


Caltech 2020 Sustainability Report

April 2021



2020 was certainly a challenging year, and the desire to move on is both natural and understandable. With that said, dismissing 2020 as an outlier would be an oversimplification. Most of the 2020 trends and metrics show an impact due to the depopulation of campus in response to the COVID-19 pandemic. This gives us an interesting perspective on the baseline metabolism of the campus infrastructure and helps us bound the potential contributions we can expect from behavior based conservation initiatives. This is particularly true for energy, water, and waste. Mobility presents another interesting case in that this year's switch to telecommuting shows us the significant potential of well-crafted flex work and commuter programs.

From an ecological perspective, change creates evolutionary opportunities. While we are all eager to move past the pandemic, our work will be focused on tailoring our initiatives to take advantage of this unique opportunity.



John Onderdonk

Interim Associate VP for Facilities
Chief Sustainability Officer

Table of Contents

3 Key Performance Indicators



4 Energy



10 Water



14 Materials



18 Built Environment









22 Mobility

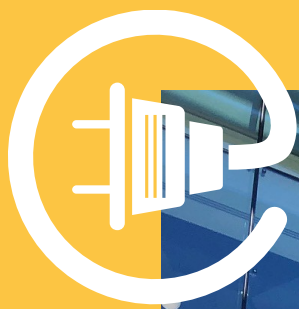


26 Emissions

30 References & Acknowledgements

2020 At A Glance — Key Performance Indicators

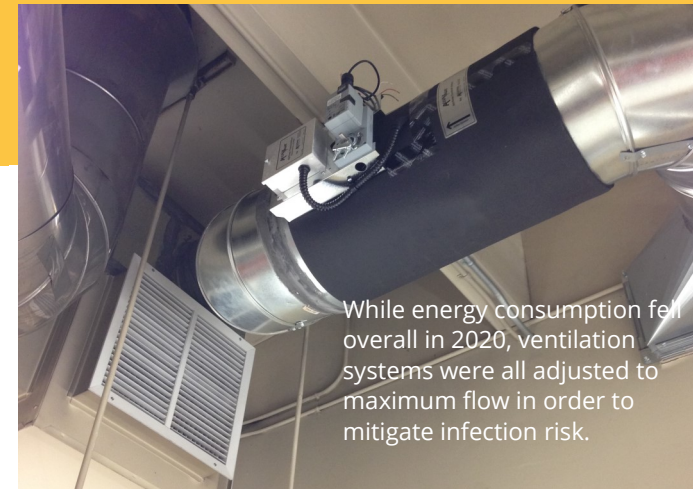
Energy Energy consumption fell again in 2020 due to increasing efficiency and low campus occupancy. A return to campus operations will allow for better understanding of progress.	↓ 9% total electricity consumption since 2016 peak, lowest consumption since 2006	100% electricity produced on-site but no net export due to turbine downtime	↓ 2% energy intensity by area since 2019 but 4% increase since 2015	\$12.7M in annual energy costs, a 13% increase from 2019	\$19M in cumulative energy cost reductions since 2011	
Water Campus water consumption fell considerably in 2020 due to low occupancy which significantly lowered consumption in buildings. Rising water costs continue to be a challenge.	↓ 9% water consumption since 2019 and a 44% decrease since 2006 peak	↓ 23% building water use from 2019 mostly due to low campus occupancy in 2020	↓ 15% water use per square foot since 2019 and lowest in the 21st century at Caltech	\$1.2M in annual water costs, down 6% from 2019 but up 12% from 2011	↑ 12% in campus costs per gallon since 2015 but up only 3% from 2019	
Materials With a nearly empty campus during the spring and limited operations during the summer and fall, Caltech waste generation predictably fell in 2020 compared to previous years.	31% campus non-hazardous waste diversion rate, up from 27% in 2019	↓ 59% municipal solid waste per capita, down to .17 tons from .41 in 2014	↑ 26% in campus hazardous waste costs since 2016	\$782K in total campus waste costs, up 1% from 2019	\$2K in net recycling revenue in 2020, down from \$70K in 2011	
Built Environment 2020 saw the completion of the Chen Neuroscience Research Building and the LEED Gold certification of the Hameetman Center. Progress continues on native flora efforts.	1 building pursuing LEED certification in 2021	600K square feet of LEED building space, totaling 13% of entire campus	16% of campus covered with low-water vegetation, up from 4% in 2012	12,000 square feet of turf removed from campus in 2020	11 campus buildings now LEED certified, up from 4 buildings in 2011	
Mobility With COVID-19 forcing many Caltech individuals to work from home, telecommuting numbers went from the single digits in 2019 to over two thousand in 2020.	2.48 campus occupants per vehicle, up from 1.60 in 2019	26% campus drive alone rate, down to lowest level ever due to COVID-19	2027 telecommuters in 2020 due to campus occupancy restrictions	41% staff drive alone rate, down from 72% in 2019	88/4 carpools and vanpools at the end of 2020, respectively	
Emissions While considerable progress was made over the past decade to manage emissions on a growing campus, Caltech was unable to meet the Climate Action Plan goal.	↓ 1% regulated greenhouse gas emissions since 2015	↓ 25% total greenhouse gas emissions since 2011	↓ 14% emissions intensity per capita since 2015	385 pounds of CO2e per research dollar, down 25% since 2019	↓ 66% Scope 3 emissions since 2019 due to reduced commuting and funded travel	



Energy



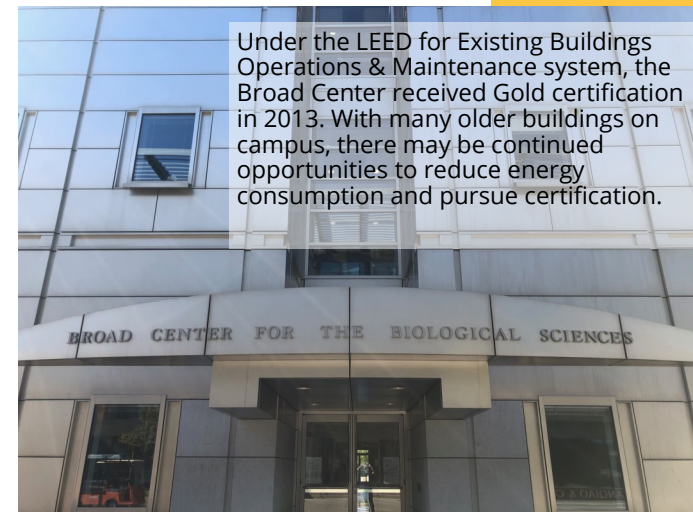
The new Chen Neuroscience Research Building will be entirely powered by a 1.2 MW fuel cell installation that operates independently of the local grid.



While energy consumption fell overall in 2020, ventilation systems were all adjusted to maximum flow in order to mitigate infection risk.



Planned changes to the Caltech energy system will affect the thousands of feet of underground tunnel systems carrying chilled water and steam to the campus.



Under the LEED for Existing Buildings Operations & Maintenance system, the Broad Center received Gold certification in 2013. With many older buildings on campus, there may be continued opportunities to reduce energy consumption and pursue certification.



Goals for Viability

Identify and recommend sources of high quality, reliable and environmentally preferable energy to support research and education while working with the campus community to improve efficiency and reduce demand.

2020 Highlights



Campus Energy Change Due To COVID-19 May 2020



Due to the unprecedented campus shutdown and subsequent limits on occupancy, Caltech saw its annual energy consumption drop to the lowest level since 2006. While information on end-use change is limited, hypotheses generally center on reduced lighting and plug load electricity consumption.

Hot Water Conversion Study Begins September 2020



While the 2019 Utility Master Plan provided very useful recommendations and a project path for the campus chilled water and electric distribution systems, more information was needed for the heating systems in order to inform a potential campus conversion from steam to hot water.

Solar 3 Installations Connected To Campus Grid December 2020



By the end of 2020, nearly all of the .7 megawatts of Caltech's Solar 3 project were installed and connected to the campus grid. Combined with Solar 1 and Solar 2, Caltech's total solar capacity is now 2.1 MW, and all available campus rooftop space is utilized.

