# Environmental Responsibility Report

2019 Progress Report, covering fiscal year 2018

Apple developed a new alloy that enables us to use
100 percent recycled aluminum without compromising quality.

# Contents

Lisa Jackson
Vice President, Environment,
Policy & Social Initiatives

Creating powerful solutions to push humanity forward takes relentless innovation. Resolving to do this without taking precious resources from the planet means holding ourselves and our suppliers to ever higher standards. We know that accomplishing this work will require all of our best efforts. At Apple, we are committed to building groundbreaking products and services with the mission to leave our world better than we found it.

It was just a year ago that we reached our goal of covering 100 percent of our operations with 100 percent renewable electricity. That work continues as we source the clean energy needed to maintain that standard — even as our company grows. And our learnings have paid off in significant ways as we help the manufacturers in our supply chain make the same energy transition we have. To date, more than 40 suppliers have made commitments to join us, putting us well on track to exceed our goal of putting 4 gigawatts of clean energy online by 2020.

At the same time, we are launching the next phase of our industry-leading work to better use and reuse materials with a state-of-the-art lab to support our research and innovation with material recovery. This initiative, along with Daisy - our fearless disassembly robot, means we're doing even more with the materials from old devices our customers return for recycling. And we've found new ways to make it easier for devices that still have value to go on to another user. Our launch of the new MacBook Air and Mac Mini with enclosures made from 100% recycled aluminum was just the beginning: Together, we're pioneering a future where we no longer need to mine precious materials from the Earth to make our products.

At Apple, it's simple. We apply the same level of innovation that goes into everything we create, design, power and manufacture to making things better for people and the planet. And we make it simple for customers and partners who share our passion to join us in this work. In a time where the threats facing our planet are too great to ignore, we are demonstrating that businesses must play a vital role. We are proud to do the hard work, to make the breakthroughs, and tirelessly search for ways to ensure the better future for our planet that we all deserve.
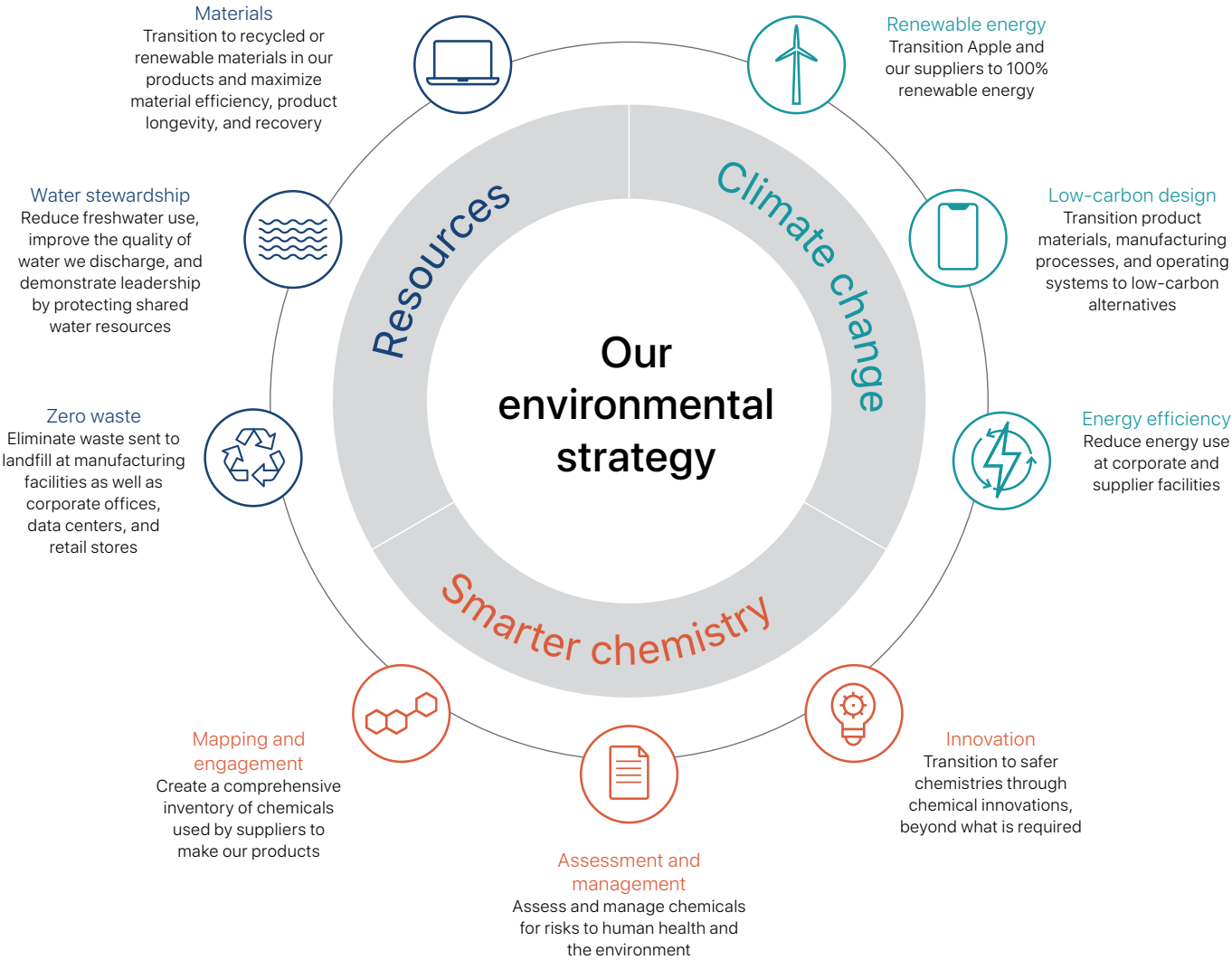
# Our ambition:
# to make products without taking from the Earth.

We've embarked on a bold mission to make products without taking from the Earth. Getting there requires focus and innovation in three key areas:

**Climate change:** We take responsibility for the emissions associated with our own operations, as well as the entire lifecycle of all our products and accessories.
**Resources:** We believe in conserving Earth's resources when operating our facilities and making our products.
**Smarter chemistry:** We believe that our products should be safe for anyone who assembles, uses, or recycles them.

**Materials**
Transition to recycled or renewable materials in our products and maximize material efficiency, product longevity, and recovery

**Renewable energy**
Transition Apple and our suppliers to 100% renewable energy

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

**Low-carbon design**
Transition product materials, manufacturing processes, and operating systems to low-carbon alternatives

**Zero waste**
Eliminate waste sent to landfill at manufacturing facilities as well as corporate offices, data centers, and retail stores

**Energy efficiency**
Reduce energy use at corporate and supplier facilities

**Mapping and engagement**
Create a comprehensive inventory of chemicals used by suppliers to make our products

**Innovation**
Transition to safer chemistries through chemical innovations, beyond what is required

**Assessment and management**
Assess and manage chemicals for risks to human health and the environment

Resources

Climate change

Smarter chemistry

Our environmental strategy

# 2018 Highlights

## Climate change

Significantly reducing emissions to address climate change

### 100%
of our global facilities are powered by 100% renewable electricity

### 70%
decrease in average product energy use in 10 years

### 35%
reduction in overall carbon footprint compared to 2015

## Resources

Transition to sourcing only renewable or recycled materials for our products and packaging

### 100%
recycled aluminum enclosures in MacBook Air and Mac mini[1]

### 100%
responsibly sourced wood fiber in all retail packaging[2]

### 14
priority materials for transitioning to 100% recycled or renewable content

## Smarter chemistry

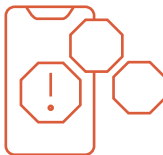Protecting the health of those who make, use, and recycle our products

### 100%
of supplier final assembly sites have adopted safer cleaners and degreasers

### 75%
We've expanded our inventory of detailed chemical composition data to over 75% by mass for all new iPhone, iPad, and Mac products

Our products are free of harmful chemicals like mercury, brominated flame retardants, PVC, phthalates, beryllium, lead in the solder, and arsenic in the display glass[3]

Apple is investing in 485 megawatts of renewable energy projects in China to address upstream supply chain emissions.

Climate Change

# Taking big steps toward a smaller footprint.

# Climate Change

We're reducing our impact on climate change by using clean power sources and driving energy efficiency in our operations. The electricity at all of our facilities worldwide, including every Apple office, store, and data center, comes from 100 percent renewable energy—a standard we have maintained, even as we continue to grow. And we're doing even more to transition our suppliers to 100 percent renewable energy and make our products of low-carbon materials.

## Highlights

### Emissions reductions

We've significantly reduced our carbon emissions: by 64% since 2011 for Apple's direct operations (Scope 1 and 2 emissions) and by 35% for Apple's entire footprint since it peaked in 2015.

### Supplier clean energy

44 Apple suppliers have committed to power all of their Apple production with 100% renewable energy. With these pledges, we are on track to far exceed our 2020 goal to bring 4 gigawatts of new clean energy into our supply chain.

### Component reductions

In the last year, we've reduced emissions from aluminum in our products by 45%.

### Product energy efficiency

In 10 years, we've reduced average product energy use by 70%.[4]

### 100% renewable energy

We're sourcing 100% renewable energy for all the electricity used at our facilities in 43 countries around the world. Two-thirds of this renewable energy comes from Apple-created projects.

### Facilities energy efficiency

We saved 41.5 million kilowatt-hours (kWh) through energy efficiency initiatives at our global facilities.

## Our Approach

# We measure more, so we can do more.

We take responsibility for our entire carbon footprint. That includes the emissions beyond our direct control, like those from sourcing materials, making our products, and our customers using their devices. We calculate our carbon footprint in five major areas: corporate facilities, product manufacturing, product use, product transportation, and product end-of-life processing. We use this information to tell us where to focus.

We prioritize use of renewable energy, starting with our own facilities. We've transitioned to 100 percent renewable energy for the electricity we use at our offices, retail stores, and data centers around the world, which has reduced facilities emissions to only 2 percent of our comprehensive carbon footprint.[5] And we've extended our efforts into our supply chain, where product manufacturing represents 74 percent of overall emissions. Whether designing a product, an operating system, or a manufacturing process, we consider the environmental impact—alongside cost, durability, form, and functionality. And because the cleanest energy is the energy you never use, we're reducing energy use at facilities we operate as well as those where our suppliers make our products.

## Our approach to climate change
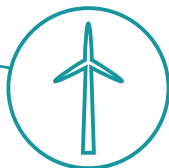
**Renewable energy**
Transition Apple and our suppliers to 100% renewable energy

**Low-carbon design**
Transition product materials, manufacturing processes, and operating systems to low-carbon alternatives
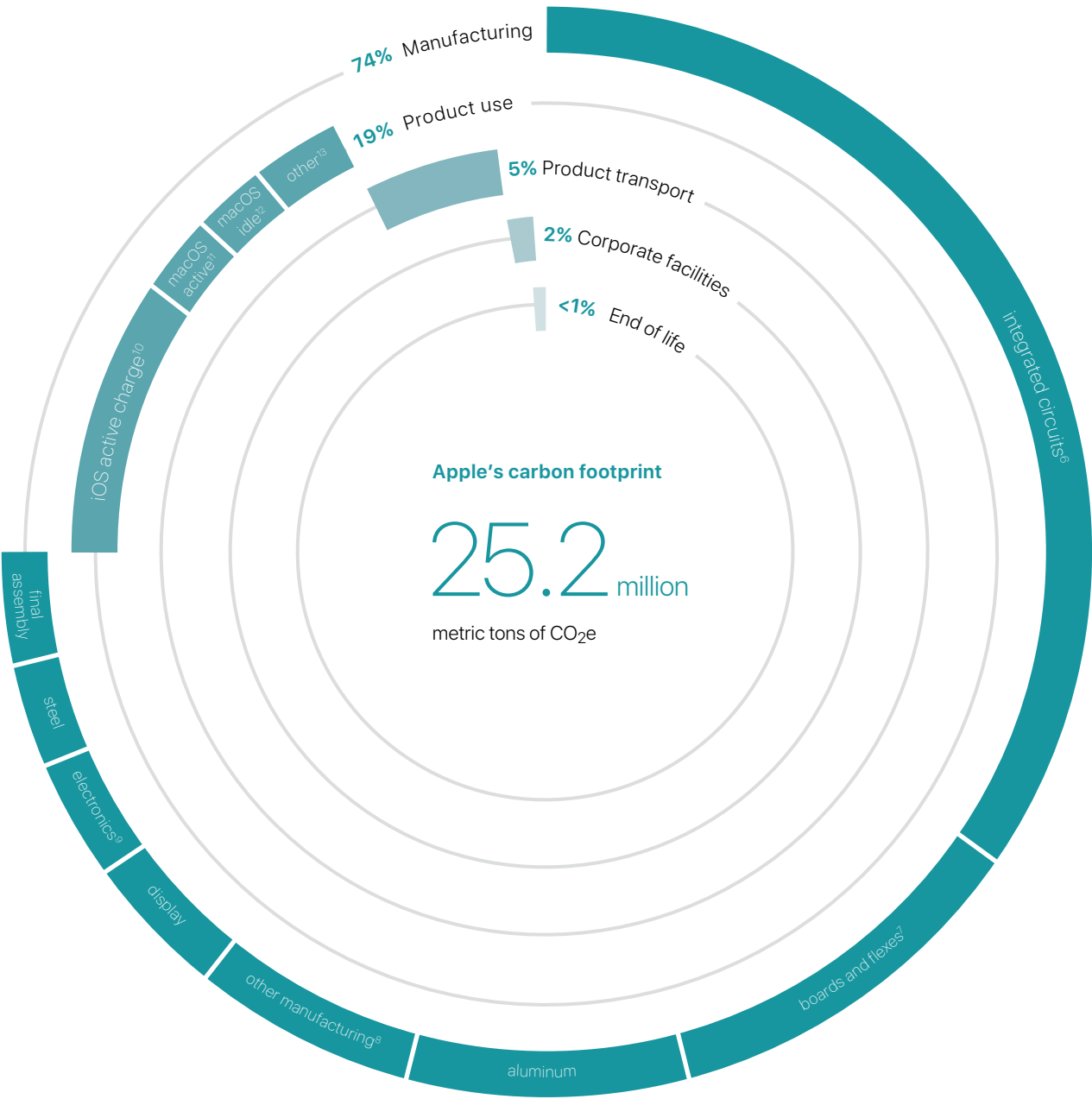
**Energy efficiency**
Reduce energy use at corporate and supplier facilities

## Apple's overall carbon footprint (fiscal year 2018)

Apple calculates its life cycle carbon footprint to understand where to focus reduction efforts.



**74%** Manufacturing

**19%** Product use

**5%** Product transport

**2%** Corporate facilities

**<1%** End of life

other[13]

macOS active[11]

macOS idle[12]

iOS active charge[10]

integrated circuits[6]

final assembly

steel

electronics[9]

display

other manufacturing[8]

aluminum

boards and flexes[7]

**Apple's carbon footprint**

# 25.2 million

metric tons of $CO_2$e

Note: Manufacturing, Product use, Product transport, and End of life are Scope 3 emissions. Corporate facilities includes Scope 1 and 2 emissions, in addition to Scope 3 emissions associated with employee commute and business travel. All emissions data is detailed in Appendix A.

In fiscal year 2018, we reduced our comprehensive carbon footprint for the third year in a row—down 35 percent compared to 2015. A major contributor to the decrease was Apple's Supplier Clean Energy Program, which lowered our carbon footprint by nearly 3.6 million metric tons compared to last year. We also made several product design changes that reduced our carbon footprint, like sourcing aluminum made with hydroelectricity and recycled content, improving product energy efficiency, and redesigning integrated circuits to use less silicon. Together, these product design changes resulted in 4.8 million fewer metric tons of carbon emissions compared to last year.

Historically, Apple's carbon footprint has paralleled its financial performance. However, beginning in 2015, our environmental work has driven down our carbon emissions, even as revenue has increased.

### Historical carbon footprint
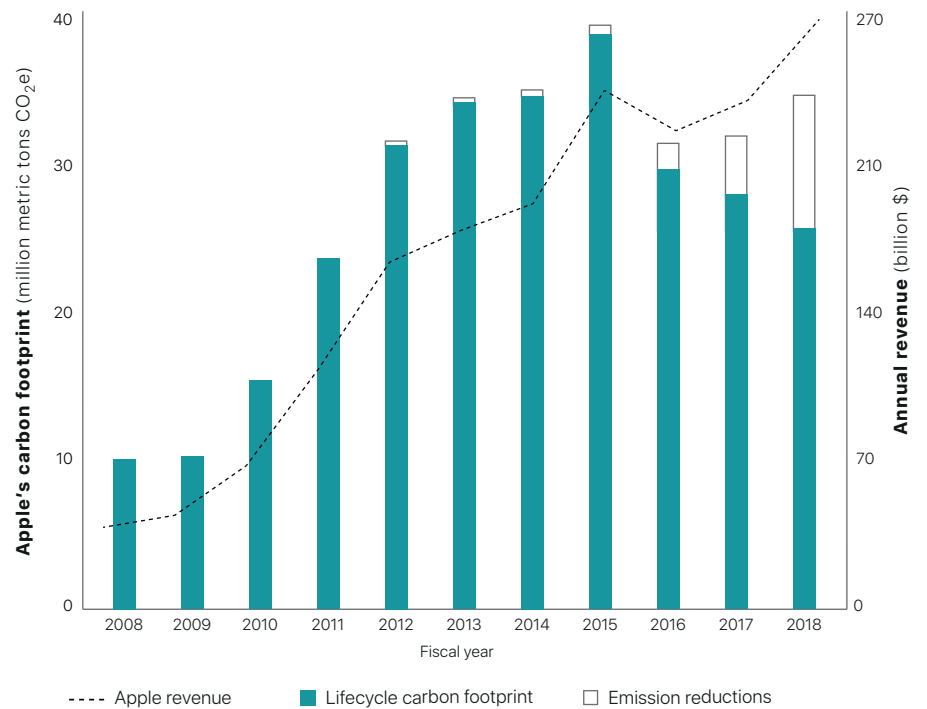


Since 2015, Apple's emissions reduction efforts have led to a significant decline in its comprehensive carbon footprint. Without these efforts, Apple's fiscal year 2018 emissions would have been 35 percent greater.

