

IARU Green Libraries Project

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Overview

In 2009, the International Alliance of Research Universities (IARU) Presidents identified “campus sustainability initiatives” as an area for IARU collaboration and the development of best practices. The IARU Sustainability Initiative and challenge statement is described further at <http://www.iaruni.org/grand-challenge/presidents-statement>). Following the lead of the university Presidents, the IARU university librarians determined at their first meeting in Singapore in 2012 that a focus on the concept of green libraries should be a recurring theme across the librarian meetings.

In December 2013, the IARU university librarians charged a project group, with a member from each of their institutions, to gather information about the activities on their campuses and in similar environments internationally into a Green Libraries Toolkit. Members were asked to agree upon the scope of the toolkit to advise IARU university librarians on potential green initiatives “with a view to making a significant contribution to the overall reduction of the campus carbon footprint, and where possible to reducing both recurrent and capital costs in IARU libraries”.

Between January and May 2014, the members collaborated in the creation of this document. Some members have been deeply involved in large scale projects that included sustainable design; some members have provided leadership for initiatives designed to encourage positive change through smaller scale innovations; and some members had not yet launched green projects at their library. Our experience illustrates that the concept of a ‘green library’ is not universal.

Green library initiatives are driven by local needs and priorities and are shaped by climate, availability of natural resources, funding, and regional and national politics. The charge requested an analysis of “the major challenges for University Libraries in relation to carbon reduction”. None of the members of the group have a formal background with these issues to develop a more fully articulated analysis that transcends the specifics of each institution’s environment.

The brief profiles of IARU libraries and case studies from other libraries around the world provide valuable insight about the range of diversity of potential library sustainability best practices. Whether embarking on a major capital project or preparing for smaller innovations that demand lower investments yet realize noticeable improvements, the IARU brief profiles offer ideas and advice along with contact information to enable universities to build on each other’s experience. The additional case studies were selected and compiled by a Berkeley Architecture graduate student minoring in Sustainable Design, modelling possibilities for engaging faculty and students in the research and implementation at each of our campuses.

Brief Library Profiles

Australian National University

University Library – Canberra, ACT, Australia

Philosophy

The University is committed to be a leader through environmental and sustainability initiatives and programs which are delivered through the ANUgreen program. ANUgreen works with staff, students, contractors and campus visitors to provide leadership, and develop innovative solutions, in the pursuit of an environmentally sustainable campus. The range of sustainable projects being undertaken across campus can be viewed at <http://sustainability.anu.edu.au>. ANUgreen is the University's award-winning environmental management program, managed by the ANU Facilities and Services Division. Established in 1999 under the ANU environment policy, ANUgreen is responsible for implementing the University's Environmental Management Plan by working directly with the University community, educating and empowering staff and students to playing an active role in reducing the collective environmental impact. Through well-developed programs and initiatives, ANUgreen strives for ANU to be an international leader in campus sustainability and provide ANU graduates with the practical knowledge and skills needed to realize a more sustainable society.

ANU's sustainability plan has the following targets to reduce energy use and greenhouse gas emissions:

- 20 % below 2006 levels by the end of 2015
- 35% by the end of 2020

The ANU Library buildings are heavily used and have been identified as priority areas for delivering of a number of sustainability initiatives, which is strongly supported by the University Librarian, Roxanne Missingham.

Library Highlights

The ANU Library has five Branches, each of which is dedicated to specific subject disciplines: the Art & Music Library, the Hancock Library, the JB Chifley Library, the Law Library and the RG Menzies Library. The Library also has an external print repository.

The Library sees its challenge is to meet energy targets but retain a good environment for staff and for the collection. Initiatives have occurred in Chifley, Hancock and Menzies Libraries. University Libraries are major consumers of energy mostly for heating, cooling, and ventilation.

Bright Ideas

An ANU Sustainability Audit of the Chifley Library was undertaken in 2013. Examples of initiatives implemented are listed below.

1. Library Lighting Changes

The University's Facilities and Services Division has assisted the Library by developing a lighting plan to reduce energy consumption. The initiative was tested first in the Chifley Library and is now being implemented in the Hancock Library. The results so far are:

- Light fittings in major areas have been significantly reduced through de-lamping and remaining lights retrofitted with LED tubes. The pilot was used to assess that sufficient lighting levels in all areas were maintained. The project is expecting to reduce the energy use for lighting in a whole year in Chifley Library by over 70% (equivalent to savings of 380,267kWh/year or **\$57,040/year**) as compared with the original lighting. The saving assumes that the price of energy does not reduce and that the lighting continues for the current hours. This has been completed in the Chifley Library and has commenced in the Hancock Library and will also be implemented in the Menzies Library.
- Sensors have also been installed in the Chifley Library toilets to switch lights off after a period of vacancy, reducing electricity waste when lights are left on without any users. Together with the upgrade to LED tubes and a reduction in tubes, this is expected to bring the percentage savings in lighting electricity in the toilets up to 90% (equivalent to savings of 15,096kWh/year or **\$2,264/year**) in these areas. It is anticipated the energy reduction will be less because of the high use of toilets in the Chifley Library based on the average number of clients entering the building.

The reduction in the heat load over summer and the maintenance savings are two of the additional benefits to the library with the changeover to LED. This will make a very small contribution to energy savings reflected in energy costs for the building. The initiatives have led to a reduction in greenhouse gas emissions which has not yet been calculated.

2. Heating, Ventilation and Air-Conditioning

The single largest component of university energy consumption and costs at around 60% is heating, ventilation and air-conditioning. As with many university libraries the buildings are mostly not new and the plant equipment is aged. The Building Management System does not allow for easy and efficient changes and does not allow for fine tuning such as different settings by floor. Information has been made available on use of energy and discussions are occurring about changing temperatures to bring them closer to the external temperatures in winter and summer. The renovations to the front entrance of Chifley Library have changed the entry doors which will improve heating and cooling requirements for the building.

3. Information Commons Computers

As part of the ANU's campaign to reduce energy and water use the ANU Campaign to Reduce Energy and Water (CREW) team installed Greentrac software which turns the Information Commons computers (those computers available to visitors and library clients) off when the branch libraries close and on, shortly before the libraries open. The initial trial took place in the Chifley Library in April 2014. The trial was successful and the software will be rolled out to all Branch Libraries in May 2014. While the use of computers is likely to be a very small consumer of energy (perhaps less than 7%), delivering an initiative that is very visible to students assists in engaging the wider university community in the sustainability program and increasing awareness of the energy saving commitment of the university.

4. Sustainability Dashboards: A Tool to Increase Awareness

The ANU Sustainability Team have installed sustainability dashboards (40 cm LCD screens) displaying building data including energy consumption within each Library building as part of the current requirements by local government to reduce energy use on campus. The purpose of the Sustainability Dashboard Screens is to inform the ANU community and members of the general public about the sustainability performance of each building against the stated targets of the ANU.

5. ANU Solar Energy Testbed

This project is establishing a network of instruments distributed across the main ANU campus to measure the spatial and temporal variations in incident solar radiation at high resolution for research on solar energy forecasting and clouds. The network is designed to support new research initiatives on solar energy forecasting, clouds and climate and environmental testing of PV systems. This 3-year project is a joint effort of the Research School of Earth Sciences, Fenner School and the Research School of Physical Sciences and Engineering. The Chifley Library was fitted with instruments on the roof of the building that will measure and collect data on solar radiation, contributing towards an ANU honors thesis. This project has not resulted in use of solar energy in the library.

Related Sites

- ANU Sustainability: <http://sustainability.anu.edu.au/>
- ANUGreen: <http://sustainability.anu.edu.au/about-anugreen>
- ANU Campaign to Reduce Energy and Water (CREW): <http://sustainability.anu.edu.au/crew>

Library Contacts

- Roxanne Missingham, ANU University Librarian, roxanne.missingham@anu.edu.au
- Helena Zobec, Manager, Chifley Library, helena.zobec@anu.edu.au

ETH Zurich

ETH Library – Zurich, Switzerland

The ETH Library is an infrastructure division from a total of 7 divisions. As central bodies of the university, the 7 infrastructure divisions support the Executive Board, the science departments and all other ETH communities. Founded in 1855, the ETH Library is now the largest public technical and scientific library in Switzerland and one of the leading science libraries in Europe.