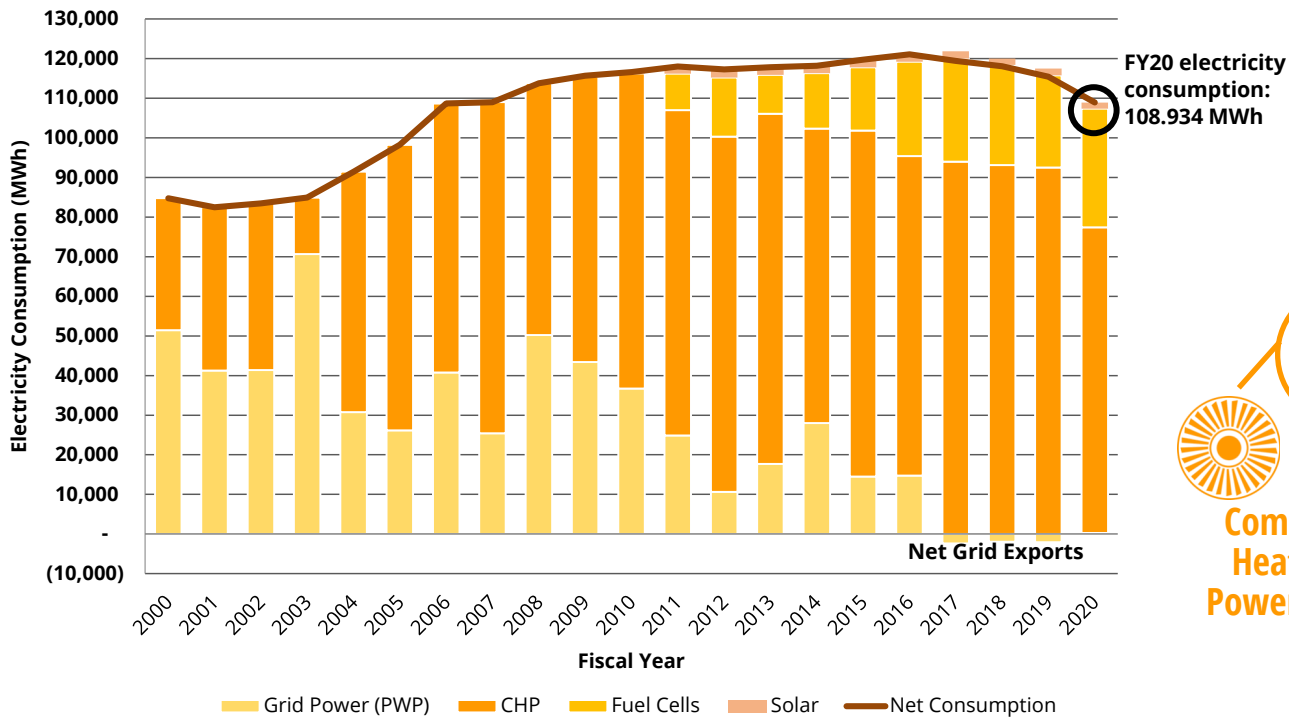
2020 Energy Update

↓5%

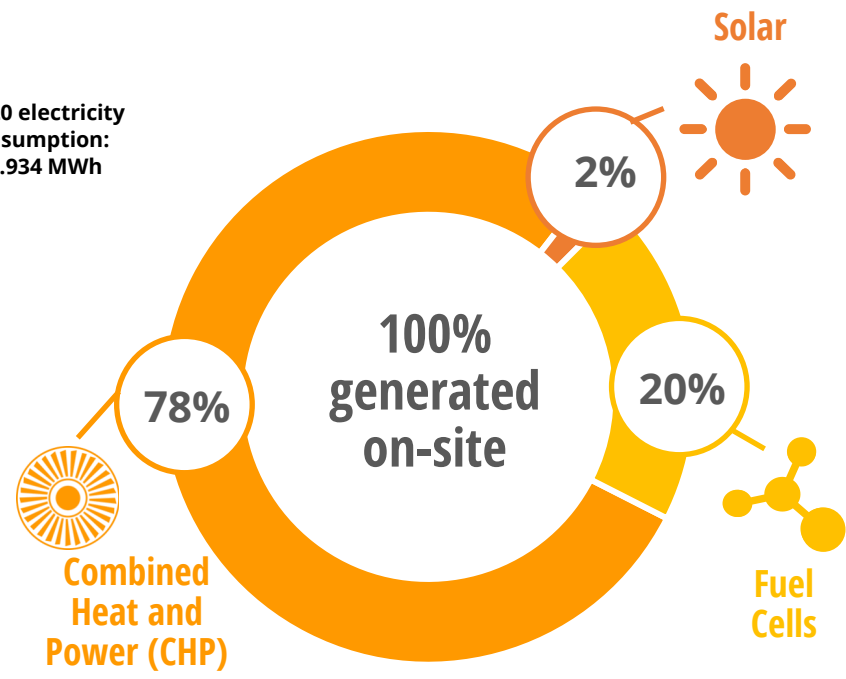
total electricity consumption from 2016 and lowest since 2006

Electricity consumption fell to the lowest level in over a decade in 2020 due primarily to reduced campus occupancy from COVID-19 restrictions. With increased heating, ventilation, and air conditioning energy consumption due to efforts to reduce potential on-campus transmission, energy savings likely came from reduced plug load and lighting usage. 2020 saw the addition of new generation assets including the 1.2 megawatt (MW) Chen fuel cell installation and the approximately 700 kilowatt Solar 3 project which covers 8 additional campus rooftops. These installations bring Caltech's total generating capacity to over 18 MW. Campus energy costs rose in 2020 due to a combination of new demand from the Chen Neuroscience Research Building and an extended period of downtime for the campus cogeneration unit.

Historical Campus Electricity Consumption



2020 Electricity Portfolio



100% electricity produced on-site¹ but no net export due to turbine downtime



2% energy intensity by area² since 2019 but 4% increase since 2015

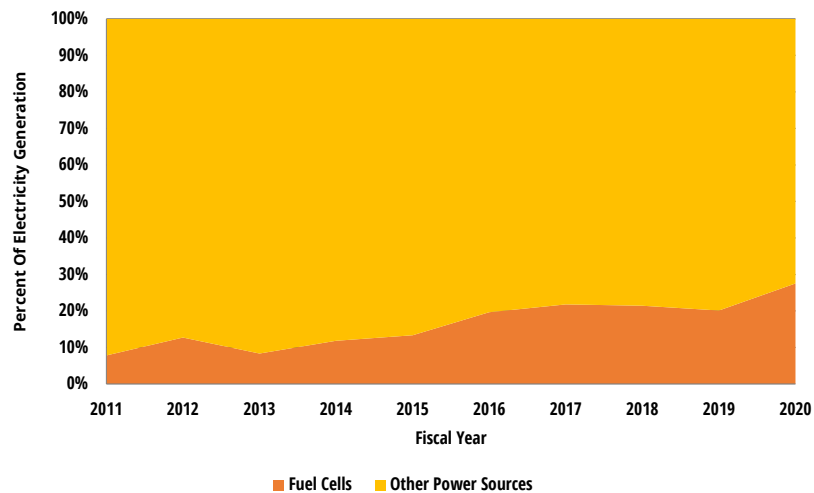
\$12.7M

in annual energy costs, an 11% increase from 2019

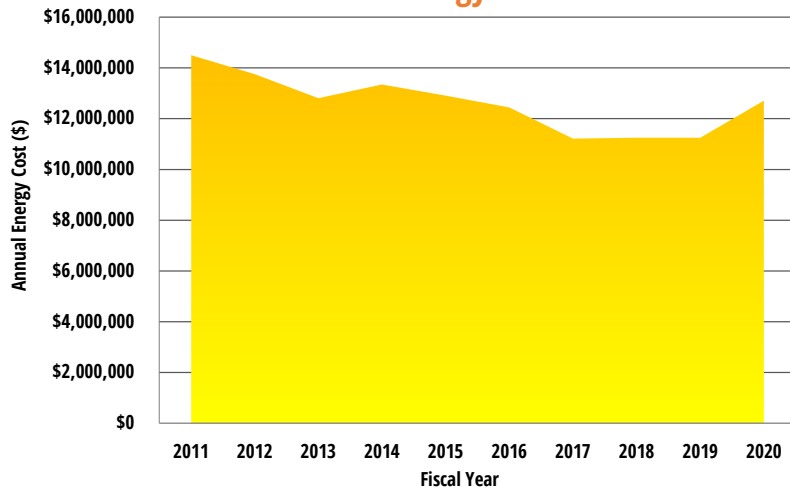


Fuel Cells Continue To Diversify Energy Mix And Stabilize Costs

Fuel Cell Share Of Campus Energy Generation



Historical Energy Cost



Chen Fuel Cells and Solar 3 Add To Campus Energy Generation

Caltech further amplified on-campus energy resources with the addition of a 1.2 MW fuel cell installation near the S. Wilson garage and 700 kW of solar capacity scattered across 8 buildings including the newer Bechtel and Hameetman buildings.



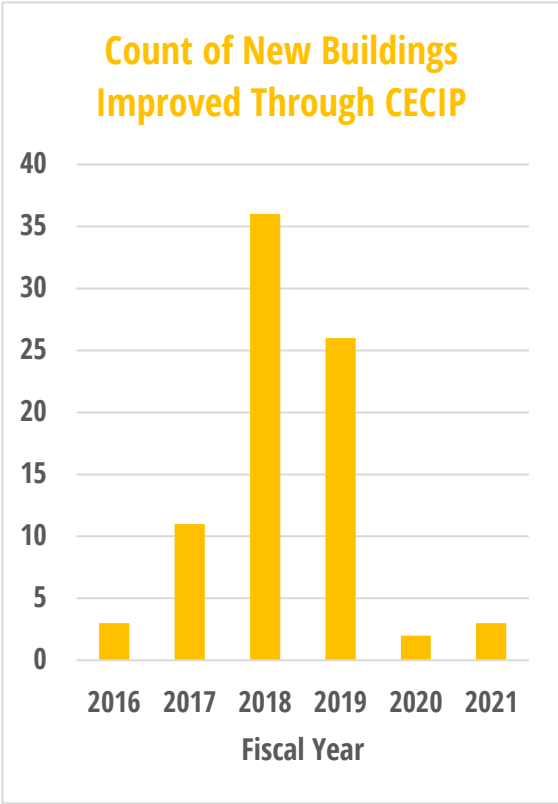
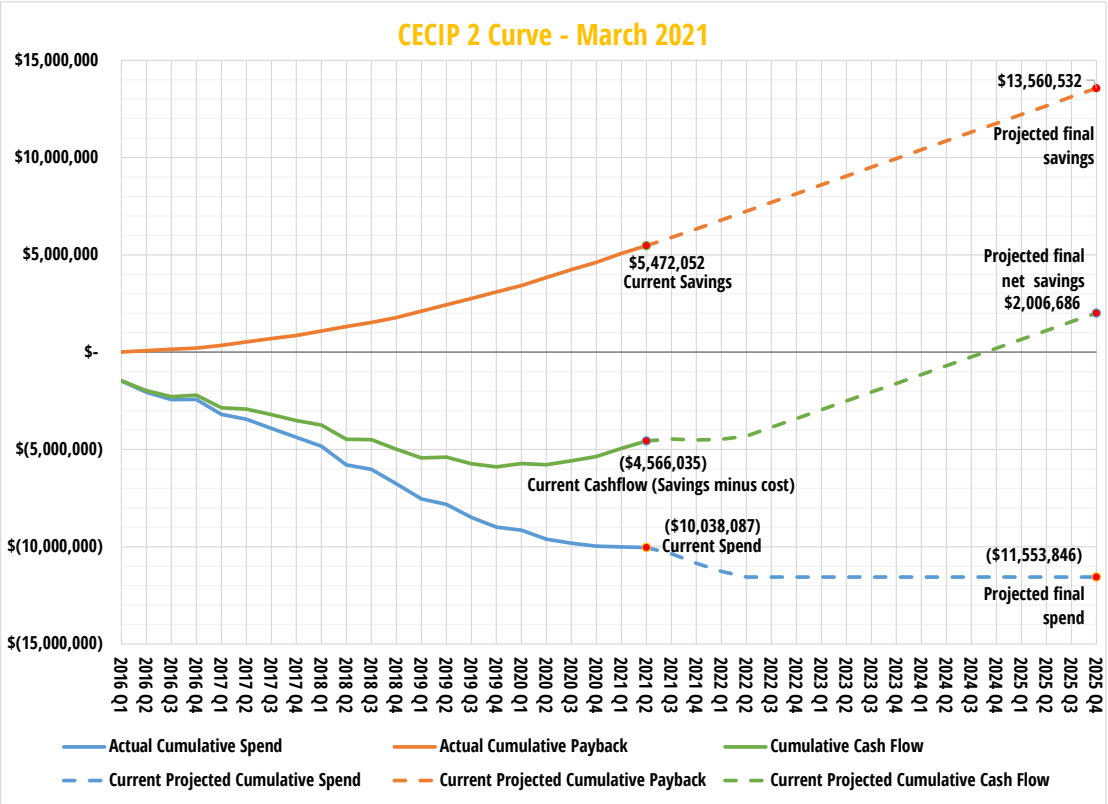
These new resources will bring Caltech's total on-site generating capacity to over 18 MW, including 4.3 MW of fuel cells and 2.1 MW of solar PV, and this will enable Caltech to continue satisfying campus load with 100% on-site electricity. While these on-site resources provide Caltech with a degree of cost stability, a competing interest is the push to decarbonize and move away from fossil fuels. Balancing these competing priorities will be crucial in the 2020s and beyond.



