4 | Sustainable Campus Framework

Sustainability at the Hayward Campus

The planned growth of Cal State East Bay presents an important opportunity to establish an environmentally sustainable university community that can be a model for the region and the CSU system. As new facilities are added and more students reside on campus, patterns of development and operations can evolve to achieve significant advances in all aspects of sustainable planning, design and operations.

Sustainability Goals

The vision for the Hayward campus is to be a vital, multicultural academic community that by the year 2030 has achieved a sustainable balance that is ecologically friendly, economically viable, and socially responsible.

The purpose of this Sustainable Campus Framework section is to present an overview of the University's vision for sustainability at Cal State East Bay utilizing a comprehensive approach which addresses the following range of focus areas:

- Energy
- Water
- Waste

- Carbon
- Transportation
- Materials
- Landscape
- Land Use and Site Development

Recommendations for these areas have been developed using a holistic, systems-based approach that provides a comprehensive overview of resource flows, linking sources to end-use.

The sections on each topic are organized to provide information on goals or targets, existing conditions, relevant current initiatives, and references and codes, and details of the approach to achieving the proposed targets.

The Cal State East Bay Hayward campus has a 1.05 MW rooftop photovoltaic (PV) installation that produces approximately 7% of its power needs.

Energy

Vision and Goals

The energy vision for the Hayward campus is to achieve a sustainable energy balance that is resilient, efficient, and leads to overall carbon neutrality at the campus by the year 2030. Included are a mix of concepts that apply to individual buildings and to the larger campus area as a whole.

For planning purposes, it is assumed that existing campus buildings will likely make up about half of the total building stock in 2030. Reduction of the energy footprint of these buildings is integral to the successful realization of the energy vision. The energy goals are therefore divided into the two categories of existing and new buildings.

Existing Buildings

The goal for the existing Cal State East Bay buildings is to achieve 30% energy savings over current consumption rates by 2030. This will require an on-going program of retrofits and retro-commissioning of approximately 80% of the existing buildings. Achieving this goal translates into an estimated 6,400 MWh electric savings and 300 kTherms gas savings annually at full build-out as depicted in Figure 10.

New Buildings

The goal for new buildings is to achieve 50% energy savings as compared to the performance of a typical, existing Cal State East Bay building. This can be achieved through a series of effective energy efficiency strategies. Based on 2006-07 metered data, achieving this goal translates into an estimated 6,300 MWh of electric savings and 250 kTherms of gas savings annually, as depicted in Figure 11.

Due to potential difficulties in comparing the energy performance of new buildings against existing buildings (e.g., variations in program, site, or metering), at the University's discretion a future building may be measured as meeting or exceeding the following goals:
- 30% below Title-24 2005/ ASHRAE 90.1 2004 (whole building performance)
- Energy Star rating of 90 or higher.

Since significant energy is used by "non-regulated" loads such as plug loads, exterior lighting, elevators, and other miscellaneous energy uses in a building, achievement of the above goals will require a purchasing, maintenance, and management effort that encourages efficiency for the non-regulated uses.

Existing Conditions

The Hayward campus today consists of approximately a million square feet of academic buildings with associated streets and utilities. Existing campus energy use is primarily electricity (20 kWh/ square feet/year) and natural gas (0.80 therms/square feet/year). The electricity on the campus is supplied by Arizona Public Service Corporation (APS) via two 12,000 VA substation feeds. The APS energy portfolio is as follows:
- 41.7% Coal
- 54% Nuclear
- 4.2% Gas
- 0.1% Hydroelectric.

The campus also draws approximately 7% of its power from its 1.05 MW rooftop photovoltaic (PV) installations.

There is no campus-wide central utility plant. Instead there are independent cooling-heating plants at select buildings, including: University Library/Warren Hall, Meiklejohn Hall, Student Health Center, Physical Education Building, Music Building, and Art and Education Building.

Based on 2006-07 metered electric data, the academic campus currently consumes approximately 18,800 MWh of energy annually, with a peak demand of 5,800 kW. Assuming current performance levels, the planned growth of the Hayward campus would increase electricity consumption by 13,300 MWh, for an annual total of 32,100 MWh. Peak electric demand is estimated to increase by 4,200 kW, bringing the total peak demand to 10,000 kW.

Similarly, the annual natural gas consumption would increase from 760,000 therms to 1,297,000 therms at build-out with current consumption trends. This corresponds to a peak demand increase from the current 580 therms/hour to 990 therms/hour.

Current Initiatives

Several energy-related initiatives already underway address short- and long-term sustainability targets for the CSU system. These measures call for a collective effort from all campuses to achieve overall reductions in energy consumption and demand.