Philosophy

ETH Zurich provides a broad range of infrastructure for research and teaching. This is mainly located at its own buildings in the city of Zurich and at the ETH Hönggerberg Campus. An optimally working infrastructure requires a highly reliable energy supply. ETH Zurich's energy requirements are covered by a variety of energy sources including electricity, natural gas, district heating and fuel. In addition to the direct use of energy for operating its own infrastructure, ETH Zurich and its affiliates also receive services that have, or necessitate, high energy usage. This indirect energy consumption is also

important in a holistic assessment of energy use at ETH Zurich. Examples include the embodied energy of building materials or the use of energy for mobility.

ETH Zurich and (Library) Highlights

ETH Zurich staff are motivated to engage in environmentally friendly behavior through awareness-raising and incentive campaigns. For example: “Stop the power consumption by switching off the computer after work”. The departments and infrastructure areas of ETH Zurich are involved in the efforts to enhance energy efficiency through incentive systems that aim to create a balance between individual responsibility and guidelines. One example is the Energy Efficiency Challenge – teams set their own goals to improve their energy efficiency at the workplace. In this campaign, topics such as office ecology, the service of servers and computers, or the operation of research equipment can be chosen. With this long-term communal commitment, energy consumption at ETH Zurich can be sustainably reduced.

Bright Ideas

ETH library reduced the number of printers in its own administration to name an example. Many old printers were replaced with a centrally located multifunctional device. As a result, a significant amount of electricity and paper could be saved.

The ETH-Bibliothek launched a so-called Knowledge Portal – easy access point to digital media – with no need to print out. As a result, there was a significant reduction of produced copies. Further, training courses for optimal use of iPad in study and at work are offered by ETH library.

Energy research at ETH Zurich has a long tradition, and is shaped by more than 40 professorships with over 200 PhD students in various centers of competence. Since 2005, the Energy Science Center (ESC) has promoted cross-departmental cooperation at ETH Zurich and identified synergies between various research disciplines.

Related Sites

- <http://www.library.ethz.ch/en>
- <https://www.ethz.ch/en/the-eth-zurich/organisation/staff-units/safety-security-health-environment.html>
- <https://www.ethz.ch/en/the-eth-zurich/sustainability/research-for-sustainable-development/energy.html>

Contacts

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ETH Zurich Contact

Dr. Dominik Brem, Deputy Head of the Safety, Security, Health and Environmental Protection Unit, Dominik-brem@ethz.ch

National University of Singapore

NUS Libraries – Singapore

The National University of Singapore (NUS) hails a history of more than 100 years and is one of the long-standing universities in Singapore. NUS Libraries comprises of 7 libraries, each specializing in subject-specific resources and serving communities from different faculties in NUS.

Philosophy

Our energy saving initiatives for NUS Libraries had been institutionalized more for operational and sustainable reasons. In the recent decade, NUS Libraries adopted green initiatives as recommended by our sustainability department in NUS to generate a meaningful environmental change. We are currently creating group awareness on green issues such as energy use, recycling, reducing paper waste etc. so as to preserve the living environment. Through nurturing of a sustainable culture, we hope to make positive impacts on our environment at our workplace.

Library Highlights

Library Energy Savings

All library staff are encouraged to practice saving of resources through 3Rs: Reduce, Reuse and Recycle. Our bottom-line is to minimize wastage of resources and reduce expenditure in the long run. We have green initiatives, and they are done at varying degrees: some initiated by staff, some from student bodies, and a growing number is from embracing our University's green practices. We are currently surveying our own library staff to gauge their green knowledge level and to solicit suggestions on green ideas that we can implement.

Implementation of 3 R's – Reduce, Reuse, Recycle

Examples of Reduce

- Print double-sided.
- Replace printed Library guides with online information on our library web pages.
- Replace printed date-due slips with e-date due slips.
- Requests for services, such as inter-library loans, intra-library loan, book recommendation etc. are submitted by users via electronic means.
- Increasing trend towards e-book subscriptions versus print for ease of access and saving of storage space.
- Use WebEx and other online conference tool for library staff training as well as delivery of user education programs. This eliminates travelling time, reduces carbon footprint and production of printed notes.
- Closure of low-traffic areas in parts of libraries during vacation period to reduce energy consumption.
- Remove unnecessary overhead lightings in user/staff areas which are over-lit or has well-lit windows.
- Use non-disposable cup at work and avoid disposable items for library visitors, e.g. polystyrene and paper cups and plates.

- Use common water boiler.
- Cease distribution of bottled water during library functions.
- Make a few copies of a document to share instead of making one copy for each individual.

Examples of Reuse

- Reuse envelopes and delivery boxes for internal dispatch.
- After refurbishment and renovation of library interiors, library shelves, peripherals and electrical equipment were salvaged and reused rather than replaced with new ones.
- Reuse retired computers within NUS campus for focused usage:
 - o Workstations at service desks
 - o OPAC terminals
 - o Projects, e.g. self-service payment machines, book-drop terminals etc.
- Adopt and or restore furniture from NUS departments that has been retired but still in good condition.

Examples of Recycle

- Adopt NUS recycling culture by adopting recycling bins for papers, plastics, cans, batteries, unusable hand-phone set, ink-jets and pen holders.
- Deposit weeded newspapers to recycling facilities on a routine basis.
- Set up book drive to collect books from NUS community and sell the books to the same community. The proceeds are donated to the NUS' needy student fund.

Bright Ideas

Revised Library Opening Hours

A study was carried out to determine user usage patterns of NUS Libraries in the first quarter of 2013. Hourly user patronage and borrowing statistics were collected from all libraries. Analysis showed that on weekends, sizeable patronage and borrowing activities took place only few hours after most libraries started operations. To maximize the use of resources library opening hours for Saturday was revised to start at a later hour. Selective libraries also had their operation hours further shortened. The initiative had reduced unnecessary use of library manpower, saved energy resources, and re-aligned the library to meet the usage patterns of library users.

Building Features of NUS Libraries

The Central Library Annex building was built in early 2000s to house monographs and rare books and it is the central depository space for resources of NUS Libraries. When the building was constructed, windows were strategically replaced with glass blocks to tap on the natural lighting. Coupled with auto-off electrical switches and usage policies on electricity, electricity used for the building for lights and powering of the compactor units was kept to the minimal. A study of the air quality in the Annex building showed that humidity and air-quality was within acceptable levels when an experiment was carried out after air-conditioning was switched off for 6 hours daily. This energy-saving method was therefore implemented during the night hours to save electrical costs. Furthermore, the use of glass blocks also reduced air exchanges cross window frames which helped in the environmental control.

In 2011, our medical library moved to its new premises into a green mark certified building. Some features include full length windows to optimize natural light, as well as motion sensors in office toilets and pantry area in an effort to optimize energy use.

Related Sites

- NUS, Office of Environmental Sustainability: <http://nus.edu.sg/oes>
- NUS, Office of Estate Development: <http://nus.edu.sg/oed>

Library Contacts

- Ms. Sylvia Yap, Library Advisor & Consultant, clbyapsb@nus.edu.sg
- Ms. Quek Tze Guek, Senior Librarian, tzeguek@nus.edu.sg
- Ms. Ratnala Sukanya Naidu, Librarian, sukanya@nus.edu.sg
- Mr. Steven Chow, Librarian, chowdm@nus.edu.sg

Peking University

Peking University Library (PUL) – Peking, China

Philosophy

The Green Campus Project is one of the most important parts of the future development of Peking University. Peking University Library's (PUL) East Building renovation is one of the pilot buildings. That renovation emphasizes the idea of green-life, environmental-protection, and energy-saving, and relies on practices that make full use of energy, save resources, improve the quality of environment, promote sustainable development, and will create a healthy living environment and a good learning atmosphere. At the same time, the library will become a demonstration building of The Green Campus Project.

Library Highlights and Bright Ideas

Adopting Clean Energy

Clean energy (New energy) is a kind of renewable energy with the advantages of less pollution and large reserves, such as solar energy and wind energy, which is developed and utilized in system on the basis of new technology. In the east building renovation, PUL will consider setting solar panels to implement photovoltaic power generated. Solar panels can be arranged in the roof platform, or shielding devices like windows and skylights. When solar energy is transformed into electric power, it will be stored in the battery along with grid problems (into the top layer of the 380v low voltage power distribution room), which should be fully considered in circuit design. After solar energy is transformed into electric power, it can be also used for online backup power to drive LED display and campus mobile phone charging stations.