Note: We have been calculating the life cycle greenhouse gas emissions of our products since 2007. Over time, we have greatly refined our model to include more Apple-specific data instead of industry averages. We made significant modeling changes in fiscal year 2016 to improve how we calculate emissions from the integrated circuits in Apple products, which resulted in a decrease in manufacturing emissions. And we make systematic changes each year to reflect changes in global electricity grids.
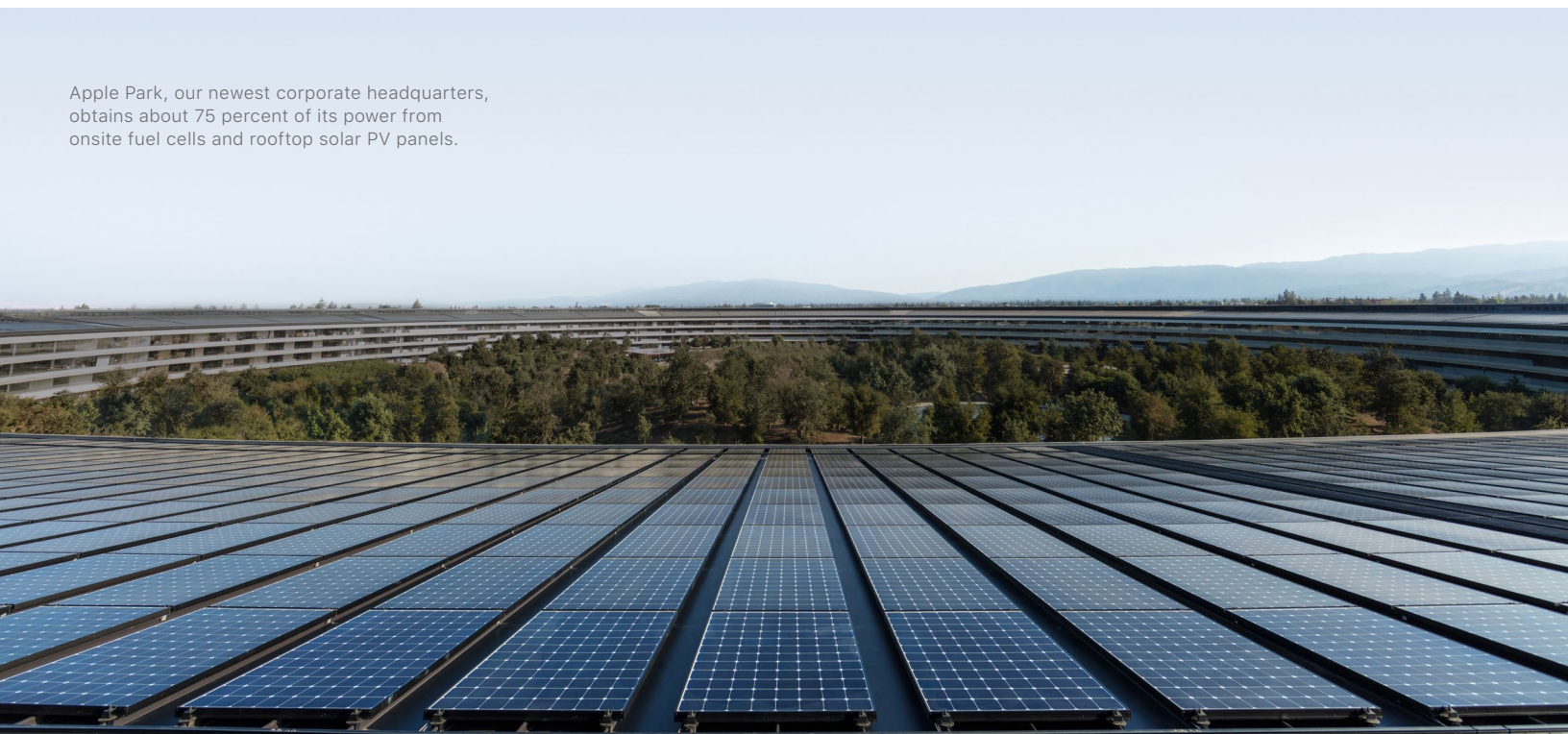
## Renewable Energy

# Charting the course to 100%.

Apple pursues the strongest possible renewable solution in all markets where we operate. We stress a regional approach, with long-term energy contracts from new projects we help create. The following three principles guide this strategy:

- **Local displacement.** We seek to displace more-polluting forms of energy in the same electric grid region as our facilities. We accomplish this by having Apple-created projects deliver into the grid as much renewable energy as our facilities take from it. In difficult renewable energy markets where our needs are less than 0.5 percent of our total energy use, we seek a renewable energy solution in the broader geographic region.

- **Materiality.** We want our involvement in a renewable energy project to be a driving force to getting it built. That might mean providing needed financial support or helping the project overcome regulatory barriers. With the rapidly changing policy dynamics in some of our key countries, we're adapting our framework to continue to comply with local laws and regulations and to yield the most positive and real energy transformation.

- **Accountability.** We apply rigor in measuring and tracking our energy supply resources and use third-party registries such as WREGIS and NC-RETS, certification programs such as Green-e Energy, and contractual provisions to ensure that only Apple takes credit for the renewable energy it generates or procures. When no such system exists, we work with industry partners and governmental entities to create them.

Apple Park, our newest corporate headquarters, obtains about 75 percent of its power from onsite fuel cells and rooftop solar PV panels.

# 600+ MW

Of the renewable energy projects Apple has helped create, we have direct ownership in over 600 megawatts. This is among the largest direct investments in renewable energy by a non-energy company.

## Powering all our facilities with 100% renewable energy.

Since 2018, 100 percent of the electricity we've used at our facilities has come from renewable sources. To secure renewable energy projects, we've taken on project ownership, made equity investments, sparked creative new partnerships with utilities, and entered into power purchase agreements. We've also deployed a variety of technologies like wind, solar PV, micro-hydro projects, and biogas fuel cells. (See Appendix B for a comprehensive view of solutions we've implemented to secure renewable energy at our facilities.)

We first focus on energy efficiency to reduce the total electricity we use, then source renewables for our remaining needs. We create new renewable energy projects whenever possible. As of January 2019, approximately 66 percent of the renewable energy Apple uses comes from projects that Apple created. And we aim to soon cover our entire electricity load with Apple-created projects. We use three contracting structures to do this.

- **Direct ownership.** Where feasible, we source our own renewable energy by building our own projects, including solar, wind, biogas fuel cells, and low-impact hydro projects.

- **Equity investment.** 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.** At other times, we sign long-term contracts for renewable energy in order to support new, local projects that meet our robust renewable energy sourcing principles, primarily solar PV and wind projects.

In cases where we need more renewable energy than what's generated by our Apple-created projects, we directly purchase renewable energy from newer projects in nearby markets, or through available utility green energy programs. When these options are not available, we are willing to procure robust renewable energy credits (RECs) tied to recently constructed projects, applying the same rigor to these purchases as we do to our Apple-created renewables. When Apple acquires RECs, we require that they are Green-e Energy certified, where available, and come from the same power grid—and preferably in the same state or country—as the Apple facility they support.

## How we're staying at 100%.

To get to—and stay at—100 percent renewable energy for the electricity at our global facilities, we've implemented new approaches to securing renewable energy: We've expanded into new markets, we're leveraging large projects to increase others' access to renewable energy, and we're investing in projects without support of government subsidies.

### New markets.

Since 2017, we have been procuring renewable energy in new markets that we only recently entered or in which we have small loads—like India, Turkey, Israel, Brazil, Mexico, and Taiwan—to cover our loads in those and neighboring countries. And as we continue to grow our global operations, we'll continue building projects in new markets.

For example, in Taiwan we worked with a local partner to build a rooftop PV system and secured a long-term contract for Apple to own the project's renewable energy certificates. We will verify our purchase by using Taiwan's newly created T-REC tracking system.

### Aggregation.

We're investing in large-scale renewable energy projects in the Great Lakes and mid-Atlantic regions totaling 245 megawatts of generation: an Illinois wind farm and a Virginia solar PV array. These projects will cover our electricity use at our retail stores and offices on the East Coast, as well as co-located data facilities in Chicago, Illinois, and Ashburn, Virginia. In addition, we've directly helped other companies access the same high-quality renewables that Apple is procuring. By working with others, we can help open the renewable energy market to companies of all sizes and accelerate the pace of new renewable generation.

### Subsidy-free projects.

As renewable energy markets around the world evolve and the technology becomes more cost-competitive, we're looking to develop projects without the government subsidies that were designed to encourage development of renewable energy. This will enable us to retain ownership of the renewable energy credits of projects we invest in. In Denmark we contracted for a new wind farm and a 42-megawatt solar PV project—one of Denmark's largest—using a commercially backed contract-for-difference power purchase agreement, the first of its kind in Denmark.

In China, we're working to create cost-competitive, subsidy-free renewable energy solutions for our facilities and suppliers. To encourage this transition, we supported China's voluntary REC market with the largest purchase to date, and kept our retail stores and corporate offices at 100 percent renewable in the process.

# We've significantly reduced our emissions.

Our transition to renewable energy has reduced our Scope 1 and 2 emissions by 64 percent since 2011, preventing over 2.8 million metric tons of $CO_2e$ from entering the atmosphere. That's equivalent to taking more than 590,000 cars off the road for one year.[14]
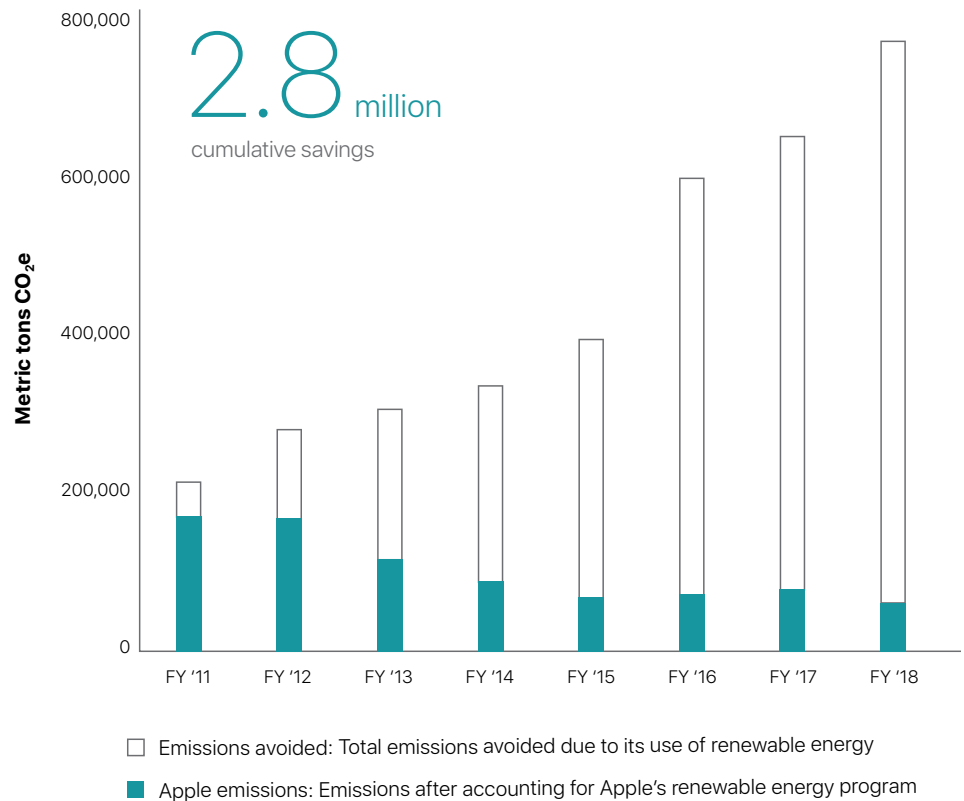
The WRI Greenhouse Gas Protocol defines the methodology for calculating carbon emissions.

**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.

**Apple's emissions since 2011 (Scopes 1 and 2)**

Since 2011, Apple has reduced emissions from our offices, data centers, retail stores, and fleet vehicles by 64 percent—even while our energy use increased by more than 3 times in this same period.



**2.8** million
cumulative savings

□ Emissions avoided: Total emissions avoided due to its use of renewable energy

■ Apple emissions: Emissions after accounting for Apple's renewable energy program

# 4 GW

By 2020, Apple and our suppliers will generate or procure at least 4 gigawatts of clean energy in our supply chain. As of April 2019, we already have commitments far exceeding our goal.

# Leading suppliers to switch to renewable energy.

Apple also takes responsibility for the carbon emissions that occur in our supply chain. Manufacturing makes up 74 percent of our carbon footprint. Most of those emissions come from the electricity used to make the parts in our products. So we're helping our suppliers reduce their energy use and transition to new renewable energy sources.

We announced Apple's Supplier Clean Energy Program in 2015, and we've seen enormous growth in just three years. In 2018, Apple and our suppliers invested in, or procured from, 1.9 gigawatts of operational clean energy that collectively generated 4.1 billion kWh. This clean energy generation avoided about 3.5 million metric tons of $CO_2e$—roughly equivalent to the electricity needed to power over 600,000 homes in the U.S. for a year.[14]

### Progress toward 4 gigawatts



Operational (GW)  Committed (GW)
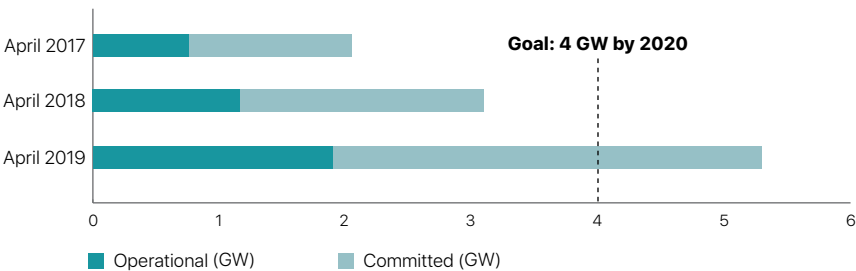
To ensure our program achieves the greatest positive impact, we have stringent social and environmental standards for supplier clean energy projects. The data above reflects only those projects that meet our strict standards and includes only clean energy generated or sourced since Apple's engagement.

# $300 Million

Apple recently launched the China Clean Energy Fund, a first-of-its-kind investment fund in China to connect suppliers with renewable energy sources. Initially, 10 suppliers and Apple will jointly invest nearly $300 million over the next four years.

### Apple's role.

Apple supports supplier transitions to clean energy. We work with them to advocate for policy change in key markets. We connect suppliers with high-quality clean energy projects and developers. And we educate them on how they can take full advantage of the benefits of clean energy.

### Demonstrating leadership.

The transition to renewable energy can be highly complex. It often requires complicated deal structures across many regions, each with their own statutory and regulatory requirements. We gained invaluable experience by meeting our own 100 percent renewable energy goal in 43 countries, and we're using that expertise to help develop nearly 500 megawatts of solar and wind projects in China and Japan. These projects are addressing upstream emissions in our supply chain as well as demonstrating our commitment to the Supplier Clean Energy Program.

**Educating partners.**

We share our learnings with our supplier partners and help them plot their transition to renewable energy. In 2017, Apple developed the Clean Energy Portal, an online platform to help suppliers identify commercially viable renewable energy solutions in regions around the world. We continue to add new content, including policy guidance and financial analysis tools, intended to make adoption of clean energy in key markets even easier. Over 100 suppliers have registered for the site.

**Advocating for strong policy.**

Clean energy technology offers tremendous benefits to our suppliers, to electricity grids, and to countries. So we actively support policies that create cost-effective renewable energy markets, and we work closely with suppliers to engage local, regional, and national governments. This encourages the development of policies that support scalable renewable energy solutions.

> "The Supplier Clean Energy Program is at the center of Apple's commitment to making world-class products with greener manufacturing. Our suppliers are taking significant actions to join us in this work, and we look forward to seeing more bold pledges as we continue to address our environmental impact."

Jeff Williams
Apple's Chief Operating Officer

**Supplier progress.**

Partners across our supply chain are installing or investing in sizable solar projects and purchasing clean energy directly from renewable projects or from their utility. As of April 2019, 44 manufacturing partners in 16 countries have committed to 100 percent renewable energy for Apple production:
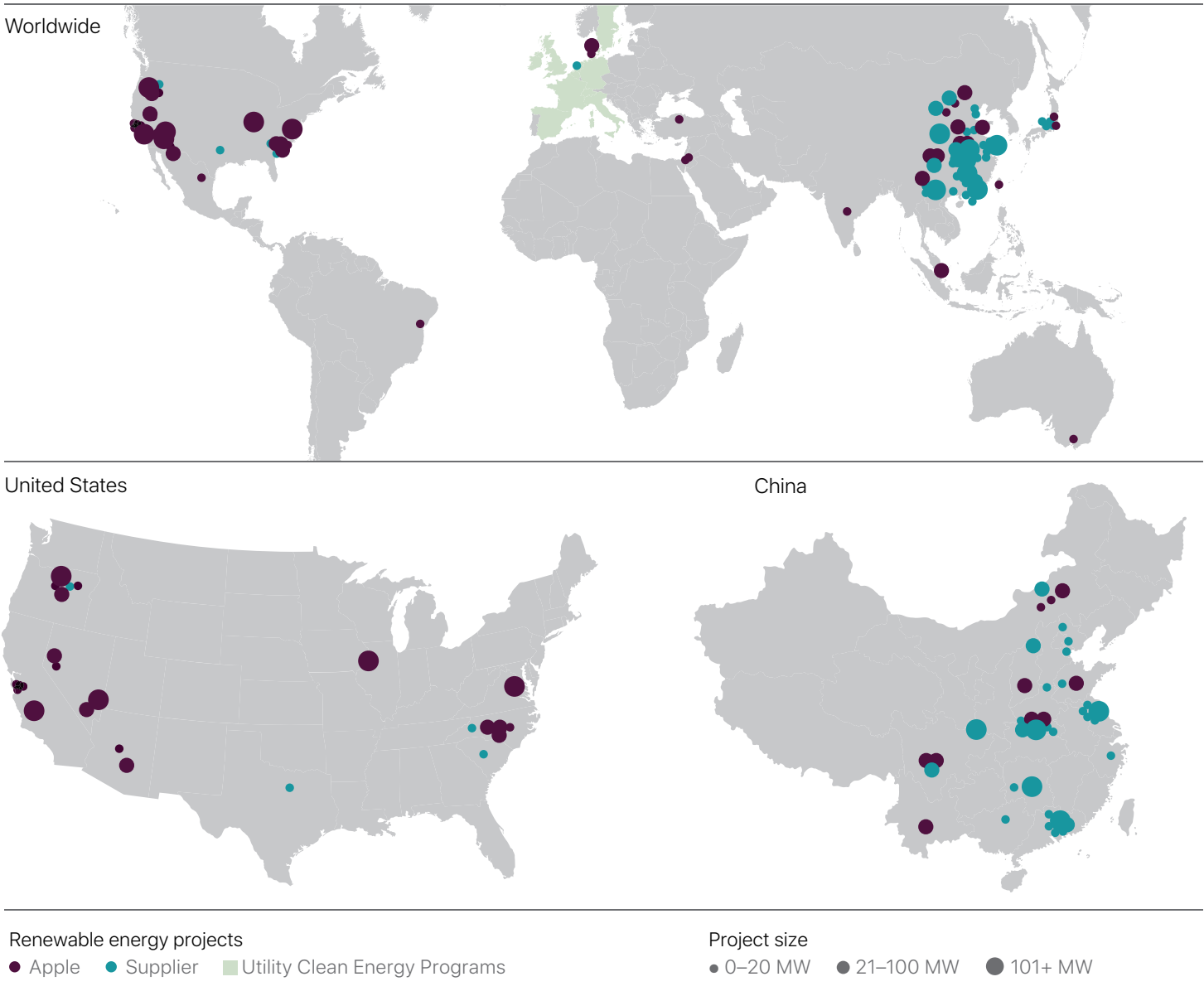
- Advanced International Multitech
- Arkema
- AT&S
- Bemis Associates
- Biel Crystal (HK) Manufactory Ltd.
- BOE
- Catcher Technology
- Compal Electronics
- Corning Incorporated
- COSMO
- DSM Engineering Plastics
- ECCO Leather
- Fastway Creation
- Finisar

- Goertek
- Golden Arrow
- H.B. Fuller
- Hon Hai Precision Industry
- Ibiden
- Jabil
- LEALEA Enterprise
- Lens Technology
- Lishen
- Luxshare-ICT
- Mega Precision
- Nidec
- Pegatron
- Primax Group
- Qorvo

- Quadrant
- Quanta Computer
- RRD
- RyPax
- SanHuan
- SDK
- Solvay
- STMicroelectronics
- Sunway Communication
- Sunwoda Electronics
- Taiyo Ink Mfg. Co.
- tesa SE
- TSMC
- Wistron
- Yuto

**Supplier Progress Report**

For more information on how our suppliers are fulfilling their renewable energy commitments, download the Program Update (PDF)

## Apple and supplier-created long-term renewable energy projects.

To reduce our carbon emissions, Apple and our suppliers are generating and procuring renewable energy. The maps below represents long-term commitments to new renewable energy projects supporting 66 percent of Apple facilities, our suppliers, and cleaner grids around the world.*

Worldwide



United States



China



Renewable energy projects
- Apple ● Supplier ● Utility Clean Energy Programs

Project size
● 0–20 MW ● 21–100 MW ● 101+ MW

To reduce our own electricity footprint (Scope 2 emissions), Apple currently has 28 operational renewable energy projects across nine countries on four continents, totaling 629 megawatts of generation capacity. And we have 15 more projects under construction. Once they're built, we'll have over 1.5 gigawatts of clean renewable energy generation spread across 12 countries and five continents. For some of our European loads, we procure electricity from utilities that only supply 100 percent renewable energy, and from our two renewable energy projects in Denmark.

