



Green Campuses: How Educational Institutions Around The World Are Making This World A Safer Place To Live

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Abstract:

Educational Institutions are of significant importance in the development of a sustainable world. They are the lightbearers of sustainable education and development in our societies and communities. They work in unison with stakeholders like students, researchers, faculty, staff, communities, societies and corporations towards the well being of the natural environment which then reciprocates as beneficial for all these stakeholders and the educational institutions as well. These institutions are setting examples in operating in a manner that not only causes less harm to the environment but also helps in preserving it to ensure its sustainability. In this paper, we critically study how leading university campuses around the world are becoming green in their different processes and activities and working towards making this world a safer place to live. Note: This paper has been funded under the JRF scheme of UGC.

Keywords: Green campus, sustainability, environment, educational institutions.

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Green Vision, Strategy and Commitment

American University signed a charter to Climate Commitment with Second Nature, a not-for-profit organization that assists educational institutions to expand their sustainability efforts. (American University, 2017a). It also has a strategic plan which asks for "an active pursuit of sustainability" on campus. The university's Office of Sustainability drafted a carbon action plan which lead to the initial framework to lead the university towards carbon neutrality. Moreover, in 2014, a detailed plan for sustainability was created in order to include action items related to all aspects of sustainability. (American University, 2017c).

Appalachian State University's Statement of Sustainability stays as "Sustainability at Appalachian State University is not a trend, it is a tradition [...]". The university identifies that all the parties to the institution are active stewards of economic, cultural and natural resources. With the help of engaged scholarship, the institute balances important, imaginative and inclusive thinking in a living laboratory, transforming theory into practice and fostering responsible citizenship. (Appalachian State University, 2017c).

The University of Connecticut signed the American College and University Presidents' Climate Commitment (PCC), which indicates the University's commitment in striving towards a carbon-neutral campus. It also has a Climate Action Plan which revolves around strategies for minimizing greenhouse gas emissions from its campus (University of Connecticut, 2017g). Colorado State was the first major institution in the U.S. to sign the Climate Reality Pledge, committing the university to 100% renewable electricity and reduce carbon emissions by 75% by 2030 and attain climate neutrality by 2050 (Colorado State University, 2017d).

The vision of Sterling College stays as "[...] the College has embarked upon a strategic path to become a global leader in the promotion of a unique educational model that prepares students to become environmental stewards [...]" (Sterling College, 2017a). The vision of Stanford University's Climate Action Planning is "To provide leadership in climate change solutions using Stanford's intellectual and financial resources [...]" It also has a detailed Energy and Climate Plan (Stanford University, 2017b).

Queen's University's Sustainability Strategic Framework acts as a campus sustainability roadmap laying down guiding principles and fosters a common understanding of sustainability. In 2010 it also signed the Climate Change Statement of Action which commits the university to participate in numerous activities intended to reduce greenhouse gas (GHG) emissions and develop research and curriculum in the areas of climate change and sustainability. (Queen's University, 2017). University College Cork, in 2016, published its Sustainability Strategy committing to becoming a world-class University leading the drive towards sustainability in Higher Education Institutes and beyond, to the community, region and the planet. (University College Cork, 2017b).

Green Procurement

Whenever likely, University of Connecticut purchases and employs cleansing and/or disinfecting accessories possessing characteristics that lower possible hazardous influence on human and/or environmental well-being. The institute, furthermore, mandates that sanitizing items employed in

establishments must satisfy environmental specifications set by an approved environmental certification plan (University of Connecticut, 2017e). The university's UConn Dining Services is the largest consumer of locally grown produce in Connecticut (University of Connecticut, 2017f). 90% of all stationery orders in the institute are now processed directly online, saving paper (University of Connecticut, 2017h).

In 2010, American University implemented a Sustainable Purchasing Policy. Pertinently the Office of Procurement and Contracts supports offices on at the campus discover providers that satisfy environmentally friendly standards. It also facilitates small, regional, and disadvantaged firms with establishments' administration contracting objectives and demands. The institute obtains EPEAT (Electronic Product Environmental Assessment Tools) qualified computer systems and uses Green Seal Certified cleansing substances wherever they are offered (American University, 2017e).