Energy-Saving and Environmental-Protection Facilities

At present, the mainly used two kinds of energy are electricity and water in PUL. Therefore, water and electricity saving is the main target of the Green Movement.

- In terms of hardware transformation, electricity and water control devices should be set in the easy operating areas to facilitate the cutting off the electricity and water power in emergency.
- Lighting on each layer will be controlled intelligently, such as light control. Light switches near the window will be controlled individually. We can't turn on the lights when it is sunny outside and completely turn off the lights in brighter areas or decrease the brightness of lights. The lights inside book repository could be changed to the infrared induction control. We can take energy-saving lamp into consideration, such as T5 fluorescent lamp in replacement of T8 fluorescent light at present, or other energy-saving lights. We can also improve the lighting brightness through the ceiling reflection of light. Individual reading lamps can be adopted in some reading rooms. Sectional control of the electric power can be used at night, such as cutting off the electric power of water dispensers and so on.
- In terms of water saving, we can consider the use of reclaimed water in toilet, or the reserved reclaimed water pipes. The maximum amount of water faucet valves may be appropriately reduced.
- Energy metering instrument can be installed to detect and analyze the energy efficiency data of the whole building.
- Central air conditioning has bigger problem, the leakage of water pump for freezing and cooling is very serious, for which we need to replace them with high-efficient and energy-saving pumps. We can consider using variable frequency control, adjusting the water flow and making the water temperature difference of freezing and cooling water in the normal range, while reducing unnecessary power consumption.
- We also consider cooperate with Schneider company and the Engineering Institute to design green and energy saving solutions for library.

Using Safe and Environmental-Friendly Building Materials

Research on indoor air pollution caused by decorative building materials has attracted more and more attention. Examples include radon released by radioactive marble stone; a variety of heavy metals and oil solvent in paint, which is the main source of VOC (volatile organic compounds); preservatives and adhesives in plywood, MDF, and other artificial plates which contain methanol, toluene, formaldehyde and other harmful substances. For plastic wallpaper, in addition to adhesives, the problem on its aging and decomposition also make it a source of pollution. Proposals in this regard are as follows:

- Select decorative materials according to the related standards formulated by the Environmental Protection Agency and other relational departments, such as Hygienic Practices of Formaldehyde in Wooden Plate. We should try to choose wood, water- soluble paint and the polymer material consistent with national security requirements, which could help to guard a pass of raw materials.
- In the process of construction, pay attention to environmental protection and ventilation to the outside as much as possible to prevent the organic pollutants from releasing into the whole library.
- Have an indoor environment test after the renovation. For example, formaldehyde can be tested by formaldehyde kit and radioactivity of radon and other pollutants can be tested by radioactivity

measuring instrument. We can ask teachers and students of indoor air pollution major from Environmental Institute to help detect other pollution such as VOC. We can't use the room until it is tested qualified. At the same time, green plants can be introduced indoors to absorb pollutants and improve the quality of environment.

- Garbage in library are mainly paper, beverage bottles, and old batteries. Most of them are recoverable. We can consider the design of garbage classification during library renovation. We could set a specific place for garbage recovering to achieve a tidy and clean effect.

Library Contact

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University of California, Berkeley

The University Library – Berkeley, California, USA

Philosophy

Since 2000, the UC Berkeley campus has set ambitious sustainability goals and launched a series of projects, partnerships and incentives to encourage widespread commitment toward reaching those goals. The Library has embraced issues dealing with energy, food, waste, transportation, procurement, academics, awareness, and the built environment. Enormous benefits have come from modest operational changes and partnerships with student groups. All current and future capital projects will meet LEED Gold certification at a minimum, and aspire to carbon neutrality.

Library Highlights

Moffitt Library Renovation

Moffitt Library is a five-story library building with a café and campus classrooms. Sustainable design principles are critical for a library that sees over 800,000 people each year and will be extending its access to 24 hours a day. Balancing many priorities within a limited budget, we are focusing our efforts on HVAC performance, plug load management, lighting and daylighting, thermal comfort, indoor air quality, acoustics, renewable energy, and using the library as a test bed for campus innovations, course-related projects, and research interests.

Library Energy Savings

The campus' Energy Incentive Program was designed to reward behavior changes that reduce energy use. The campus created a dashboard with baseline metrics for historical energy usage by unit, and set targets for reduced consumption. The Library focused on infrastructure changes (e.g. lighting), equipment changes (e.g. higher efficiency computers), and behavioral changes (e.g. tips for staff). We receive quarterly reports from campus summarizing usage for each of our 19 locations. Last year we received a bonus allocation representing a percentage of our savings.

Bright Ideas

Student Partnerships

The Library has partnered with the Building Sustainability @ Cal Program that trains and utilizes students to help reduce the environmental footprint of campus buildings. The program consists of a service learning course, student interns in buildings, and individual outreach and auditing projects. Over the years the Library has engaged students to conduct waste, water and energy audits; survey building occupants and users; recommend sustainable design ideas for the Moffitt Library renovation; create videos as part of a course field study related to Moffitt Library; and offer green office hours to increase awareness of individual choices and changes people can make in their daily lives.

Library Occupant Survey

Berkeley's Center for the Built Environment aims to improve the environmental quality and energy efficiency of buildings by providing timely, unbiased information on building technologies and design and operation techniques. The Library partnered with CBE on a building occupant survey for Moffitt Library. The core survey includes modules for office layout, office furnishings, thermal comfort, air quality, lighting, acoustics, and building cleanliness and maintenance. Additional optional modules focused on way finding, safety, and security. Core questions stay consistent from survey to survey to maintain data integrity for the purposes of benchmarking and trend analysis. The results were shared with Library staff as the foundation for understanding people's experiences with the building and setting some shared priorities.

Computing Efficiencies

Over the past three years the Library has adjusted some of computer-related practices and services which have resulted in reduced energy usage and reduced waste: a) all computers and technical hardware have ENERGY STAR certification and meet standards for efficient energy use and reduced heat exhaust, b) all computers in staff and public areas are set to utilize the energy-saving sleep mode, c) staff computers now use networked photocopier/printers, lowering the number of independent devices needing paper and toner, d) public photocopiers were replaced with scanning stations to reduce the amount of printing and paper usage.

Green Business Certification

The Bay Area Green Business Program certified the Free Speech Movement Café. Certification verifies that the business meets high standards of environmental performance in prevention of pollution, conservation of resources, minimization of waste, and reduction of carbon footprint.

Related Sites

- UC Berkeley Sustainability: <http://sustainability.berkeley.edu>
- Building Sustainability @ Cal: <http://buildingsustainability.berkeley.edu>
- Center for the Built Environment: <http://www.cbe.berkeley.edu>
- California Green Business Program: <http://www.greenbusinessca.org>

Library Contacts

- Elizabeth Dupuis, Associate University Librarian, edupuis@berkeley.edu
- Sukhjit Johal, Project Designer at Library Design Office, sjohal@library.berkeley.edu

University of Cambridge

Cambridge University Library – Cambridge, UK

Philosophy

The University is committed to achieving a 34% reduction in energy-related carbon emissions by 2020 against a 2005 baseline. The University Library responded to a call from the Pro-Vice Chancellor for Institutional Affairs for expressions of interest to become a pilot site for the University's Energy and Carbon Reduction Project (ECRP) for carbon mitigation schemes across the University. Due to its temperature controlled archival storage the main University Library is one of the largest consumers of energy in the University. The project was considered an ideal opportunity to examine the Library's needs with sustainable considerations, guiding our review of current systems and controls and how they could be adjusted without compromising the conditions necessary to store our collections. The Library and Estates Management are working closely together to identify and act upon initiatives which will result in a significant and sustainable reduction of its current emissions.

Library Highlights

Small Change Leading to Long-Term End User Behavior Change

- The UL's Green Futures Group are focusing on influencing and motivating staff and readers to change their behavior by embracing a clearer and more personal sense of ownership of carbon reduction issues. They have channeled ideas and fun activities to this audience so that individuals can actively contribute towards a variety of structured initiatives during their everyday life at the UL.

As an example, a charity based bicycle repair team has been invited to operate from the car park on the UL site one day per week to service and repair bicycles for staff and readers. This practical solution will encourage and help people to make better choices in terms of their day to day transport needs when their bicycle develops a fault.