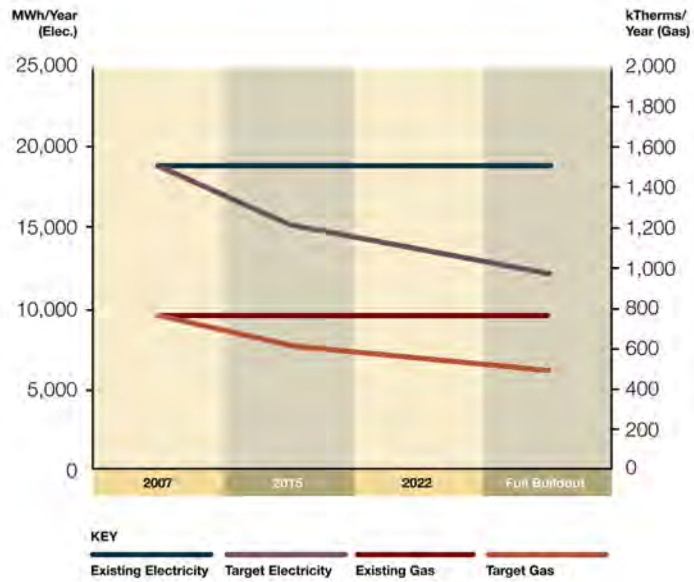


Figure 10
Energy Goals for Existing Buildings

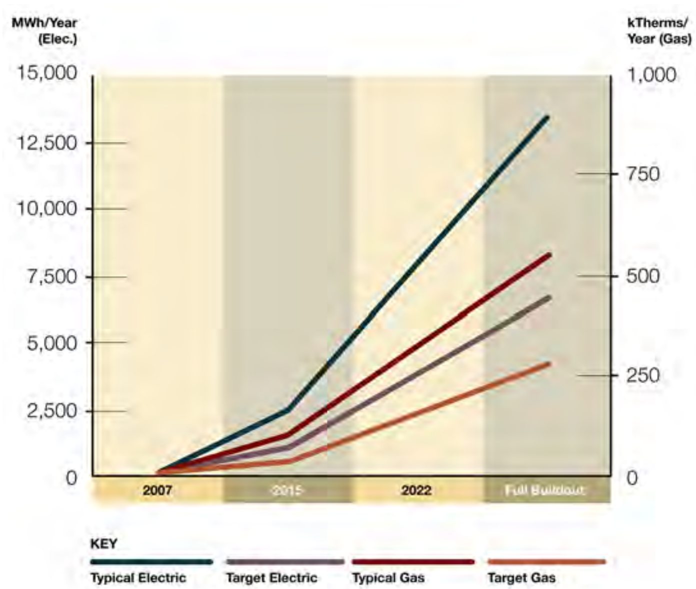
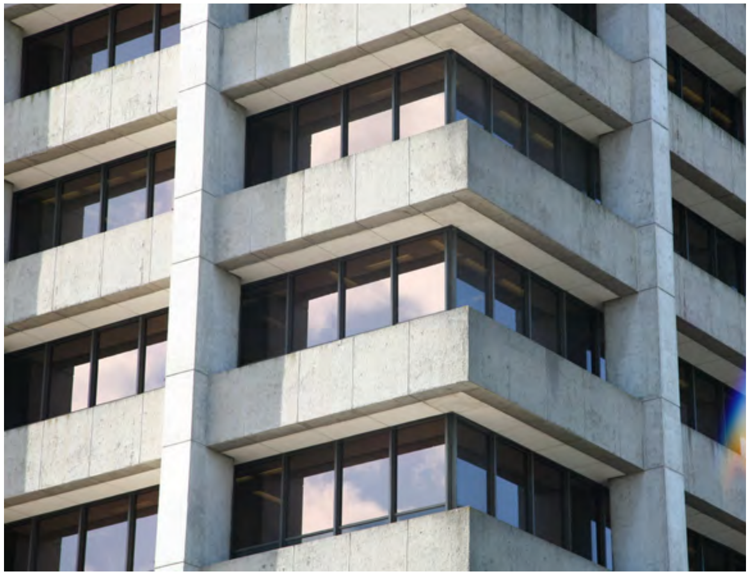


Figure 11
Energy Goals for New Buildings

Several existing buildings on the Hayward campus have energy saving window overhangs or sun shades integrated into the architecture.

(upper)
Warren Hall.

(lower)
The Art & Education Building.



- Executive Order 987 calling for a 15% reduction in 2003/4 energy levels by 2009/10
- Executive Order S-12-04 requesting that CSU campuses participate in State-wide energy conservation and reduced electrical demand
- A total co-generation capacity increase from 24 MW to 40 MW by 2014
- Executive Order-987 setting guidelines for lighting, building envelope and the use of efficient equipment
- An overall renewable energy increase from 2 MW to 10 MW by 2014.

In addition to the above system-wide initiatives and the campus' photovoltaic system, Cal State East Bay is in the final stages of procuring a multi-resource fuel cell.

