



**Arizona State University
Tempe, Arizona
Environmental Education or Outreach**

SCHOOL

Arizona State University, public 4-year, 67,000 students, Tempe, Arizona.

ABSTRACT

ASU's Campus Metabolism™ project, launched May 2008, is an interactive and educational website <http://cm.asu.edu/> displaying real-time energy consumption data for thirteen campus buildings. It was created to highlight the often overlooked and hidden connection between the actions in our daily lives, resource use and the resulting environmental consequences. The system was developed and implemented through a collaborative effort within ASU and between many departments within its community. The website is currently tracking "Energy" which includes Chilled Water (used for cooling), Electricity, and Hot Water/Steam (used for heating and hot water) with plans to expand the program to all buildings on all four campuses and include additional data points such as solid waste and water.

GOALS AND OUTCOMES

Goals

ASU has launched an ambitious goal to integrate sustainability through-out all aspects of the university. The Global Institute of Sustainability is the organizing hub of this goal which includes four pillars: Research, Education, Outreach/Engagement, and Campus Sustainability Practices. Cutting across these pillars is the vision to use the campus as a "living laboratory" – Campus Metabolism™ is not only an example of one such project, but is also an important tool to facilitate future projects.

The Campus Metabolism™ web tool was envisioned and created by students, faculty, staff and utility personnel to increase community wide awareness of campus energy use and the associated environmental impacts. By providing real-time energy use information to building occupants they better understand how their individual and collective behaviors play a powerful role in campus resource use.

In the near future Campus Metabolism™ plans to display Potable Water, Recyclable and Non-Recyclable Waste as well as other important resource information such as the recent campus solar projects and a virtual dorm room and office. Roll-out to all buildings on all four campuses is in the planning phase.

Accomplishments and Outcomes

Historical and future data can be used to quantify the change in energy use performance due to capital improvement projects. Providing real, quantifiable data greatly improves the accuracy of return on investment (ROI) analysis which proves very useful when making decisions on future campus improvement projects.

Students and faculty are now using this tool in many class projects. Historical data can be downloaded as Microsoft Excel files for every building being tracked on the site. Students from a variety of disciplines use this system to quantitatively correlate building energy use to human behavior, building design, local

climate and a wide range of other parameters. Accessing information is quick and simple enabling teaching through inquiry based learning for students outside of the traditional technical disciplines.

Users are encouraged to send feedback emails directly from the site. In some instances users find unusual or abnormal energy use patterns and point this out to facilities management. This direct communication allows the ASU community to take a participatory role in improving the way buildings are operated. The tool can also be used to examine the benefits of building improvements measures, especially those related to energy conservation and efficiency.

Here is a listing of other Campus Metabolism™ outcomes.

- Users can visualize real-time energy consumption of multiple campus buildings.
- Users can compare the energy use of buildings against one another or against historical data – last week, last month, or last year, as well as download data for offline use.
- Enables teaching and learning about resource consumption as it relates to the built environment and occupant behavior.
- Abnormally high energy use patterns have been identified with this tool leading building managers to correct problems that may have otherwise gone unnoticed.
- Student lead intra-campus energy conservation competitions have lead to increased sustainability awareness and a quantifiable decrease in energy use per student in the participating buildings.

Challenges and Responses

While many institutions have out-sourced the development of their building dashboard type programs, an expensive option that creates a rigid design, we built this in house through a cross-departmental collaboration and in partnership with our energy services company. This is the largest system of its kind in the country. While other universities have implemented other resource monitoring systems tracking only one form of energy, ASU's system provides several data points per building including heating, cooling, and electricity. The system currently displays data from 13 buildings with an additional 37 buildings to be added in the near future. This is the only data visualization tool to draw on the metaphor portraying a university campus as a system with its own metabolism.

Campus Climate Action: Your School's Carbon Footprint

This data enables facilities management to be more aware of building energy performance and often reveals hidden energy consumption trends that can be used to target and justify specific energy conservation measures.

It's through the launch and success of the Campus Metabolism™ site that an "Energy Wars" competition was created to place all ten Tempe Campus Residence Halls in competition with themselves to reduce their heating, cooling, and electricity usage when compared to the previous semester. The Energy Wars concept is promoting a rather simple principle called a Negawatt, which is electricity that isn't created, due to energy efficiency.

By focusing on the three indicators the project was able to narrow its message. In respect to heating and cooling, residents were asked to turn down their heater during the winter and consider wearing more layers of clothing, and during the summer months turning up the thermostat and wear light-weight cotton apparel. With electronic products becoming more and more integrated in our everyday life, Energy Wars promoted un-plugging or turning off items when you leave the room, to stop power from being used when people aren't around. Together ASU's Campus Metabolism and Energy Wars are promoting a more sustainable use of university provided resources. An Energy Wars competition can be held on any college campus.