CECIP Deep Dive

56 buildings improved since 2016

In 2008, Caltech created the Caltech Energy Conservation Investment Program (CECIP) to utilize the endowment to finance energy efficient infrastructure projects in order to reduce Caltech’s energy costs. These projects must exhibit verifiable savings, payback initial investments within a set period, contain a plan for periodic measurement & verification, and most importantly, not have a negative impact on research. These projects have covered a range of target building improvements, including lighting systems, HVAC equipment upgrades and controls, air distribution improvements, data center upgrades, and an end-user program to incentivize purchasing energy efficient freezers. The first phase of CECIP projects ran from 2008-2015 and generated \$9 million in avoided utility costs. Phase 2 has been ongoing since FY2016 and has funded around 40 projects. To date, these projects have saved a cumulative \$5.5 million in avoided utility costs on a \$10 million investment and are projected to break even in FY2024. Current CECIP projects are saving over 7,000 MWh of electricity and over 40,000 MMBTU of thermal energy every year, which is equivalent to heating and powering 750 average US homes annually.





160K MMTBU

of thermal energy savings since 2016

95 GWH

of electricity savings since 2008

\$12.9M

in energy
savings from
CECIP projects
since 2008

LED Retrofits Summary



Improving a building's lighting systems is a great, cost-effective way to reduce electric usage while enhancing the occupants' experience within the space. Retrofitting old light fixtures with efficient LED lamps and fixtures is often regarded as a "low hanging fruit" because this measure can be implemented relatively easily and pay back the upfront costs quickly. Over the past 5 years Caltech has implemented multiple phases of lighting improvement CECIP projects that spanned 56 buildings campus-wide.



These projects are saving 4,820 MWh of electricity every year compared to the business-as-usual baseline, which has the greenhouse gas equivalency to over 380,000 gallons of gasoline. In addition to the positive environmental impacts of these projects, they were economically successful as well; the Institute saved \$2.8 million (so far) and is paying back the \$3.4 million investment in under 4 years.

South Mudd Data Center Upgrades



Projects to improve building HVAC systems are often expensive to implement and payback periods from energy savings are longer. However, there is a lot of opportunity for improvements to aging equipment and traditional operational practices which can provide the required space conditioning at a much lower energy cost. In 2016 Caltech completed a project in a data center in the South Mudd building that was able to achieve tremendous savings in a fast payback period. Mission critical spaces like data centers are sensitive to temperature and humidity conditions and are often over-conditioned.



Prior to this project, 6 air handlers would cool the space running at 100% power 24/7. The system was retrofitted from constant to variable which senses conditions in the room and provides the necessary cooling only. This project paid for itself in less than 2.25 years and continues to save the Institute \$30-\$40,000 every year in electric and chilled water reductions compared to business-as-usual. Additionally, the data center benefits from improved temperature sensing and controls which enhances reliability and resiliency.



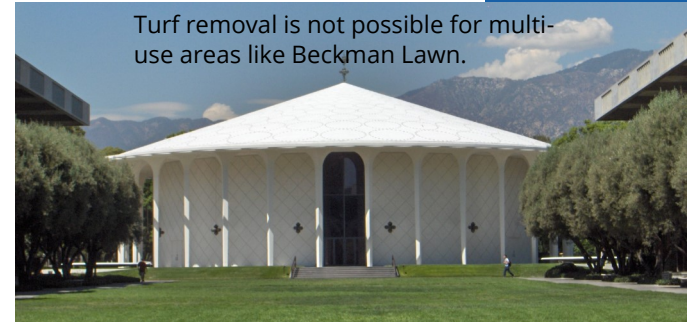
Water



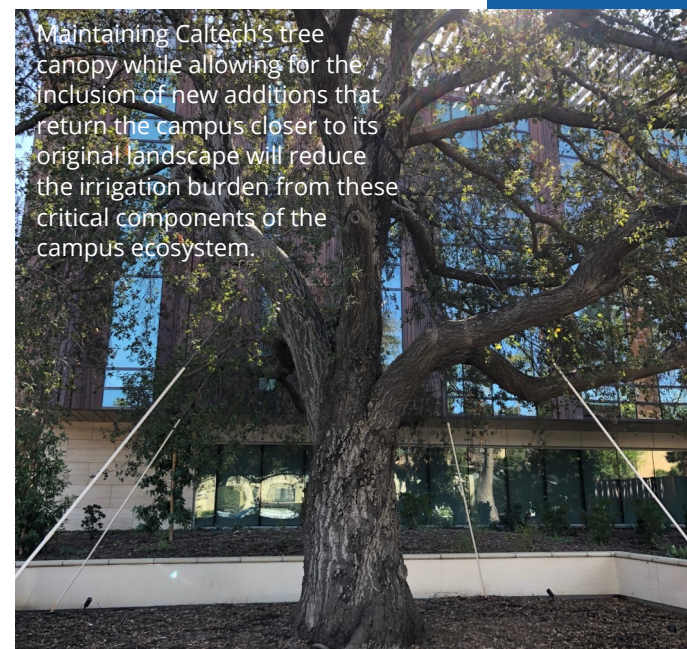
The space in front of the Caltech Library (formerly Millikan) received a landscaping upgrade that reintroduced Engelmann Oaks and utilizes climate-adapted vegetation.



Decreased snowpack in the Sierra Nevada range affects water availability and the likelihood of wildfires throughout California and the southwestern United States.



Turf removal is not possible for multi-use areas like Beckman Lawn.



Maintaining Caltech's tree canopy while allowing for the inclusion of new additions that return the campus closer to its original landscape will reduce the irrigation burden from these critical components of the campus ecosystem.

Goals for Viability

Responsibly steward water resources by focusing on efficiency, cultivating climate adapted landscape, minimizing potable water use, and maximizing use of reclaimed water.

2020 Highlights

Irrigation Rises During Drier Year

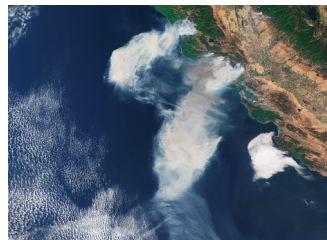
April 2020



The winter of 2020 brought lower rainfall totals compared to the previous winter. This resulted in a 26% increase in irrigation compared to the winter of 2019. While the past two years have seen rainfall above the 20th century average, a changing climate will make droughts like the one seen last decade more common.

Increased Wildfire Threats Tied To Decreased Snowpack

August 2020



A combination of unusually hot temperatures, reduced historical burns, and lower seasonal rainfall created one of the worst fire seasons in recent memory. Orange skies blanketed the LA basin for nearly a week while lightning storms in the northern part of the state led to 4 out of the 5 largest fires in California history.

Water Use Decreases Across Low-Occupancy Campus

October 2020



Water use fell by 10% across the campus in 2020 compared to the previous year, and much of this decrease can be attributed to a 23% drop in building-level consumption due to low campus occupancy. Labs empty for months at the start of the pandemic were the definitive cause.

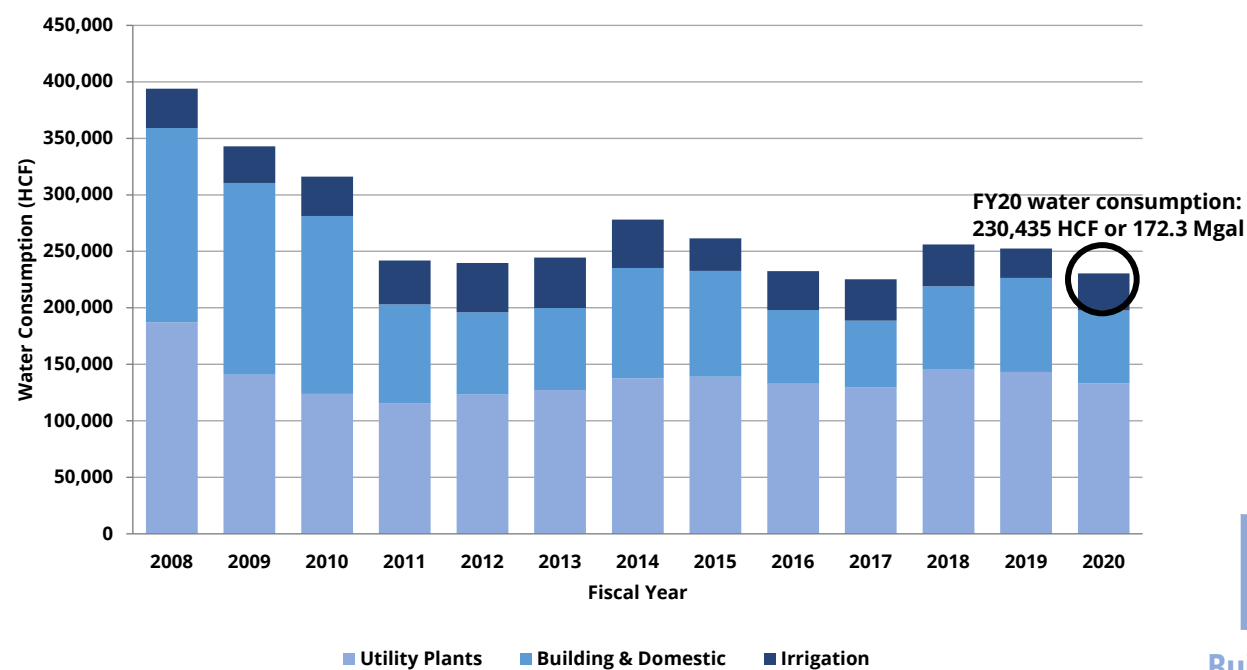


2020 Water Update

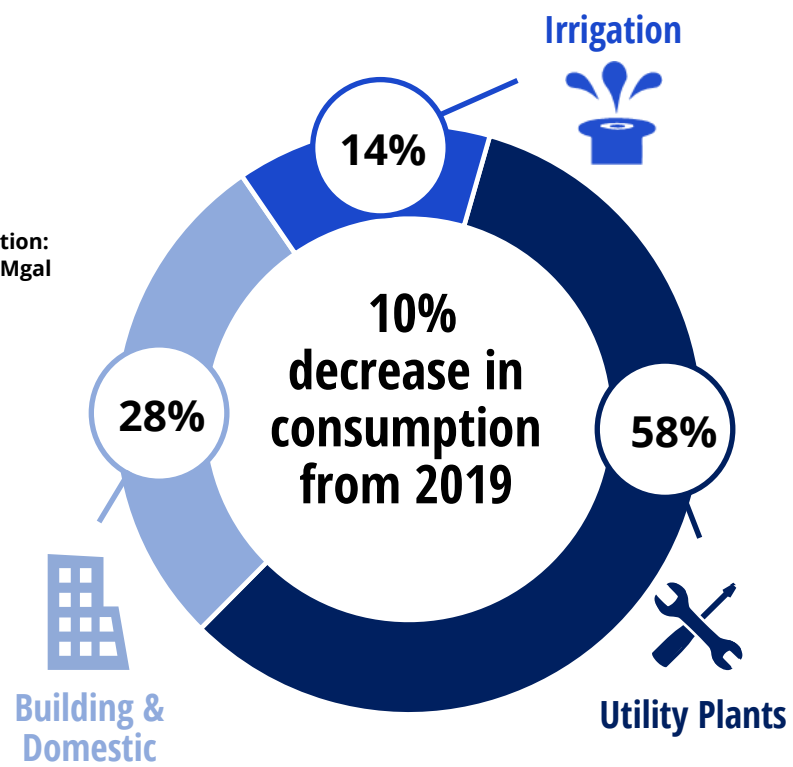
↓ 10% water consumption since 2019 and a 44% decrease since 2006 peak