To address emissions from manufacturing products, Apple and our suppliers have invested in or procured from 1.9 gigawatts of grid-connected projects, with another 3.3 gigawatts in development. These projects apply a mix of clean energy technology including wind (67 percent) and solar (23 percent).

* The map does not include REC and Guarantee of Origin purchases, certain utility clean energy programs, short-term contracts, and projects that are not yet sited.

## Low-Carbon Design

# Lowering emissions through product design.

We design our products with great care to reduce their carbon footprint. We think about how to make them powerful while using as little energy as possible. We use materials efficiently, and we source from materials that have a low-carbon profile.

## Designing our products to use less energy.

Energy efficient products not only maximize battery life, but they're better for the environment, too. We establish aggressive efficiency targets early in the design phase, and we consistently outperform ENERGY STAR, which sets the standard across commercial products in the U.S. In the last 10 years, we've decreased average product energy use by 70 percent across all Apple's major product lines.[4] For example, the 11-inch iPad Pro introduced in fall 2018 is 69 percent more efficient than the ENERGY STAR standard. MacBook Air with Retina display consumes three times less power in sleep mode than the previous-generation MacBook Air. When you multiply these reductions by all the Apple devices in the world, the impact on our carbon footprint really adds up.
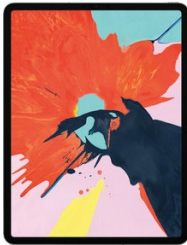
## 69%

The 11-inch iPad Pro models are more than 69 percent more efficient than the ENERGY STAR standard.

## 40%

iMac Pro consumes 40 percent less power during sleep and off mode—the result of an innovation in power supply design.[15]

## 3x

MacBook Air with Retina display consumes three times less power in sleep than the previous-generation MacBook Air.

## Lowering impact by design.

Our carbon footprint tells us which components are carbon intensive, so we know where to focus our efforts. We reduce the amount of material we need to make certain components by changing the design and re-engineering manufacturing processes. And by sourcing from recycled or renewable materials, we can often further decrease the carbon emissions from certain components.

Integrated circuits, or chips, make up a large portion of our manufacturing carbon footprint. Turning a silicon wafer into an integrated circuit is an energy-intensive process. So we seek out ways to reduce the amount of silicon used in chips, while maximizing their performance. The A11 and A12 chips used in iPhone 8, X, XS, XS Max, and XR allow more processing power to be packed into smaller silicon dies, which reduced Apple's 2018 carbon footprint by 160,000 metric tons.

The carbon footprint of aluminum enclosures of MacBook computers has been steadily decreasing since 2015—for some products, it's over six times less. We've done this by sourcing aluminum from hydro-powered smelters, improving the material efficiency of manufacturing processes, and increasing recycled content in our products. And by using 100 percent recycled aluminum for the enclosure of the new MacBook Air with Retina display, we cut the product's carbon footprint in half.

## Paving the way for carbon-free aluminum smelting

Aluminum is a key material in many of Apple's products, and, for more than 130 years, it's been produced through a carbon-intensive process. Through a partnership with aluminum manufacturers Alcoa Corporation and Rio Tinto Aluminum, announced in May 2018, that's changing. The joint venture between Alcoa and Rio Tinto will commercialize patented technology that eliminates direct greenhouse gas emissions from the traditional smelting process, a key step in aluminum production. 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 its products through innovation, the company 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 to future research and development.



The world's first aluminum produced through a carbon-free smelting process.

"Apple is committed to advancing technologies that are good for the planet and help protect it for generations to come. We are proud to be part of this ambitious new project, and look forward to one day being able to use aluminum produced without direct greenhouse gas emissions in the manufacturing of our products."

Tim Cook
Apple's CEO

## Energy Efficiency

# The cleanest energy is the energy you never use.

Even as we're aggressively transitioning to renewable energy at our corporate facilities and in our supply chain, we prioritize energy efficiency. When we use less energy, we have less to procure from clean sources.

To increase energy efficiency at our Apple's offices, data centers, and retail stores, we start with designing buildings to optimize energy use. For existing buildings at our facilities and in our supply chain, we conduct energy efficiency audits to identify system improvements that could reduce energy use.

## A more energy efficient Apple.

In 2018, we have continued to expand our energy efficiency programs to data centers, retail stores, offices, and R&D facilities located around the world. This past year, we have opened new buildings on Apple campuses in Cork, Ireland; Hyderabad, India; and Shenzhen, China. Each of these buildings exemplifies Apple's commitment to energy efficiency with measures such as efficient HVAC systems with optimized air distribution, heat recovery, and radiant cooling; rooftop solar thermal; and occupancy controlled efficient lighting throughout.

We also implemented a program within the past year to significantly reduce the energy consumption of new retail stores worldwide. We're creating energy models during the design process to benchmark energy use and using those models to evaluate specific efficiency measures. The result is energy savings of approximately 10 to 30 percent, thanks to more thoughtful design and selection of building envelope components, lighting, and HVAC systems, as well as controlling all of these systems as efficiently as possible.

In fiscal year 2018, we reduced our energy use by an additional 41.5 million kWh and 129,000 therms—a significant increase in energy savings compared to last year, due to the expansion of our program. Combined with ongoing energy savings from past years, we are now cumulatively saving over 110 million kWh of electricity and 2.5 million therms of natural gas per year.

# 8 million sq. ft.

In fiscal year 2018, we implemented energy efficiency measures in more than 8 million square feet of Apple facilities, with a combined annual electricity use of over 350 million kWh—resulting in an average energy savings of about 12 percent. In the past two years, we have made energy efficiency improvements to 17 million square feet.

# A more energy efficient supply chain.

In 2015, we started engaging directly with suppliers to help them reduce their energy use. We aim to educate them about energy efficiency, identify energy efficiency project opportunities, and manage those projects to completion. We prioritize facilities with the highest energy use and potential for improvement. Then 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.

Since the inception of this program in 2015, we have engaged 59 suppliers at 85 facilities. In 2018, our program implemented energy efficiency measures that prevented 466,000 metric tons of $CO_2e$ from entering the atmosphere.

Daisy, Apple's line of disassembly robots, can now disassemble 15 models of iPhone, recovering more of the important materials stored inside.

Resources

# Putting the planet's limited materials to good use. And reuse.

# Resources

We're on a mission to one day use only recycled and renewable materials in our products and packaging, and to eventually eliminate our reliance on mining altogether.[16] We're reducing the amount of water we use and waste we produce to make our products. And after our devices have enjoyed long lives, we look to them as a resource for the future.

## Highlights

### Daisy expansion

We updated Daisy to disassemble six more models of iPhone for a total of 15.

### Plastic reduction

We reduced plastic use in our packaging by 48% in three years.

### Material recovery lab

We're partnering with industry experts and academia to further expand innovation around recycling and disassembly.

### Recycled tin

We expanded, to 11 products, our use of 100% recycled tin in the solder on main logic boards.

### Recycled cobalt

We're starting to use recycled cobalt—sourced from iPhone batteries recovered from Daisy and scrap from select supplier sites—in the batteries of new products.

### Recycled aluminum

We launched our 2018 MacBook Air and Mac mini with 100% recycled aluminum enclosures, cutting the carbon footprint of each product nearly in half.

### Recycled plastic

We introduced 82 components with an average of 38% recycled plastic across products released just this year.
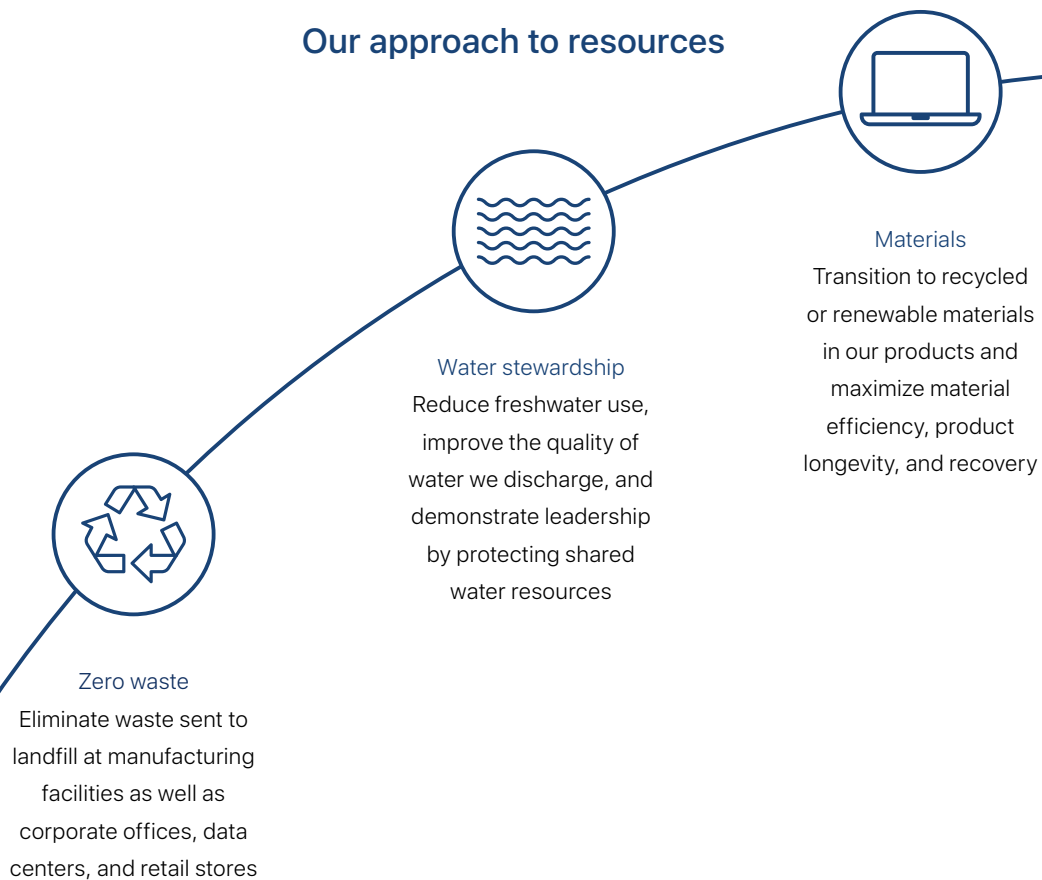
### Product take-back

We refurbished more than 7.8 million devices and recycled more than 48,000 metric tons of e-waste this year.

# Making the most of limited resources.

Many resources are finite, and even those that are bio-based need to be managed in a way that makes them renewable. Whether it's materials in our products or packaging, waste generated at our own facilities and in our supply chain, or water that we use to operate our buildings, deliver services, and make products, our commitment remains the same: to protect and conserve these precious resources.

## Our approach to resources

**Materials**
Transition to recycled or renewable materials in our products 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**
Eliminate waste sent to landfill at manufacturing facilities as well as corporate offices, data centers, and retail stores

## Materials

# More recycled material inside and out.

**We're focusing our initial efforts on the following materials:**

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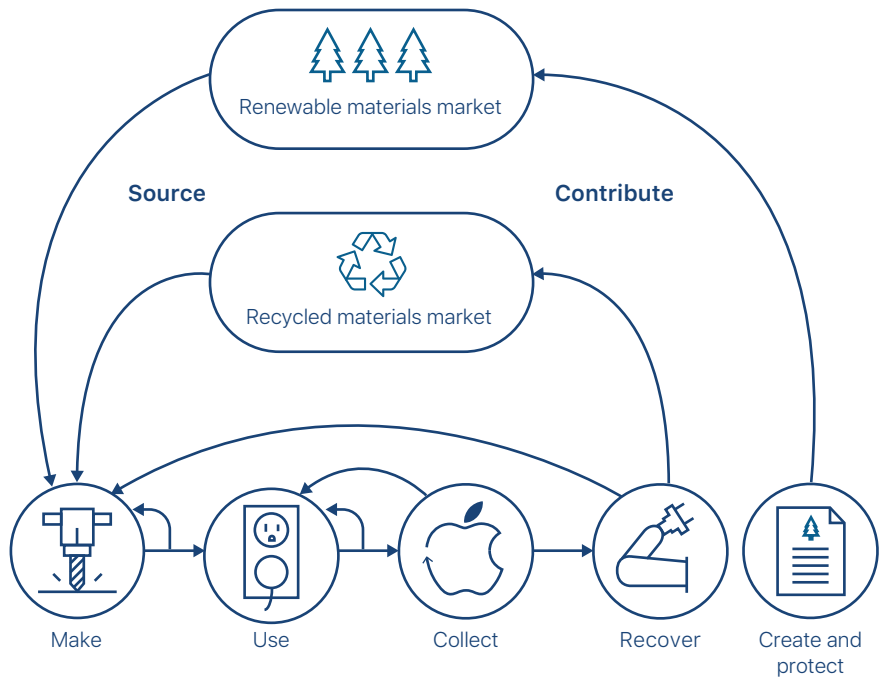- Rare earth elements
- Steel
- Tantalum
- Tin
- Tungsten
- Zinc

For more information on how we prioritized these materials, read our paper on Material Impact Profiles (PDF)

Since we announced, in 2017, our ambitious goal to one day make our products using only recycled and renewable materials, we've made notable progress—especially when it comes to materials like aluminum, cobalt, tin, paper, and plastics. We make the most of materials by reducing waste and creating long-lasting products. And when our customers return products through Apple Trade In, we make sure the materials in those devices are used again and again.

Our strategy is to create circular supply chains and reduce our impact on the planet's resources by:

- Designing and building products and packaging with recycled and renewable materials, and using materials more efficiently.
- Making long-lasting products by designing highly durable hardware, creating a broad network of repair providers, and ensuring software compatibility with older models.
- Collecting products through Apple Trade In to extend their life or recover their materials.

**How we define a circular supply chain**



Renewable materials market

Source          Contribute

Recycled materials market

Make          Use          Collect          Recover          Create and protect

**Creating a circular supply chain**
Reaching our goal means focusing on three key aspects of our supply chain:
1) Source strategically and make efficiently: Use recycled and renewable materials while manufacturing products efficiently to minimize use of materials.
2) Use for a long time: Design products to be durable, so they can have long lives.
3) Contribute: Ensure materials go back into the market for Apple or others to use.

## Sourcing recycled and renewable materials.

**Supplier responsibility**

We hold ourselves and our suppliers to the highest standards when it comes to human rights, environmental protection, and health and safety practices in our supply chain—including for sourcing of materials. Learn more >

We aim to end our reliance on mining. That's why we are transitioning to recycled[16] and renewable materials, and maximizing material efficiency, all while maintaining the exceptional quality and finish of our final products.

With such a broad ambition, we needed a robust, data-driven way to determine where to start. So we assessed 45 elements and raw materials based on their environmental, social, and supply impacts. The resulting Material Impact Profiles helped us identify a short list of materials on which to focus first. And we continue to use these profiles to determine which materials to tackle next.

Each material requires a different solution. For some, like rare earth elements, recycled material is not widely available. So simply understanding the barriers to recovery requires significant exploration, and the learning represents meaningful progress. For other materials, like tin, recycled material markets are more robust. So we piloted uses of recycled tin in select applications and brought them to scale. Throughout these explorations and across many materials, we've deepened our relationships with downstream recyclers. And we've partnered with suppliers further upstream to use fewer materials and find alternative, recycled sources.

## Aluminum

To use 100 percent recycled aluminum, we had to invent a whole new kind. Standard recycled aluminum accumulates impurities each time it's recycled. So we engineered an alloy that can accommodate scrap sources of aluminum and delivers the same strength, durability, and flawless finish. We use sophisticated computational models to identify an alloy chemistry that can withstand a countless number of recycling loops. Our own products and processes are a valuable source of aluminum scrap for our custom alloy, including iPhone enclosures recovered by Daisy. In fall 2018, we introduced MacBook Air and Mac mini models with 100 percent recycled aluminum enclosures. And use of recycled materials helped cut the carbon footprint of each product nearly in half. In 2019, these efforts will allow us to avoid mining more than 900,000 metric tons of aluminum-bearing bauxite.
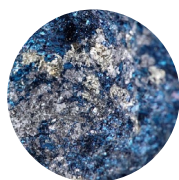
## Cobalt[17]

We use cobalt primarily in batteries. A limited supply of recycled cobalt is available on the market for use in batteries like ours, not because recyclers lack the ability to recover cobalt, but because many recyclers don't have enough scrap sources, like batteries. So we set out to find new sources of scrap for our recyclers, starting with our own supply chain. We began sending iPhone batteries recovered from Daisy, Apple's iPhone disassembly robot, to our upstream recycler in Apple's battery supply chain. And after a successful pilot program, select battery and final assembly suppliers now send Apple's battery scrap to our recycler upstream. Recycled cobalt from both scrap sources is being recycled into the batteries of new Apple products—a true circular supply chain.

## Copper

As a highly conductive metal, copper is used to make our printed circuit boards, cables, and connectors. We're engaging with our suppliers to investigate new methods to manufacture our printed circuit boards in a way that uses less copper. For the copper we do use, we are moving to recycled sources. We are currently certifying the recycled copper content in the printed circuit boards of select iPhone models and estimate that the recycled copper used for these products represents over 60,000 metric tons of mined ore. To increase our contribution to recycled material streams, Daisy now liberates seven different components from which copper can be recovered, including the main logic board and the camera. And we're directing these components to recyclers and smelters that can recover copper at high rates.
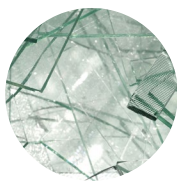
## Glass

For glass, we're focused on material efficiency and recovery. We're working with our cover glass suppliers to ensure that all glass scrap generated during the manufacturing process is recycled at the highest level possible. Glass is incredibly sensitive to impurities and changes in composition—even the production of new devices introduces impurities—so maintaining the quality is essential for recycling glass.

## Gold[18]

Gold is already recovered at high rates due to its value. We're continuing to identify ways to reduce the amount of gold we use in the plating of components like our printed circuit boards. In iPhone XS, for example, gold represents less than 0.01 percent of the overall product mass. We're working within the complex gold supply chain in order to increase the use of certified recycled gold.

## Paper

We've successfully created a closed-loop, circular supply chain for paper. For the second year in a row, 100 percent of the wood fiber in our packaging was either from recycled sources or from responsibly managed forests or controlled wood sources. And to ensure we're not taking away from the world's supply of responsibly sourced paper, for the third year in a row, we are protecting or creating enough sustainably managed forests to cover all the wood fiber we use in our packaging.

