the highest level of resiliency and automation. It will allow Apple to eliminate emergency generators altogether—in addition to eliminating air emissions associated with diesel fuel delivery. At our data centers in Nevada, Arizona, and Oregon, we have added a second transmission line, which increases the reliability of the power supply and, therefore, minimizes the need for emergency operation of the generators. We are in the process of deploying this system at our North Carolina data center as well.

Our colocation facilities

The majority of our online services are provided by our own data centers; however, we also use third-party colocation facilities for additional data center capacity. While we don't own these shared facilities and use only a portion of their total capacity, we include our portion of their energy use in our renewable energy goals. Starting January 2018, 100 percent of our power for colocation facilities was matched with renewable energy generated within the same state or NERC region for facilities in the United States, or within the same country or regional grid for those around the world. As our loads grow over time, we'll continue working with our colocation suppliers to match 100 percent of our energy use with renewables.

Furthermore, we worked with one of our main suppliers of colocation services to help it develop the capability to provide renewable energy solutions to its customers. This partnership advances Apple's renewable energy program and those of other companies that use this colocation provider.

Energy use and emissions at Apple's colocation facilities

	Total energy use (kWh)	**Renewable energy** (kWh)	**Default utility emissions**[1] (metric tons CO_2e)	**Apple's emissions—including renewable energy**[2] (metric tons CO_2e)	**Percent renewable energy**[3]
FY2011	42,500	0	10	10	**0%**
FY2012	38,552,300	1,471,680	17,200	16,500	**4%**
FY2013	79,462,900	46,966,900	31,800	14,500	**59%**
FY2014	108,659,700	88,553,400	44,300	11,000	**81%**
FY2015	142,615,000	121,086,100	60,500	12,700	**85%**
FY2016[4]	145,520,900	143,083,200	66,300	1,600	**98%**
FY2017	289,195,800	286,378,100	125,600	1,500	**99%**
FY2018	327,663,800	326,959,700	146,600	400	**99.8%**
FY2019	**339,047,649**	**339,047,649**	**146,400**	**0**	**100%**

[1] We calculate "default utility emissions" to provide baseline emissions of what our carbon footprint would have been without the use of renewable energy. This allows us to demonstrate the savings resulting from our renewable energy program.

[2] Apple's greenhouse gas emissions are calculated using the World Resources Institute Greenhouse Gas Protocol methodology for calculating market-based emissions.

[3] We calculate our progress toward our 100 percent renewable energy goal on a calendar year basis, while the numbers reported in this table are based on fiscal year. Beginning January 1, 2018, all of the electricity use at our colocation facilities is from 100 percent renewable energy.

[4] Over the past few years, we have been installing submeters in colocation facilities to better track electricity usage. Beginning in FY2016, we started reporting this submetered electricity usage. Prior to fiscal year 2016, reported electricity usage was conservatively estimated based on maximum contract capacity quantities. We've updated our fiscal year 2016 colocation facilities footprint to reflect more accurately Apple's operational boundaries. Per the WRI Greenhouse Gas Protocol, we've removed from our electricity usage and scope 2 calculations those emissions associated with colocation facility cooling and building operations.

Regional energy use at Apple's colocation facilities (2019)

	Total energy use (kWh)	**Renewable energy** (kWh)	**Percent renewable energy**
AMR	275,376,450	275,376,450	100%
EMEIA	30,777,487	30,777,487	100%
APAC	32,893,712	32,893,712	100%
FY2019 total	**339,047,649**	**339,047,649**	**100%**

Third-party computing

Beyond the use of our own data centers and colocation facilities, we also use third-party computing services to support some of our on-demand cloud storage–based services. We are requiring these suppliers to adopt a 100 percent renewable energy strategy for their Apple energy use.

In addition, we are in the process of collecting data on associated carbon emissions from suppliers, and plan to publish these results in our next Environmental Progress Report.

Appendix C

Assurance and review statements

INDEPENDENT ASSURANCE STATEMENT

To: The Stakeholders of Apple, Inc.

Introduction and objectives of work

Apex Companies, LLC (Apex) was engaged by Apple, Inc. (Apple) to conduct an independent assurance of select environmental data reported in its 2020 environmental report (the Report). This Assurance Statement applies to the related information included within the scope of work described below. The intended users of the assurance statement are the stakeholders of Apple. The overall aim of this process is to provide assurance to Apple's stakeholders on the accuracy, reliability and objectivity of select information included in the Report.

This information and its presentation in the Report are the sole responsibility of the management of Apple. Apex was not involved in the collection of the information or the drafting of the Report.