- An audit of electrical energy using devices has been carried out at the UL to provide us with an accurate picture of the types of devices currently being used by staff all over the library. We can assess how many of those devices can be removed or replaced with a more energy efficient device. We will begin to control the type and specification of all future needs so that only approved carbon sensitive devices are purchased and used at the UL.

Larger Change Leading to Sustainability

- In 2013, the UL ECRP Working Group worked with an academic colleague from the Department of Land Economy, together with a team of undergraduate engineers to identify the main UL's thermal profile and to illustrate where heat was being lost.

- In January 2014, a feasibility study was commissioned by the ECRP Working Group to investigate the complexities of the UL building interior and the functionality it must deliver to end users whilst making a significant reduction to its carbon footprint and running costs. The results will allow the ECRP to make an informed choice on the most effective interventions to focus their resource on.
- A lighting replacement project has begun at the UL.
- A rolling program of computer replacements has begun to ensure we have the most efficient hardware operating our systems at the UL.

Bright Ideas

- The establishment by the University of an **Energy and Environment Team** whose Head reports directly into the Pro-Vice Chancellor of the University has been critical and now works closely with the UL. There are consequently clean links to the overall energy strategic objectives of the organization as a whole. Individuals from that team provide expertise and consultation to the UL Working Group in terms of advice on carbon reduction methods, engineering and energy program management.
- The Energy and Environment group provide **financial incentives** to the UL to encourage initiatives that will result in a significant reduction of carbon usage and any associated cost reductions to our energy use over a prescribed number of years.
- **Targets** of 34% by 2020 have been set at institutional level so that we all know what it is we are aiming to do and how long we have to do it.
- **An ECRP Working Group** has been set up at the UL to review matters relating to the fabric of the building, plant, machinery and environmental considerations requiring investment and significant specialist input from external and internal expert sources.
- **A Green Futures Group** has been set up at the UL to effect behavioral change amongst the staff and readers at grassroots level through ongoing small but effective initiatives to directly influence user behavior.
- The Chair of the ECRP Working Group and the GFG have both been elected as **Energy Champions for the UL** and provide shared goals, leadership and guidance to staff and readers on energy matters. It is also a goal to make carbon considerations a constant agenda item on other key committees e.g. Staff Liaison Group, Health & Safety Committee, Staff Divisional and Departmental Meetings and others.
- We have an **ECRP Steering Group** which is chaired by the University Librarian and ensures that the UL is fulfilling its commitment to energy saving and carbon reduction at all times. This group is focused on results and proactively planning actions for the term ahead so that the ECRP agenda is expanded into everything we do.

Related Sites

The UL is going through a time of continuous change and service improvement. Factors influencing our physical working environment are rapidly changing the needs and profiles of library users. Rapid and significant changes that have taken place in technology, access as well as very powerful global economic imperatives resulting in not singular, but multiple paradigm shifts in how we operate going

forward. The Library Annual Report for 2012–13 (page 10) includes a section on our energy and carbon reduction program: http://www.lib.cam.ac.uk/About/annual_report_2012-2013.pdf

- Pro-Vice Chancellor Stated commitment to carbon reduction
<http://www.environment.admin.cam.ac.uk/policy-overview>
- Corporate Energy University wide to provide guidance, expert opinion and support
- Committees for local groups
<http://www.environment.admin.cam.ac.uk/home>
- Steering Group for Energy & Carbon Reduction Programme (ECRP) to drive for results
- Working Group for ECRP to co-ordinate building-wide projects and initiatives
- Green Futures Group for ECRP to influence ‘hearts and minds’ of local staff and library users to participate and engage with our commitment to this cause

Contacts

Library Contacts

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University of Cambridge Contacts

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University of Copenhagen

Copenhagen University Library Service – Copenhagen, Denmark

Philosophy

Copenhagen University Library Service (CULIS) is a corporative organization comprising a number of libraries owned by the University of Copenhagen, and a number of libraries owned by The Royal Library. As such CULIS does not have a single green philosophy. The part of CULIS that is owned by the University of Copenhagen is obliged to follow the University’s Green Campus initiative, which aims to reduce carbon emissions, energy consumption and make sustainable purchasing. The part of CULIS that is owned by The Royal Library does not have a specific green philosophy. As a governmental institution, it is however obliged to support initiatives and goals set by the government. The primary vision is to achieve a 40% reduction of greenhouse gasses before 2020.

Library Highlights

The most recent initiative to reduce energy consumption and by that greenhouse gas emissions, is the planned installation of LED lighting in one of the reading rooms at the main branch of The Royal Library. It is expected that this initiative will reduce the energy consumption by 75% in that reading room, as well as a derived gain from a reduced need for air conditioning in the summer. Rebuilding the boiler rooms at two addresses to use district heating rather than locally produced steam, has reduced the energy consumption for heating significantly. These initiatives have had a major part in the reduction of energy used for heating from 11,44 GWh to 9,13 GWh from 2008 to 2013, almost 20%. Finally the approaches to controlling the climate in closed stacks have been adjusted. Formerly the HVAC systems were running 24/7, but a closer analysis revealed that it was possible to achieve the same results only running 1/3 of the time.

Bright Ideas

Due to the organizational structure of CULIS, the library does not have any formal role in campus groups regarding green initiatives. Depending on local circumstances, the library does encourage patrons to reduce paper waste and promote recycling.

Related Site

http://climate.ku.dk/green_campus

Library Contact

Christian Knudsen, acting Head of the Library of Pharmaceutical Sciences

The University of Tokyo

University Library – Tokyo, Japan

Philosophy

The University of Tokyo (UTokyo) has made it one of its missions to contribute to the realization of a sustainable society by creating a sustainable campus. This ground-breaking project is called the Todai Sustainable Campus project (TSCP). In the New Library Project, the new building in the basement responds exactly to the Todai Sustainable Campus Project.

Library Highlights

The main challenge for the library system of our University is to perform the New Library Project: the New Library as “Academic Commons” of the 21st century. Last academic year (2013.4-) UTokyo started the first phase of the construction of an entirely new building beneath the place in front of the current library (phase 1: 2013–2016).

In Tokyo's climate condition, the temperature can vary during the four seasons from 5 C to + 30 C, but the temperature underground is constant about 17 C. The new underground building makes use of this

geothermal energy. In addition, the underground condition makes it possible to preserve the existing view of the place.

The Library Plaza (see Figure 1) at first basement floor level (3,000 m³), is conceived for group sessions, active learning for students. It will be open 24 hours a day. In comparison with an air conditioning system, the radiant heating/cooling system which we will adopt will permit a reduction of 20% of heat source energy and of 50% of carry energy.



Figure 1: Library Plaza (image view)

Bright Ideas

UTokyo adopts a **real-time electric power consumption monitoring system**, permitting each building to monitor electric power consumption level with updating interval of 30 min. This system proved efficient especially in the critical period following the 3.11 Earthquake of Tohoku Japan 2011. (<http://www.gutp.jp/en/>)

Related Sites

- The University of Tokyo New Library Project, <http://new.lib.u-tokyo.ac.jp/en>
- Todai Sustainable Campus Project, <http://www.tscp.u-tokyo.ac.jp/en>

Library Contacts

- Hidetaka Ishida, Deputy University Librarian/Professor, Graduate School of Arts and Sciences, director@lib.u-tokyo.ac.jp
- New Library Project Office, ac-info@lib.u-tokyo.ac.jp

Yale University

Yale University Library – New Haven, Connecticut, USA

Philosophy

Yale Sustainability Principles:

- **Balance & Systems Thinking** – Recognize the interdependent relationship between society, economy and the natural environment through using a systems-thinking approach, which acknowledges that decisions within one system may unintentionally impact another system.
- **Adaptation & Resiliency** – Plan for and manage campus growth and development in a financially viable manner that reduces negative impacts on ecosystem vitality and human health while developing the capacity to adapt and endure in the face of unanticipated changes over time.
- **Stewardship & Community** – Respect and enrich the environmental integrity of Yale’s physical campus through conservation practices that enhance not only the quality of life of campus, but also link the university to the city and region beyond.
- **Inclusion & Accountability** – Advance multi-stakeholder processes for collaborative planning and implementation that enable broad participation in and accountability for sustainability endeavors.
- **Capacity Building & Innovation** – Foster a culture of sustainability that provides opportunities to continually challenge and expand thinking in order to better the university and the individuals working and studying at Yale. (<http://sustainability.yale.edu/office-sustainability>)

Library Highlights

Recent and future renovation projects include the conversion to LED lighting with programmatic controls.