## Plastics

We've first focused on using less plastic through material efficiency. For example, we re-designed the way plastic was injected into the mold of a high-volume part in iPhone XS and iPhone XR, cutting the scrap produced by one-third. For the plastic we do use, we're looking for renewable or recycled alternatives to fossil fuel-based plastics. However, we use vast numbers of distinct grades of plastic, each designed to meet specific requirements. We are systematically exploring and qualifying recycled and renewable alternatives for each grade, so that whatever type of plastic a product needs, we will have a recycled or renewable option. So far, we've identified recycled alternatives for 24 different grades of plastic, allowing us to use an average of 38 percent recycled plastic across 82 components for products released this year. In our packaging, we're working to eliminate the need for plastics altogether, and we have reduced plastic in our product packaging almost by half in three years.

## Rare earth elements

Elements like neodymium, praseodymium, and dysprosium are used in magnets for audio applications, in cameras, and in haptics technology. Traditional recyclers don't recover these rare earth elements, because they are used in small quantities and technology has not advanced sufficiently to recover them. However, Daisy recovers the small components that contain rare earth elements from iPhone. By consolidating these sources, we're creating an opportunity for new technology to efficiently recover these materials.
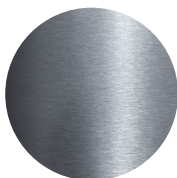
## Steel

Our primary use of stainless steel is in the enclosure of iPhone XS and iPhone XS Max, and in some Apple Watch models. We're working with our suppliers to increase and certify the recycled content in the stainless steel we source. And we've updated Daisy to recover the steel from iPhone enclosures and bands, which we then send to recyclers who are able to recover this highly recyclable material.

## Tin[18]

A market supply of recycled tin exists, but we need to make sure it meets our quality standards. In 2017, we proved we could use 100 percent recycled tin for the solder on the main logic board—where the majority of tin is found—of iPhone 6s. We're now specifying 100 percent recycled tin for the solder of the main logic boards of seven subsequent iPhone models plus the newly released MacBook Air with Retina display, iPad Air, and iPad mini. Using recycled tin in Apple devices will prevent us from mining almost 29,000 metric tons of tin ore in 2019. But we want to recover as much tin as we're using—and make sure the tin is recycled and put back into the world's supply. Unfortunately, tin is not recovered by all electronics recyclers. So we're prioritizing recyclers that recover tin, in addition to copper and precious metals, from the main logic boards and camera modules retrieved by Daisy.

## Tungsten[18]

Traditional recyclers shred products to quickly break them down. Though shredding makes separation easier, it can cause the recycler to lose many materials, like tungsten. That's why we designed Daisy as an alternative to whole unit shredding. Daisy is able to separate out the Taptic Engine, which we send to speciality recyclers that recover tungsten from it. We're also working with our suppliers to certify the use of recycled tungsten in our products.

## Lithium, tantalum,[18] and zinc

As we've advanced in our work to create circular supply chains, we've expanded our program to include other materials in our products, using the Material Impact Profiles to guide us. We recently added lithium, tantalum, and zinc. And we've already begun exploring new recycled sources and prioritizing recyclers that can recover these key materials.

# Built to last as long as humanly possible.

You count on your device day after day. So we design our products with durable materials, support them with ongoing OS updates, and make them easy to get repaired if anything happens. Because the longer a device is in use, the better use we make of the Earth's resources.

## Durable by design.

We design our products for durability. For example, we built iPhone XS to meet the IP68 international standard for dust and water resistance, which means the devices can withstand being submerged to a depth of 2 meters for up to 30 minutes. And we prove that recycled and renewable materials can also meet our standards. For example, the solder in the main logic board of iPhone is made with 100 percent recycled tin that performs every bit as well as newly mined tin.

In our Reliability Testing Lab, we amplify real-world conditions to enhance the durability of our designs. We test your device's ability to withstand mechanical stresses, such as a sudden impact with a hard surface. In climate tests, we pit our devices against extreme heat and cold, dry and humid conditions, and intense sun exposure. Our chemical sensitivity tests evaluate the ability of devices to stand up to accidental spills like coffee, soda, sunscreen, or ketchup. We often go beyond international standards, and sometimes even create our own.

With these tests, we intentionally push our products beyond their limits so we can study what happens. We then use state-of-the-art equipment, such as CT scanners and electron microscopes, to thoroughly understand impacts to the microstructure. This information flows back to our designers and engineers to enable further durability improvements. We repeat this cycle through our product development process until our products meet our rigorous performance standards.

## iOS updates your older device with new capabilities.

iOS has the best software update mechanism in the industry, bringing updates to more devices than anyone else. We provide this support so customers and developers alike can take advantage of the latest features, privacy and security updates, and other key improvements— enabling our customers to use devices longer.

iOS 12 was released in 2018 but is optimized for devices as far back as 2013, the largest base of support ever for an iOS release. It makes devices faster and more responsive; for example, iOS 12 enables an up to 70 percent faster camera swipe, up to 50 percent faster keyboard display, and up to two times faster app launch on the iPhone 6 Plus.[19] And many past generations of iPhone or iPad can take advantage of the latest features like Group FaceTime and Screen Time. Out of all devices using iOS—including those released many years ago—80 percent are using iOS 12.
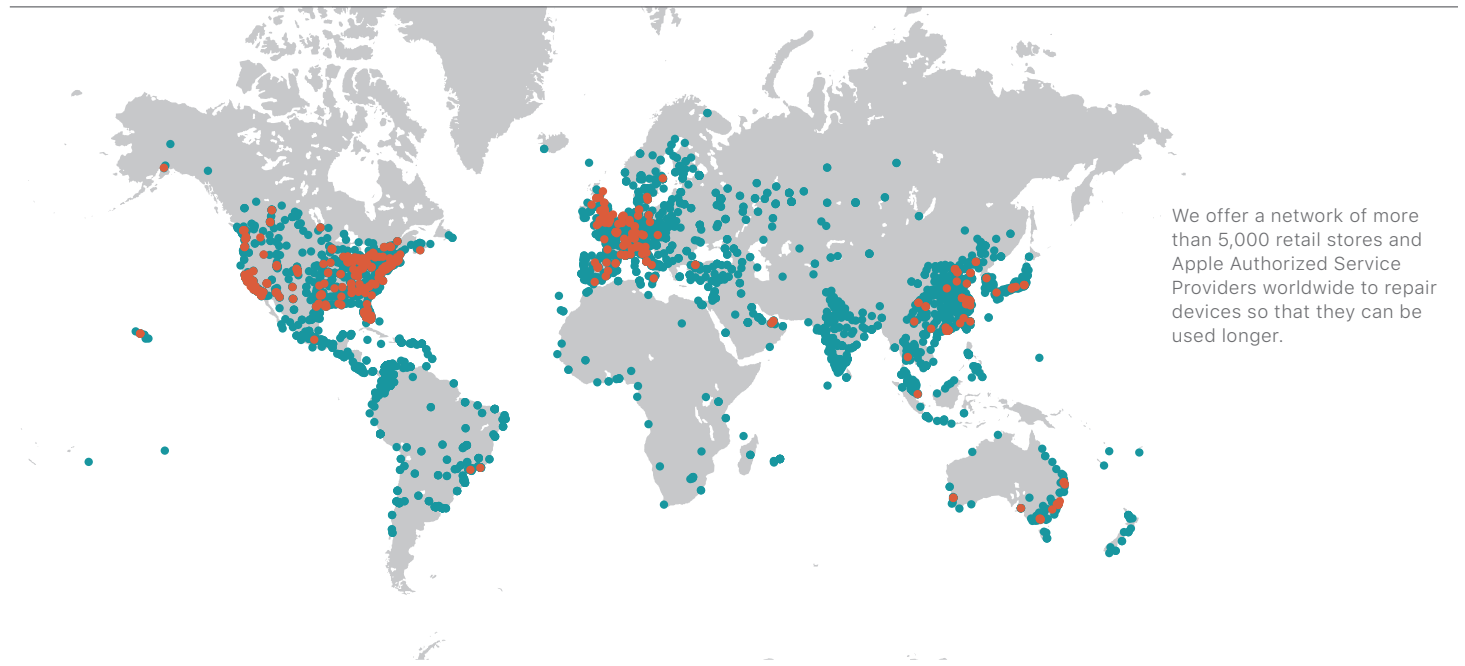
## Better use of materials through repair.

When devices are repaired rather than replaced, we make better use of the materials in them. And we know even the most dependable products sometimes need service. That's why we offer a network of more than 5,000 Apple Store locations and Apple Authorized Service Providers worldwide to provide safe, high-quality repairs. We offer battery replacement for all of our products—and we make sure the replaced batteries are recycled responsibly. Customers can access these repair locations in person or by mail. And we are continuing to expand our services.

To make sure that repairs are performed safely, securely, and to the highest quality, we continuously train and certify service channel personnel, with over 265,000 active trained personnel. Our providers perform diagnostics and calibrations to target repairs precisely, avoiding unnecessary service and replacements of parts. When new parts are needed, only genuine Apple parts are used, so repaired devices work exactly the way they should. And all Apple-certified repairs are backed by Apple.

We continue to expand access to high-quality and convenient repair options for our customers. Our new method for optimizing iPhone screen repairs has allowed thousands more independent shops to start offering this repair service.

**Repair locations**



We offer a network of more than 5,000 retail stores and Apple Authorized Service Providers worldwide to repair devices so that they can be used longer.

● Apple Authorized Service Providers  ● Retail stores

# Trade it in. Help the planet out.

Even when you're done with your device, chances are it still has more to give to the world. Apple Trade In is a simple way to exchange your old device for credit so that it can be reused by a new owner. If it isn't eligible for credit, we'll recycle it free of charge.[20] Either way, your trade-in helps reduce the amount of materials that need to be mined from the Earth. That's a trade-off that works for everybody.

## Refurbishing for a new life.

Our devices are built to last. That's why they often go on to a second or even third user. Through Apple Trade In, customers in 27 countries can trade in their devices either online or in-store. For products that still have more to give, customers can receive an Apple Store Gift Card or a refund on their purchase. These devices are repaired when necessary and sent to their next owner. If a product is at the end of its life, we'll recycle it for free. We also collect and refurbish used devices through our iPhone Upgrade Program, AppleCare, and, inside Apple, our Hardware Reuse Program for employees. Altogether, we directed 7,860,000 devices to new users in fiscal year 2018. Keeping these devices in use rather than needing to make new products to serve those customers resulted in tangible material and carbon emissions savings.
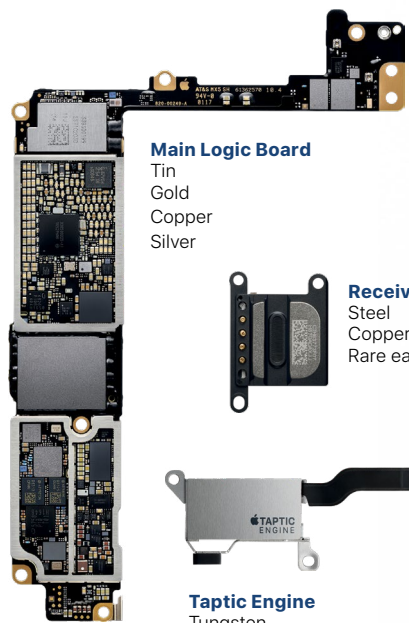
## Recycling for material recovery.

After sourcing responsibly and creating long-lasting products, we focus next on recovering materials. We participate in and offer product collection and recycling programs in 99 percent of the countries in which we sell products.[21] These programs recycle our products and other electronics, all for free. In fiscal year 2018, we helped divert more than 48,000 metric tons of electronic waste from landfills. And we continue to make these programs more accessible.

To truly end our reliance on mining, we also need to better capture the materials inside the products we recover. We created our disassembly robot, Daisy, to remove and sort components, so we can recover more materials at a higher quality than traditional recyclers can. This year, we updated Daisy to disassemble six additional iPhone models—15 models in total—from iPhone 5 to iPhone XS. Even while identifying models in real-time and disassembling devices with greater variation, Daisy can take apart 200 iPhone devices per hour. In the U.S. and the Netherlands, Daisy is now processing end-of-life iPhone models returned to us through Apple Trade In and AppleCare.

Some of the recovered materials are already heading back into our supply chain for new products. Most of the aluminum recovered from iPhone, for example, became part of the 100 percent recycled aluminum enclosure of MacBook Air. And cobalt we recovered from the iPhone battery is used to make new Apple batteries. Because of our efforts to keep harmful substances out of our products, these materials are safer to recover and reuse.

For some materials, however, efficient recycling technologies don't exist. We don't believe technology should be a barrier to conserving the Earth's resources. That's why we created our new Material Recovery Lab in Texas. The lab will focus on three key areas: optimizing existing recycling practices, improving the ability to disassemble devices, and advancing research and development of the next generation of recycling technologies. We aim to benefit the broader recycling industry through this research. After all, the more material that gets reused, the less that needs to be mined from the Earth.

## Components and materials Daisy recovers

**Main Logic Board**
Tin
Gold
Copper
Silver

**Receiver**
Steel
Copper
Rare earth elements

**Taptic Engine**
Tungsten
Rare earth elements
Steel
Copper

**Wireless Charging Coil**
Gold
Copper
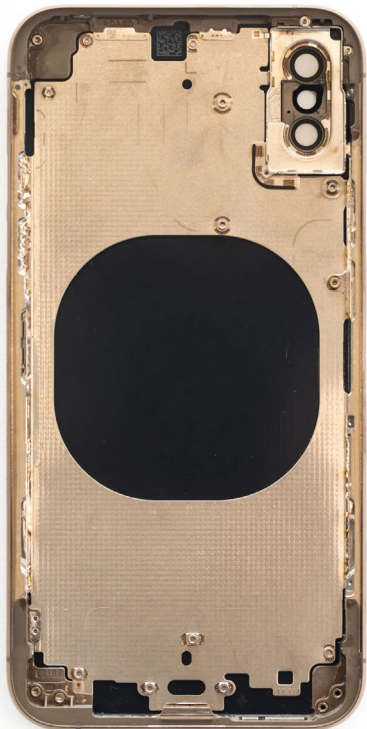
**New Enclosures** (iPhone 8 and later)**
Aluminum
Copper
Steel

**Old Enclosures** (iPhone 7 and earlier)
Aluminum
Steel

**Battery**
Cobalt

**Speaker**
Steel
Copper
Rare earth elements
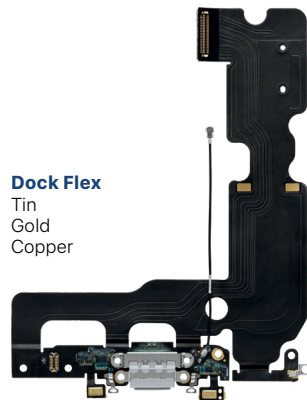
**Dock Flex**
Tin
Gold
Copper

**Rear Camera**
Copper
Tin
Gold
Rare earth elements

**Front Camera and Face ID**
Copper
Tin
Gold
Steel

### For every 100,000 iPhone devices, Daisy has the potential to recover:*

| | |
|---|---|
| **Aluminum** | 1,500 kg |
| **Gold** | 1.1 kg |
| **Silver** | 6.3 kg |
| **Rare earth elements** | 32 kg |
| **Tungsten** | 83 kg |
| **Copper** | 1,000 kg |
| **Tin** | 29 kg |
| **Cobalt** | 790 kg |
| **Steel** | 1,400 kg |

* These quantities are based on an estimated product mix for what Daisy is likely to disassemble in the upcoming year, reflecting additional iPhone models. Recovery quantities do not reflect potential losses that may occur during the recycling process.

** Includes a support plate, backglass, and housing band.

# Building a circular fiber packaging supply chain

To improve our packaging, we are working to eliminate plastics, increase recycled content, and reduce our packaging overall. The results are more beautiful than ever—for our packaging and for the planet.

## Cutting down on plastic.

In three years, we've reduced our plastic use in U.S. product packaging by 48 percent. Starting with iPhone 7 and iPad Pro, we changed the plastic tray in the packaging to an all molded fiber alternative. This switch allowed us to also create iPhone XS and XR, iMac Pro, MacBook Air, iPad mini, and iPad Pro with majority-fiber packaging. And as of March 2019, we've transitioned to 100 percent fiber retail bags in all retail stores. These new bags even have a knitted paper handle and contain 80 percent recycled fiber.

## Using recycled and responsible sources.

We aim to maximize the use of recycled paper in our packaging. In fiscal year 2018 we used 58 percent recycled paper, on average. When virgin paper is needed, we require our suppliers to source wood fiber from responsibly managed forests or Forest Stewardship Council (FSC) controlled wood sources.[22] For the second year in a row, all of our packaging suppliers sourced their paper responsibly. And we conduct regular audits to ensure their claims.

Outside of packaging, less than 1 percent of our total fiber use is for our corporate offices—of which approximately 85 percent came from recycled or responsible sources in 2018.

**Packaging fiber and plastic footprint\* (metric tons)**

| | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| Plastic | 37,000 — 21% | 34,000 — 21% | 24,000 — 14% | 19,000 — 10% |
| Total | 171,500 | 165,000 | 169,000 | 187,000 |
| Virgin fiber\*\* | 53,000 — 31% | 50,000 — 30% | 51,000 — 30% | 60,000 — 32% |
| Recycled fiber\*\* | 81,500 — 48% | 81,000 — 49% | 94,000 — 56% | 108,000 — 58% |

■ Plastic    ■ Recycled fiber\*\*    ■ Virgin fiber\*\*
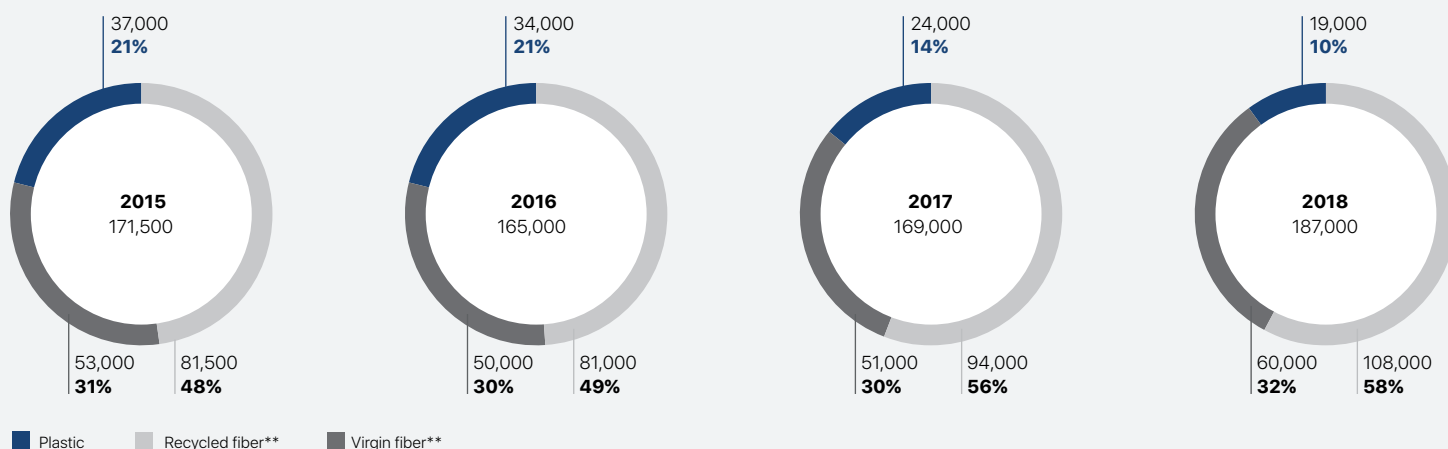
\* The packaging fiber and plastic footprint includes retail and shipping boxes.