At Green Mountain College, Sustainable Purchasing Policy outlines standards for paints, adhesives, and other products that may cause Indoor Air Quality issues and also provides guidelines for the purchase of new materials for renovation or construction ensuring their sustainability (Green Mountain College, 2017a). Companies working with the institute are required to have certain environmental standards which involve going beyond the effort to disclose information and show sustained commitment to high environmental standards in products and services (Green Mountain College, 2017b). Colorado State University has an Environmentally Preferable Purchasing Policy (EPPP) & also increased qualifying purchases to 25 percent in their Sustainability Strategic Plan in 2017 (Colorado State University, 2016).

The University also encourages suppliers to demonstrate environmental stewardship through their Environmental Management Programs (Colorado State University Policy Library, 2015). The University operates a full-time surplus property function where University departments declare surplus furniture and equipment which is then made available for reissue to other CSU departments (Colorado State University, 2017e). University of Rochester: Microfiber mops are used at the university which save 35 gallons of water per day when compared to their conventional counterpart (University of Rochester, 2017b). It also operates envelope storage where departments instead of ordering new ones can call mail services for used but serviceable envelopes (University of Rochester, 2017c). Sterling College publications are printed on recycled paper and use soy ink. Their printers are also Forest Stewardship Council certified. The campus has no vending machines. no soda. no mac-n-cheese from a box making it the top college in the United States serving food that is local, sustainable, humane, and fair-trade. 20 percent of the food served on campus is grown by students in gardens, greenhouses, orchards, and forests all around and in the campus. They also use no chemical pesticides and fertilizers. (Sterling College, 2017b).

Green Logistics

At University of Washington cycling is encouraged by offering bike storages and bike racks. The university recently installed 3 bike maintenance stations with bike pumps, bike stands, and tools to do simple bike repairs (Roselyn, 2016). Carpoolers at the university are rewarded with prime parking spots. A ParkingSense parking guidance system helps decrease idling of vehicles by efficiently searching for parking spots. The university also works with King County Metro, the City of Bothell, and the City of Woodinville in order to

improve alternative transportation services throughout the region (University of Washington Bothell, 2017d). Green Mountain College offers road bikes and mountain bikes to students, staff, and faculty for free through the Green Bikes Program. Employees who travel to work on bikes are given a monthly reimbursement on expenses. The university also operates Go Vermont, a free online carpool service which allows users to request as well as post rides and split the cost of gas with other. The college prohibits idling of vehicles on the GMC campus which reduces greenhouse gases in the atmosphere, saves fuel and improves air quality. The college prohibits idling of vehicles on the campus which decreases greenhouse gases in the atmosphere, saves fuel and improves air quality. (Green Mountain College, 2017d).

The university also operates Go Vermont, a free online carpool service which allows users to request as well as post rides and split the cost of gas with other. The college prohibits idling of vehicles on the GMC campus which reduces greenhouse gases in the atmosphere, saves fuel and improves air quality.

The college prohibits idling of vehicles on the campus which decreases greenhouse gases in the atmosphere, saves fuel and improves air quality. Appalachian State University asks staff to contribute eight dollars to the institute in order to purchase carbon offsets like methane capture and destruction, intermodal transport, reducing energy use, etc. It motivates people to do so by asking them to reduce their carbon footprints through carbon offsets. It tells them that these eight dollars are equal to a pizza or 1.9 metric tons of carbon dioxide which they can help eliminate (Appalachian State University, 2017b). The institute has teamed up with UHaulCarShare to enable students, faculty and staff have transportation options allowing them to maintain a sustainable lifestyle in one cost-effective and convenient package (Appalachian State University, 2012).

According to the Colorado State University's commuter survey, alternative transportation like bus, biking, walking and ride-sharing is used by almost half of the university's faculty, staff, and students. The campus has over 16,000 bicycle parking spaces throughout campus, on-campus cyclings educational and motivational opportunities, such as We Ride, Bike to Breakfast Events, Women's Rides and Smart Cycling Courses, two on-campus bike share stations, integrated with the Fort Collins Bike Share. The institute also supports Longboarding to campus through the installation of longboard racks near building entrances, and encouragement events such as Longboard to Lunch (Colorado State University, 2017a).