A study of the HVAC units in our book stack tower found that we could shut down our HVAC units for 8 hours a day without significant change to the environmental conditions of the stack tower. This will save approximately 1/3rd of our energy costs for this 15 story book stack tower. This study was done as part of an Institute of Museum & Library Services grant and conducted by the Image Permanence Institute.

(http://ipisustainability.org/wp-content/uploads/2010/06/IMLS_Energy_Saving_Project.pdf)

Bright Ideas

- **Bike program:** The Beinecke Library staff will soon be split between two locations, approximately 1 mile away. We will be purchasing bikes so that the staff can opt to move between the two sites via bikes traveling on the “Farmington Canal Greenway”.
- Default to double-sided printing on all staff printers.
- Move all Libraries to Yale’s “Single Stream” recycling program (<http://youtu.be/lyGn6S9ris4>).
- Saved fuel and reduced carbon emissions by reviewing the delivery routes used by the Libraries’ trucks. This review is made possible through the GPS system installed in 2007, which allows the departmental managers to monitor data related to driving time and mileage.

- Install “Smart Strips” (surge protectors that reduce energy usage by shutting down power to products that go into standby mode) wherever possible.
- Configure workstations across the library system to go into S3 sleep mode after a predetermined period of inactivity. In this state, a workstation is consuming minimal power but can still be “awakened” by a tap of the keyboard or remotely by a Wake-on-Lan packet.
- Encourage Library Sponsored events to be green-certified by the Yale Office of Sustainability: <http://sustainability.yale.edu/green-event-certification>. Green-certified events implement actions items recommended by the Sustainability Office and include “promoting green transportation methods, using renewable products, ordering locally produced food, disposing waste carefully, and most importantly spreading the sustainable spirit to the participants”. Encourage or require caterers for Library events to use reusable, recyclable, or biodegradable serving materials.
- Nearly all public photocopies have been replaced by scanners, significantly reducing the amount of photocopy paper being consumed throughout the Libraries.

Related Site

<http://sustainability.yale.edu>

Library Contact

Susan Gibbons, Yale University Librarian, susan.gibbons@yale.edu

Ideas for Action

Behavioral Change Approaches

Noelle Sexton, Cambridge University Library

Cambridge University Library has focused on influencing and motivating staff and readers to change their behavior by embracing a clearer and more personal sense of ownership of carbon reduction issues. Key effective actions that can influence change behavior and achieve carbon reduction results include:

- Lead from the front, and ensure your leadership models the desired behaviors.
- Raise the profile of carbon reduction by including it in all large meetings to staff and readers to ensure everyone is clear that this is an important issue for the University (and the Library).
- Listen to and implement staff and reader ideas (where appropriate) to ensure they are part of the solution and seen to be.
- Ensure you practice ongoing and consistent communication, to reinforce the message at every opportunity and also thank people for their contributions.
- Adjust your procurement policy to reflect sustainable principles.
- Understand what motivates staff and ensure there is a fun factor in some of the initiatives being promoted.
- Identify some quick wins that may come from carbon friendly initiatives e.g. promote local tradespeople and their services or even bring them on site to help staff and readers reach them efficiently (e.g. bike repair services).
- Adapt and get behind larger national initiatives for local application e.g. used clothing exchange / walk to work week / recycle electrical appliances week etc. Choose those most relevant to your Library's situation or focus.
- Review appliances you can replace, ideally, make redundant a group of appliances e.g. Multi-Functional Devices could replace desk top printers, faxes and photocopiers. It's easier for staff to use a single device and it can result in the reduction of many more carbon reduction tons.
- Put an embargo on carbon hungry devices and provide a list of alternatives for staff to use instead. Don't just say no.
- Measure everything and communicate to staff and others so that people can see they are making a tangible difference – this will encourage staff to keep going when motivation is low.
- Replace all hidden desk bins with floor ECO bin areas; encourage communal responsibility for recycling waste at departmental level, per floor of the building.
- Compete for results (inter-departmental) and reward success.
- Audit all your electrical appliances and replace the worst offenders with better more carbon friendly models.
- Include your carbon principles in your staff induction program so that new staff will know how to operate from day one.

- Run an 'ECO Month' at the Library (e.g. along the lines of Band Aid event) where everyone donates 'carbon tons' by making a pledge to make a change for the month and perhaps for the year so that they can make a difference. Publish pledges for targets promised by individuals; the overall Target Tons Pledged for the Library could feature on its web page for all its staff and end users to see. End users (students/readers) can also pledge.
- Set up smaller groups at the departmental level to work at the grassroots level. In this way staff work directly with readers, and everyone shares the responsibility in the spirit of teamwork.
- Identify Library Energy Champions to help make carbon considerations a constant agenda item on other key library committees and business activities.

Behavioral Changes and Pilot Approaches

Helena Zobec, Australian National University Library

Challenges

- Culture of the University and then the Library as a whole
- Gaining support from Library staff to make their contributions towards the outcome
- Gaining support from other areas of the University in achieving relevant goals in relation to components of the Project
- Obtaining the financial support required centrally to implement sustainability measures in order to realize long-term savings
- Change to more sustainable practices, undertaken at times that were not convenient to business activities during the academic year
- Working collaboratively with the trades people to maintain business operations whilst the work was being undertaken (e.g. maintaining service delivery during the transition period)
- Heritage listed buildings limiting what could be easily fitted and was affordable within the existing infrastructure
- Some of the Library buildings not being free-standing, thus collaboratively shared, requiring a shared approach to the outcome by Library and teaching areas

Suggestions

- Look at the University in the context of local/state/regional initiatives.
- Form collaborative networks with the areas of the University that will assist/support you in achieving the desired outcomes.
- Access funding grants at the institution level to assist in achieving long-term benefits.
- Take opportunities that present themselves such as:
 1. Chifley Library Sustainability Audit undertaken by the University's Sustainability Group (2012).
 2. Worked closely with the ANU Facilities and Services Unit to collaboratively achieve the agreed outcome (as benefited both areas of the University) (2013).

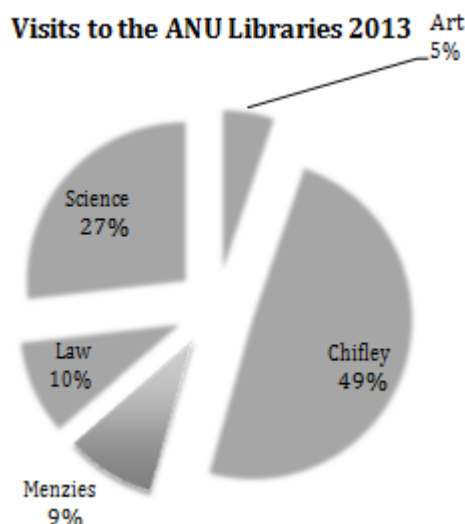
3. Built good working relationships with strategic areas across the University to emphasize the collaborative approach to meeting the goals for wider environmental and economic benefits to the University as a whole (2013).
4. Build on the successes through those areas that are champions across the University in the area of sustainability.
5. Support students who are looking to undertake assessment tasks in the area of sustainability studies where the Library can become a case study.

Ideas for Pilot Approaches

Initiatives have occurred in the major libraries – Chifley, Hancock and Menzies Libraries. In selecting the libraries for initiatives, a number of factors were considered, including the number of visitors to the branch libraries, impact on, and opportunities to engage, with the clients.

The Chifley Library was originally approached in 2010 by ANU Green to undergo an audit (completed by a group of students) to identify improved ways of utilizing existing energy and developing more sustainable practices. Staff were encouraged to implement small scale changes to support this outcome (for example, by staff turning off computers and lights in the building each day; installing recycling bins outside the Library and in the staffroom) to start creating a culture of sustainability within the Library. These initiatives brought a focus on the Chifley Library by the ANUGreen group, leading to a number of sustainability projects implemented in Chifley initially before expanding those initiatives across other University Library branches.

A number of the ANU Library sustainability initiatives were therefore piloted in Chifley due to its size and number of visitors to this branch.



Behavioral Changes in Your Organization

The ANU Library piloted these initiatives to support the broader directions of the University. In determining the best places to pilot the initiatives the University's Sustainability Office took into account utilities costs, length of operational hours of buildings aiming to reduce costs for the Library and overall for the University.