Commentary and Reflection

Campus Metabolism™ proves that universities can build this type of system by drawing on the creativity of their faculty, staff and students thereby spending less than the cost of out-sourcing the development of the system. This collaborative effort demonstrates that similar projects can be used to forge stronger cross-departmental working relationships while creating an engaging tool to raise awareness about resource consumption and sustainability on campus.

As a result of this experience, trust and relationships have been established across traditional university silos that is fostering future work both between the design team as well as spin-off projects inspired by the Campus Metabolism™ system.

ENGAGEMENT AND SUPPORT

Leaders and Supporters

The cross departmental conceptual design team included representatives from the Global Institute of Sustainability, ASU Facilities Management, The National Center of Excellence on SMART Innovations, University Student Initiatives, Barrett Honors College, Student Affairs, ASU Residential Life, University Architects Office, College of Design, Ira A. Fulton School of Engineering, Psychology, the student chapter of Engineers Without Borders, and APS Energy Services.

This project began as a student project proposed by Joby Carlson, advisor to the ASU Engineers Without Borders ASU Chapter, in November of 2006. The project was titled “Visualizing the Campus Metabolism” and was submitted to ASU engineering department for consideration. Students began initial conceptual planning of the monitoring system for two student residential buildings on the ASU main campus. As the students contacted and met with university management the project grew to include many more campus buildings. To make this possible, Bonny Bentzin of the Campus Sustainable Operations group organized a conceptual design team with stakeholders and management from across many campus departments. The milestones are as follows:

- February of 2008 - Conceptual design meetings for the campus wide system initiated.
- May 2008 - Initial trial version of Campus Metabolism™ for a single building was released including the website and an interactive touchscreen in the lobby of ASU’s Global Institute of Sustainability building.
- September of 2008 - Twelve additional campus buildings were added along with major design revisions. This is the current version of Campus Metabolism™.
- August 2009 - Next version of the system released including energy data for at least twenty more buildings. The next release will also include campus solar energy generation, and a unique interactive room and office energy calculation tool. The Campus Metabolism™ system will be maintained and continually improved as part of the university’s Building Controls group for the benefit of the ASU community for years to come.
- December 2009 – Water and waste data added.
- On-going – Continue roll-out across all four campuses.

Funding and Resources

The Campus Metabolism project has been given full support by university leaders within the office of the president, the office of the campus architect, capital programs management, research and economic affairs, and residential life. Roll-out to all buildings on all four campuses is in the planning phase.

Education and Community Outreach

Campus Metabolism™ has impacted the ASU community as follows:

1. Campus Metabolism™ has fostered strategic partnerships and alliances within the university to successfully engage leaders and members of the academic, research and operations communities as ASU continues to institutionalize a culture of sustainability at the university. It also serves as further evidence to the ASU community that sustainability continues to be an important institutional management objective at ASU and that an interdisciplinary approach to solving problems can be successfully applied to daily operations, not just research. Consequently, Campus Metabolism™ has also contributed to the already existing environment of cooperation at ASU which has facilitated other projects requiring an interdisciplinary approach.
2. Campus Metabolism™ has increased the awareness by members of the ASU community as to how their everyday choices impact energy consumption at the University. Through visible real-time feedback, members of the community can more easily understand how their decisions are having positive or negative impacts on energy consumption.
3. Campus Metabolism™ provides a highly visible platform to promote learning, teaching, researching and empowering change in the area of sustainability at ASU. A sense of pride amongst the student body and the administration has emerged from the appreciation that Campus Metabolism™ was successfully developed in house without any outsourcing. This resulted in substantial cost savings and significant flexibility.

CONTACT INFORMATION

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MORE ABOUT YOUR SCHOOL

Campus Sustainability History

The Global Institute of Sustainability evolved from over 30 years of environmental research conducted by the Center for Environmental Studies at Arizona State University (ASU). The Institute conducts research, education, and problem-solving related to sustainability, with a special focus on urban environments. Within the Global Institute of Sustainability there is a University Sustainability Practices group. This is a group of several individuals who are dedicated to oversee campus sustainability. We initiate and coordinate sustainability efforts of several campus community groups and stakeholders. University Sustainability Practices has established four goals for campus sustainability. 1) Carbon Neutrality, 2) Zero Waste, 3) Active Engagement and 4) Principled Practice. We have established several sustainability initiatives to help the university achieve these four goals. <http://sustainability.asu.edu/>