Buildings at the University of Rochester provide indoor and outdoor bicycle storage to promote the use of bicycles by residents and staff. It also offers a carpooling option that provides reduced parking rates for carpool participants. If people participate in a 4 person carpool they are charged nothing for parking. Similarly, two and three person carpools receive a discount compared to the regular parking rates. (University of Rochester, 2017d)

With the help of Transportation Demand Management (TDM) program, Stanford University works to reduce commuter emissions and encourage alternative transportation. Through this program in 2016, almost half of the employees drove alone to work on a regular basis which represents a 33% decrease since 2002, the year that the TDM program began (Stanford University, 2017). It also has 80+ EV (Electric Vehicle) charging stations on campus in addition to 23 departmental bike shares on campus, 550+ members of commute club, 100,000+ riders on the free Marguerite shuttle service.

Green Processes

University of Washington Bothell campus composts food waste and yard waste which enables it to keep and re-use more of its organic material within campus boundaries, through vermicomposting and yard waste compost bins. Large equipment, appliances, and furniture that are not needed by a department are sent to the UW Surplus program which reallocates them to departments which are in need. Bins with educational signs for what to compost, recycle, and throw away are installed in most of the campus buildings. For event support, additional bins for compost and recycling are provided so that held events can have compost and recycling.

Wherever possible compostable plates, silverware, and cups are used in cafes in the campus which can easily be disposed of in the compost bins (University of Washington Bothell, 2017c). American University, with the help of many programs including energy efficiency initiatives, renewable energy, green buildings, sustainable transportation programs, and zero waste efforts, has reduced its greenhouse gas emissions by more than 52 percent when compared to the 2005 baseline. The university engages in Mixed Recycling in which all recyclables including paper, bottles, cans, and plastics will be recycled in one container instead of colored bins for different types of waste. There are Campus Collection points in the University of Connecticut where e-waste can be disposed of into specially marked bins to ensure their safe disposal (University of Connecticut, 2017b).

The copy center at the university's library uses discarded copies for draft printing/scrap paper, thereby reducing their paper usage by 30% (University of Connecticut, 2017h). Over a period of 3 years, Green Mountain College has improved its trash diversion rate by over 20% by extending its compost and e-waste programs, while also improving the efficiency of the recycling personnel. Currently, it possesses a constant waste diversion rate of 50%. A majority of this achievement was conducted by student proposals and student initiatives targeted at lowering consumption, maximizing reuse, and making recycling easier (Green Mountain College, 2018).

Because of the sustainability efforts of Appalachian University, it has prevented \$29 million in energy and waste costs since 2007 (Appalachian State University, 2017f). Colorado State University distributed more than 100 pounds of on campus-grown greens weekly to the dining centers on the campus. Plate waste has been reduced by 40% with the help of Tray-less dining at these dining centers. By using Compostable to-go containers the university eliminated more than 350,000 Styrofoam containers every year which would have otherwise ended up in the landfill. 2000 pounds are received each day by its in-vessel system, Earth Bin composter. Biodiesel is made by recycling used cooking oil collected from all the dining centers. Every year 27,000 pounds of cooking oil is collected by a local company from these dining services which is then recycled (Colorado State University, 2018).

Acquiring the top place in the Sustainability Tracking, Assessment, and Rating System (STARS), 2017 with 85.74 score Stanford University (Stanford University, 2017d) runs the Stanford Energy Systems Innovation Program which has reduced its carbon emissions by 68% and cut potable water usage by 15%. When levels in the year 2000 and 2017 are compared, greenhouse-gas emissions have reduced by 68 percent, energy

intensity by 25 percent, domestic water by 49 percent, and landfill waste by 24 percent (Stanford University, 2017d).

To save the resources needed to treat regular waste and improve the capacity to treat such waste at the University of Rochester, nonregulated waste is separated from regulated medical waste collection containers (University of Rochester, 2017c). Two Ford Escape Hybrid vehicles are using for the purpose of security patrolling. These cars get 14 miles more per gallon in city driving emit 81% less emissions (University of Rochester, 2017d). By 2018 Colorado State University mulls to fully implement Green Cleaning Certification for all custodial staff on campus (Colorado State University, 2016). Sustainability Council at Appalachian State University, containing more than 70 administrators, faculty, students, and staff, is charged with setting and executing the vision for sustainability on campus and in the surrounding community. Twelve sub-committees, actively focus on specific initiatives - Zero Waste, Natural Environment, Housing, Transportation, Grants & Funding, Curriculum and Research, Social Justice, Sustainability in the Arts, Assessment and Data, Outreach and Engagement, Sustainable Food, Health & Wellness and Energy Efficiency (Appalachian State University, 2017d).