The Library was keen to participate in broader institutional goals, taking into account a strong philosophy of sustainability at the ANU, both as a teaching area and a general value of the University. Staff developed an increased awareness of energy savings in their local work area for the benefits of the University as a whole. Sometimes it requires initial financial input for the overall benefit to the University in the long-term.

Additional Useful Resources

- The Green Building Council of Australia (GBCA): <http://www.gbca.org.au>
GBCA has released a draft of a rating tool open for public feedback until 31 July 2014. This tool will be able to assess the sustainability of most building types in Australia (including libraries) and includes sustainability from transport, rewarding projects for implementing measures to reduce the impact of transport to and from the building using the developed benchmarks.
- Macquarie University Library
<http://www.library.mq.edu.au/newlibrary/sustain.html>
http://www.researchonline.mq.edu.au/vital/access/manager/Repository/mq:19616;jsessionid=5B9E0E70D60EDEEBAC468D80B49AA4FC?f0=sm_subject%3A%22Acad
- The University of Queensland: <https://ppl.app.uq.edu.au/content/10.10.01-sustainability-0>
- The University of Wollongong
<http://www.uow.edu.au/content/groups/public/@web/@bg/documents/doc/uow028242.pdf>
The University of Wollongong Energy Audit Report completed an audit on the whole campus and has made this information available at this link and includes charts of total energy use by application on page 4 of this document.

Constructing Green Buildings in Singapore and NUS

National University of Singapore Libraries Green Library Team

Singapore is a densely built-up urban nation with limited land space and few natural resources. Thus, greening buildings is vital to sustainability as is one of the most effective ways for a city to reduce its carbon footprint in the long term, whether in terms of energy and water efficiency, waste reduction, or the use of sustainable materials.

With this goal in mind, Singapore embarked on its greening journey with the Building and Construction Authority's (BCA) Green Mark Scheme in 2005.^[1]

Overview of BCA Green Mark Scheme

BCA Green Mark Scheme is a rating system to evaluate a building's environmental impact and recognize its sustainability performance, designed specifically for buildings in the tropics.

There are five key areas in the assessment criteria: energy, water efficiency, environmental protection, indoor environmental quality and other green features and innovation. The National Library Building, a winner of many green awards, was also the first building in Singapore to be awarded the Green Mark Platinum award in 2005.

Since its inception, several new schemes have been launched to encourage wider adoption of green building technologies such as the Green Mark Incentive Scheme for Existing Buildings in 2009 and more recently the new Green and Gracious Builder Scheme for Small and Medium Construction Firms in 2014.^[2]

Comparison of BCA Green Mark with LEED System

The BCA Green Mark has been described as the tropics' answer to the US-developed Leadership in Energy and Environmental Design (LEED) certification. It differs from other green building rating systems in these points:

- A stronger emphasis on energy efficiency;
- Tailored to tropical climates: heat gain and cooling of inner spaces with air- conditioning are key design considerations;
- High standards of measurement and verification instrumentations for air- conditioning chiller plants to ensure continual performance monitoring.

Unlike other rating systems administered by nongovernmental organizations, BCA works closely with building owners to conduct regular follow-up sessions and post occupation verifications. This is to ensure that design features are properly implemented and the building performs to the standards set under the BCA Green Mark.^[3]

Rise of Green Buildings in Singapore

In a short span of eight years, the number of green buildings in Singapore has grown steadily from a mere 17 in 2005 to almost 1700 in 2013 (Figure 2)^[3]. Due to various initiatives such as government's implementation of a strong regulatory framework, intense educational efforts, active promotion and robust market incentives, more than 20% of all Singapore's buildings are now green.

One of the earliest and most significant steps in accelerating Singapore's green building agenda was the change to the Building Control Act in April 2008 which made the Green Mark certification mandatory for all new buildings and existing buildings undergoing major retrofits^[3].

Financial incentive schemes were also offered to overcome challenges in retrofitting of existing buildings.



Figure 1: Green Building Projects in Singapore (2005 – Sep. 2013)

Next Steps: National Target for 2030

With the growing awareness of the benefits and strong business case of green buildings, instead of resting on its laurels, Singapore's next bold target is to green 80% of all existing buildings to attain the minimum Green Mark standards by 2030.

To achieve this goal, Singapore has set out specific initiatives to lead Singapore's building and construction industry in greening our built environment.

Buildings are estimated to account for 1/3 of greenhouse gas emissions, 40% of global energy consumption and resources and 25% of global water consumption. The energy consumption in buildings can be reduced by 30% to 80% using proven and commercially available technologies. Such buildings will also be water efficient, with a high quality and healthy indoor environment, integrated with green spaces and constructed from eco-friendly materials^[3].

To accelerate the process, BCA is working on the details for the 3rd Green Building Master Plan to guide Singapore's green building journey over the next five to 10 years.

Singapore's Leadership in Green Building Advancement in the Tropics / Asia

The new Master Plan has set a Green Building Vision, with the aspiration for Singapore to be a "A global leader in green buildings, with special expertise in the tropics and sub-tropics – enabling sustainable development and quality living".

The new vision leverages Singapore's potential to take the lead in addressing challenges and exploring solutions in green building developments, including innovative, sustainable and actionable solutions for the tropics and sub-tropics.

The 3rd Green Building Master Plan (Figure 2) will emphasize on building capability in the industry, engaging the tenants and occupants for closer partnership between the people, private and public sectors, driving consumption behavioral adjustments, as well as developing an environment that addresses the well-being of the people.

The shift in focus onto the users and people can drive the green building agenda further and bring about greater impact and contribution towards the nation's efforts for a high-quality living environment for the people and to become a climate resilient global city that is well-positioned for green growth^[4].



Figure 2: 3rd Green Building Master Plan – Green Building Vision and Strategic Goals

Green Buildings in NUS

National University of Singapore has committed itself to campus sustainability and is a founding member of International Sustainable Campus Network (ISCN).

Greening New NUS Buildings

All new buildings in NUS are required to obtain Green Mark certification from BCA. NUS has more than 150 experts working on energy-related research and education and has used its campuses and buildings as test beds for energy research ideas and energy-efficient designs that optimize natural ventilation in the tropics, with several newer developments winning local and international environmental design and sustainability awards^[5].

It is the first tertiary institution in Singapore to be awarded the BCA Green Mark Champion Award in 2012. To qualify for the award, the developer is required to deliver at least ten Green Mark projects of Gold or higher rating, including a minimum of three Green Mark Platinum projects and three Green Mark GoldPlus projects respectively^[6].

NUS has 13 Projects awarded Gold and above (including 4 Platinum and 5 GoldPlus awards). One of the GoldPlus awards is given to University Town for its green district design.

The list of all Green Mark Certified NUS buildings is as follows:

Green Mark for Buildings Award (Platinum)

- Education Resource Centre at NUS' University Town (UTown)
- Stephen Riady Centre
- Kent Vale II Staff Housing Development
- Yong Loo Lin School of Medicine MD1

Green Mark Gold Plus

- The UTown Residence (GoldPlus District)
- University Hall
- Residential College 4 and College of Alice & Peter Tan
- Aquatic Science Research

Green Mark for Buildings Award (Gold)

- NUS Business School: Mochtar Riady Building
- Residential colleges: Cinnamon College and Tembusu College
- Centre For Translational Medicine MD6
- Yong Loo Lin School of Medicine Block MD2