Scope of Work

Apple requested Apex to include in its independent review the following:

- Assurance of select environmental data and information included in the Report for the fiscal year 2019 reporting period (September 30, 2018 through September 28, 2019), specifically, in accordance with Apple's definitions and World Resources Institute (WRI)/World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Protocol:
  - Energy: Direct (Million Therms) and Indirect (Million kilowatt hours (mkWh))
  - Renewable Energy (mkWH)
  - Water Withdrawal (Million Gallons)
  - Greenhouse Gas (GHG) Emissions: Direct Scope 1 emissions by weight, Indirect Scope 2 emissions by weight, Indirect Scope 3 emissions by weight (Employee Commute and Business Travel) (Metric Tonnes of Carbon Dioxide equivalent)
  - Waste Quantities and Disposition (Metric Tonnes)
  - Paper Quantities (Metric Tonnes)
  - Appropriateness and robustness of underlying reporting systems and processes, used to collect, analyze, and review the environmental information reported;

Excluded from the scope of our work is any assurance of information relating to:

- Text or other written statements associated with the Report
- Activities outside the defined assurance period

Assessment Standards

Our work was conducted against Apex's standard procedures and guidelines for external Verification of Sustainability Reports, based on current best practice in independent assurance. Apex procedures are based on principles and methods described in the International Standard on Assurance Engagements (ISAE) 3000 Revised, Assurance Engagements Other than Audits or Reviews of Historical Financial Information (effective for assurance reports dated on or after Dec. 15, 2015), issued by the International Auditing and Assurance Standards Board.

Methodology

Apex undertook the following activities:

1. Site visits to Apple facilities in Elk Grove, California; Reno, Nevada; Hyderabad, India; and Bengaluru, India.
2. Visit to Apple corporate offices in Cupertino, California;
3. Interviews with relevant personnel of Apple;
4. Review of internal and external documentary evidence produced by Apple;

5. Audit of environmental performance data presented in the Report, including a detailed review of a sample of data against source data; and
6. Review of Apple information systems for collection, aggregation, analysis and internal verification and review of environmental data.

The work was planned and carried out to provide reasonable assurance for all indicators and we believe it provides an appropriate basis for our conclusions.

Our Findings

Apex verified the following indicators for Apple's Fiscal Year 2019 reporting period (September 30, 2018 through September 28, 2019):

Parameter	Quantity	Units	Boundary/ Protocol
Natural Gas Consumption:	13.8	Million Therms	Worldwide occupied properties / Apple Internal Protocol
Electricity Consumption:	2,427	Million kilowatt hours (mkWh)	Worldwide occupied properties / Apple Internal Protocol
Renewable Energy	2,427	Million kilowatt hours (mkWh)	Worldwide / Invoiced quantities & self-generated
Scope 1 GHG Emissions	50,549	metric tons of carbon dioxide equivalent (tCO_2e)	Worldwide occupied properties / WRI/WBCSD GHG Protocol
Scope 2 GHG Emissions (Location-Based)	862,127	tCO_2e	Worldwide occupied properties / WRI/WBCSD GHG Protocol
Scope 2 GHG Emissions (Market-Based)	0	tCO_2e	Worldwide occupied properties / WRI/WBCSD GHG Protocol
Scope 3 GHG Emissions – Business Travel	325,502	tCO_2e	Worldwide occupied properties / WRI/WBCSD GHG Protocol Value Chain (Scope 3)
Scope 3 GHG Emissions – Employee Commute	194,657	tCO_2e	Worldwide occupied properties / WRI/WBCSD GHG Protocol Value Chain (Scope 3)
Water Withdrawal	1,318	Million gallons	Worldwide occupied properties / Apple Internal Protocol
Trash disposed in Landfill	17,380	Metric tonnes	Worldwide occupied properties / Apple Internal Protocol
Hazardous Waste (Regulated waste)	2,765	Metric tonnes	Worldwide occupied properties / Apple Internal Protocol
Recycled Material (Removal by recycling contractor)	32,812	Metric tonnes	Worldwide occupied properties / Apple Internal Protocol
Composted Material	4,936	Metric tonnes	Worldwide occupied properties / Apple Internal Protocol
Waste to Energy	512	Metric tonnes	Worldwide occupied properties / Apple Internal Protocol
Paper	1,434	Metric tonnes	Worldwide occupied properties / Apple Internal Protocol

Our Conclusion

Based on the assurance process and procedures conducted, we conclude that:

- The Energy, Water, Waste, Paper, and Scope 1, 2 & 3 GHG Emissions assertions shown above are materially correct and are a fair representation of the data and information; and
- Apple has established appropriate systems for the collection, aggregation and analysis of relevant environmental information, and has implemented underlying internal assurance practices that provide a reasonable degree of confidence that such information is complete and accurate.

Statement of independence, integrity and competence

Apex has implemented a Code of Ethics across the business to maintain high ethical standards among staff in their day to day business activities. We are particularly vigilant in the prevention of conflicts of interest.