Water consumption dropped 10% in 2020 on a total basis and 18% per square foot compared to 2019. This overall decrease can mostly be attributed to the drop in building and domestic consumption due to low campus occupancy; building consumption dropped 23% on an absolute basis in 2020 from the previous year. Water costs continue to rise on a multi-year average, but the costs are not yet high enough to allow projects such as campus-wide wastewater treatment and reuse to make financial sense. Looking further at the campus water use profile, irrigation amounts increased due to a drier winter, and utility plant consumption fell slightly as a likely result of lower building cooling needs. Continued efforts to utilize climate adapted planting and other mitigation strategies will help offset the rising water needs brought about by climate change.

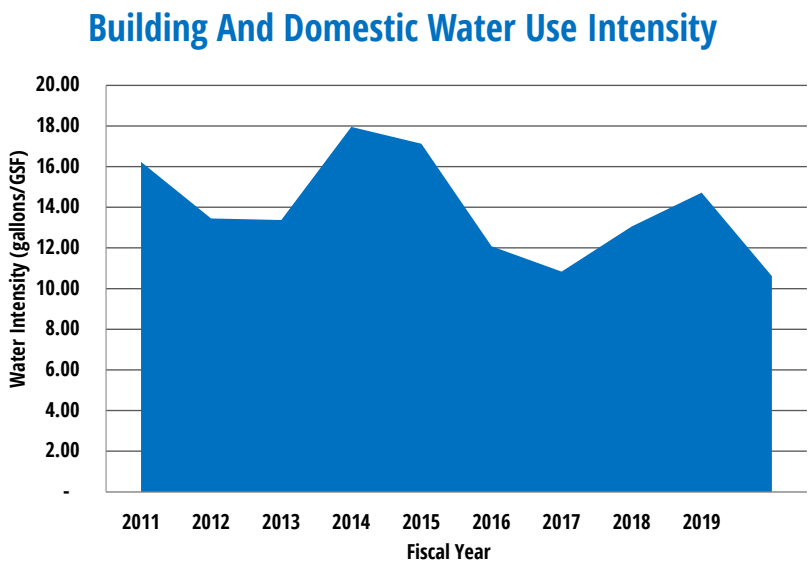
Historical Campus Water Consumption



2020 Water Use Profile

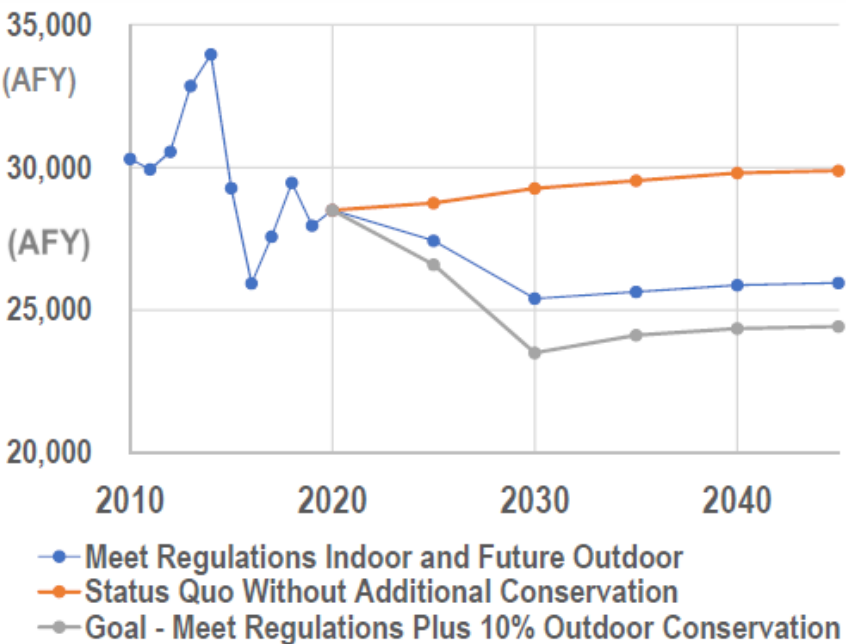


Building Water Consumption Falls Due To Emptier Labs



Pasadena Plots Course For Local Water Sustainability

Work continued in 2020 on Pasadena’s Water System Resources Plan, and Caltech is a key stakeholder in evaluating and guiding the City’s future water planning. Key takeaways include the necessity of both indoor and outdoor conservation, resilience measures for the Raymond Basin, and securing a consistent supply of imported water.



The above graphic illustrates that the City aims to push beyond the standards of current regulation and set more ambitious goals for total consumption. This plan will require significant infrastructure and equipment upgrades along with customer engagement to set up the necessary behavioral change. Caltech will continue to conserve water on our campus and participate meaningfully in City planning.



Materials



While recycling traditionally comes to mind, green waste from trees, shrubs, and grasses along with food waste make up the majority of material removed from campus and diverted from the landfill.



Republic Services provided all waste handling, composting, and recycling services for the campus starting in September 2020.



Recyclability of materials varies from city-to-city and sometimes between vendors making consumer education difficult.



Continued growth of the Caltech campus required the recycling yard to be moved.

Goals for Viability

Reduce waste through responsible procurement practices and encourage materials reuse and recycling.

2020 Highlights

Lab Waste Receives Extra Attention

March 2020



Students in the CHE 190 class were asked to choose a sustainability project with either a research component or a benefit to operations on the campus. One interesting project was Kaleigh Durst and Vidhya Dev's deep dive into the costs and benefits of recycling two common lab materials: pipet tips and solvents.

Shift Towards Disposables Due To COVID Precautions

April 2020



COVID-19's initial wave led to numerous uncertainties in how the virus spreads and infects new people. At the start of the pandemic, surface contamination was a significant concern which led to proliferation of single-use plastics and disposable materials in addition to rigorous sanitization practices.

Caltech Transitions To A New Waste Vendor

September 2020



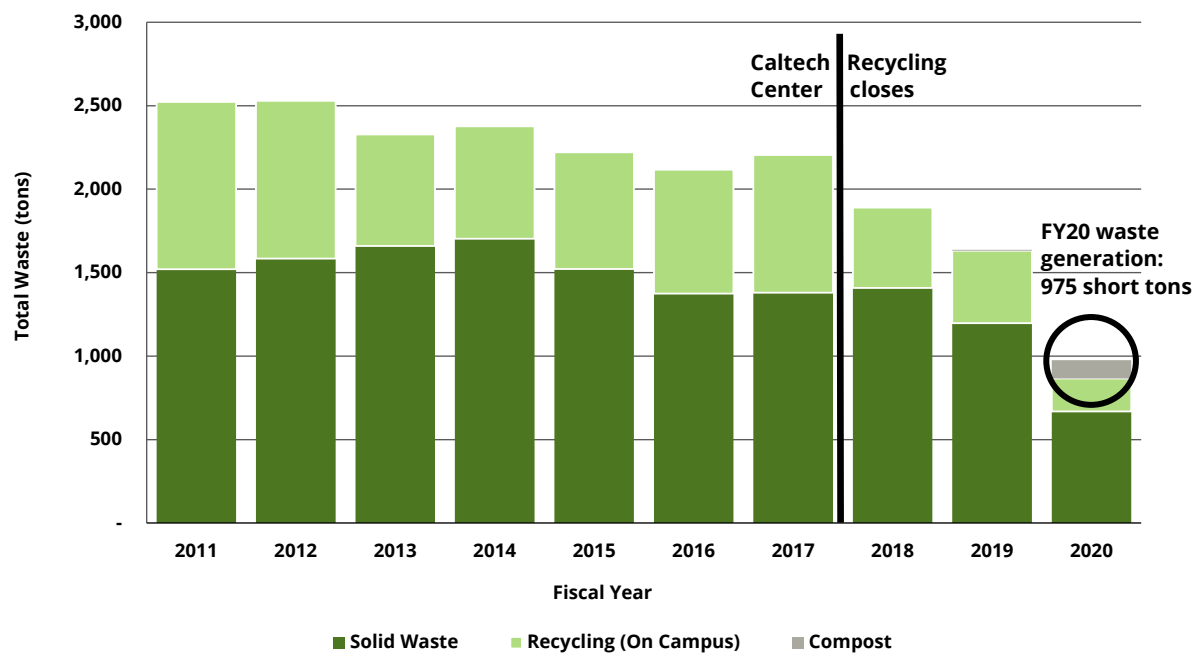
With Caltech's waste and recycling contracts both ending at the conclusion of Fiscal Year 2020, Caltech Sustainability worked with Buildings & Grounds on a detailed process for identifying a new vendor to provide both services. Republic Services was selected to provide waste, recycling, and composting for the campus.