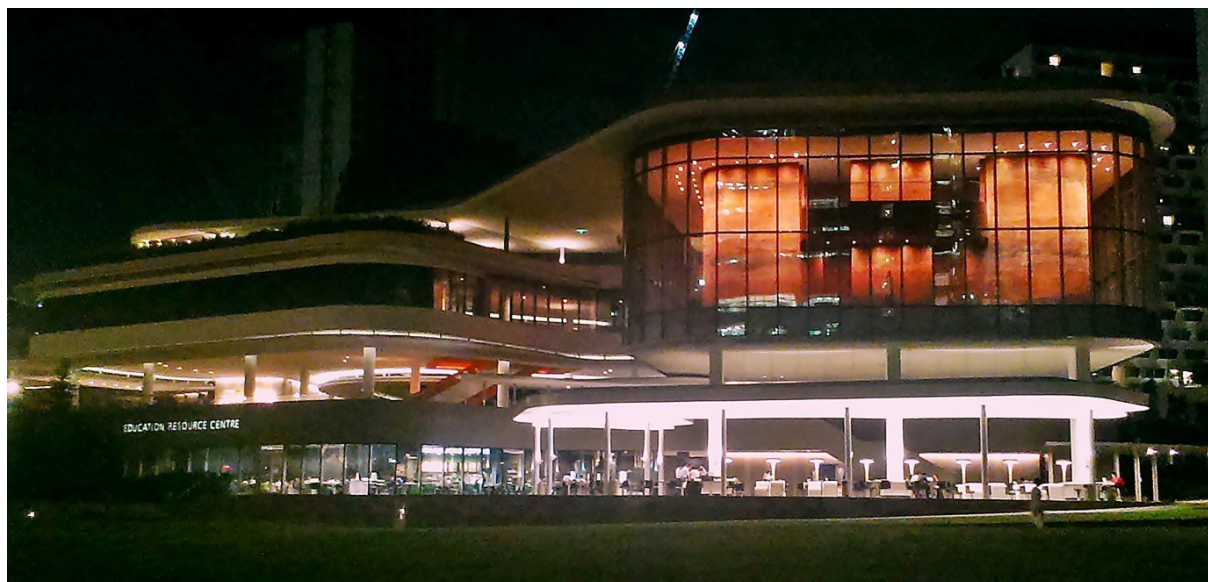
Green Mark for Buildings Award (Certified)

- T-Lab at NUS: a joint development project between NUS and Defence Science and Technology Agency (DSTA)
- Interim Dentistry School

Greening Existing NUS Buildings

NUS has identified 24 existing buildings (Phase 1) to be Green Mark certified by year 2020. NUS Libraries' Central Library is one of them.

The overall goal for NUS is to achieve 25% energy savings for new buildings and 15% for existing buildings by 2020^[7].

Education Resource Centre (ERC) at NUS University Town (UTown)

The ERC building is a focal building in the NUS UTown vicinity which was planned and designed to be environmentally sustainable. The building possesses a cluster of seminar rooms, study areas, a large café, a fully-equipped self-service library book dispenser, and computer facilities. Most facilities are opened 24/7 to support the residences in the town and to create a vibrant vibe. It is a green building that has won Singapore's Green Mark Platinum awards in 2010 and was accorded a list of recognitions

including being named the “Building of the Year” at the ARCASIA Awards for Architecture 2013. The ERC building was completed in 2011 and has notable sustainable architectural features.

Massing Concept

ERC is designed with a low-lying plate structure that complements the surrounding buildings in UTown. As one of the center architecture in the area, its massing concept therefore seeks not to clutter the space with neighboring taller buildings.

Topography and Protection of Existing Trees

Lower stories of the building were constructed at lower contour areas to minimize excavation and disturbances to the ground. Existing mature and large trees in the area were retained and they served as building marks around the building – courtyards, entrances and vehicular drop-offs.

Ventilation and Micro-Climate

The courtyard was built around three mature trees and has major openings in the north and south direction to regulate and improve ventilation through capturing of North-South breezes. Pedestrian walkways were strategically planned around the building to ensure and enhance natural ventilation within the building.

Air and Lighting Features

Double doors were used to lock air-conditioning and to minimize infiltration of humidity indoors. Windows in non-west facing study spaces are double-glazed with low E fritted glass panels to maximize light into the building. To provide visual comfort and cut indoor cooling load, sun-shading canopies, vertical green screens, light-dimming features and auto-blinds were carefully deployed to selective areas.

Green Roof

The building possesses a green roof with ground-covering plants to reduce heat absorption into top-level rooms, therefore reducing also the indoor cooling load.

Recycled Materials for Building

Outdoors, timber flooring at the courtyard and foyer were made from recycled hard wood fiber dust. Indoors, acoustic feature walls in the lecture theatre are made of recycled timber off-cuts. The theatre seats are made of recycled polyester upholstery fabric.

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- (4) Building and Construction Authority, *Snippets of 3rd Green Building Master Plan: Featuring the Business Case for Green Buildings*, in *BuildGreen: International Green Building Conference 2013*
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- (7) National University of Singapore. *ISCN (International Sustainable Campus Network) – GULF Sustainable Campus Charter Report*. 2011 16 April 2014, available from: http://issuu.com/environmental_sustainability/docs/nus_2011_iscn_charter_report?e=3329739/2670344

Case Studies of Green Libraries

Selected, researched and summarized by Jacquelyn Aiello

National Library of Singapore, Singapore

Singapore, T.R. Hamzah & Ken Yeang with ARUP, 2005



World renowned for its high quality performativity aspects, the National Library of Singapore is one of the most influential sustainable libraries yet built. This library, which houses 25 other libraries in 16-stories and 3 basement levels, is an icon for the nation. It encourages the expansion of knowledge, creativity, culture, and sustainability.

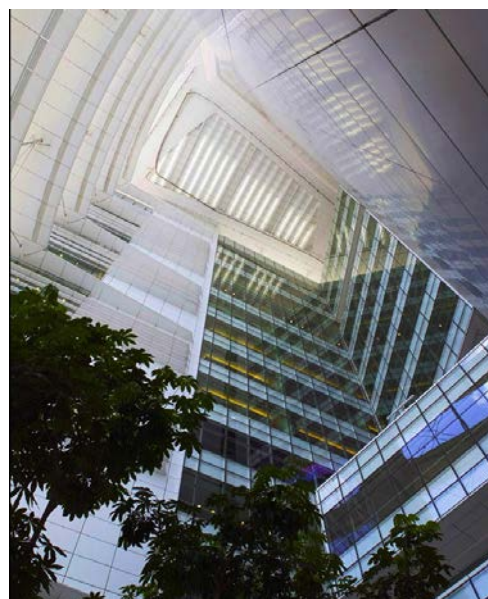
The National Library uses both energy-efficient and passive methods to limits, one of the largest concerns being ventilation because of the tropical climate of Singapore. These features, listed below, allow the building to save 31% of its energy use, which is 17% more than the projected amount.

The main feature of this design is the central plaza that creates an open, vertical atrium that allows natural light and ventilation to penetrate into the deeper parts of the building. This system responds to the surrounding climate and enables the building to use less energy for air-conditioning. The plaza in the center of the blocks is a main community space within the city and holds cafes, retail, and the main foyer of the library. Along with the plaza, there are SkyCourts throughout the building that hold bioclimatic vegetation and landscaping for both performativity and psychological benefits.

The National Library of Singapore is an important precedent to learn from because it is a very holistic model that solves the issues of sustainability and community space within a large library system.

Green Features

- Orientated in East-West direction
- Low-emissive double-glazed glass and large overhangs
- Light shelves throughout the building
- Daylight sensors and automatic blinds
- Energy-efficient lights
- Rain sensors and water efficient taps
- Bioclimatic vegetation and landscaping
- Night setback for air-conditioning system
- CO2 sensors and Energy monitoring system
- Use of recycled materials



Awards

- 2007 Energy Efficiency and Construction Best Practice for Energy Efficient Buildings: New and Existing
- ASEAN Centre for Energy
- 2006 Award of Merit - Best Buildable Design Award, Building and Construction Authority (BCA)
- 2005 Platinum Award - Green Mark Awards, Building and Construction Authority

Canada Water Library, London, England

London, England, CZWG, 2011



Sustainable design does not necessarily always suggest that the building has a plethora of environmentally sound solutions in it, but it can also be creating a pleasurable public space that invites a multitude of users in to create a cohesive and diverse community. This was the main initiative for the Canada Water Library in London, while also implementing sustainable technologies within the system.

While this generation is turning more towards informational technology and libraries are seemingly becoming obsolete, the Southwark region of London is expanding their library use because they understand the continued potential that libraries have to be important to society. Instead of being used simply for research and reading, libraries are now being used as communities centers as well.

The main design feature of this library is its inverted pyramid form to allow the louder, more public use spaces to be on the ground floor and the quiet reading areas to be on the top, away from the noise below and allowing users to relax and read peacefully. The form also allows for a smaller footprint, therefore causing less impact on the environment below and using less material on the external envelope. The Canada Water Library is a symbol of the revitalization of libraries within the 21st century culture as a place for a community to grow in knowledge through social interaction as well as traditional library use.