No member of the assurance team has a business relationship with Apple, its Directors or Managers beyond that required of this assignment. We have conducted this verification independently, and there has been no conflict of interest.

The assurance team has extensive experience in conducting verification and assurance over environmental, social, ethical and health and safety information, systems and processes, has over 30 years combined experience in this field and an excellent understanding of Apex standard methodology for the Assurance of Sustainability Reports.

Attestation:

Trevor A. Donaghu, Lead Assuror
Program Manager
Sustainability and Climate Change Services

John Rohde, Technical Reviewer
Practice Lead
Sustainability and Climate Change Services

March 25, 2020

Fraunhofer IZM

Letter of Assurance

Comprehensive Carbon Footprint – Scope 3: Product related Carbon Footprint for Fiscal Year 2019

Fraunhofer IZM reviewed Apple's scope 3 carbon footprint data related to the products manufactured and sold by Apple Inc. in fiscal year 2019.

1 Summary

This review checks transparency of data and calculations, appropriateness of supporting product related data and assumptions, and overall plausibility of the calculated comprehensive annual carbon footprint comprised of emissions derived from the life cycle assessment (LCA) of Apple products shipped in fiscal year 2019. This review and verification focuses on Scope 3 emissions for products sold by Apple Inc. (as defined by WRI/WBCSD/Greenhouse Gas Protocol – Scope 3 Accounting and Reporting Standard). It is noted that emissions relating to the facilities that are owned or leased by Apple (scope 1 and 2 emissions) as well as business travel and employee commute were subject to a separate third party verification and are therefore excluded from the scope of this statement. Confidential data relating to product sales and shipments were also excluded from the scope of this verification.

This review and verification covers Apple's annual greenhouse gas emissions and does not replace reviews conducted for individual product LCAs for greenhouse gas emissions (GHGs). The life cycle emissions data produced by Apple for individual products has been calculated in accordance to the standard ISO 14040/14044: Environmental management – Life cycle assessment – Principles and framework / Requirements and guidelines. This review and verification furthermore complies with ISO 14064-3: Greenhouse gases -- Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions.

The review of the annual carbon footprint has considered the following criteria:

- The system, boundaries and functional unit are clearly defined
- Assumptions and estimations made are appropriate
- Selection of primary and secondary data is appropriate and methodologies used are adequately disclosed

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These criteria are also fundamental to the review of LCAs conducted for individual product emissions. The reviewers note that the largest share (98%) of Apple Inc. annual carbon footprint is comprised of scope 3 emissions from individual products. The aforementioned criteria have been regularly reviewed by Fraunhofer IZM since 2007 with a view to providing independent feedback that can facilitate continuous improvement and refinement in the LCA methodology applied by Apple Inc.

Data reported by Apple is as follows:

	Manufacturing	Transportation	Product Use	Recycling
2019	18.91	1.44	4.10	0.06
	[MMT CO_2e]	[MMT CO_2e]	[MMT CO_2e]	[MMT CO_2e]

MMT CO_2e: million metric tons carbon dioxide equivalents

Including a reported value of 0.57 million metric tons CO_2e for facilities (out of scope of this verification), total comprehensive carbon footprint is reported to be 25.1 million metric tons CO_2e.

Apple's comprehensive carbon footprint includes an increasing amount of greenhouse gas emissions reductions for manufacturing resulting from Apple renewable energy projects, supplier renewable electricity purchases, and supplier renewable electricity installations. These reductions are part of Apple's Clean Energy Program. Fraunhofer IZM has not verified these emissions reductions.

Based on the process and procedures conducted, there is no evidence that the Greenhouse Gas (GHG) assertion with regards to scope 3 carbon footprint

- is not materially correct and is not a fair representation of GHG data and information, and
- has not been prepared in accordance with the related International Standard on GHG quantification, monitoring and reporting.

2 Reviewed Data and Plausibility Check

A verification and sampling plan as required by ISO 14046-3 has been established for the comprehensive carbon footprint review and verification, defining the level of assurance, objectives, criteria, scope and materiality of the verification.

As part of this review and verification Apple disclosed following data to Fraunhofer IZM:

- Sales data for FY2019, including accessories and including AppleCare, Apple's extended warranty and technical support plans for their devices.

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- Life cycle GHG emissions for all products, differentiating the actual product configurations (e.g. memory capacity)
- Calculation methodology for the comprehensive carbon footprint and methodological changes implemented in 2019
- The total carbon footprint – scope 3 for the fiscal year 2019
- Detailed analysis of the comprehensive carbon footprint including:
    - The breakdown of the carbon footprint into life cycle phases manufacturing, transportation, product use and recycling
    - Detailed product specific split into life cycle phases
    - The contribution of individual products and product families to the overall carbon footprint

The data and information supporting the GHG assertion were projected (use phase and recycling) and historical (i.e. fiscal year 2019 data regarding sales figures, manufacturing, transportation, use patterns where available).