\*\* Beginning in FY18 we considered bagasse to be responsibly sourced virgin fiber, instead of recycled fiber.

# Protecting responsibly managed forests.

We don't just specify that all of our virgin fiber be sourced responsibly, we also want to make sure we're not diminishing the world's supply of responsible paper. For the third consecutive year, production from the responsibly managed forests we've protected or helped to improve exceeded the amount of virgin fiber we used in our product packaging.[23]

One year early, we achieved our 2020 goal of transitioning one million acres of forest across China to improved management. This is part of our five-year partnership with World Wildlife Fund, which is focused on three primary objectives:

- Increase responsible management of working forests in China—by creating up to 375,000 acres of FSC-certified forests, and up to 640,000 acres of forests under improved management.

- Contribute to the improvement of China's policy framework to encourage responsible forest management.

- Help China establish long-term market incentives for responsibly sourced paper.

In addition to improving the management of 1 million acres of forest directly, the project has the potential to influence millions more by supporting the development of the China Sustainable Plantation Management Guidelines. These guidelines, informed by our project and released by China's National Forestry and Grassland Administration, have been selected by the national government for use in the National Reserve Forest Plan, which guides the management of more than 40 million acres of forest.

In the U.S., we continue to partner with The Conservation Fund (TCF) and support its innovative Working Forest Fund® model. Through this fund, TCF purchases threatened working forests, protects them into the future through conservation easements, then sells the protected forest to begin the process again. So far, we've protected 36,000 acres of forest in the Eastern United States that are now certified as sustainably managed. And when forests thrive, so do local communities and wildlife.

**Our journey to responsible packaging**
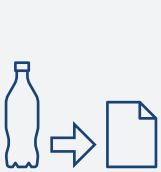


**48%** ↓
reduction in plastic use in 2018, compared to 2015

**58%**
average recycled wood fiber content

**100%**
of wood fiber in our packaging comes from certified responsibly managed forests

**100%**
We are protecting or creating enough responsibly managed forests to cover all of the virgin paper we use in our packaging

# Finding new ways to keep old materials out of landfills.

We're working to reuse, recycle, compost, or when necessary, convert into energy all the waste created by our own facilities and in our supply chain. Reaching this goal requires collaboration among multiple Apple teams, local governments, and specialty recyclers, and we've already seen great success.

## A zero waste program for Apple facilities.

We're currently pursuing an ambitious goal of Zero Waste to Landfill at our more than 450 corporate facilities, our more than 500 retail stores, and our five data centers.[24] Our first aim is to reduce the waste we generate by rethinking the materials we use—in areas from building renovations to food service. And for the waste we do create, we're working to recover it to its highest and best use through robust composting, recycling, and reuse programs.

In fiscal year 2018, we generated 74,000 metric tons of waste and diverted about 74 percent from landfill through recycling and composting, up 3 percentage points from fiscal year 2017. To reduce the waste we generate, we work with our upstream vendors to streamline materials used and select those designed with the environment in mind. For example, we set up new packaging standards for all of our data centers, eliminating unnecessary packaging and finding ways to reuse the packaging shipped. When we do create waste, we focus on managing it responsibly. In renovations across our hundreds of corporate facilities, nearly 85 percent of the furniture is recovered, repaired, and made available for reuse. And because lack of data is one of the biggest obstacles to managing waste well, we installed remote monitoring systems that allow us to identify problem areas and resolve them quickly and accurately.

Across facilities that generate hazardous waste, Apple takes great strides to ensure it is managed responsibly. We complete regular audits of the Transportation, Storage, and Disposal Facilities (TSDFs) where hazardous waste is ultimately sent to be treated, recycled, or incinerated. Only facilities we audit are allowed to accept and treat the hazardous waste Apple generates. We take this commitment seriously—if any TSDF does not meet our strict standards for environment, health, safety, and waste management protocols, we send waste to an alternate, approved facility.

# 1 million metric tons

Through our supplier Zero Waste Program, we've diverted enough waste to cover more than 4,000 soccer fields 1 meter deep.

## A zero waste program for our suppliers.

In 2015, we launched a Zero Waste Program for suppliers, which provides them with onsite support to recycle and reuse materials. The aim is to divert 100 percent of waste from landfills. We provide tools and guidance, including the services of experts in sustainable waste management.

Initially we prioritized suppliers with the most significant waste impact: final assembly facilities where components from all over the world come together to be assembled into Apple products. Our goal was to help these facilities drastically reduce the waste they send to landfill. And in 2018, we achieved UL's Zero Waste to Landfill certification for all final assembly facilities across iPhone, iPad, Mac, Apple Watch, AirPods, and HomePod.[25] This includes the Apple-operated final assembly site in Cork, Ireland, which was the first Apple facility to receive the designation from UL.

We've since expanded our efforts further upstream in our supply chain to include sub-assembly suppliers. However, the deeper we go, the more complex the waste streams become. So we are looking for new technological innovations, exploring up-cycling techniques to reuse by-products, and even reassessing manufacturing processes.

In 2018, we diverted 375,000 metric tons of waste from landfills. And to date, we've engaged 90 suppliers and diverted more than 1 million metric tons of waste—enough to cover more than 4,000 soccer fields a meter deep.

## Water Stewardship

# Protecting Earth's most precious resource.

Water supports all life on Earth. And while water itself is plentiful, only a small fraction is available to those who need it. The scarcity of freshwater continues to increase, a trend exacerbated by climate change. So we hold ourselves accountable for the water we use, whether at our corporate offices, data centers, distribution centers, and retail stores, or at our suppliers' facilities around the globe.

## How we're tackling our water footprint.

Water is necessary to operate our corporate facilities, including for cooling at our data centers. At our manufacturing facilities, suppliers use water for processes like etching, cutting, cleaning, and cooling. So we work to conserve it and be smarter about the water we do use. We focus both on improving water use in our facilities and—through our Clean Water Program—helping our suppliers conserve water and prevent water pollution. And we are engaging communities where we operate and manufacture products to make sure shared water resources are protected and accessible. We're proud of the progress we've made, but we know there's still work to do.

We mapped our global water use to different levels of water risk. As a result, we're focused on three locations with elevated water risk—Maiden, North Carolina; Mesa, Arizona; and Santa Clara Valley, California—where 52 percent of our total use occurs.

To continue to improve our water use by our facilities and our suppliers, we focus on:

- Using water efficiently to reduce overall use.
- Identifying alternative water sources, such as recycled and reclaimed water.
- Discharging water responsibly to prevent pollution.
- Expanding our water stewardship to keep watersheds healthy for all who rely on them.

Water resources are extremely local. That's why we focus on areas where our efforts can have the largest positive impact. We map our global water use against water quality, quantity, and regulatory factors to understand which regions have an elevated risk. We then prioritize those locations based on how much water we're using. We continually update our risk assessment based on new data and better understanding of the regional environments in which we are operating. And when engaging with suppliers, we put a special emphasis on working with those with high water usage, the potential for poor discharge quality, and facilities in water-stressed regions. Working with suppliers is key, as early assessments show that manufacturing represents the majority of our water footprint.[26]

## Using water efficiently.

Water is essential to the work we do. However, we aim to minimize the water used by our facilities and our suppliers' operations, especially in areas of elevated water risk. And by continuing to expand our reduction efforts, we aim to improve our footprint over time.

In fiscal year 2018, Apple used about 1.26 billion gallons of water directly, a 26 percent increase over the previous year. This increase was driven largely by growth in a few locations, and by increased visibility into temporary water use. These temporary uses accounted for 140 million gallons of water in 2018, and include things like dust control for new construction and the establishment of mature, drought-tolerant trees in landscaping.

### Water use at Apple facilities
We track our corporate water use for our data centers, retail stores, and corporate offices.



**Millions of gallons**

■ Freshwater use  ☐ Recycled water use  ▉ Temporary freshwater use
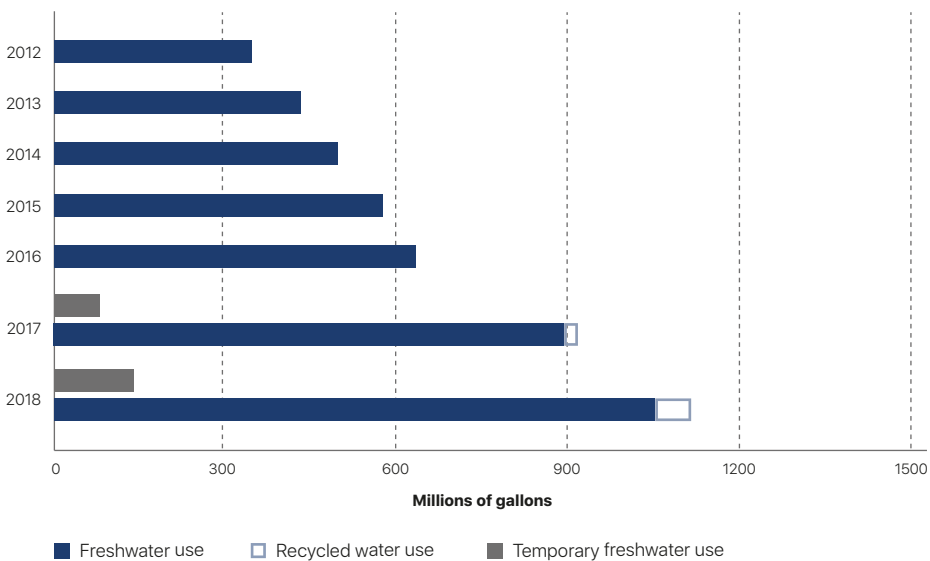
Beginning in fiscal year 2017, our boundary expanded to include more than 150 million gallons of water used annually at distribution centers and co-located data centers.

# 5x

increase in total water
savings from the Clean
Water Program in two years

Our water footprint shows us that we need to continue to reduce our water demand. This year, a number of different water efficiency efforts helped minimize our freshwater use. We designed our latest data centers buildings in Maiden, North Carolina; Reno, Nevada; Viborg, Denmark; and China to use 80 percent less water for cooling than at previous data centers. In our retail stores, our newly launched back-of-store, or "backstage," design includes low-flow fixtures that save up to 30 percent more water compared with our previous design. And at our corporate offices in Santa Clara Valley, our landscape efficiency program continues to reduce our outdoor water use—by more than 15.3 million gallons per year—through turf replacement and irrigation system upgrades. Around the world, our pursuit of water efficient design is expected to save more than 90 million gallons of water per year.

Through our supplier Clean Water Program, we help those who make our products improve their water use by performing baseline assessments, providing technical support on water-saving improvements, and monitoring progress. Our suppliers conserved 7.6 billion gallons of water across 116 facilities in 2018, bringing the total cumulative savings to 21 billion gallons since 2013. These savings were achieved through diverse initiatives including installation of low-flow fixtures, use of meters to control consumption, and employee education. And since many of our suppliers also build components for other companies, we're reducing the water footprint of non-Apple products, too.

## Finding alternative sources.

As we work to minimize our overall water use, we also look to alternative sources to help reduce freshwater withdrawals, including recycled water, reclaimed water, and harvested rainwater.

Across our facilities, use of recycled water worldwide grew from 24 million gallons to 63 million gallons in fiscal year 2018. This reflects recycled water use in two of our three largest co-located data centers as well as offices in Elk Grove, Singapore, and India. We have also made significant investments to bring recycled water to our campuses in Santa Clara Valley, an effort that will replace over 30 million gallons of potable freshwater a year.

Captured rainwater represents another alternative source of water for our facilities. In 2018, we captured and reused 4 million gallons of rainwater for cooling, irrigation, and construction needs at our Maiden, North Carolina, data center, and at our corporate offices in Cork, Ireland, and Yokohama, Japan. And our newest retail location, Apple Champs-Élysées, features a rainwater collection system which can collect up to 1,800 gallons of water a day. This system will reduce potable freshwater use by 15 percent per year at the store.

When we engage suppliers, we also focus on ways to reclaim and reuse water. We look for creative sources of water to reclaim, including condensation from centralized air conditioning. For water reuse, even simple solutions can be highly impactful. For example, we encourage the re-use of the water used to wash products in-between production stages. As they are rinsed, products are moved from tub to tub of water, and as they do so, both the device and water gets cleaner. Simply moving rinse water in the opposite direction of the devices as it gets dirtier, rather than dumping it, allows the same rinse water to be reused two to three times. With solutions both simple and complex, we've increased the average water reuse to 39 percent across suppliers.

Water Treatment Manager at a Clean Water Program facility for packaging manufacturing, China.

## Discharging water responsibly.

Managing wastewater discharge is also an important way to conserve water resources in a watershed.

At our Santa Clara Valley campus, we're implementing an onsite wastewater treatment system that will treat approximately 550,000 gallons per year of water onsite and return it to the municipal wastewater system. And at our data centers in Prineville, Oregon, and Reno, Nevada, our teams have been deploying a mineral filter media that allows us to recapture more of the water we use in cooling, reducing water discharge by up to 30 percent.

Our Supplier Code of Conduct includes standards for wastewater discharge quality, and we regularly audit for compliance with these high standards. Our Clean Water Program engagement goes beyond compliance to help our suppliers build world-class water management systems. We target supplier sites based on water discharge risk and launch intensive, multi-year engagements. We begin with a comprehensive assessment that leads to targeted improvements, including installation of improved infrastructure, use of cutting-edge wastewater treatment technologies, and the creation of systems for validating discharge. Throughout the program, we engage deeply to create cultural change and promote greater water literacy.

**Pursuing water stewardship.**

Water connects communities. It's also essential for human health and thriving ecosystems. So we look beyond our own operations to restore water resources in critical regions and ensure that local communities have water access.

In Prineville, Oregon, we created a water supply solution to meet the needs of Apple's local data center and the broader community for years to come. We partnered with the City of Prineville to build an aquifer storage and recovery system, which uses natural underground spaces to cost-effectively store water throughout the year for use in peak demand months. With a storage capacity of up to 180 million gallons—significantly more than we use for our data center—the system also helps mitigate future climate-related risks of water shortages.

Apple and our suppliers have also partnered with the Alliance for Water Stewardship (AWS), a collaboration between businesses and nongovernmental organizations (NGOs), in a program to support water management beyond the factory and into the community. We've launched a pilot project with five suppliers in the Kunshan region of China, an area with a cluster of electronics suppliers that is experiencing water-quality challenges. These five suppliers aim to meet the AWS global standards, which promote effective water management and safe water, sanitation, and hygiene (WASH) for local communities. Already, two Apple suppliers have received AWS certification, including the first Gold certification ever to be awarded in the electronics industry. And we plan to expand our supplier stewardship program to improve water quality at other sites like the Yangtze River Delta and the Pearl River Delta.

Apple Champs-Élysées is expected to receive a BREEAM "Very Good" green building rating. Environmental features include energy efficient lighting, a rainwater collection system, and responsibly sourced materials.

# Championing green building design

## 12 million sq. ft.

We are constructing and certifying more than 12 million square feet of green building space worldwide.

 Buildings are the embodiment of our commitment to conserve water and energy, reduce waste, and use renewable energy. We actively apply green building principles to all of our offices, data centers, and retail stores around the world.

Wherever possible, we pursue green building certifications like U.S. Green Building Council's LEED certification and the Building Research Establishment Environmental Assessment Methodology (BREEAM). Apple Park, our new headquarters in Cupertino, is on track to be the largest LEED Platinum-certified office building in North America. When we constructed our Hollyhill building at our campus in Cork, it was one of only six in Ireland to be awarded an "Excellent" rating by BREEAM. And our data center in Viborg, Denmark, is LEED Gold certified—as are buildings at our data centers in Reno, Nevada; Maiden, North Carolina; Mesa, Arizona; and Prineville, Oregon.

At our retail stores, we also apply green building principles to reduce our demand on the environment, while providing healthier spaces for our customers to experience our products. When we renovated a historic building on the Avenue des Champs-Élysées for our new retail location, we installed environmental features like high-efficiency lighting systems, rainwater collection, and onsite PV panels, which are expected to earn the building a rating of "Very Good" from BREEAM. Our newly launched back-of-store design for retail locations reduces energy load by 40 percent and is made of recycled materials, including insulation made with 80 percent post-consumer recycled denim. More than 50 stores have already been built with this design. We have also committed to sourcing only Forest Stewardship Council (FSC) certified materials for all tables, benches, and wood fixtures in all new retail stores—nearly 150 locations and hundreds of tables in 2018 alone. FSC only certifies wood made from forests that protect water resources, promote biodiversity, and enhance the lives of workers and local communities.

Since 2017, 100 percent of supplier
assembly sites have adopted safer cleaners
and degreasers with our help.

Smarter Chemistry

# Making products as safe as they are sound.

# Smarter Chemistry

Materials are what make products faster, tougher, and more beautiful. But they're not all created equal. That's why Apple applies our best innovation to choosing materials that are safe for the people who use our products, for the people who make and recycle them, and for our planet.

## Highlights

### RSS updates

We updated the Apple Regulated Substances Specification to strengthen supplier requirements and restrictions on harmful substances.

### Safer cleaners and degreasers

All supplier final assembly sites have adopted safer cleaners and degreasers.

### Full Material Disclosure

We continued to expand our Full Material Disclosure (FMD) program, and we collect comprehensive chemical data for over 75% by mass of new iPhone, iPad, and Mac products.

### Chemicals management

In 2018, we graduated 50 supplier facilities from our supplier Chemicals Management Program.

## Our Approach

# Better thinking means better chemistry.

We have led the industry in removing many harmful substances from our products, and we go to great lengths to make sure that what we take out stays out. Our approach begins with collecting comprehensive chemical composition information for the substances used to make our products as well as the process chemicals, like cleaners and degreasers, suppliers apply when making our products. We use this information to evaluate supplier compliance with the Apple Regulated Substances Specification (RSS)—our own set of global chemicals restrictions that goes beyond regulatory requirements and is based on best industry practices or toxicology properties. We go even further by using the chemical composition information we've collected in order to assess the hazard and risk of unregulated substances. And if we ever identify a substance that needs replacement, we innovate with our suppliers to find safer alternatives.