The University of Rochester Carpet reclamation program which makes new resins by recovering nylon from broadloom carpet (University of Rochester, 2017c) Stanford University, since 2001, holds annual Winter Closure Program which involves two-week campus shutdown during the winter holidays to save energy by turning off heating and ventilation systems in most buildings across campus. This has resulted in a cumulative net energy cost savings of \$4 million since its inception (Stanford University, 2017c) In 2016, over 40 ERP (Energy Retrofit Programs) projects at Stanford University lead to savings over \$600,000 per year (Stanford University, 2017). University of Michigan achieved a historical environmental feat by relocating of a 250-year-old bur oak tree near the Stephen M. Ross School of Business (University of Michigan, 2017) .

Green Initiatives

At University of Washington, the Campus Sustainability Fund (CSF) is a student-run organization which provides grants for student-initiated environmental projects. From 2010-2017 this fund has granted more than \$2 million to around 100 separate projects (University of Washington, 2017). At American University Student Sustainability Educators work with students across campus to extend sustainability awareness and increase commitment. Students work 5-10 hours per week which include meetings and at least two hours in the Office of Sustainability working on planning and outreach (American University, 2017b).

At Colorado State University Eco Leaders are students who help in increasing awareness regarding sustainability concerns and motivate environmentally-responsible behaviors for an academic year. There is at least one of these leaders in every residence hall and apartment help to in educating students in their hall about sustainability problems such as waste minimizing and energy conservation, help arrange activities and campaigns (Colorado State University, 2017b).

University of Rochester organizes E Cycle Day, an annual electronics collection and recycling event in which 25,000 lbs of old, broken, and unwanted electronic equipment such as cell phones, computers, chargers is sent for recycling annually (University of Rochester, 2017c). The Whole Building Energy Retrofit Program (WBERP) at Stanford University seeks to reduce energy consumption in Stanford's most energy-intensive buildings. This \$30 million capital program includes the top 27 buildings, representing 60% of total campus energy use. These retrofits have delivered annual energy cost savings of \$4.7 million paying back themselves in 4 years, and local utility rebates of \$2.2 million. On average, buildings that have participated in the WBERP program see 24% reductions in energy usage, with some buildings realizing savings of up to 50% (Stanford University, 2017c).

Green Infrastructure

At University of Washington all new buildings are required to be built to the standard of LEED Silver or higher and make use of variable output building heating and cooling system to regulate building temperatures. This allows fine-tuned control of energy use in maintaining interiors climate, so that rooms are never cooled or heated to excess (University of Washington Bothell, 2017a). There is a 102 kW roof-mount solar PV system on one of the library buildings. Each of the two parking garages on campus have a 10 kW PV system. These PV system in the campus

Green roofs on structures at American University decrease runoff and enhance energy efficiency. These green roofs have rain gardens and stormwater maintenance capabilities. They assist in slowing down and soaking up water during storms. This, in turn, helps prevent the runoff which actually moves on from the campus to city's wastewater and sewage facilities. In order to reduce runoff from pavements, permeable pavers are used on the campus which helps in water conservation (American University, 2017d).

The Olwen Garage in Green Mountain College, constructed by REED pupils in 2014, attributes a passive heat design. The structure does not have any mechanized heating supply, indicating that it doesn't warm up with electrical energy, fossil fuels, gas, or simply wood. It is basically warmed up by the sunlight. The institution also receives eco-friendly, photovoltaic energy from 150 kW solar system established on private property which offsets about 10% of its electrical energy every year (Green Mountain College, 2017c)

Appalachian State University generates 11kWh by photovoltaic production, 322 kWh by wind production and 38000 kWh and Solar Thermal Production (Appalachian State University, 2017a). University of Connecticut shelters a Co-Generation Facility replacing a number of oil-fired power boilers and allowing the University to fulfill its power requirements at the main campus. It generates both electric or mechanized energy and valuable thermal energy from just one source of energy allowing it to create 80% of the fuel energy to be generated (University of Connecticut, 2017a). In addition, there is a 400kW fuel cell which electrochemically couples hydrogen fuel and oxygen from the air and churns out electricity, thermal energy, and water. This facility also will help the campus in eliminating 831 metric tons of carbon dioxide every single year, which is the equal to growing greater than 192 acres of plants (University of Connecticut, 2017d).