This review comprises a check of selected data, which are most influential to the overall carbon footprint. The overall plausibility check addressed the following questions:

- Are product LCAs referenced and updated with more recent data correctly?
- Are results for products, for which no full LCA review was undertaken, plausible?
- Are carbon emission data for individual products plausible in the light of methodological changes as indicated by Apple?

This review was done remotely.

3 Findings

In FY2019 and beginning of FY2020, 11 recent product LCA studies have been reviewed successfully against ISO 14040/44. These LCAs cover product segments iPhone, iPad, iMac, Mac mini, and AirPods. These recently reviewed LCA studies cover products which represent in total 29.2% of the total scope 3 carbon footprint. Representatives of other product segments (iPod, Mac Pro, MacBook Pro, MacBook Air, Apple Watch, HomePod, AirPort Express / AirPort Extreme, Apple TV, and Beats products) underwent no or only minor design changes compared to those which went through a full LCA review in former

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years. All reviewed LCA studies up to now cover in total 70.7% of the total scope 3 carbon footprint.

All questions raised in the course of the review were answered by Apple and related evidence was provided where needed.

4 Conclusions

Apple's assessment approach is excellent in terms of granularity of the used calculation data. A significant share of components is modelled with accurate primary data from Apple's suppliers.

For all product LCA calculations, where exact data was missing, the principle of a worst-case approach has been followed and results have been calculated with rather conservative estimates.

The review has not found assumptions or calculation errors on the carbon footprint data level that indicate the scope 3 carbon footprint has been materially misstated. The excellent analysis meets the principles of good scientific practice.

Berlin, April 18, 2020

- Karsten Schischke -
Fraunhofer IZM
Dept. Environmental and
Reliability Engineering

- Marina Proske -
Fraunhofer IZM
Dept. Environmental and
Reliability Engineering

INDEPENDENT ASSURANCE STATEMENT

To: The Stakeholders of Apple, Inc.

Introduction and objectives of work

Apex Companies, LLC (Apex) was engaged by Apple, Inc. (Apple) to conduct an independent assurance of its Supplier Clean Energy Program data reported in its 2020 environmental report (the Report). This Assurance Statement applies to the related information included within the scope of work described below. The intended users of the assurance statement are the stakeholders of Apple. The overall aim of this process is to provide assurance to Apple's stakeholders on the accuracy, reliability and objectivity of select information included in the Report.

This information and its presentation in the Report are the sole responsibility of the management of Apple. Apex was not involved in the collection of the information or the drafting of the Report.

Scope of Work

Apple requested Apex to include in its independent review the following:

- Methodology for tracking and verifying supplier clean energy contributions, including the Energy Survey, Renewable Energy Agreement, and other forms of supporting documentation provided by suppliers where available;
- Assurance of Clean Energy Program data and information for the fiscal year 2019 reporting period (September 30, 2018 through September 28, 2019), specifically, in accordance with Apple's definitions:
  - Energy: Reported megawatt-hours (MWh) of clean energy attributed to the Clean Energy Program for suppliers;
  - Avoided Greenhouse Gas (GHG) emissions associated with clean energy attributed to the Clean Energy Program;
  - Operational Capacity in megawatts (MWac) of clean energy in support of Apple manufacturing as a part of Apple's Supplier Clean Energy Program;
  - Appropriateness and robustness of underlying reporting systems and processes, used to collect, analyze, and review the information reported;

Excluded from the scope of our work is any assurance of information relating to:

- Text or other written statements associated with the Report
- Activities outside the defined assurance period

Assessment Standards

Our work was conducted against Apex's standard procedures and guidelines for external Verification of Sustainability Reports, based on current best practice in independent assurance. Apex procedures are based on principles and methods described in the International Standard on Assurance Engagements (ISAE) 3000 Revised, Assurance Engagements Other than Audits or Reviews of Historical Financial Information (effective for assurance reports dated on or after Dec. 15, 2015), issued by the International Auditing and Assurance Standards Board.

Methodology

Apex undertook the following activities:

1. Visit to Apple corporate offices in Cupertino, California;
2. Interviews with relevant personnel of Apple;
3. Review of internal and external documentary evidence produced by Apple;
4. Audit of reported data, including a detailed review of a sample of data against source data; and
5. Review of Apple information systems for collection, aggregation, analysis and internal verification and review of environmental data.

The work was planned and carried out to provide reasonable assurance for all indicators and we believe it provides an appropriate basis for our conclusions.