2020 Materials Update

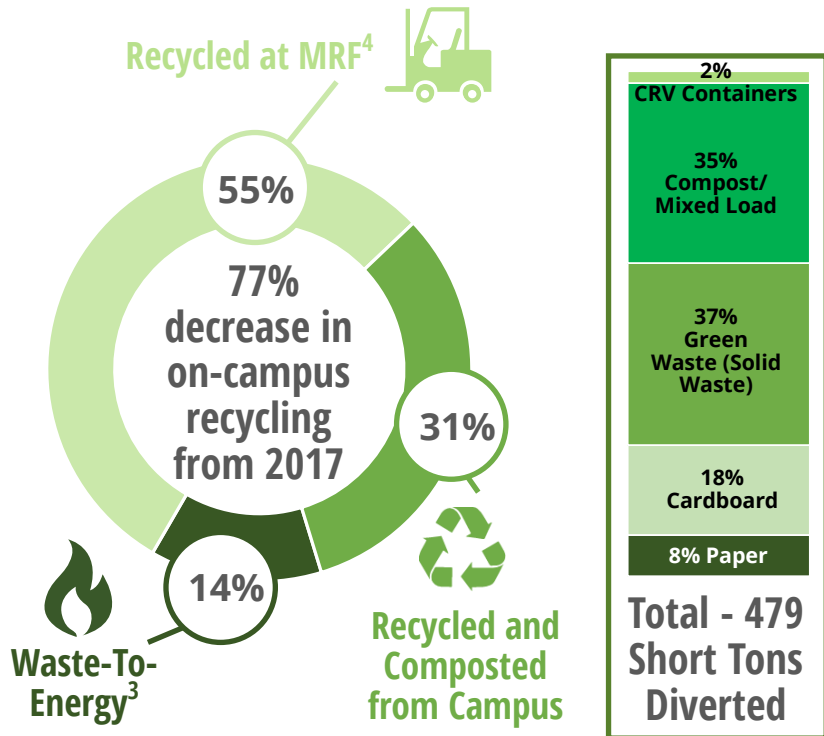
31% campus non-hazardous waste diversion rate, up from 27% in 2019

The challenge of waste management and materials usage was further complicated by the COVID-19 pandemic in 2020. Single-use plastic became even more ubiquitous as concerns about contamination and infection spread pushed the campus community and the entire world away from reusable materials. CRV volumes plummeted due to low campus occupancy, and on-campus diversion of recyclable materials fell to the lowest levels seen since the early 2000s. However, there were a number of bright spots as composting began to take hold in both the dining halls and student houses. With the composting program diverting over 100 tons of food waste from the normal waste stream, trash levels fell to historic lows. Progress continues with sustainable purchasing as new contracts and agreements encourage vendors to supply environmentally preferred purchasing (EPP) data.

Historical Campus Waste & Recycling Generation



2020 Waste & Recycling Profile



374

pounds
municipal waste
generated per
person, down
from 755 in 2017



26%

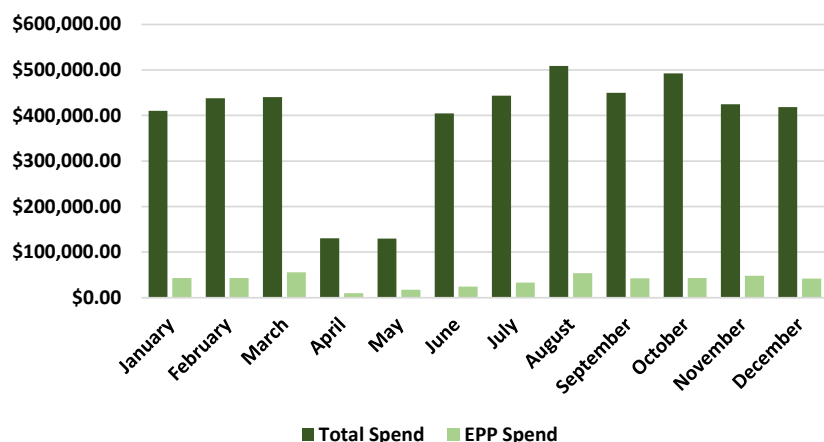
in campus
hazardous waste
costs since 2016

\$782K

in total campus
waste costs, up
1% from 2019

Caltech Gathers More Sustainable Purchasing Data

2020 Caltech Total vs. EPP Spend



2020 Month	% EPP	2020 Month	% EPP
January	10.5%	July	7.5%
February	9.8%	August	10.6%
March	12.7%	September	9.4%
April	7.5%	October	8.7%
May	13.3%	November	11.3%
June	6.0%	December	10.0%

Caltech Composting Program Turns One Year Old

Late in 2019, Caltech began setting up the entire campus for its first large-scale composting effort. Beginning in the kitchens at campus dining halls, the Broad Café, and the Athenaeum, the program quickly expanded to undergraduate houses. Despite the COVID-19 pandemic significantly limiting on-campus dining, the Institute successfully diverted over 100 tons of food waste in 2020.



In October, Caltech transitioned waste handling and recycling services from Athens Services to Republic Services. With consistent coordination and communication, the transition was smooth and the campus is well-positioned for an increase in occupancy and waste volumes this fall. With this program in place, Caltech Sustainability will begin to evaluate more preferable options for diversion including food donation. Pursuing these efforts along with a focus on local and sustainable foods will further reduce emissions of purchased food.



Built Environment



TIANQIAO &
CHRISSY CHEN
NEUROSCIENCE RESEARCH BUILDING

The brand new Chen Neuroscience Research Building stands at the corner of Del Mar Blvd. and Wilson Ave. as the new hub for Caltech's research of the brain and spinal cord.



While the Jorgensen Laboratory housed the Resnick Institute at its inception, the Resnick Sustainability Center will be the new hub from 2024.



This entire stretch along Holliston Ave. has been converted from high water-use turf to drought resistant vegetation in recent years.



This picture near the Caltech Library is from nearly 15 years ago and shows how the landscape has now changed without the Engelmann Oak and grassy landscaping.

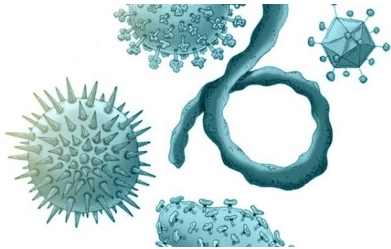
Goals for Viability

Ensure existing and future facilities meet and maintain a high level of energy, water, and resource efficiency.

2020 Highlights

Understanding The Built Environment During COVID

April 2020



The worst pandemic in a century brought about a flurry of new challenges with regard to occupant safety, building operation, and risk mitigation. With the safety of faculty, staff, and students as the guiding principle, the Institute confronted many new challenges in 2020.

Hameetman Center Achieves LEED Gold

September 2020



After a lengthy review process, Hameetman Center was finally awarded LEED Gold certification in 2020. This continues the Institute standard of achieving at least LEED Gold for all new building projects.

Chen Neuroscience Building Completed

October 2020



Caltech and our construction partners were up to the immense challenge of completing a building project during a pandemic, as the Chen Neuroscience Research Building now stands at the corner of Wilson Ave and Del Mar Blvd. At 151,000 square feet, this building will serve as the new hub for researching the brain and nervous system.

2020 Built Environment Update

11

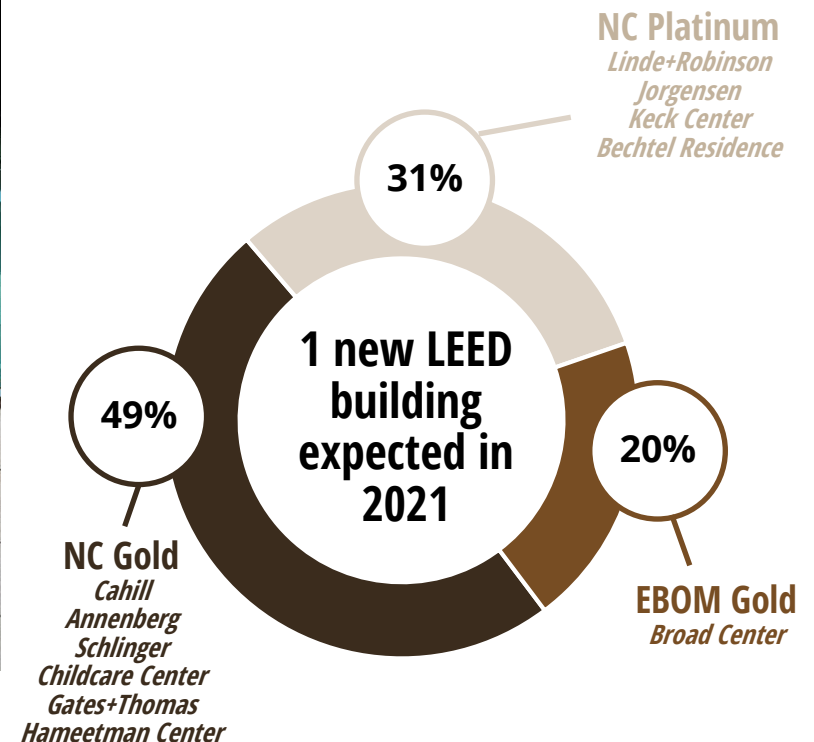
LEED certified buildings,
13% of Caltech's total
campus space, with one
more expected in 2021

2020 saw the Chen Neuroscience Research Building rise from the ground at the corner of Del Mar Blvd. and Wilson Ave., with occupancy beginning in early 2021. The Hameetman Center achieved LEED Gold status, making it the 6th new construction project to reach Gold status and the 11th LEED certified building overall. Efforts continue to reduce high water use turf in favor of low water use turf and to replace all eligible turf with native vegetation. A tree study was completed to update and modernize the inventory of Caltech's canopy; these trees provide numerous ecosystem services and diversify the land cover of the campus. Following upon the \$750 million gift from Lynda and Stewart Resnick, planning continues around the design of the Resnick Sustainability Center which will serve as a hub for all Resnick Institute initiatives and other sustainable research.

Native Plants At New Chen Building



2020 LEED Square Footage Breakdown



↑ 300% increase in low water vegetated campus cover since 2012

151,000

square feet of LEED space scheduled to be added by 2021

1

construction project currently pursuing LEED certification

Caltech Continues Journey To Sustainable Built Environment

2020 Campus Land Use Breakdown

21% High Water Use⁵

79% Low Water Use⁶

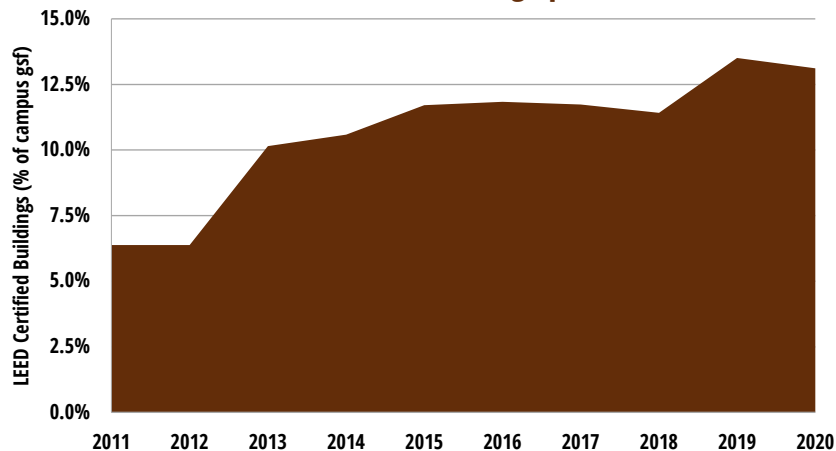
49% Hardscape

26% Buildings⁷

18% Turf

16% Vegetation

LEED Certified Building Space



Resnick Sustainability Center Slated For 2024 Completion

The new Resnick Sustainability Center (RSC) Building will be located at a site that is currently occupied by the Mead Chemistry Teaching Building, which is at the northwest side of campus off Wilson Ave. The proposed site is just south of the Beckman Lawn and adjacent to the Noyes and Braun laboratory buildings.