Stanford University has 25,000 datapoints metered and evaluated to inform efficient building procedures. 135 buildings across the campus are graded through sustainability report cards. When compared with the national benchmark, Stanford structures rank high in sustainability performance. In fact, all of Stanford's buildings operate at a LEED Gold degree. Nevertheless, Stanford aims for continuous progress and has designed an intensive internal sustainability rating process to determine wherein extra resources have to be put in and inspire action (Stanford University, 2017a). <http://sustainable.stanford.edu/buildings>

The University of Rochester accommodates Green Space which is a unique interest accommodation accessible to students who are eager to live environmentally friendly. It shelters 17 students in a mix of singles and doubles and is available to non-residents too ([University of Rochester, n.d.](#)). Similarly, Colorado State University has the world's first solar-heated and solar-cooled building. Its 5.3 megawatt, 30-acre solar plant, is one of the largest at a U.S. college or university. It has 27 buildings which are certified with different levels of LEED (Leadership in Energy and Environmental Design) which is an internationally recognized rating system for design, manufacturing, and operation of high-performing, sustainable buildings.(Colorado State University, 2017d).

Monmouth University added 46,000 square feet of solar paneling on seven additional buildings doubling the previous amount. These solar installations have aided the university to offset the use of gasoline by 171,079 gallons and reduced carbon dioxide emissions by more than 1,516 tons which is equal to planting 38,017 trees (Monmouth University, 2017b). To enhance air quality, low VOC (volatile organic compounds) substances are utilized in adhesives, paints, and sealants used the building at University of Rochester (University of Rochester, 2017d). Structures in the campus reduce harmful influences microclimates, and human and wildlife habitats by eliminating "Heat island" effect. White colored rooftops, with higher reflectivity and emissivity, and vegetative roofing make it easier to cool buildings as well as the surrounding area (University of Rochester, 2011).

Building components and items are usually from reused materials such as carpet, ceiling tiles and grids, and gypsum drywall paper. This avoids effects because of the extraction and processing of fresh materials (University of Rochester, 2017a).

Green Technology

At the University of Washington Bothell campus garden site, the grounds team maintains a vermicomposting bin filled with red wiggler worms. The red wiggler worms process food waste. The campus also uses a state of the art Rainbird Maxicom irrigation system which is an evapotranspiration based central control system and supplies water on demand (University of Washington Bothell, 2017b). Team Sunergy at Appalachian State University symbolizes the university's dedication to environmentally friendly energy endeavors at global contests for solar power automobiles (Appalachian State University, 2017e). In order to charge electric vehicles the campus has four-plug solar-powered charging stations (Appalachian State University, 2017). In newly built buildings, Stanford University, uses sensors, zone cooling, and heating, proximity sensors, lighting technology equipment to attain efficiency in energy (Stanford University, 2017).

Moreover, it also operates Sustainable IT program to efficiently handle the extensive network of computing apparatus belonging to the university, staff, faculty, and students (Stanford University, 2017c). Real-Time Metering at University of Rochester documents the utility usage for electrical power, refrigerated water, city water, steam and hot water as it is being utilized (University of Rochester, 2017). With its state of the art recycling technologies University College Cork has increased its Recovered Food/Compost Waste per head from 49 percent to 85 percent from 2014 to 2017 respectively (University College Cork, 2017a).

Green Human Resource Management

Stanford University motivates people to participate in "Cardinal Green". The My Cardinal Green offers a system to motivate personal action and connect users to the myriad of assets across campus, rewarding finished sustainability efforts (Stanford University, 2017). It is additionally promoting collaborations with students and employees to build behavior modification, decrease energy and water utilization, curtail waste generation, and incorporate enduring sustainable planning into how it works. It prioritizes regional, natural, humanely brought up, fairly traded food and options from family-owned farmlands and sustainable fisheries (Stanford University, 2017). The University of Sheffield started a Walking Group in 2016 with little lunchtime strolls, lasting about 45 minutes, experiencing the beautiful environment of Weston Park. It has also established a running group in order to acquaint the members of the group with the scenery of the campus (The University of Sheffield, 2017).