## Our approach to smarter chemistry

**Mapping and engagement**
Create a comprehensive inventory of chemicals used by suppliers to make our products

**Assessment and management**
Assess and manage chemicals for risks to human health and environment

**Innovation**
Transition to safer chemistries through chemical innovations, beyond what is required
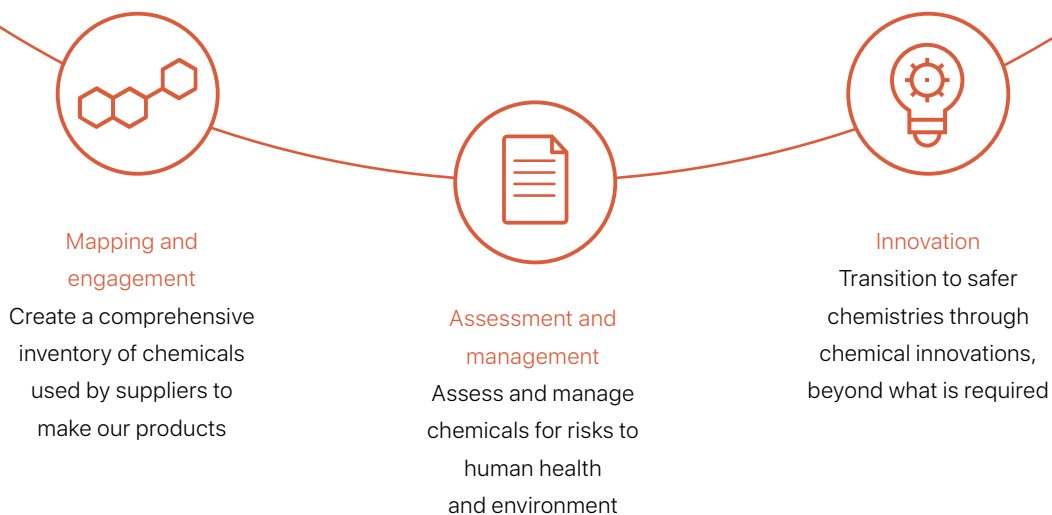
## Mapping and Engagement

# We're exhaustively mapping materials in our products.

Evaluating the chemicals in the tens of thousands of components used in our products is an enormous task, but it's essential to our commitment to customer safety. It starts with creating an extensive inventory of chemicals used to make them. That means collecting information not just from our suppliers, but from their suppliers, too. We're working closely with our partners to construct a detailed map of every chemical inside our materials, including many of the chemicals used to manufacture them.

We go beyond what's required by law to eliminate harmful chemicals from our products. In 2016, we launched the Full Material Disclosure (FMD) program, an ambitious initiative aimed at helping us more comprehensively understand the chemical composition of every substance in every part of our products. This can be challenging because it requires that suppliers disclose proprietary information. We overcome this by storing the data securely and limiting access to a select number of people within Apple who are responsible for toxicological assessments. We prioritize materials with the greatest risks, such as those used in high quantities or those with the greatest human exposure. We collect detailed chemical information for tens of thousands of components and over 75 percent of product mass for new iPhone, iPad, and Mac products. We won't stop until we rigorously understand the chemistry of every material.

In 2015, we went a step further by creating an inventory of chemicals that are used at supplier facilities but don't reside in the products. We mapped the process chemicals used in our final assembly facilities and evaluated all control measures such as ventilation, personal protective equipment, and worker training programs. The mapping resulted in the further identification—and continued replacement—of potentially harmful substances that required controls and personal protective equipment from cleaners at final assembly sites.

## Assessment and Management

# We evaluate chemicals for risks to your health, and the planet's.

 In 2002, we introduced the RSS, which identifies the harmful chemicals we limit or prohibit in our manufacturing processes and products. In 2006, we built our own Environmental Testing Lab, where our chemists look for any potentially harmful substances and test products to evaluate compliance with the RSS. Since the lab's opening, we have expanded it to more than 30 times its original size and have regularly updated it with state-of-the-art equipment—like an inductively coupled plasma mass spectrometer, liquid and gas chromatography mass spectrometers, and a laser-induced breakdown spectrometer similar to the one used by NASA. We even manufacture artificial sweat to simulate human exposure and evaluate the safety of our materials that come into contact with skin.



We screen our materials with comprehensive risk assessment tools, including GreenScreen®, which evaluates substances against 18 different hazards, including carcinogens, mutagens, and endocrine disruptors.

At Apple's onsite environmental testing lab, chemists assess products for harmful chemicals.

With information collected from the environmental testing laboratory, and the FMD and chemical mapping programs, we can then generate comprehensive toxicology assessments. This includes GreenScreen®, which considers 18 criteria to help us understand the materials' effects on people's health and 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—addressing a major challenge in this field. Only materials that pass our rigorous review process are accepted for our products.

We're just as committed to the safety of the people who make our products. We require our suppliers to follow the standards set in our RSS. In 2014, we launched our Chemical Management Program to help suppliers develop a comprehensive approach to managing chemicals safely. The program, which has grown to 113 participating supplier facilities, enables our partners to shift to safer chemicals and improve general safety, awareness, and training. And to help drive toward safer chemicals, we map chemicals use and screen them using GreenScreen® to assess the safety of cleaners and degreasers used at supplier final assembly facilities.

## Chemistry Innovation

# Inventing ways to replace bad substances with good ones.

We're continually evaluating the materials used in our products and design to avoid harmful substances altogether. We seek to reduce and remove toxins, by developing new, safer chemistries. When there is not an existing alternative to a chemical we've determined harmful, we innovate. We work with our suppliers to develop custom chemistries made with safer substances. To find a replacement for PVC and phthalates, for example, we and our suppliers invested in four years of research and development to create power cords and headphone cables that had both the performance and chemistry that met Apple standards.[27] This deep commitment to innovating on safer chemistries sets Apple apart from many others who still use PVC and phthalates in their cables.

We began to identify and phase out harmful substances in the late 1990s, beginning with PVC in our packaging, and moving on to the lead that was in our display glass and solder.[28] Since then, we've also replaced mercury displays with energy efficient and mercury-free LEDs and OLEDs; eliminated arsenic from display glass;[29] replaced brominated flame retardants from thousands of parts such as enclosures, cables, circuit boards, and connectors, using safer metal hydroxides and phosphorus compounds in their place;[30] and eliminated beryllium-copper connectors and springs from all new product designs.

We're also focused on replacing harmful substances in manufacturing process chemicals to keep workers in our supply chain safe. We have long been engaging with our manufacturing partners to ensure safe working conditions. After analyzing the chemical composition of cleaners and degreasers used at supplier final assembly sites, we chose to go a step further and replace all identified hazardous chemicals with safer alternatives such as ethanol, isopropyl alcohol, glycerol, and water. In our first year of this Safer Cleaner Substitution program, we helped 18 sites replace 24 problematic formulations.[31] In addition, in 2018, we added n-Propyl Bromide (nPB) to our RSS list of banned process chemicals for cleaning and degreasing. These efforts seek to avoid use of harmful chemicals, which protects the people who make, use, and recycle our products and keeps pollutants out of the land, air, and water.

## 100%

Since 2015, 100 percent of the process chemicals used at our supplier final assembly facilities complied with Apple's Regulated Substances Specification.

We removed PVC and phthalates from all our power cords, headphones, and cables.

**A timeline of smarter chemistry**

Our program initially moved beyond a strictly compliance focus in the late 1990s, when we started to phase out PVC from our packaging. The scope and depth of our work has significantly expanded since then, always remaining above what's required by law.

Eliminated brominated flame retardants

All supplier final assembly sites adopted safer chemicals and degreasers

Initial phase-out of PVC in product packaging

Phased out lead from display glass and solder

Replaced PVC and Phthalates with safer alternatives**

Eliminated beryllium

**2000**  **2004**  **2008**  **2012**  **2016**  **2020**

Introduced RSS

Environmental Testing Lab opened

Eliminated mercury

First supplier audits

10th Update to RSS

Process chemicals mapped at supplier final assembly sites

Launched supplier Chemical Management Program

Eliminated arsenic from display glass*

\* Arsenic is present in minuscule quantities in some semiconductor devices.

\*\* Every Apple product is free of PVC and phthalates with the exception of power cords in India, Thailand, and South Korea, where we continue to seek government approval for our PVC and phthalates replacement.

We partnered with Conservation International to protect a 27,000-acre mangrove forest in Colombia and develop a new methodology for quantifying the "blue carbon" that mangroves sequester underwater.

Better Together

# Leading.
# And listening.

# Better Together

The challenges we're tackling—like powering a global business with 100 percent renewable energy, or making products using only recycled or renewable materials—are too big for any one company to solve alone. So we listen. We speak. We convene. We advocate. We lead. We learn. And we engage at all levels: locally, nationally, and internationally; and with policymakers, researchers, non-governmental organizations, other companies, and our customers. Every conversation, every meeting, and every presentation brings us closer to unlocking more environmental innovations that we—and others—can apply. Because bold ideas and creative solutions can emerge anywhere, from anyone, at any time.

## More partnerships. More progress.

We work with a wide range of nonprofit, industry, government, and business partners from across the globe. We've built strong relationships with a broad group of stakeholders, including those who might disagree with our approach. We do this because we believe that addressing their concerns often leads to better solutions. Exposing ourselves to varied perspectives helps us challenge our assumptions and refine our methods. That's critical when you're pursuing a vision that's as bold and complex as ours: to one day make products without taking from the Earth.

Joining industry associations allows us to work closely with some of the best companies across all sectors. Our memberships in organizations like the World Business Council for Sustainable Development (WBCSD), World Economic Forum's Platform for Accelerating Circular Economy, Ellen MacArthur Foundation, Aluminum Stewardship Initiative, Ceres, Corporate Eco Forum, the Chinese Association of Circular Economy, Digital Europe—and most recently, the Japan Climate Leaders Partnership—provide us the opportunity to exchange ideas with those who share our commitment to a more sustainable future.

Lisa Jackson speaks at the annual meeting of the American Geophysical Union about the role of the private sector in spurring smart, innovative environmental action. At Apple, we believe that telling the story of our vision and our progress can inspire others to join our efforts.

# Collaborating for joint success.

We've continued to work with cross-sector companies, researchers, suppliers, technical experts, and customers to forge new paths, build unique solutions, and inspire others to continue their efforts.

## Academic partnerships.

We are building relationships with key academic institutions worldwide—like Tsinghua University's School of Economics and Management in Beijing, where we are funding a $3 million endowed chair professorship based on Responsible Innovation. We also collaborated with Tsinghua University's School of Public Policy and Management on its Summer Institute for China's Green Innovators (SICGI) program. In the past three years, 112 students from 50 universities joined the program to identify creative policy solutions to environmental challenges through course training and internships with local environment agencies.

To support our Smarter Chemistry work, in 2015, we formed a Green Chemistry Advisory Board, made up of some of the world's leading toxicologists, researchers, and academics. The board helps us explore innovative ways to minimize or eliminate toxins from our supply chain and to incorporate the latest breakthroughs in green chemistry into our products and processes.

# Customer engagement.

We seek to engage customers in our environmental mission, giving them opportunities to join in our efforts. In the past three years, we have launched two customer-facing campaigns: Apps for Earth; and communications around the benefits of returning devices to Apple for trade-in or recycling.

Apps for Earth was a 2016 partnership with app developers and customers that generated over $8 million to support World Wildlife Fund's global environmental projects. As of November 2018, World Wildlife Fund has fully invested the funds raised in conservation projects spanning all seven continents. These projects have helped protect wildlife through improved tracking, increase access to freshwater in vulnerable communities, promote sustainable food production and consumption, improve community management of forests, use technology to advance ocean conservation, and build resilience in ecosystems threatened by climate change.

For every device received through Apple Trade In during a two-week period around Earth Day 2018, Apple made a donation to Conservation International. We then partnered with the nonprofit to use the funds 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 can also store up to 10 times more carbon than forests on land. This is because mangroves store significant amounts of "blue" carbon in the soil below the water line, in addition to storing carbon in their roots, leaves, and branches like other trees. Our project with Conservation International was the first to fully value the entire ecosystem— trees and soil—for its climate mitigation value. We hope this effort will encourage the protection of threatened mangrove ecosystems globally as important resources in the fight against climate change.

We also donated to the SEE Foundation in China with funds raised from the Earth Day campaign. With this contribution, SEE Foundation supported 20 grassroots NGOs in China focused on enhancing waste management and pollution control. SEE also facilitated cross-industry collaboration such as introducing Zero Waste concepts to the outdoor sports industry.

# Stakeholder roundtables.

Over the past several years, we have invited key stakeholders to participate in roundtables in Europe, the United States, and China to obtain feedback on Apple's key environmental programs, like our work on Smarter Chemistry and our ambition to create a circular supply chain for the materials in our products. Attendees at these roundtables have included a range of academics, NGOs, industry leaders, and other companies. Since these meetings, we have collaborated with subject-matter experts, think tanks, NGOs, and consulting firms to support our work.

# Speaking up for stronger climate policies.

Climate change is one of the greatest threats facing our planet. Clean energy technology offers tremendous benefits to our suppliers, electricity grids, and communities around the world. We believe that if policymakers fully and properly value these benefits, clean energy becomes more cost-competitive than fossil fuel energy. Market and policy design is not one-size-fits-all, so we work closely with our suppliers and local experts to find the best solution for each country. For the past four years, we have been advocating for strong climate policies that promote decarbonizing our economy and support procurement of renewable energy.

**July 2015 (U.S.):** Apple joined the White House's American Business Act on Climate Pledge, in which participating companies voiced support for a strong outcome at the COP21 in Paris and demonstrated an ongoing commitment to climate action.

**April 2016 (U.S.):** Apple joined Google, Microsoft, and Amazon to sign an amicus brief in support of the U.S. EPA's Clean Power Plan

**June 2016 (World):** Lisa Jackson addressed 700 senior government, business, and community leaders at the seventh Clean Energy Ministerial, where she called for governments across the world to put a price on carbon to address climate change.

**April 2017 (Japan):** Apple joined nine other companies, including Fujitsu, Ikea, Microsoft, Patagonia, and Sony to formally encourage the Japanese government to promote corporate renewable energy use.

**June 2017 (China):** Apple spoke at the eighth Clean Energy Ministerial in China to highlight our commitment to climate change, particularly our partnership with suppliers to reduce carbon emissions from manufacturing.

**June 2017 (U.S.):** Apple urged the White House to remain in the Paris climate agreement and take meaningful action on climate change

**August 2017 (China):** Apple met with central and provincial-level policymakers across China to advocate for corporations to be able to purchase directly from renewable energy power plants.

**November 2017 (China):** Apple hosted a roundtable with the Green Electricity Consumption Cooperative Organization (GECCO) to create a platform for buyers in China to discuss renewable energy procurement challenges and opportunities, and inform future policy.

**November 2017 (Vietnam):** Apple joined a number of other companies urging the government of Vietnam to make regulatory changes allowing companies to procure renewable energy through direct power purchase agreements.

**March 2019 (Kenya):** Apple participated in the UN Environmental Assembly and conducted bilateral discussions with a number of countries to advocate for policies that enable a circular economy and bold action on climate.

**January 2019 (Vietnam):** Apple met with government officials to discuss benefits of electricity market reform, including allowing businesses to purchase power directly from renewable power plants.

**December 2018 (China):** Apple provided feedback and insights on its approach to renewables procurement in China in support of a publication developed to help the broader corporate community identify renewable energy solutions.

**October 2018 (Japan):** Apple spoke about clean energy and closed loop innovation at Japan's Innovation for Cool Earth Forum (ICEF), an international gathering to tackle climate change through technical innovation.

**October 2018 (South Korea):** Apple met with government officials in Korea to advocate for increased renewable generation and for retail choice, whereby consumers can select their power source.

**April 2018 (U.S.):** Apple filed individual comments to the U.S. EPA, urging it not to repeal the Clean Power Plan because of its importance in reducing emissions.

**April 2018 (China):** Apple submitted formal comments to China's National Development and Reform Commission about the implications of draft policy on corporate clean energy procurement.

**February 2018 (Japan):** Apple filed comments with the Japanese government, calling for the development of a robust and verifiable renewable energy trading system.

**January 2018 (U.S.):** Apple filed comments to the Federal Energy Regulatory Commission, urging it not to finalize a rule that would subsidize fossil fuels, which would limit the ability of renewables to compete in the electricity market. FERC chose not to finalize that rule.

Appendix A

# Apple's Operations: Environmental Data

**Facilities Environmental Performance Indicators (Page 56)**

**Product Environmental Performance Indicators (Page 57)**

**Scopes 1 and 2 Carbon Emissions Breakdown (Page 58)**

**Natural Gas and Electricity Use (fiscal year 2018) (Page 59)**

# Facilities Environmental Performance Indicators

The following table summarizes environmental performance indicators relating to Apple's global facilities, including our data centers, corporate offices, and over 500 retail stores, together occupied by 132,000 Apple employees.[1]

| KPI | | Unit | Fiscal Year | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 |
| Greenhouse Gas Emissions | Scope 1 | metric tons $CO_2e$ | 54,590 | 45,400 | 34,370 | 28,100 | 28,490 | 29,300 | 21,220 |
| | Natural gas, diesel, propane[2] | | 39,990 | 34,560 | 27,000 | 19,360 | 20,710 | 22,090 | 14,300 |
| | Fleet vehicles | | 11,110 | 8,300 | 7,370 | 8,740 | 7,780 | 7,210 | 6,920 |
| | Process emissions[3] | | 3,490 | 2,540 | — | — | — | — | — |
| | Scope 2[4] | | 8,730 | 36,250 | 41,000 | 42,460 | 63,210 | 91,510 | 139,160 |
| | Scope 3[5] | | 520,500 | 293,440 | 303,910 | 312,910 | 259,130 | 225,630 | 202,060 |
| | Business travel[6] | | 337,340 | 121,000 | 117,550 | 139,940 | 110,940 | 90,948 | 85,090 |
| | Employee commute[7] | | 183,160 | 172,440 | 186,360 | 172,970 | 148,190 | 134,685 | 116,970 |
| | Total facilities emissions (Scopes 1, 2, 3) | | 583,820 | 375,090 | 379,280 | 383,470 | 350,830 | 346,440 | 362,440 |
| Energy Use | Electricity | million kWh | 2,182 | 1,832 | 1,420 | 996 | 839 | 708 | 608* |
| | U.S. | | 1,830 | 1,536 | 1,157 | 831 | 702 | 590 | — |
| | International | | 351 | 296 | 262 | 166 | 137 | 118 | — |
| | Natural gas | million BTU | 1,419,240 | 1,225,210 | 974,570 | 851,660 | 922,860 | 764,550 | 304,000 |
| | U.S. | | 1,333,850 | 1,127,550 | 901,950 | 794,830 | 840,490 | 676,630 | 240,230 |
| | International | | 85,390 | 97,660 | 72,620 | 56,830 | 82,370 | 87,920 | 63,770 |
| Energy Efficiency[8] | Electricity saved per year as a result of energy efficiency measures | kWh/year | 113,203,780 | 69,989,660 | 55,288,800 | 37,875,000 | 31,225,000 | 26,241,600 | 11,354,200 |
| | Natual gas saved per year as a result of energy efficiency measures | therms/year | 2,541,440 | 2,453,410 | 2,228,477 | 1,676,735 | 1,431,215 | 1,238,291 | 548,508 |
| Renewable Energy | Renewable energy sourcing (fiscal year)[9] | % | 99 | 97 | 96 | 93 | 87 | 73 | 60 |
| | Emissions avoided as a result of renewable energy sourcing (fiscal year)[10] | metric tons $CO_2e$ | 690,000 | 589,000 | 541,000 | 336,000 | 255,000 | 195,000 | 116,000 |
| Water Use | Total | million gallons | 1,260 | 1,000 | 630 | 573 | 494 | 430 | 345 |
| | Data centers[11] | | 460 | 410 | 207 | 166 | 113 | 69 | 57 |
| | Retail | | 110 | 110 | 99 | 111 | 103 | 94 | 71 |
| | Corporate[12] | | 690 | 480 | 324 | 296 | 278 | 267 | 217 |
| Waste Generation[13] | Landfilled | pounds | 36,553,900 | 31,595,200 | 21,618,850 | 13,110,880 | 6,833,000 | 5,923,810 | 4,850,160 |
| | Recycled | | 108,515,200 | 68,509,300 | 28,198,560 | 19,599,570 | 14,621,940 | 15,866,650 | 11,464,020 |
| | Composted | | 10,397,400 | 14,567,500 | 13,737,320 | 3,006,170 | — | — | — |
| | Hazardous waste | | 6,277,800 | 3,342,700 | 2,287,320 | 1,002,300 | 508,040 | 70,550 | 123,460 |
| | Waste to energy[14] | | 1,105,100 | 645,000 | — | — | — | — | — |
| | Landfill diversion rate | % | 74 | 71 | 66 | 63 | 68 | 73 | 70 |

Notes

1  As reported in Apple's Form 10-K Annual Report filed with the SEC for fiscal year 2018.

2  Starting in fiscal year 2016, Scope 1 Emissions capture diesel use in emergency back-up generators and propane gas use in corporate offices.