The proposed RSC (final design subject to change) will serve as Caltech's new hub for energy, sustainability, and climate change research, as well as provide a home for state-of-the-art chemistry teaching laboratories, active learning environments, and collaboration spaces. These will amplify and expand the work of the Resnick Sustainability Institute (RSI), established over a decade ago. The new building will be built within a structure that adheres to and takes advantage of Caltech's campus master plan goals and objectives and is envisioned to house roughly 80,000 gross square feet of space.

Mobility

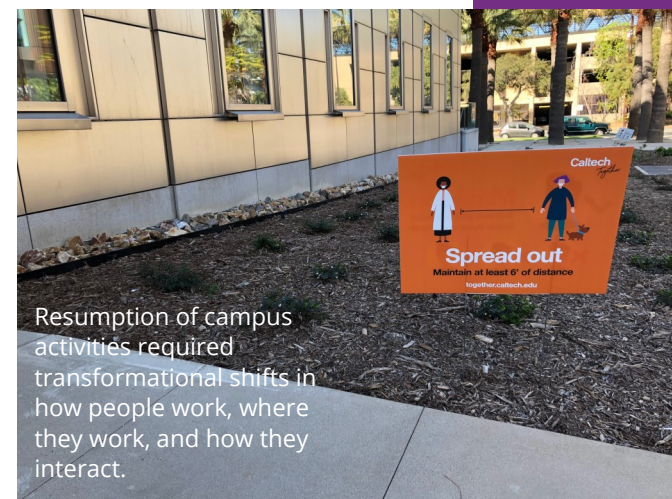


Statewide lockdowns to prevent the spread of COVID-19 brought unfamiliar sights, including empty highways in southern California.



Soon after the start of the COVID-19 pandemic, face masks were required on all public transit.

Caltech was awarded with a Best Practice Award at the California Higher Education Sustainability Conference for their EV charging partnership with PowerFlex.



Resumption of campus activities required transformational shifts in how people work, where they work, and how they interact.

Goals for Viability

Maintain a fuel-efficient fleet of vehicles and actively promote and enhance mobility options for the Caltech community.

2020 Highlights

Caltech Unveils New Programs

January 2020



After a year-long planning effort, Caltech rolled out a coordinated set of new programs to enhance the commuter experience and bring parking rates into sync with market standards. The E-Pass and U-Pass are offered for free while vanpool subsidies were increased.

COVID-19 Forces Telecommuting Shift

March 2020



COVID-19 caused an enormous shift towards telecommuting in 2020. While Caltech only has telecommuting numbers dating back to 2018, records indicate that an average year would see telecommuters in the single digits. In 2020, we had over 2,000 people regularly telecommuting.

Commuting Patterns Change Dramatically

October 2020



The drastic shift towards telecommuting caused our AVR to temporarily spike from 1.6 to 2.48. This corresponded with a decrease across the board for all other commute modes but especially for public transit. While public transit volumes should rebound, telecommuting will likely have a sustained presence into the future.

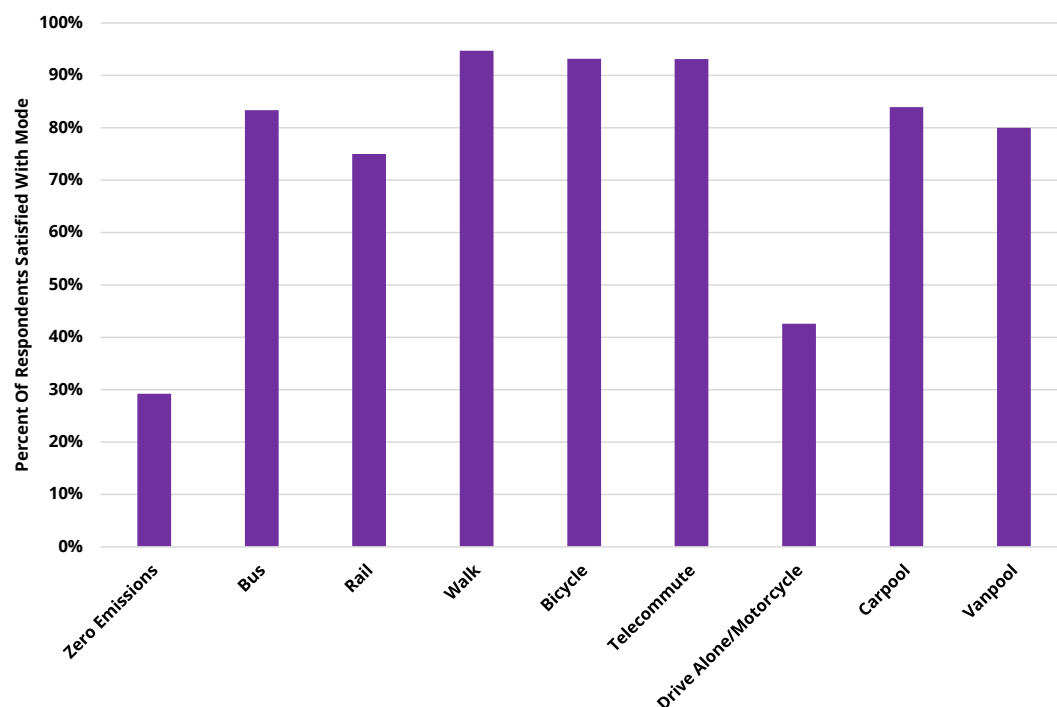


2020 Mobility Update

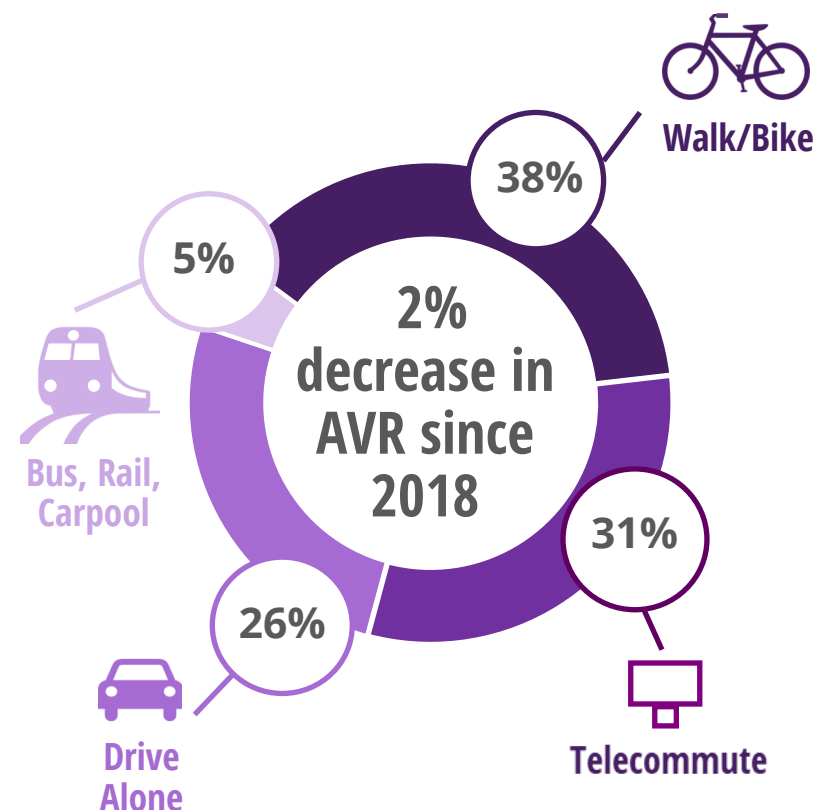
2.48 campus occupants per vehicle, up from 1.60 in 2019

While the COVID-19 pandemic impacted many aspects of our normal lives, few were changed as drastically as mobility, commuting, and transportation. Regular telecommuter counts from previous years typically tallied in the single digits, but 2020 saw that number jump to over 2,000 Caltech employees. As a result of Stay-At-Home orders, commuter volumes in the southern California region dropped to a fraction of normal. This drastically altered Caltech's commuter profile which saw an explosion in telecommuting, along with a significant drop in public transit commuters, carpoolers, and single-occupant vehicle drivers. Campus Average Vehicle Ridership (AVR)⁸, defined as the number of campus commuters divided by the number of commuting vehicles, rose to the highest level ever at 2.48. As we exit the pandemic, the staying power of these trends will be very interesting to follow.