University of Illinois's Landscape and Human Health Laboratory (LHHL) is a hybrid research laboratory dedicated to studying the connection between greenery and human well-being (University of Illinois, 2017). Each office at Cornell University selects a Green Ambassador who leads their office in the certification process and in university-wide initiatives, as well as initiatives of their own, such as organizing an Office Clean-Out Day in January (Cornell University, 2017). The University of Michigan hired more than 1,700 people to act as Planet Blue Ambassadors (University of Michigan, 2017)

Green Education

At Colorado State University, the most sustainable university in the nation (BestColleges.com), 962 out of 2633 courses offered are related to sustainability (Colorado State University, 2017).

Sustainability-related research is conducted in more than 90 percent of the academic departments at CSU (Ciaravola, 2015). Colorado State hosts The Institute for the Built Environment (IBE) which multidisciplinary research institute that fosters custodianship and sustainability of the created and natural settings via interdisciplinary academic platform (Colorado State University, 2017c). Online and on-campus, CSU offers 962 credit courses having sustainability as subject matter (Best Colleges, 2017). At American University 500 faculty members are accredited green teachers. The Green Teaching Program, managed by CTRL in association with the university student environmental organization Eco-Sense, accredits teachers who train sustainably. Teachers can get certified by responding to several questions regarding their endeavors to create their programs even more environmentally friendl Nearly 500 courses in the campus are sustainability-focused or sustainability-related (American University, 2017).

Green Mountain College's curriculum is ranked number one by Association for the Advancement of Sustainability in Higher Education (AASHE). It welcomes its freshers with Wilderness Challenge orientation program. The program teaches the newcomers with nature-skills like wilderness medicine - all with nature at its core. It also has Kellen Sams-GreenMAP Scholarship, the goal which is to provide outdoor-based professional enhancement opportunities to students. (Green Mountain College, 2017). At Stanford University 350 people received sustainability training in 2017. Across all seven schools at Sandford University, 3200 students graduate from a degree program with sustainability as a learning outcome. 1000+ sustainability-focused courses, 70 continuing education sustainability courses, 440 faculty members doing sustainability research (Stanford University, 2017).

University College Cork shelters the Environmental Research Institute (ERI) which is the center of interest for numerous of the "green" study activities and gathers all together over 300 ecological researchers from science , engineering , business and humanities to subjects in order to tackle complicated ecological issues in a multi-disciplinary technique (University College Cork, 2017). Energy Resource Management Committee (ERM) and the Sustainability Advisory Council established at Monmouth University work towards promoting ecological awareness by means of teaching and exposure to research (Monmouth University, 2017a).

Green Collaboration

Students at the University of Connecticut run the EcoHusky Student Group which collaborates on projects and events with the university's Office of Environmental Policy other nature groups on the campus and in the surrounding region (University of Connecticut, 2017c). Monmouth University entered into a partnership with Zipcar for cost-effective and convenient transportation alternative by sharing rides, taking at least 15 personally owned vehicles off the road with each Zipcar shared (Monmouth University, 2017b). It also committed to WasteWise Partnership which is run through the EPA (Environment Protection Agency) and targets at removing expensive municipal solid waste and certain commercial wastes to save the planet



(Monmouth University, 2017). Colorado University students and faculty in CSU's Engineers Without Borders initiative headed an engineering mission that delivered a secure water supply to a 1,200-person agrarian village in El Salvador (Colorado State University, 2017d).

Colorado State University assists the global One Health Initiative by well-prepared participation as well as partnership with the ecological, public, and wildlife health groups (Colorado State University, 2017f). At Stanford University there are 162 community garden plots (Stanford University, 2017). Queen's University has been working in partnership with the consulting firm Delphi Group to develop a Climate Action Plan for the university encompassing current campus greenhouse gas (GHG) inventory; GHG emission projections; operations climate action goals and strategies to reduce emissions; and mechanisms to track progress on goals and actions (Queen's University, 2017). The Environmental Association of Universities and Colleges leads and empowers the post-16 education sector to make sustainability 'just good business'. It represents universities and colleges with more than 2 million students and nearly 400,000 staff with a spending budget of over £25 billion (Environmental Association of Universities and Colleges, 2017).

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