3  Emissions from R&D processes.

4  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.

5  In fiscal year 2017, we started calculating scope 3 emissions not listed above. In fiscal year 2018, these include electricity transmission and distribution losses (21,500 metric tons $CO_2e$) and lifecycle emissions associated with renewable energy (78,000 metric tons $CO_2e$).

6  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. Without the methodology change, these emissions would have increased by 14 percent, which reflects the growth in our business.

7  We adjusted our methodology for fiscal year 2017 to take into account Apple's "At Home Advisors" program, where employees work remotely.

8  Because energy efficiency measures have lasting benefits, energy efficiency savings are calculated cumulatively since 2011. All efficiency measures are retired based on their effective useful lifetime as documented by the Claifornia Energy Commission.

9  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.

10  We have adjusted previous years' avoided emissions to remove double counting biogas emissons.

11  Beginning in fiscal year 2017, "Data centers" includes water use at colocation facilities.

12  Beginning in fiscal year 2017, "Corporate" includes water use at Apple distribution centers.

13  Beginning in fiscal year 2017, we're including waste from Apple's distribution centers. Starting fiscal year 2018, electronic waste is reported under the "Recycled" figure.

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

# Product Environmental Performance Indicators

The following table summarizes the environmental performance indicators relating to Apple's products—including the life cycle greenhouse gas emissions associated with the manufacturing, transportation, use, and end of life of our products. In fiscal year 2018, we sold 217,722,000 iPhone devices, 43,535,000 iPad units, and 18,209,000 Mac products.[1]

We also publish individual product environmental reports for all of our products. These are available at www.apple.com/environment.

| Fiscal Year | 2018 | 2017 | 2016 | 2015 |
|---|---|---|---|---|
| **Scope 3 - Life cycle greenhouse gas emissions (metric tons CO$_2$e)[2,3]** | **24,600,000** | **27,100,000** | **29,200,000** | **38,000,000** |
| Manufacturing | 18,500,000 | 21,100,000 | 22,800,000 | 29,600,000 |
| Product transportation | 1,300,000 | 1,200,000 | 1,200,000 | 1,300,000 |
| Product use | 4,700,000 | 4,700,000 | 4,900,000 | 6,600,000 |
| End of life[4] | 50,000 | 100,000 | 300,000 | 500,000 |
| **Packaging fiber footprint (metric tons)** | **168,000** | **145,000** | **129,000** | **133,000** |
| Recycled fiber | 64% | 65% | 62% | 60% |
| Responsibly sourced virgin fiber | 36% | 35% | 38% | 40% |
| Other virgin fiber | — | — | <1% | <1% |
| **Packaging plastics footprint** | 19,000 | 24,000 | 34,000 | 36,000 |
| **Safer materials** | | | | |
| Arsenic[5] | Removed from glass by 2008 | | | |
| PVC[6] | PVC-free AC power cord available in all regions except India, Thailand, and South Korea | | | |
| Beryllium | Eliminated from all new product designs. Beryllium is found in copper alloys used to make connectors and springs | | | |
| Mercury | Eliminated in display 2009 | | | |
| Lead[7] | Phased out of display glass and solder in 2006 | | | |
| Brominated flame retardants (BFRs)[8] | Eliminated from thousands of parts since 2008 | | | |

[1] As reported in Apple's Form 10-K Annual Report filed with the SEC for FY2017.

[2] We have been calculating the life cycle greenhouse gas emissions of our products since 2006. Over time, we have greatly refined our model to include more Apple-specific data instead of industry averages. The decrease in Scope 3 emissions in fiscal year 2016 is partly due to these modeling changes, including improved modeling of the integrated circuits in Apple products. Further, there are systematic changes made in some emissions factors to reflect changes in global electricity grids.

[3] Scope 3 emissions associated with employee commute and business travel are included in the table "Facilities Environmental Performance Indicators."

[4] Carbon emissions associated with our products' end of life decreased in fiscal year 2017, because of changes in methodology to more accurately reflect disposal and recycling practices.

[5] Arsenic is present in minute quantities in some semiconductor devices.

[6] Every Apple product is free of PVC and phthalates with the exception of power cords in India, Thailand, and South Korea, where we continue to seek government approval for our PVC and phthalates replacement.

[7] Apple products comply with the European Union Directive 2011/65/EU and its amendments, including exemptions for the use of lead such as high-temperature solder. Apple is working to phase out the use of these exempted substances where technically possible.

[8] While Apple's phaseout covers the vast majority of products and components, products by Beddit, which Apple recently acquired, and some older Apple product designs may not be fully BFR-free and PVC-free. However, these products, including their replacement parts and accessories, were still designed to meet regulatory requirements.

**Overview of Apple's product life cycle carbon assessment (LCA) methodology**

Apple uses five steps when conducting a product LCA.

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.

# Scopes 1 and 2 Carbon Emissions Breakdown (metric tons CO$_2$e)

| Fiscal Year | 2018 | | 2017* | | 2016 | | 2015 | |
|---|---|---|---|---|---|---|---|---|
| Location | Scope 1 | Scope 2 | Scope 1 | Scope 2 | Scope 1 | Scope 2 | Scope 1 | Scope 2 |
| **Corporate** | **29,980** | **7,980** | **25,430** | **33,290** | **20,537** | **30,408** | **15,415** | **19,564** |
| Cupertino, CA | 24,720 | 0 | 20,580 | 0 | 17,121 | 0 | 13,248 | 0 |
| Elk Grove, CA | 630 | 0 | 530 | 0 | 397 | 0 | 369 | 0 |
| Austin, TX | 320 | 0 | 330 | 0 | 248 | 0 | 233 | 0 |
| Other U.S. | 1,350 | 0 | 1,160 | 0 | 883 | 0 | 121 | 0 |
| Cork, Ireland | 890 | 0 | 710 | 0 | 780 | 0 | 892 | 0 |
| Singapore | 30 | 0 | 90 | 0 | 65 | 0 | 0 | 3,767 |
| China | 200 | 0 | 220 | 0 | 38 | 0 | 117 | 2,201 |
| Other International | 1,840 | 7,980 | 1,810 | 33,290 | 1,005 | 30,408 | 435 | 13,596 |
| **Data centers** | **60** | **410** | **4,210** | **1,520** | **2,738** | **1,621** | **13** | **0** |
| Maiden, NC | 30 | 0 | 150 | 0 | 126 | 0 | 0 | 0 |
| Newark, CA | 0 | 0 | 70 | 0 | 139 | 0 | 0 | 0 |
| Prineville, OR | 20 | 0 | 950 | 0 | 1,077 | 0 | 13 | 0 |
| Reno, NV | 0 | 0 | 1,530 | 0 | 713 | 0 | 0 | 0 |
| Mesa, AZ | 10 | 0 | 1,510 | 0 | 683 | 0 | — | — |
| Viborg, Denmark | — | 0 | — | 0 | — | — | — | — |
| Colocation facilities (U.S.)** | N/A | 0 | N/A | 0 | N/A | 0 | N/A | — |
| Colocation facilities (International)** | N/A | 410 | N/A | 1,520 | N/A | 1,621 | N/A | — |
| **Retail stores** | **4,300** | **350** | **4,920** | **1,440** | **3,679** | **8,920** | **3,800** | **22,893** |
| U.S. | 2,720 | 0 | 2,490 | 0 | 1,597 | 0 | 2,269 | 0 |
| International | 1,580 | 350 | 2,430 | 1,440 | 2,082 | 8,920 | 1,531 | 22,893 |
| **Business fleet** | **11,110** | **N/A** | **8,300** | **N/A** | **7,370** | **N/A** | **8,744** | **N/A** |
| **Process emissions*** | **3,490** | **N/A** | **2,540** | **N/A** | **—** | **N/A** | **—** | **N/A** |
| **Other Scope 1 (Diesel, Propane, fugitive emissions)** | **5,640** | **N/A** | **—** | **N/A** | **—** | **N/A** | **—** | **N/A** |
| **Totals** | **54,600** | **8,730** | **45,400** | **36,250** | **34,324** | **40,953** | **27,972** | **42,457** |

| Fiscal Year | 2014 | | 2013 | | 2012 | | 2011 | |
|---|---|---|---|---|---|---|---|---|
| Location | Scope 1 | Scope 2 | Scope 1 | Scope 2 | Scope 1 | Scope 2 | Scope 1 | Scope 2 |
| **Corporate** | **15,335** | **21,555** | **13,727** | **17,503** | **11,343** | **48,215** | **12,656** | **59,516** |
| Cupertino, CA | 12,929 | 0 | 10,747 | 0 | 9,132 | 25,450 | 9,238 | 39,428 |
| Elk Grove, CA | 411 | 0 | 509 | 0 | 560 | 0 | 556 | 0 |
| Austin, TX | 148 | 0 | 83 | 0 | 59 | 0 | 45 | 0 |
| Other U.S. | 115 | 0 | 337 | 0 | 237 | 4,265 | 564 | 2,141 |
| Cork, Ireland | 1,000 | 0 | 743 | 0 | 715 | 0 | 804 | 0 |
| Singapore | 51 | 6,852 | 50 | 5,826 | 32 | 4,946 | — | 3,243 |
| China | 385 | 8,577 | 390 | 7,490 | — | 1,049 | — | 280 |
| Other International | 296 | 6,126 | 868 | 4,187 | 609 | 12,505 | 1,449 | 14,424 |
| **Data centers** | **18** | **0** | **2,201** | **0** | **146** | **7,664** | **0** | **28,988** |
| Maiden, NC | 0 | 0 | 2,201 | 0 | 146 | 0 | 0 | 0 |
| Newark, CA | 0 | 0 | 0 | 0 | 0 | 7,664 | 0 | 28,988 |
| Prineville, OR | 18 | 0 | 0 | 0 | 0 | 0 | — | — |
| Reno, NV | 0 | 0 | 0 | 0 | 0 | 0 | — | — |
| **Retail stores** | **5,355** | **41,658** | **6,158** | **74,002** | **2,812** | **83,285** | **2,600** | **65,769** |
| Domestic (U.S.) | 2,812 | 11,036 | 3,548 | 44,606 | 787 | — | 746 | — |
| International | 2,543 | 30,662 | 2,610 | 29,397 | 2,025 | — | 1,854 | — |
| **Business fleet** | **7,778** | **N/A** | **7,214** | **N/A** | **6,923** | **N/A** | **6,400** | **N/A** |
| **Totals** | **28,486** | **63,213** | **29,300** | **91,505** | **21,224** | **139,164** | **21,656** | **154,273** |

— Indicates that the energy source is not yet online.

Scope 1 emissions result from natural gas use in buildings, and fuel use for fleet vehicles. As is typical, these emissions are tracked separately from our 100 percent renewable energy claim. Starting in fiscal year 2016, Scope 1 emissions capture diesel use in emergency back-up generators and propane gas use in corporate offices. Scope 1 emissions are calculated using emissions factors from EPA clean energy website https://www.epa.gov/climateleadership/center-corporate-climate-leadership-ghg-emission-factors-hub.

Scope 2 emissions result from electricity use for Apple's facilities, calculated using a market-based approach, following the WRI Greenhouse Gas Protocol.

* Apple also calculates what our emissions would have been had we not taken action to supply new, clean renewable energy to our facilities. If we remove the emissions reduction benefits of our renewable energy program, then our Scope 1 emissions in fiscal year 2018 would have been 95,636 metric tons CO$_2$e and our Scope 2 emissions would have been 698,944 CO$_2$e for our corporate operations, data centers, and retail stores. In fiscal year 2018, combustion of biogas for our fuel cells resulted in 41,040 metric tons of direct CO$_2$e emissions. The biogas fuel cells are included in our Scope 1 and Scope 2 emissions since they are within our operational control and their renewable certificates are matched with our data center load. These emissions are not counted in Apple's footprint because they would have occurred naturally even if we had not combusted the biogas.

** 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.

*** Emissions from R&D processes.

# Natural Gas and Electricity Use (fiscal year 2018)

The chart below provides a detailed breakdown of fiscal year 2018 energy use, which we used to calculate our greenhouse gas emissions.

| Fiscal Year 2018 | | | | |
|---|---|---|---|---|
| | **Natural Gas** | | **Electricity** | |
| **Location** | **Total Gas (mmBTU)** | **Renewable Biogas (mmBTU)** | **Total Electricity (million kWh)** | **Renewable Electricity (million kWh)** |
| **Corporate** | **796,730** | **232,430** | **638** | **625** |
| Cupertino, CA | 697,670 | 232,430 | 381 | 381 |
| Elk Grove, CA | 11,840 | — | 15 | 15 |
| Austin, TX | 6,090 | — | 54 | 54 |
| Other U.S. | 25,410 | — | 22 | 22 |
| Cork, Ireland | 16,730 | — | 16 | 16 |
| Singapore | 630 | — | 16 | 16 |
| China | 3,830 | — | 29 | 29 |
| Other International | 34,530 | — | 105 | 92 |
| **Data centers** | **541,690** | **540,970** | **1,349** | **1,348** |
| Maiden, NC | 540,970 | 540,970 | 295 | 295 |
| Newark, CA | — | — | 114 | 114 |
| Prineville, OR | 460 | — | 252 | 252 |
| Reno, NV | — | — | 253 | 253 |
| Mesa, AZ | 260 | — | 104 | 104 |
| Viborg, Denmark | — | — | 4 | 4 |
| Colocation Facilities (USA)** | N/A | N/A | 244 | 244 |
| Colocation Facilities (International)** | N/A | N/A | 83 | 82 |
| **Retail stores** | **80,820** | **—** | **195** | **194** |
| Domestic (U.S.) | 51,160 | — | 96 | 96 |
| International | 29,660 | — | 99 | 98 |
| **Totals** | **1,419,240** | **773,400** | **2,182** | **2,167** |
| **Percent renewable*** | | **54%** | | **99%** |

— Data not tracked

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

\* Beginning January 1, 2018, we reached 100 percent renewable energy.

\*\* 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.

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 Facilities Renewable Energy Supplement 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 secure 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 project delivers renewables to our Oregon data center, and the California Flats solar project to our data center 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 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.

## A focus on data centers

We used over 1.3 billion kWh of electricity in fiscal year 2018 to power our data centers and colocation facilities around the world, representing over 60 percent of 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. In fiscal year 2018, we avoided the equivalent of more than 466,000 metric tons of carbon dioxide emissions by using 100 percent renewable energy for our data centers—that's equivalent to taking almost 100,000 cars off the road for a year.[1]

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.

[1] Greenhouse gas equivalencies calculated using the U.S. EPA Greenhouse Gas Equivalencies Calculator: http://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Solar + Biogas Fuel Cells

# Maiden, North Carolina

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 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 2018, the Maiden data center was supported by projects that generated 303 million kWh of renewable energy, which is equivalent to the energy used by almost 24,000 North Carolina homes.[2]

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—100% renewable since opening June 2010 | | | |
|---|---|---|---|
| **303 million kWh energy use in fiscal year 2018** | | | |
| **Duke Energy Default Grid Mix** | | **Apple Actual Renewable Energy Use** | |
| Nuclear | 51% | Apple's Solar Projects | 38% |
| Coal | 33% | Apple's Biogas Fuel Cells | 24% |
| Other | 16% | Duke Green Source Rider (100% solar) | 12% |
| Renewable | <1% | NC GreenPower (100% solar) | 14% |
| | | Other Solar Contracts | 12% |
| **2018 Default Emissions (mtons CO$_2$e/year)** | **110,910** | **2018 Effective Emissions (mtons CO$_2$e/year)** | **0** |
| From Duke Energy Carolinas 2015 Statistical Supplement generation data | | Actual fiscal year 2018 energy data | |

[2] Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2017 data: https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Wind + Solar + Low-Impact Hydro

# Prineville, Oregon

To support our Prineville data center, we recently signed a 200-megawatt power purchase agreement for a new Oregon wind farm, the Montague Wind Power Facility, set to come online later in 2019. It's our largest project to date, producing over 560 million kWh of clean, renewable energy a year.

Additionally, we executed a 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 a 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 2018, the Prineville data center was supported by projects that generated 252 million kWh of renewable energy, which is equivalent to the energy used by 21,670 Oregon homes.[2]

Our Prineville data center takes advantage of the cool and dry climate by cooling the 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—100% renewable since opening May 2012 | | | |
|---|---|---|---|
| 252 million kWh energy use in fiscal year 2018 | | | |
| **Pacific Power Default Grid Mix** | | **Apple Actual Renewable Energy Use** | |
| Coal | 59% | Apple's Micro-hydro Projects | <1% |
| Natural Gas | 15% | Oregon Solar (via Direct Access) | >99% |
| Other | 9% | | |
| Renewable | 17% | | |
| **2018 Default Emissions (mtons CO$_2$e/year)** | **74,706** | **2018 Effective Emissions (mtons CO$_2$e/year)** | **0** |
| https://www.pacificpower.net/content/dam/pacific_power/doc/About_Us/Rates_Regulation/Oregon/17645-37_OR_LabelingInsert_LrgBiz_F.pdf | | Actual fiscal year 2018 energy data | |

[2] Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2017 data: https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Solar

# Reno, Nevada

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 137 million kWh of renewable energy a 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 when it comes online later this year. Next was the 50-megawatt Turquoise Nevada project, estimated to produce 110 million kWh a year and come online in 2020.

In fiscal year 2018, the Reno data center was supported by projects that generated 253 million kWh of renewable energy, which is equivalent to the energy used by 24,690 Nevada homes.[2]

Like in Prineville, our Reno data center takes advantage of the mild climate by cooling the 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—100% renewable since opening December 2012 | | | |
|---|---|---|---|
| 253 million kWh energy use in fiscal year 2018 | | | |
| **NV Energy—North Default Grid Mix** | | **Apple Actual Renewable Energy Use** | |
| Natural Gas | 58% | Apple's Solar Projects (via the Nevada Green Rider program) | 100% |
| Coal | 16% | | |
| Large Hydro | 8% | | |
| Other | 2% | | |
| Renewable | 16% | | |
| **2018 Default Emissions (mtons CO$_2$e/year)** | **78,760** | **2018 Effective Emissions (mtons CO$_2$e/year)** | **0** |
| https://www.nvenergy.com/publish/content/dam/nvenergy/bill_inserts/2019/01_jan/power-content-insert-south-2019-01_03_31.pdf | | Actual fiscal year 2018 energy data | |

[2] Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2017 data: https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Solar
# Newark, California

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're acquiring 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 2018, the Newark data center was supported by projects that generated 114 million kWh of renewable energy, which is equivalent to the energy used by 17,150 California homes.[2]

| Newark, California—100% renewable since January 2013 | | | |
|---|---|---|---|
| 114 million kWh energy use in fiscal year 2018 | | | |
| **Pacific Gas & Electric Default Grid Mix** | | **Apple Actual Renewable Energy Use** | |
| Natural Gas | 20% | Bundled Solar (via Direct Access) | 100% |
| Nuclear | 27% | | |
| Large Hydro | 18% | | |
| Unspecified | 2% | | |
| Renewable | 33% | | |
| **2018 Default Emissions (mtons CO$_2$e/year)** | **7,570** | **2018 Effective Emissions (mtons CO$_2$e/year)** | **0** |
| https://www.energy.ca.gov/pcl/labels/2017_labels/PG_and_E_2017_PCL.pdf | | Actual fiscal year 2018 energy data | |

[2] Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2017 data: https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

Solar

# Mesa, Arizona

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, 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 more than fully matches the energy used by the data center.