Green Features

- Ground source heat pump
- Grey water harvesting system
- Green sedum roof
- Skylights for daylighting



Awards

- 2012 Royal Institute of British Architects (RIBA) Regional London Award
- 2013 Civic Trust Selwyn Goldsmith Award for Universal Design
- 2013 EDGE Award in the physical category

Villanueva Public Library, Villanueva, Colombia

Villanueva, Colombia, Carlos Meza, Alejandro Piñol, Germán Ramírez, Miguel Torres, 2006



One library that may not fit the typical “sustainable” label, but is one that libraries can certainly still learn from is the Villanueva Public Library in Colombia. The library is a very unique experience in that it was designed by local architects, engineers, and contractors and used local design techniques and local materials in a sustainable and economical fashion. This library was a necessity within the community of Villanueva because political and economic problems have caused its members to

suffer from a lack of proper educational tools.

The design is relatively small (16,000 square feet), but still houses all of the essentials of a 21st century library: a reading room, an auditorium, a kids’ library, administrative offices, and work spaces as well as an attractive outdoor plaza. The main materials used to construct this building are stone gabions from the nearby river and pine wood from an eco- logically controlled forest, reducing transportation costs and the building’s carbon footprint. Through the center of the building, five metallic white lattice boxes connect the programs, creating an open space and allowing air to run through the building using a passive ventilation system. Local community members and former outlaw militants constructed the building, forcing the construction technique to be relatively easy and the connectivity of people throughout the area.

The Villanueva Library does not only act as a space for the local communities to congregate and access knowledge, but it’s also a catalyst for social movements and action throughout the area. In a region surrounded by wars and conflicts, this space gives the community a safe place to come, learn, share, and create a better future for their town.



Green Features

- Local materials used to reduce carbon footprint
- Passive ventilation system

Oberlin College Lewis Center, Oberlin, Ohio, USA

Oberlin, Ohio, William McDonough + Partners, 2000



Although not directly a library, a lot can be learned about sustainable design within the education and research realm by studying The Oberlin College Lewis Center for Environmental Studies. This building was one of the first successfully large scale education building in the world to become a zero-net energy building. The building houses classrooms, office space, an auditorium, a library, a greenhouse, and an open atrium. Its main focus is to allow environmental studies students to get hands-on experience in an

ecologically friendly environment through using recycled and sustainably grown material and energy efficient and passive systems throughout.

The landscaping on the exterior and interior holds native ecosystems to create a storm water management and storage system. These plants can also filter and clean the wastewater from the building to be reused. The building was designed and constructed before the LEED program existed, so it was not able to get a rating. However, it fits the criteria to be considered a LEED Platinum building.

The most intriguing idea behind this building is that it practices what it preaches. The Environmental Studies Department holds classes about solar energy, ecological design, conservation of resources, and other subjects dealing with sustainability issues in a building that puts those subjects into practice, so students are able to see what they are learning about in action.

Green Features

- Recycled and sustainably grown material used
- Natural storm water management and storage system
- Photovoltaics and passive solar heating
- Double- and triple-pane, argon-filled, low-e glass windows
- Closed-loop groundwater heat pump system
- Radiant floor heating
- Photo and occupancy sensing compact fluorescent lights



Awards

- 2001 National Convention of the Associated Contractors of America Build America Award
- 2000 Associated Contractors of Ohio Build Ohio Award
- 2009 AIA Committee on Architecture and Education Honor Award
- 1999 Chicago Anthaeum American Architecture Award
- 2002 AIA “One of the Tip 10 Green Projects”
- U.S. Department of Energy “One of the 30 Milestone Buildings of the 20th Century”
- 2010 Architect Magazine “Most Important green building constructed in the last 30 years”

UC Merced Kolligian Library, Merced, California, USA

Merced, California, SOM, 2005



UC Merced has quickly become a leader in sustainable design throughout the entire campus, including the Kolligian Library designed by SOM in 2005. In a town with hot summers and cold winters, sun mitigation strategies are important to design towards to allow the most comfort with the least about of energy use. Orientating the building at the north-south axis, using an insulated concrete shell, and using deep shading systems helps keep the building cool during the summer and warmer during the winter.

Along with the passive sustainable systems, there are other systems that directly decrease the amount of energy use. The building uses photo sensors to control the interior perimeter lights to use the lights only when necessary, as well as a chilled water system, which loops throughout the building to keep it cool.

UC Merced also has its own sustainable strategies throughout the campus, including ensuring that all of its buildings are LEED certified and making all new buildings a minimum LEED Gold certification status as well as a “triple zero commitment” including net-zero energy, zero landfill waste, and net-zero greenhouse gas emissions. The campus is a model looked at by the entire UC system to create a new sustainable system throughout all university campuses.

Green Features

- External shading devices
- Photo sensors to control interior perimeter lights
- Insulated concrete shell
- North-south axis orientation
- High-performance windows for daylighting
- Chilled water system

Awards

- 2009 Chicago Antheum Green Good Design Award
- 2007 AIA Energy Efficiency Integration Merit Award, Savings by Design
- 2008 UC/CSU/CCC Sustainability Best Practices Award for Overall Sustainable Design
- 2011 AIA Design Award, Excellence in Architecture
- LEED Gold



University of Aberdeen Library, Aberdeen, Scotland Scotland, UK, Schmidt Hammer Lassen Architects, 2012



The University of Aberdeen Library is another campus library that both brings students and cultures together and also supports a sustainable lifestyle. Designed by Schmidt Hammer Lassen Architects for a competition, the library houses one million books and is a top science and research library while also providing meeting and community spaces, creating the whole package for a 20th century university library.

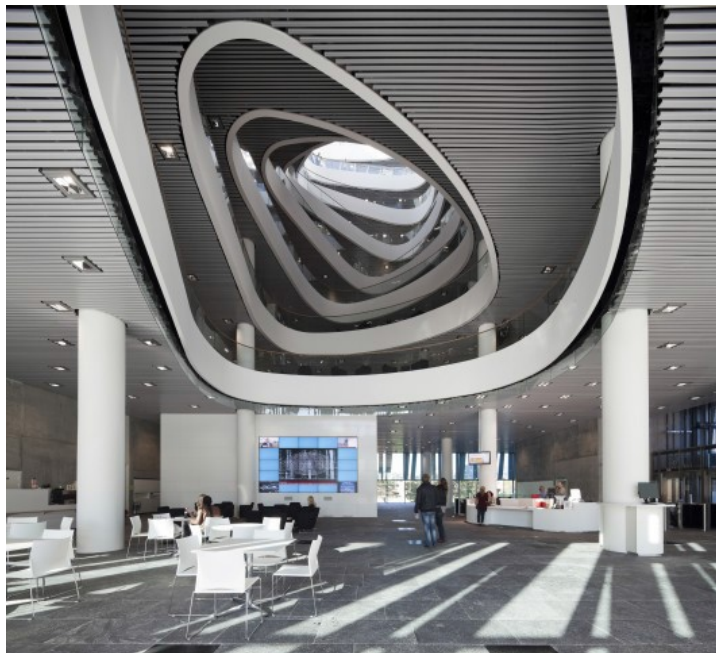
It's most prestigious award is winning an Excellent Award in BREEAM, the Building Research Establishment Environmental Assessment Methodology, for its sustainability practices. It is the premier rating and environmental assessment system for sustainable buildings and continually encourages more sustainable practices, including this library.

To improve daylighting, the building's facade is designed with high performance glazing and

irregularly placed insulating panels, which creates a diffused lighting system. There is an atrium down the center of the library made of an organic shape to bring light into the deeper parts of the building for more daylighting purposes. It also uses a displacement air system to create passive ventilation throughout the building.

On the roof of the library, a rainwater harvesting system is implemented and photovoltaic panels allow the building to use sustainable energy sources. These active sustainable systems help gear the library towards a net-zero energy building and lower energy costs.

The University of Aberdeen Library is more than a research center for the students of the university, but also a community center for the city of Aberdeen, Scotland. Since its construction, the library has had an increase of visitors from the library that it replaced and it has instilled pride in the city, now considered one of the city's monuments.



Green Features

- High performance glazing and insulating panels
- Energy efficient lighting
- Displacement air system
- Rainwater harvesting
- Photovoltaic panels

Awards

- 2013 RIAS Andrew Doolan Best Building in Scotland Award
- 2013 RIBA National Award Winner
- BREEAM Excellent Rating
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