User Satisfaction By Commute Mode



2020 Commuter Breakdown



31%

telecommuted in 2020 compared to less than 1% in 2019

41%

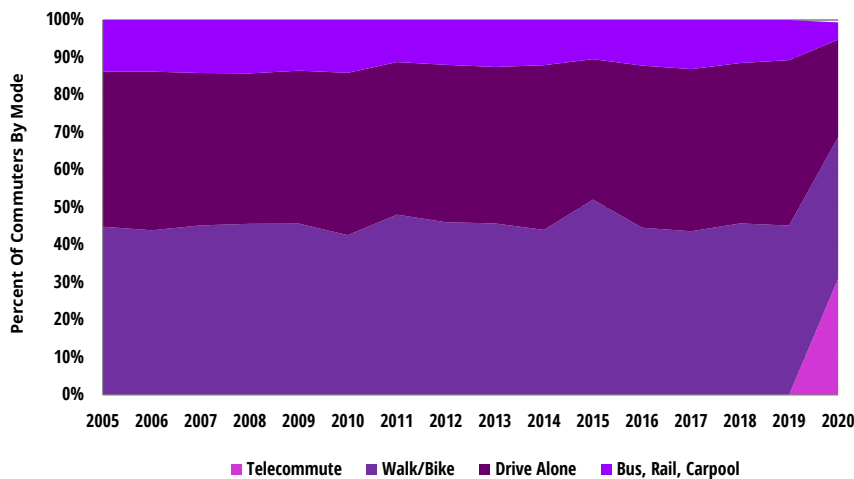
staff drive alone rate, down from 72% in 2019

2,027

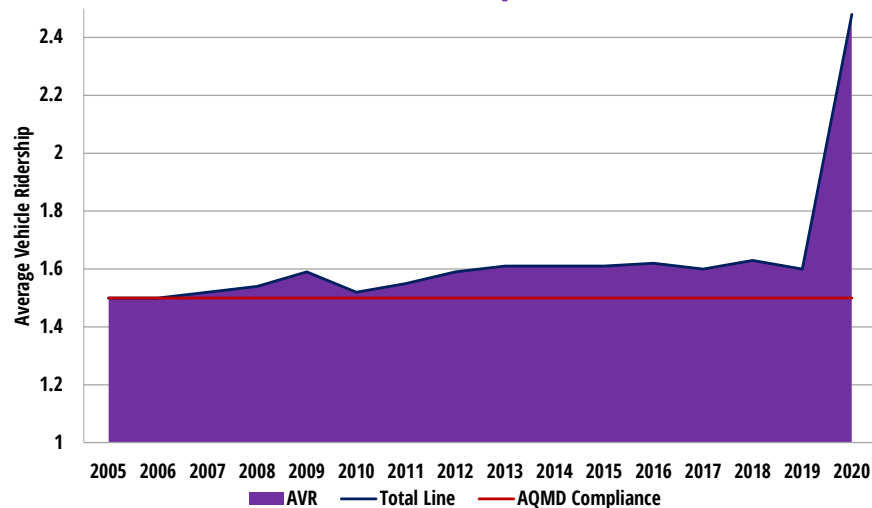
telecommuters in 2020 due to campus occupancy restrictions

Telecommuting Boosts Caltech AVR

Historical Commute Mode Breakdown



Historical Campus AVR



COVID-19 Pandemic Forces Shift Towards Telecommuting

Mobility changed dramatically in 2020 as workers around the world moved from the office to the home office. Caltech was no exception as essential workers in Facilities and a few other departments were tasked with keeping the campus running while all others worked from home. Commuting patterns, utilization of public transit, and the utility of cars all went through a shift that may be permanent even as infection numbers fall and talk turns towards a return to “normal”.



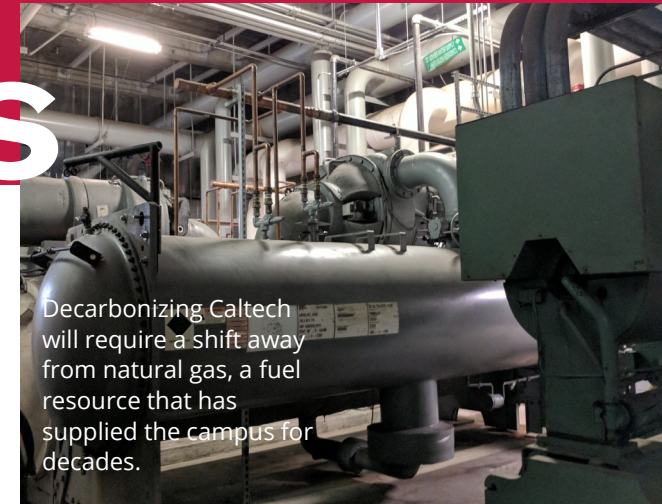
As research returns and Caltech, California, and the entire U.S. inch towards more pre-pandemic practices, a preference for telecommuting and schedule flexibility will remain. HR and every department at Caltech is evaluating how to equitably offer working options that meet an increased expectation of flexibility. While originally not a consideration of our 2019 Transportation Demand Management Plan, telecommuting will factor heavily into plans for resumption of these programs once full operations return. Weekly commute modes will be more varied as will alternative work schedules, and commuter programs will need to cater to that preference.

Emissions Effluents & Waste

↑↑
STEAM VENT
STEAM VENT

↑↑
STEAM VENT
STEAM VENT

Caltech is evaluating the financial, research, and carbon impact of transitioning the campus energy distribution system from steam to hot water.



Decarbonizing Caltech will require a shift away from natural gas, a fuel resource that has supplied the campus for decades.



Caltech's COVID-19 surveillance testing system was critical to limiting spread on the campus, but significant volumes of biohazardous waste were produced as a result.



New fuel cells further reduce Caltech's carbon intensity, but absent new carbon-neutral technology, these installations won't solve Caltech's long-term carbon goals.

Goals for Viability

Explore, evaluate, and implement innovative techniques for minimizing the impact of campus emission, effluent, and waste streams.

2020 Highlights

Caltech Pursues Utility Planning Through Ivy+

December 2019



Caltech Facilities and Caltech Sustainability presented to the Ivy+ group, a coalition of prestigious universities, on Caltech's utility master planning process. This presentation led to a collaborative information-sharing process with input from four other schools on their plans and production of a summary document for executive leadership.

Campus Scope 3 Emissions Fall Significantly

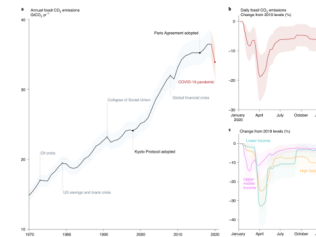
October 2020



Campus Scope 3 emissions, including those from commuting and Institute-financed air travel, plummeted in 2020 to only one-third of their 2019 levels. While this trend is likely to rebound partially in 2021, it does make clear that these both have significant impact as we look towards a new set of carbon goals.

Global Emissions Drop and Due To COVID-19

December 2020



The months-long freeze on travel, reduction in office energy consumption, and overall slowdown in economic activity led to a 7% global decrease in carbon emissions in 2020. While economic activity has already begun to resume, a comparable 7% drop in emissions will be needed every two years to meet Paris Agreement goals.

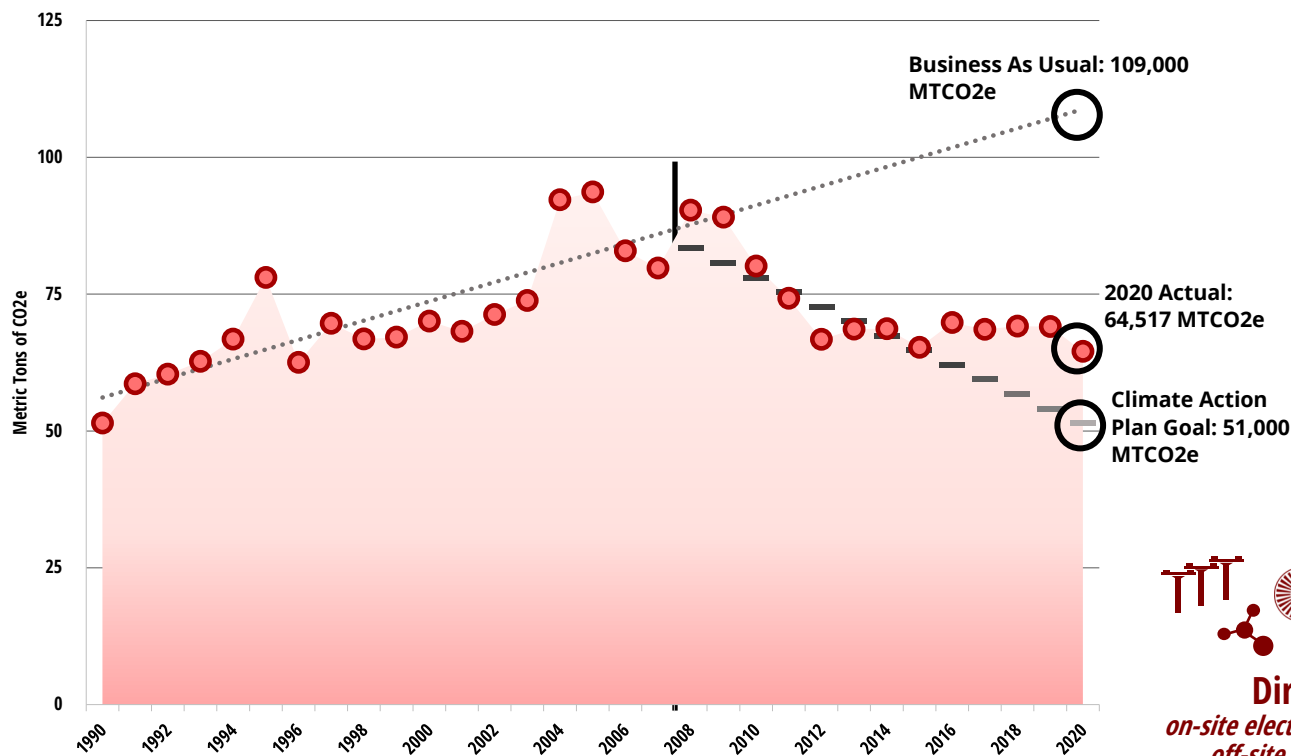


2020 Emissions, Effluent & Waste Update

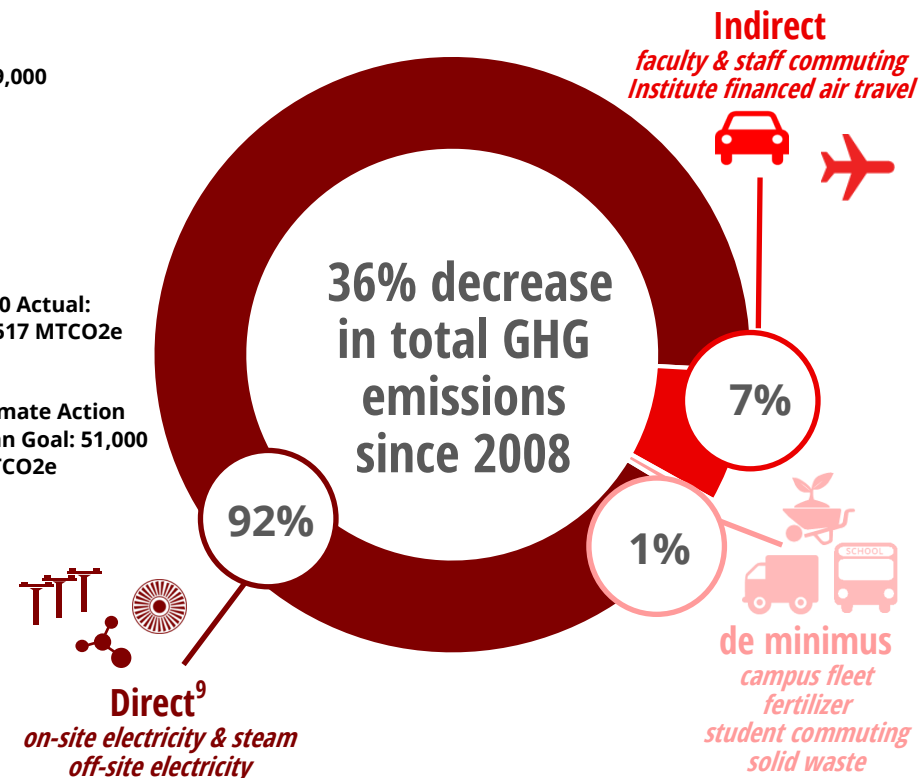
↓ **1%** regulated greenhouse gas emissions¹⁰ since 2015

Despite significant effort and progress being made, Caltech will miss our Climate Action Plan goal. The target to return to 1990 emissions by 2020 was set in 2008 when emissions had already increased by over 50% since 1990, and the Institute not only halted a pattern of annual increases but managed to decrease emissions significantly over the past 12 years. With new energy plans in the works and an overall strategy to align with the state goal of carbon neutrality by 2045, Caltech has a lot of work ahead. 2020 was an unusual year in many ways, but perhaps the most significant deviation is the 66% drop in Scope 3 emissions from 2019. A 50% drop in commuting and a freeze on all Institute sponsored travel since late March led to this staggering change. A rebound in Scope 3 emissions is almost certain, but the degree to which emissions return to pre-COVID levels will be very interesting to watch.