Our Findings

Apex verified the following indicators for Apple's Fiscal Year 2019 reporting period (September 30, 2018 through September 28, 2019):

Parameter	Quantity	Units	Boundary/ Protocol
Clean Energy Use	5.71	Million megawatt hours (mMWh)	Apple suppliers / Apple Internal Protocol
Avoided GHG Emissions	4.39	Million metric tons of carbon dioxide equivalent ($mMtCO_2e$)	Apple suppliers / Apple Internal Protocol
Operational Capacity	2,713	Megawatts (MWac)	Apple suppliers / Apple Internal Protocol

Our Conclusion

Based on the assurance process and procedures conducted, we conclude that:

- The Clean Energy Use, Avoided GHG Emissions, and Operational Capacity assertions shown above are materially correct and are a fair representation of the data and information; and
- Apple has established appropriate systems for the collection, aggregation and analysis of relevant environmental information, and has implemented underlying internal assurance practices that provide a reasonable degree of confidence that such information is complete and accurate.

Statement of independence, integrity and competence

Apex has implemented a Code of Ethics across the business to maintain high ethical standards among staff in their day to day business activities. We are particularly vigilant in the prevention of conflicts of interest.

No member of the assurance team has a business relationship with Apple, its Directors or Managers beyond that required of this assignment. We have conducted this verification independently, and there has been no conflict of interest.

The assurance team has extensive experience in conducting verification and assurance over environmental, social, ethical and health and safety information, systems and processes, has over 30 years combined experience in this field and an excellent understanding of Apex standard methodology for the Assurance of Sustainability Reports.

Attestation:

Trevor A. Donaghu, Lead Assuror
Program Manager
Sustainability and Climate Change Services

John Rohde, Technical Reviewer
Practice Lead
Sustainability and Climate Change Services

March 25, 2020

Fraunhofer IZM

Review Statement

Comprehensive Fiber Footprint

Fraunhofer IZM reviewed Apple's comprehensive fiber footprint data related to corporate fiber usage from products, corporate, and retail operations in fiscal year 2019.

1 Summary

This review checks transparency of data and calculations, appropriateness of supporting product and packaging related data and assumptions, and overall plausibility of the calculated corporate annual fiber footprint of Apple products shipped in fiscal year 2019 and of corporate and retail operations in the same period.

As there is no standardised method available for calculating a product or company fiber footprint Apple defined a methodology for internal use. The scope of the Fiber Footprint includes Apple's corporate fiber usage from products, corporate, and retail operations. The fiber footprint tracks the total amount of wood, bamboo, and bagasse fiber, both virgin and recycled, that Apple uses in packaging, and other paper products. Apple obtains and analyses supplier-specific data for each product line and sums up these figures for the entire company using sell-in numbers. The output is a total fiber footprint.

The review of the corporate annual fiber footprint has considered the following criteria:

- The system boundaries are clearly defined
- Assumptions and estimations made are appropriate
- Use of supplier data is appropriate and methodologies used are adequately disclosed

Data reported by Apple is as follows:

2019	Total Fiber	Virgin Fiber	Recycled Fiber
Packaging Fiber	173,500	63,000	110,500
Retail Bag Fiber	1,500	500	1,000
Corporate Fiber	1,500	500	1,000
Total	176,500	64,000	112,500
	[metric tons fiber]	[metric tons fiber]	[metric tons fiber]

All results and figures reviewed for fiscal year 2019 are plausible.

2 Reviewed Data and Findings

As part of this review Apple disclosed following data to Fraunhofer IZM:

- Calculation methodology for the corporate fiber footprint
- Sales data for FY2019, including accessories
- Aggregated fiber data for all products and the total corporate fiber footprint for the fiscal year 2019

The methodology paper (Fiber Footprint at Apple - Methodology Description - V1.1) provided by Apple and reviewed in 2017, is considered a sound and appropriate guidance for determining the company fiber footprint. Where appropriate, this approach follows methodological principles applied for state-of-the-art Life Cycle Assessments.

This review comprises a check of packaging fiber data for selected products (iPhone XR, iPhone XS Max, AirPods with wireless case).

Plausibility of some data has been questioned and discussed with Apple in detail. Corrections were made accordingly.This review was done remotely. All questions raised in the course of the review were answered by Apple.

Fraunhofer IZM

Based on the process and procedures conducted, there is no evidence that the corporate fiber footprint is not materially correct and is not a fair representation of fiber data and information.