In fiscal year 2018, the Mesa data center was supported by 104 million kWh of renewable energy, which is equivalent to the energy used by 8,390 Arizona homes.[2]

| Mesa Arizona—100% renewable since opening March 2017* | | | |
|---|---|---|---|
| 104 million kWh energy use in fiscal year 2018 | | | |
| Salt River Project Default Grid Mix | | Apple Actual Renewable Energy Use | |
| Coal | 53% | Apple's Solar Project | 100% |
| Nuclear | 18% | | |
| Natural Gas/Other | 17% | | |
| Renewable | 12% | | |
| 2018 Default Emissions (mtons $CO_2$e/year) | 49,330 | 2018 Effective Emissions (mtons $CO_2$e/year) | 0 |
| www.srpnet.com/about/stations/pdfx/2014irp.pdf | | Actual fiscal year 2018 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.

# Denmark

We're currently constructing a new data center in Viborg, Denmark. It will run on 100 percent renewable energy. In fiscal year 2018, the construction process used 3.5 million kWh of electricity that was supplied with 100 percent wind power from a local retailer in Denmark that only supplies renewable energy. We have long-term supply contracts with Denmark wind and solar projects that will come online by 2020. The solar project, at 42 megawatts, will be one of Denmark's largest.

Due to its proximity to one of Denmark's largest electrical substations, the data center won't require backup generators, which typically run on diesel and require periodic testing and burning of fuel.

We're working with Aarhus University, Foulum campus, which is conducting important research to increase the production of anaerobic digesters. We are co-developing a project using agricultural waste biomass, which has long been used in Denmark to generate energy.

# 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.

[2] Carbon emissions equivalences calculated using U.S. Energy Information Administration, 2017 data: https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

# 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%** |

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 two 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

| | Total Energy Use (kWh) | Renewable Energy (kWh) | Percent Renewable Energy |
|---|---|---|---|
| U.S. | 244,376,400 | 244,376,400 | 100% |
| Europe | 30,831,400 | 30,114,500 | 98% |
| APAC | 52,456,000 | 52,368,800 | 100% |
| **FY2018 Total** | **327,663,800** | **326,859,700** | **99.8%** |

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.

Appendix C

# Assurance and Review Statements

**Bureau Veritas: Facilities energy, carbon, waste, paper, and water data (Pages 70–72)**

**Fraunhofer Institute: Product life cycle carbon footprint (Pages 73–76)**

**Bureau Veritas: Supplier clean energy program (Pages 77–79)**

**Fraunhofer Institute: Comprehensive fiber footprint (Pages 80–82)**

**Fraunhofer Institute: Packaging plastic footprint (Pages 83–85)**

### Introduction and objectives of work

Bureau Veritas North America, Inc. (BVNA) was engaged by Apple, Inc. (Apple) to conduct an independent assurance of select environmental data reported in its 2019 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. BVNA was not involved in the collection of the information or the drafting of the Report.

### Scope of Work

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

- Assurance of select environmental data and information included in the Report for the fiscal year 2018 reporting period (October 1, 2017 through September 29, 2018), 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

### Methodology

BVNA undertook the following activities:

1. Site visits to Apple facilities in Mesa, Arizona; Cork, Ireland; Shanghai, China; and Singapore.
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.

Our work was conducted against Bureau Veritas' standard procedures and guidelines for external Verification of Sustainability Reports, based on current best practice in independent assurance.

Bureau Veritas procedures are based on principles and methods described in the International Standard on Assurance Engagements (ISAE) 3000.

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

BVNA verified the following indicators for Apple's Fiscal Year 2018 reporting period (October 1, 2017 through September 29, 2018):

| Parameter | Quantity | Units | Boundary/ Protocol |
|---|---|---|---|
| Natural Gas Consumption: | 14.2 | Million Therms | Worldwide occupied properties / Apple Internal Protocol |
| Electricity Consumption: | 2,182 | Million kilowatt hours (mkWh) | Worldwide occupied properties / Apple Internal Protocol |
| Renewable Energy | 2,166 | Million kilowatt hours (mkWh) | Worldwide / Invoiced quantities & self-generated |
| Scope 1 GHG Emissions | 54,600 | metric tons of carbon dioxide equivalent (tCO$_2$e) | Worldwide occupied properties / WRI/WBCSD GHG Protocol |
| Scope 2 GHG Emissions (Location-Based) | 776,500 | tCO$_2$e | Worldwide occupied properties / WRI/WBCSD GHG Protocol |
| Scope 2 GHG Emissions (Market-Based) | 8,700 | tCO$_2$e | Worldwide occupied properties / WRI/WBCSD GHG Protocol |
| Scope 3 GHG Emissions – Business Travel | 337,300 | tCO$_2$e | Worldwide occupied properties / WRI/WBCSD GHG Protocol Value Chain (Scope 3) |
| Scope 3 GHG Emissions – Employee Commute | 183,200 | tCO$_2$e | Worldwide occupied properties / WRI/WBCSD GHG Protocol Value Chain (Scope 3) |
| Water Withdrawal | 1,300 | Million gallons | Worldwide occupied properties / Apple Internal Protocol |
| Trash  disposed in Landfill | 16,600 | Metric tonnes | Worldwide occupied properties / Apple Internal Protocol |
| Hazardous Waste (Regulated waste) | 2,800 | Metric tonnes | Worldwide occupied properties / Apple Internal Protocol |
| Recycled Material (Removal by recycling contractor) | 49,200 | Metric tonnes | Worldwide occupied properties / Apple Internal Protocol |
| Composted Material | 4,700 | Metric tonnes | Worldwide occupied properties / Apple Internal Protocol |
| Waste to Energy | 500 | Metric tonnes | Worldwide occupied properties / Apple Internal Protocol |
| Paper | 1,300 | 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, impartiality and competence
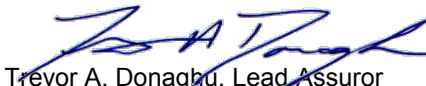
BVNA is an independent professional services company that specializes in Quality, Health, Safety, Social and Environmental management with over 180 years history in providing independent assurance services.

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

BVNA has implemented a Code of Ethics across the business to maintain high ethical standards among staff in their day-to-day business activities.

The assurance team has extensive experience in conducting assurance over environmental, social, ethical and health and safety information, systems and processes, has over 20 years combined experience in this field and an excellent understanding of BVNA standard methodology for the Assurance of Sustainability Reports.

**Attestation:**

Trevor A. Donaghu, Lead Assuror
Program Manager
Sustainability and Climate Change Services
Bureau Veritas North America, Inc.

John Rohde, Technical Reviewer
Practice Lead
Sustainability and Climate Change Services
Bureau Veritas North America, Inc.

March 22, 2019

# Letter of Assurance

Comprehensive Carbon Footprint – Scope 3: Product related Carbon Footprint for Fiscal Year 2018

Fraunhofer IZM reviewed Apple's scope 3 carbon footprint data related to the products manufactured and sold by Apple Inc. in fiscal year 2018.

## 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 2018. 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

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 |
|---|---|---|---|---|
| **2018** | **18.49** | **1.33** | **4.65** | **0.05** |
| | [MMT CO$_2$e] | [MMT CO$_2$e] | [MMT CO$_2$e] | [MMT CO$_2$e] |

*MMT CO$_2$e: million metric tons carbon dioxide equivalents*

Including a reported value of 0.58 million metric tons CO$_2$e for facilities (out of scope of this verification), total comprehensive carbon footprint is reported to be 25.2 million metric tons CO$_2$e.

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 FY2018, including accessories and including AppleCare, Apple's extended warranty and technical support plans for their devices.

- Product specific data on transportation including breakdown of air and sea shipment

- 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 2018

- The total carbon footprint – scope 3 for the fiscal year 2018

- Detailed analysis of the comprehensive carbon footprint including:

  o The breakdown of the carbon footprint into life cycle phases manufacturing, transportation, product use and recycling

  o Detailed product specific split into life cycle phases

  o 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 2018 data regarding sales figures, manufacturing, transportation).

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 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 FY2018 and beginning of FY2019 10 recent product LCA studies have been reviewed successfully against ISO 14040/44. These LCAs cover product segments MacBook Pro, iMac, Apple Watch, Homepod and iPhone. These recently reviewed LCA studies cover products which represent in total 44,9% of the total scope 3 carbon footprint. Representatives of other product segments (iPod, iPad, Mac Pro, Mac Mini, 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 years. All reviewed LCA studies up to now cover in total 67,9% 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' 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.
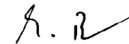
For all product LCA calculations, where exact data was missing, the principle of a worst-case approach has been followed and results have been calculated with rather conservative estimates.

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 3, 2019

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

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

# BUREAU VERITAS NORTH AMERICA
## INDEPENDENT ASSURANCE STATEMENT

### Introduction and objectives of work

Bureau Veritas North America, Inc. (BVNA) was engaged by Apple, Inc. (Apple) to conduct an independent assurance of its Supplier Clean Energy Program data reported in its 2019 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. BVNA was not involved in the collection of the information or the drafting of the Report.

### Scope of Work

Apple requested BVNA 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 2018 reporting period (October 1, 2017 through September 29, 2018), specifically, in accordance with Apple's definitions:

  o Energy: Reported megawatt-hours (MWh) of clean energy attributed to the Clean Energy Program for suppliers;

  o Avoided Greenhouse Gas (GHG) emissions associated with clean energy attributed to the Clean Energy Program;

  o Operational Capacity in megawatts (MWac) of clean energy in support of Apple manufacturing as a part of Apple's Supplier Clean Energy Program;

  o 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

### Methodology

BVNA 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.

Our work was conducted against Bureau Veritas' standard procedures and guidelines for external Verification of Sustainability Reports, based on current best practice in independent assurance. Bureau Veritas procedures are based on principles and methods described in the International Standard on Assurance Engagements (ISAE) 3000.

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

## Our Findings

BVNA verified the following indicators for Apple's Fiscal Year 2018 reporting period (October 1, 2017 through September 29, 2018):

| Parameter | Quantity | Units | Boundary/ Protocol |
|---|---|---|---|
| Clean Energy Use | 4.12 | Million megawatt hours (mMWh) | Apple suppliers / Apple Internal Protocol |
| Avoided GHG Emissions | 3.53 | Million metric tons of carbon dioxide equivalent (mMtCO$_2$e) | Apple suppliers / Apple Internal Protocol |
| Operational Capacity | 1,950 | Megawatts (MWac) | Apple suppliers / Apple Internal Protocol |

## Our Conclusion

Based on the assurance process and procedures conducted, there is no evidence that the assertions for Clean Energy Consumption, Avoided GHG Emissions, and Operational Capacity shown above:

- Are not materially correct;

- Are not a fair representation of the stated information; and

- Have not been prepared in accordance with Apple's stated protocols for their Clean Energy Program.

It is our opinion that Apple has established appropriate systems for the collection, aggregation and analysis of quantitative data for determination of the above indicators for the stated period and boundaries.

## Statement of independence, impartiality and competence

BVNA is an independent professional services company that specializes in Quality, Health, Safety, Social and Environmental management with over 180 years history in providing independent assurance services, and an annual 2018 revenue of $4.8 billion Euros.

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

BVNA has implemented a Code of Ethics across the business to maintain high ethical standards among staff in their day-to-day business activities.

The assurance team has extensive experience in conducting assurance over environmental, social, ethical and health and safety information, systems and processes, has over 20 years combined experience in this field and an excellent understanding of BVNA standard methodology for the Assurance of Sustainability Reports.

**Attestation:**

Trevor A. Donaghu, Lead Verifier
Program Manager
Sustainability and Climate Change Services
Bureau Veritas North America, Inc.

John Rohde, Technical Reviewer
Practice Lead
Sustainability and Climate Change Services
Bureau Veritas North America, Inc.

March 22, 2019

# Review Statement
## Corporate Fiber Footprint

Fraunhofer IZM reviewed Apple's corporate fiber footprint data related to corporate fiber usage from products, corporate, and retail operations in fiscal year 2018.

## 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 2018 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:

| 2018 | Total Fiber | Virgin Fiber | Recycled Fiber |
|------|-------------|--------------|----------------|
| Packaging Fiber | 168,000 | 60,000 | 108,000 |
| Corporate Fiber | 3,000 | 1,000 | 2,000 |
| Total | 171,000 | 61,000 | 110,000 |
|  | [metric tons fiber] | [metric tons fiber] | [metric tons fiber] |

All results and figures reviewed for fiscal year 2018 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 FY2018, including accessories
- Aggregated fiber data for all products and the total corporate fiber footprint for the fiscal year 2018
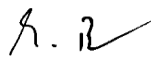
The methodology paper (Fiber Footprint at Apple - Methodology Description - V1.1) provided by Apple and reviewed in 2017, is considered a sound and appropriate guidance for determining the company fiber footprint. Where appropriate, this approach follows methodological principles applied for state-of-the-art Life Cycle Assessments.

This review comprises a check of packaging fiber data for selected products (iPhone X, iPhone 8 Plus, MacBook 13" Air).

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.

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, March 22, 2019

- 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 settop-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

# 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 2018.

## 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 2018 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 | |
|---|---|
| **2018** | **19,000** |
| | [metric tons plastic] |

The two main drivers for the plastic packaging footprint are HIPS (high-impact polystyrene) and adhesives.

All results and figures reviewed for fiscal year 2018 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 FY2018, 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 2018

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.
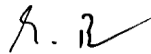
This review comprises a check of packaging plastic data for selected products (iPhone X, iPhone 8 Plus MacBook 13" Air).

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. Including ink use of photobooks in future footprints is suggested for consistency between plastic and fibre footprint, although the impact on the overall packaging plastic footprint is expected to be low.

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.

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, March 20, 2019

- 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 settop-boxes, machine tools, welding equipment)
- various environmental gate-to-gate assessments in research projects since 2000 (wafer bumping, printed circuit board manufacturing)

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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 efficiency, and protect the environment.

Strive to create products that are safe in their intended use, conserve energy and materials, 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 2019

## Report Notes

- This report is published annually in April and covers fiscal year 2018 activities, unless otherwise noted.
- This report addresses environmental impacts and activities at Apple-owned 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.

[1] Recycled content claims for materials in our products have been verified by an independent third party to a recycled content standard that conforms to ISO 14021.

[2] Responsible sourcing of wood fiber is defined in Apple's Sustainable Fiber Specification (PDF). We consider wood fibers to include bamboo.

[3] Apple defines its restrictions on harmful substances, including definitions for what Apple considers to be "free of," in the Apple Regulated Substances Specification. 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 replacements. While Apple's phaseout covers the vast majority of products and components, products by Beddit, which Apple recently acquired, 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 such as high-temperature solder. Apple is working to phase out the use of these exempted substances where technically possible.

[4] Based on sales-weighted averages.

[5] Emissions from corporate facilities increased by one percentage point in 2018, due to a reduced overall carbon footprint and to changes to how we calculate air travel, which significantly increased Scope 3 business travel emissions.

[6] The CPU, SoC, DRAM, and memory (NAND) make up the bulk of the integrated circuit emissions.

[7] "Boards and flexes" refers to bare printed circuit boards and flexible printed circuits.

[8] Integrated circuits, aluminum, bare boards and flexes, display, onboard electronics, steel, and final assembly facilities make up 93 percent of manufacturing emissions. The remaining 7 percent ("other manufacturing") includes battery cells, other materials (such as copper), plastic, packaging, glass, and miscellaneous upstream transportation. These are listed in order of their contribution.

[9] "Electronics" includes capacitors, resistors, transistors, diodes, and other electronic components soldered to bare board and flexes, other than the integrated circuits.

[10] iOS active charge: active charging of the battery for iOS devices.

[11] macOS active: active use of macOS devices.

[12] macOS idle: macOS devices that are awake, but non-active.

[13] other: all other modes and devices.

[14] Greenhouse gas equivalencies calculated using the U.S. EPA Greenhouse Gas Equivalencies Calculator: www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

[15] Compared to a conventional, single-converter power supply design. iMac Pro incorporates a high-efficiency, dual-converter power supply design.

[16] Recycling enables use of recovered materials instead of mined materials, thus conserving finite resources. Recycled content claims for materials in our products have been verified by an independent third party to a recycled content standard that conforms to ISO 14021.

[17] Apple is committed to the responsible sourcing of materials for our products. In 2018, our efforts to responsibly source cobalt continued, and 100 percent of identified refiners participated in third-party audits, for the third year in a row. Our independent third-party audits go beyond conflict to consider human rights and other risks.

[18] In 2018, 100 percent of tin, tantalum, tungsten, and gold smelters and refiners participated in a third-party audit program. Download Apple's Conflict Minerals Report (PDF).

[19] Testing conducted by Apple in May 2018 using iPhone 6 Plus supporting normal peak performance, prerelease iOS 11.4, and prerelease iOS 12. Keyboard tested using Safari; Camera tested by swiping from the Lock screen. Performance varies based on specific configuration, content, battery health, usage, software versions, and other factors.

[20] When we receive your device, it will be thoroughly inspected to determine if it can be reused or recycled. Recycling recovers a portion of the product materials.

[21] Countries are defined as those in which we have an Apple Retail Store, Apple Online Store, or Apple Premium Reseller.

[22] For more details on FSC Controlled Wood standards, see Forest Stewardship Council, "FSC Controlled Wood," 2017. https://ic.fsc.org/en/what-is-fsc-certification/controlled-wood.

[23] 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.

[24] Our target is for waste reduction by weight, from a baseline of fiscal year 2018. We consider ongoing operations and renovations within this boundary but not new construction.

[25] Final assembly supplier sites are third-party certified as Zero Waste by UL LLC (UL 2799 Standard). For all platinum certified final assembly sites, this means that they do not generate any waste sent to landfill. In two cases, assembly facilities were certified Gold with a maximum of 5 percent waste to landfill because the carbon impact of shipping materials for recycling outweighed the environmental benefit of diversion.

[26] Our early efforts to footprint our water use show that vast majority of non-electricity related water withdrawals are related to our supply chain. We are working to expand our understanding of our non-electricity water use so that we can build a more comprehensive water footprint. Our best estimates to isolate process water withdrawals helps us prioritize our work in the supply chain to sub-assembly and commodity suppliers like those that build our semiconductors, displays, and enclosures.

[27] Apple products are free of PVC and phthalates with the exception of 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 covers the vast majority of products and components, products by Beddit, which Apple recently acquired, and some older Apple product designs may not be fully BFR-free and PVC-free.

[28] Apple products comply with the European Union Directive 2011/65/EU and its amendments, including exemptions for the use of lead such as high temperature solder. Apple is working to phase out the use of these exempted substances where technically possible.

[29] Arsenic is present in minuscule quantities in some semiconductor devices.

[30] While Apple's phaseout covers the vast majority of products and components, products by Beddit, which Apple recently acquired, and some older Apple product designs may not be fully BFR-free and PVC-free.

[31] Only chemicals that meet GreenScreen® benchmark 3 and 5 are considered safer and preferred for use.