Historical Greenhouse Gas Goal Progress



2020 Emissions Profile



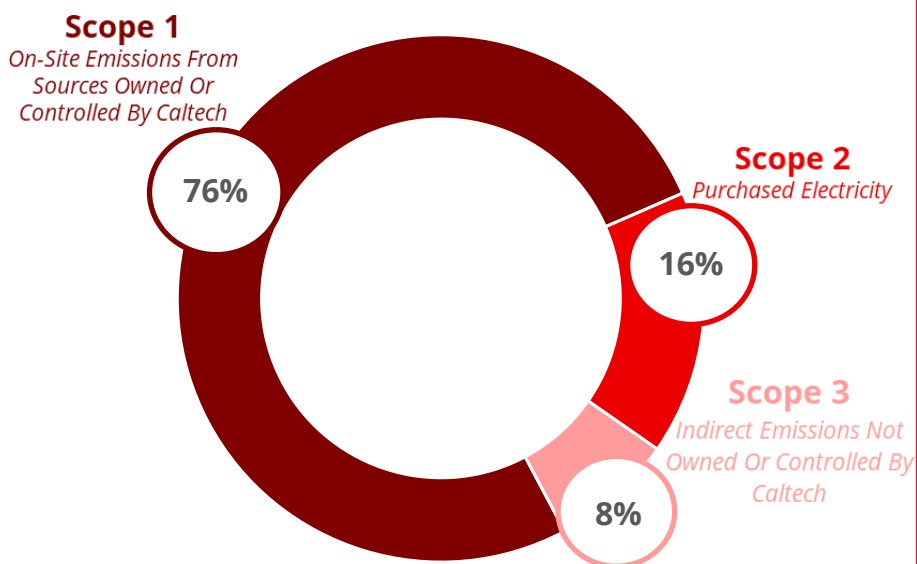
↓25% total greenhouse gas emissions since 2011

11.9 MTCO₂e per person, a 14% decrease from 2015

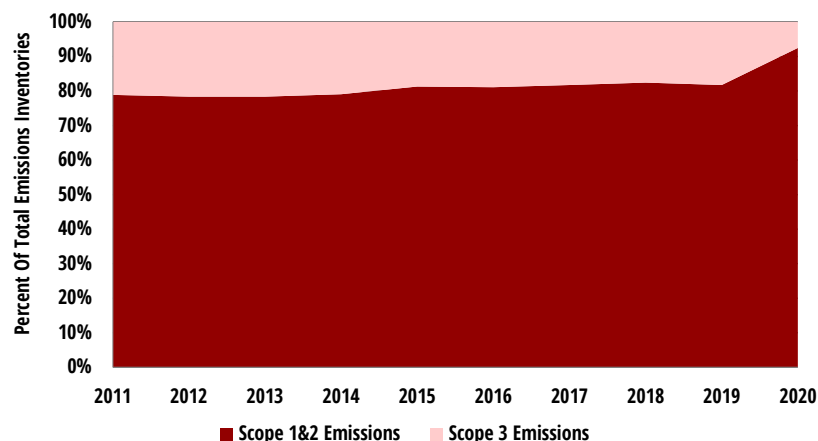
.85 pounds of CO₂e per research dollar, down 25% since 2019

Scope 3 Emissions Drop in 2020

2020 Emission Profile By Scope

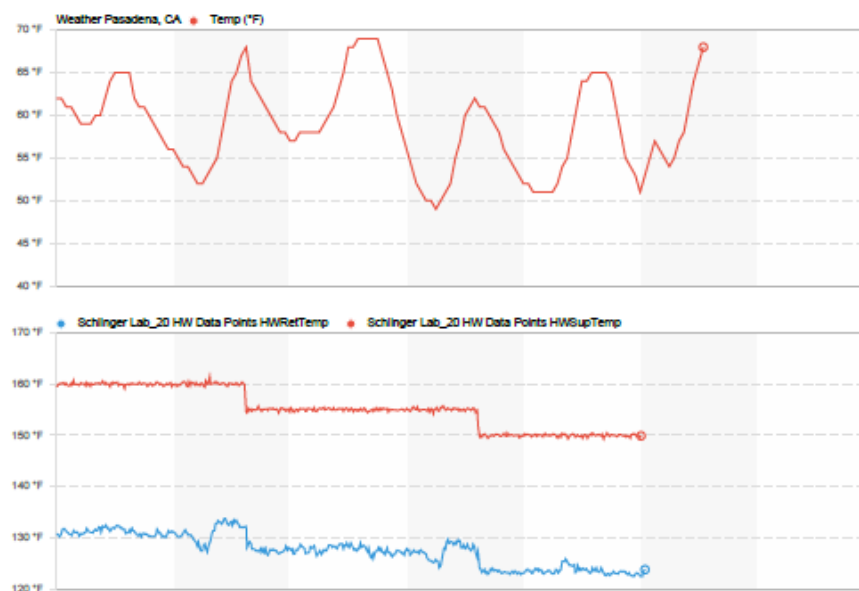


Scope 3 Emissions Vs. Total Emissions



Hot Water Study Provides Opportunity For Decarbonization

The Energy Resource Plan and Utility Master Plan both made clear the need for infrastructure upgrades to the electric and chilled water systems. It also demonstrated the need for a large, offsite renewable energy source in the absence of the current cogeneration system. With this knowledge, Caltech has identified and begun to implement the upgrades needed to modernize these systems, but questions remained on the thermal system.



As such, it became clear that further study of the hot water system was needed in order to identify needed upgrades, pursue full decarbonization of the campus energy supply, and explore the possibility of transitioning the entire campus from steam to hot water heating. If feasible and approved, the transition would take place over a number of years in order to minimize any potential disturbance to research. Successful implementation would allow Caltech to meet a 2045 carbon neutrality goal.

Key Institutional Data

Metric	Unit of Measure	2020	2019	% Change
Core Campus Building Square Footage	Square Feet	4,548,624	4,232,602	+7.5%
Research Square Footage	Square Feet	2,008,745	1,893,852	+6.1%
Population ¹¹	Number (#)	5,869	5,992	-2.1%
Faculty & Post Doctoral Scholars	Number (#)	1,350	1,418	-4.8%
Staff	Number (#)	2,228	2,337	-4.7%
Students	Number (#)	2,231	2,237	-0.3%

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Photos and Images

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Footnotes

1. On-site electricity generation refers to electricity produced on the core campus through the co-generation plant, solar PV and fuel cell systems.
2. Site energy use intensity is calculated by taking the total usable energy consumed (electricity and steam) on-campus and does not include fugitive energy from heat or transmission losses.
3. Caltech's waste hauler sends a portion of the waste collected from the core campus to the Southeast Resource Recovery Facility (SERRF) in Long Beach. This facility employs a technology generally known as "mass burn" where solid waste is incinerated with little to no pre-combustion while recovering electrical energy. This technology reduces solid waste by as much as 80 percent. The remaining ash residue can be used as top cover at landfills. For more information, please visit the SERRF facility website at <http://www.covantaenergy.com/facilities/facility-by-location/long-beach.aspx>
4. Includes recyclables collected from the municipal solid waste stream (ie CRV containers, metals, plastics, paper, cardboard etc); excludes e-waste recycling.
5. High water use turf is defined by any turf species with an irrigation factor of at least 20.72gallons/sqft/yr, according to the Department of Energy cool season turf regional irrigation factors.
6. Low water use turf is defined by any turf species with an irrigation factor of at most 14.64gallons/sqft/yr, according to the Department of Energy warm season turf regional irrigation factors.
7. The building footprint is the sum of the first floor area (above grade) for all buildings on the core campus; includes applicable parking structures. Additionally, this report includes the North Athletic Field artificial turf in the building footprint total, as it was installed to serve as a high-use outdoor space, drains water like a building and does not provide any habitat to biodiversity like other turf.
8. Average vehicle ridership (AVR) is calculated using the South Coast Air Quality Management District's Employee Commute Reduction Program measurement methodology. The Caltech campus is surveyed for a week each year, providing the total number of vehicle trips to campus and the average number of riders per vehicle trip. The commuter profile is determined by finding the dominant commute mode during this survey period for each respondent and extrapolating to the total campus population. Thus, AVR and drive alone trends may differ over time.
9. Direct emissions are those from sources owned or operated by the Institute. Caltech's direct emissions inventory includes on-campus stationary sources, purchased electricity and transmission and distribution (T&D) losses. Purchased electricity and T&D losses are included in this category because the amount of electricity purchased is a direct result of operational decisions and campus activities.
10. Total emissions include regulated, indirect, and de minimus emissions. Indirect emissions result from the activities of Caltech but occur at sources owned or controlled by another entity. Indirect emissions include faculty and staff commuting and directly financed air travel. De minimus emissions comprise less than five percent of the Institute's total emissions and are not traditionally inventoried on an annual basis. These emissions may be direct or indirect emissions but are tracked separately. Caltech's de minimus emissions result from university owned fleet transportation, refrigerants and chemicals, fertilizer application, student commuting and solid waste disposal.
11. Human Resources provided faculty, post doc and staff population statistics. The Office of the Registrar provided population statistics and include those seeking undergraduate and graduate degrees.