Berlin, April 18, 2020

- Marina Proske -
Fraunhofer IZM
Dept. Environmental and Reliability Engineering

- Karsten Schischke -
Fraunhofer IZM
Dept. Environmental and Reliability Engineering

Reviewer Credentials and Qualification

Marina Proske: Experience and background in the field of Life Cycle Assessments include

- Life Cycle Assessment course and exam as part of the Environmental Engineering studies (Dipl.-Ing. Technischer Umweltschutz, Technische Universität Berlin, 2009)
- Critical Reviews of LCA studies incl. water, fiber and plastic footprints since 2012 for 2 industry clients and of the EPEAT Environmental Benefits Calculator
- Life Cycle Assessment of a modular smartphone (Fairphone 2)
- Studies on the environmental assessment and carbon footprint of ICT
- Studies on material and lifetime aspects within the MEErP methodology

Further updated information at: https://de.linkedin.com/in/marina-proske-74347164/en

Karsten Schischke: Experience and background in the field of Life Cycle Assessments include

- Life Cycle Assessment course and exam as part of the Environmental Engineering studies (Dipl.-Ing. Technischer Umweltschutz, Technische Universität Berlin, 1999)
- More than 100 Critical Reviews of LCA studies since 2005 (batteries, displays, mobile devices, networked ICT equipment, home automation devices, servers, desktop computers) for 5 different industry clients and of the EPEAT Environmental Benefits Calculator
- Coordination of and contribution to compilation of more than 100 ELCD datasets (available at www.lca2go.eu; product groups: hard disk drives, semiconductors, printed circuit boards, photovoltaics)
- Environmental Lifecycle Assessments following the MEEuP / MEErP methodology in several Ecodesign Product Group Studies under the European Ecodesign Directive since 2007 (external power supplies, complex set-top boxes, machine tools, welding equipment)
- Various environmental gate-to-gate assessments in research projects since 2000 (wafer bumping, printed circuit board manufacturing)

Further updated information at: www.linkedin.com/in/karsten-schischke

Fraunhofer IZM

Review Statement

Corporate Packaging Plastic Footprint

Fraunhofer IZM reviewed Apple's corporate packaging plastic footprint data related to corporate packaging plastic usage from products and retail operations in fiscal year 2019.

1 Summary

This review checks transparency of data and calculations, appropriateness of supporting product and packaging related data and assumptions, and overall plausibility of the calculated corporate annual packaging plastic footprint of Apple products shipped in fiscal year 2019 and of retail operations in the same period.

As there is no standardised method available for calculating a packaging plastic footprint Apple defined a methodology for internal use. The scope of the plastic packaging footprint includes Apple's corporate packaging plastic usage from products and retail operations. The packaging plastic footprint tracks the total amount of plastic, adhesives, and ink, that Apple uses in packaging. Apple obtains and analyses supplier-specific data for each product line and sums up these figures for the entire company using sell-in numbers. The output is a total packaging plastic footprint.

The review of the corporate annual packaging plastic footprint has considered the following criteria:

- The system boundaries are clearly defined
- Assumptions and estimations made are appropriate
- Use of supplier data is appropriate and methodologies used are adequately disclosed

Data reported by Apple is as follows:

	Total Plastic	Packaging Plastic	Retail Bags
2019	16,000	15,500	500
	[metric tons plastic]	[metric tons plastic]	[metric tons plastic]

The main drivers for the plastic packaging footprint are adhesives, OPP (oriented polypropylene) and HIPS (high-impact polystyrene).

All results and figures reviewed for fiscal year 2019 are plausible.

2 Reviewed Data and Findings

As part of this review Apple disclosed following data to Fraunhofer IZM:

- Calculation methodology for the corporate packaging plastic footprint
- Sales data for FY2019, including accessories
- Selected product and supplier specific data on packaging materials and production yields
- Aggregated packaging plastic data for all products and the total corporate packaging plastic footprint for the fiscal year 2019

The methodology paper provided by Apple (Packaging Plastic Footprint at Apple – Methodology Description – V1.0) in 2018, is considered a sound and appropriate guidance for determining the company packaging plastic. Where appropriate, this approach follows methodological principles applied for state-of-the-art Life Cycle Assessments.

This review comprises a check of packaging plastic data for selected products (iPhone XR, iPhone XS Max, AirPods with wireless case).

Plausibility of some data has been questioned and discussed with Apple in detail. Corrections were made accordingly. Similarly, scope for the packaging plastic and fibre footprint have been discussed.

This review was done remotely. All questions raised in the course of the review were answered by Apple and related evidence was provided where needed.

Fraunhofer IZM

Based on the process and procedures conducted, there is no evidence that the corporate packaging plastic footprint is not materially correct and is not a fair representation of plastic data and information. The excellent analysis meets the principles of good scientific practice.

Berlin, April 18, 2020

- Marina Proske -
Fraunhofer IZM
Dept. Environmental and
Reliability Engineering

- Karsten Schischke -
Fraunhofer IZM
Dept. Environmental and
Reliability Engineering

Reviewer Credentials and Qualification

Marina Proske: Experience and background in the field of Life Cycle Assessments include

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- Life Cycle Assessment of a modular smartphone (Fairphone 2)
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- Coordination of and contribution to compilation of more than 100 ELCD datasets (available at www.lca2go.eu; product groups: hard disk drives, semiconductors, printed circuit boards, photovoltaics)
- Environmental Lifecycle Assessments following the MEEuP / MEErP methodology in several Ecodesign Product Group Studies under the European Ecodesign Directive since 2007 (external power supplies, complex set-top boxes, machine tools, welding equipment)
- Various environmental gate-to-gate assessments in research projects since 2000 (wafer bumping, printed circuit board manufacturing)

Further updated information at: www.linkedin.com/in/karsten-schischke

Appendix D

Environmental health and safety policy statement

Mission statement

Apple Inc. is committed to protecting the environment, health, and safety of our employees, customers, and the global communities where we operate.

We recognize that by integrating sound environmental, health, and safety management practices into all aspects of our business, we can offer technologically innovative products and services while conserving and enhancing resources for future generations.

Apple strives for continuous improvement in our environmental, health, and safety management systems and in the environmental quality of our products, processes, and services.

Guiding principles

Meet or exceed all applicable environmental, health, and safety requirements. We will evaluate our EHS performance by monitoring ongoing performance results and through periodic management reviews.

Where laws and regulations do not provide adequate controls, we will adopt our own standards to protect human health and the environment.

Support and promote sound scientific principles and fiscally responsible public policy that enhance environmental quality, health and safety.

Advocate the adoption of prudent environmental, health, and safety principles and practices by our contractors, vendors, and suppliers.

Communicate environmental, health, and safety policies and programs to Apple employees and stakeholders.

Design, manage, and operate our facilities to maximize safety, promote energy and water efficiency, and protect the environment.

Strive to create products that are safe in their intended use, conserve energy and resources, and prevent pollution throughout the product life cycle including design, manufacture, use, and end-of-life management.

Ensure that all employees are aware of their role and responsibility to fulfill and sustain Apple's environmental, health, and safety management systems and policy.

Luca Maestri,
Senior Vice President and CFO
January 2020

Appendix E

ISO 14001 certification

Apple operates manufacturing facilities in Cork, Ireland. We certify 100 percent of these facilities with ISO 14001.

NSAI

Certificate of Registration
of Environmental Management System to I.S. EN ISO 14001:2015

Apple Operations Europe

Hollyhill Industrial Estate
Hollyhill
Cork

NSAI certifies that the aforementioned company has been assessed and deemed to comply with the provisions of the standard referred to above in respect of:-

The management of all EMEA operational activities related to manufacturing, sales, delivery and after sales support for direct retail and channel customers.

Approved by:
Fergal O'Byrne
Head – Business Excellence, NSAI

ENVIRONMENT ISO 14001:2015 NSAI Certified

Registration Number: 14.0202
Original Registration: 20 March 2001
Last amended on: 11 July 2018
Valid from: 11 July 2018
Remains valid to: 10 July 2021

This certificate remains valid on condition that the Approved Environmental Management System is maintained in an adequate and efficacious manner. NSAI is a partner of IQNet – the international certification network (www.iqnet-certification.com)

Partner of IQNet

All valid certifications are listed on NSAI's website – www.nsai.ie. The continued validity of this certificate may be verified under "Certified Company Search"

NSAI (National Standards Authority of Ireland), 1 Swift Square, Northwood, Santry, Dublin 9, Ireland T +353 1 807 3800 E: info@nsai.ie www.nsai.ie

CERT-161 FOBY: 14001 2015 INAB (1)

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

NSAI has issued an IQNet recognised certificate that the organisation:

Apple Operations Europe

Hollyhill Industrial Estate
Hollyhill
Cork

has implemented and maintains a

Environmental Management System

for the following scope:

The management of all EMEA operational activities related to manufacturing, sales, delivery and after sales support for direct retail and channel customers.

which fulfils the requirements of the following standard:

I.S. EN ISO 14001:2015

Issued on: 11 July 2018
First issued on: 20 March 2001
Expires on: 10 July 2021

This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document

Registration Number: IE-14.0202

Alex Stoichitoiu
President of IQNet

Fergal O'Byrne
Head - Business Excellence, NSAI

IQNet Partners*:
AENOR *Spain* AFNOR Certification *France* APCER *Portugal* CCC *Cyprus* CISQ *Italy* CQC *China* CQM *China* CQS *Czech Republic* Cro Cert *Croatia* DQS Holding GmbH *Germany* FCAV *Brazil* FONDONORMA *Venezuela* ICONTEC *Colombia* Inspecta Sertifiointi Oy *Finland* INTECO *Costa Rica* IRAM *Argentina* JQA *Japan* KFQ *Korea* MIRTEC *Greece* MSZT *Hungary* Nemko AS *Norway* NSAI *Ireland* *NYCE-SIGE México* PCBC *Poland* Quality Austria *Austria* RR *Russia* SII *Israel* SIQ *Slovenia* SIRIM QAS International *Malaysia* SQS *Switzerland* SRAC *Romania* TEST St Petersburg *Russia* TSE *Turkey* YUQS *Serbia*
IQNet is represented in the USA by: AFNOR Certification, CISQ, DQS Holding GmbH and NSAI Inc.

* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

CERT-067: IQNet NSAI A4 (9)

About this report

This report is published annually in April and covers fiscal year 2019 activities, unless otherwise noted. This report addresses environmental impacts and activities at Apple facilities (corporate offices, data centers, and retail stores), as well as the life cycle impacts of our products, including in the manufacturing, transportation, use, and end-of-life phases.

To provide feedback on this report, please contact environment-report@apple.com

End notes

1. The Taptic Engine represents 24 to 28 percent of the total rare earth elements used in these devices.
2. Power adapter efficiency: Efficiency when tested at 100 percent, 75 percent, 50 percent, and 25 percent of the power adapter's rated output current with the inbox cable.
3. Eligible products are those in a product category for which ENERGY STAR certification exists.
4. Based on sales-weighted averages of Mac, iPad, iPhone, Apple Watch, Apple TV, HomePod, AirPods, and Beats.
5. Eligible products are those in a product category for which EPEAT registration exists, which includes desktop computers, notebook computers, computer displays, and mobile phones.
6. U.S. Environmental Protection Agency, Global Greenhouse Gas Emissions Data: www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
7. U.S. EPA Greenhouse Gas Equivalencies Calculator: www.epa.gov/energy/greenhouse-gas-equivalencies-calculator
8. Greenhouse gas equivalency is calculated using the U.S. EPA Greenhouse Gas Equivalencies Calculator: www.epa.gov/energy/greenhouse-gas-equivalencies-calculator
9. International and industry standards with F-GHG reduction strategies include the Intergovernmental Panel on Climate Change Assessment Reports, U.S. Environmental Protection Agency Greenhouse Gas Reporting Program (GHGRP), IEEE 1680.1 Standard, and UL 110 Standard.
10. These final assembly supplier sites are third-party certified as Zero Waste by UL LLC (UL 2799 Standard). UL requires at least 90 percent diversion through methods other than waste to energy to achieve Zero Waste to Landfill (Silver 90–94 percent, Gold 95–99 percent, and Platinum 100 percent) designations.
11. For those materials that can only be made from recycled sources, we do not require additional verification.
12. Responsible sourcing of wood fiber is defined in Apple's Sustainable Fiber Specification (PDF). We consider wood fibers to include bamboo.
13. U.S. retail packaging is 90 percent fiber-based by weight.
14. Based on expected equivalent fiber production from our forestry projects and virgin fiber used for Apple product packaging. To determine the output of Apple's projects, we work with our partners to understand the productive potential of these working forests. The forest management plans required to achieve or maintain certification limit harvest volumes to sustainable levels. We use these potential harvest volumes to estimate the sustainable productive capacity of these forests.
15. As measured by the App Store on January 27, 2020.
16. Total does not include construction and demolition waste nor electronic waste for 2018 or 2019.
17. Diversion rates do not include construction and demolition waste or electronic waste for 2018 or 2019.
18. Assumes an average garbage truck weight of 13 metric tons: https://www.scdhec.gov/environment/land-and-waste-landfills/how-landfills-work
19. These final assembly supplier sites are third-party certified as Zero Waste by UL LLC (UL 2799 Standard). UL requires at least 90 percent diversion through methods other than waste to energy to achieve Zero Waste to Landfill (Silver 90-94 percent, Gold 95-99 percent and Platinum 100 percent) designations.
20. Every Apple product is free of PVC and phthalates with the exception of AC power cords in India, Thailand, and South Korea, where we continue to seek government approval for our PVC and phthalates replacement. While Apple's phaseout of BFRs covers the vast majority of products and components, Beddit products and some older Apple product designs may not be fully BFR-free and PVC-free. Apple products comply with the European Union Directive 2011/65/EU and its amendments, including exemptions for the use of lead. Apple is working to phase out the use of these exempted substances where technically possible.
21. Every Apple product is free of PVC and phthalates with the exception of AC power cords in India, Thailand, and South Korea, where we continue to seek government approval for our PVC and phthalates replacement.
22. While Apple's phaseout of BFRs covers the vast majority of products and components, Beddit products and some older Apple product designs may not be fully BFR-free and PVC-free.
23. Apple products comply with the European Union Directive 2011/65/EU and its amendments, including exemptions for the use of lead. Apple is working to phase out the use of these exempted substances where technically possible.
24. Arsenic is present in minuscule quantities in some semiconductor devices.