References and Codes

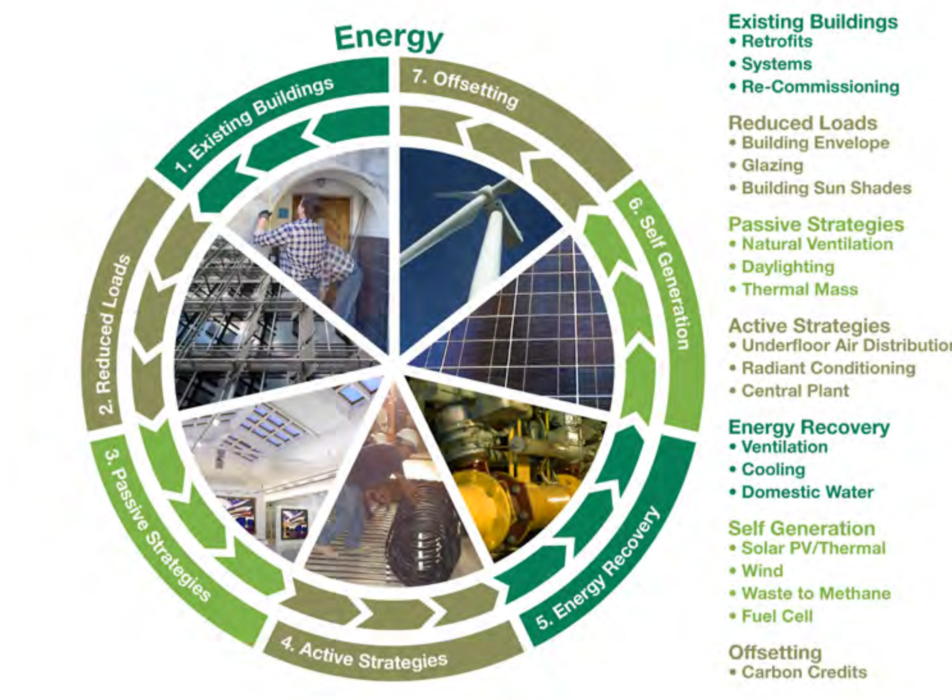
There are several nationally-recognized standards and rating systems that provide energy guidelines and performance assessments. The American Society for Heating Refrigeration and Air Conditioning (ASHRAE) publishes the national standard for energy use in buildings (Standard 90.1), and for indoor environmental quality (Standard 62.1). These standards are constantly updated and can provide valuable insights into the state of knowledge. ASHRAE standards are also referenced by the LEED™ rating system.

State- and local-level building codes often require meeting or exceeding ASHRAE standards for energy consumption. These can also provide useful guidance for the University.

Energy Approach

The energy approach shown in Figure 12 illustrates design strategies that will ensure the greatest cumulative reduction in campus energy use. This approach outlines general building and site-level strategies that are applicable to both existing and new development.

Figure 12
The Energy Approach



Existing Buildings

Energy consumption in existing buildings will significantly influence overall campus energy use, particularly in the near term during which the existing built size will outweigh new development. Many of these buildings may require significant architectural and systems upgrades. The University will develop a systematic program to identify, renovate and retrofit such buildings.

Recommissioning of building systems, training of operators, and occupant education are also needed. Such occupant- and operator-initiated improvements are anticipated to reduce existing energy use by 15%. Retrofits are expected to result in an additional reduction in energy use of 8%.

Reduced Loads

Load reduction is the first step in achieving an energy efficient design for new construction. These strategies result in "reducing the size of the energy pie" through efficient building design, especially of the building envelope.

Strategies to optimize the thermal performance of the building envelope include: optimum space planning and right-sizing, optimum building solar and wind orientation, building material selection for better thermal performance, internal equipment right-sizing, preferred purchasing, and good energy management practices.

Passive Strategies

Hayward's mild climate allows for a significant number of annual hours that can be passively conditioned (heated or cooled without the use of mechanical air conditioners and heaters) using a bio-climatic approach to building design. "Bio-climatic architecture refers to the design of buildings and spaces (both interior and exterior) based on local climate, aimed at providing thermal and visual comfort, making use of solar energy and other environmental sources. Basic elements of bio-climatic design are passive solar systems which are incorporated onto buildings and utilize environmental sources (for example, sun, air, wind, vegetation, water, soil, sky) for heating, cooling and lighting the buildings."[1] Bio-climatic architecture combined with the adoption of adaptive comfort standards, which allow warmer indoor temperatures for naturally ventilated buildings during summer and cooler temperatures during winter, can greatly reduce the energy consumption of individual buildings.

Active Strategies

A new campus central utility plant is planned which will tap into the existing plants serving independent buildings, thus capturing the economies of scale. (See the Infrastructure and Utilities Framework chapter for a more complete discussion on the central utility plant.)

At the building level, efficient and progressive technologies such as radiant floor and under floor air distribution can minimize the amount of energy expended in meeting the remaining heating and cooling loads not met through passive strategies. Suitability of such systems will be explored in detail as part of the building design process on a case-by-case basis.

Energy Recovery

The next set of strategies in the stepped improvement process is aimed at recovering, wherever possible, energy that was consumed. Technologies such as heat pipes or heat wheels will be explored as part of the design process to recover energy in the ventilation system. This energy recovery results in further reducing the overall "primary," or grid energy used, which in turn raises the overall efficiency of systems. Such a strategy also reduces demand during peak periods when energy is most expensive.

Renewable Energy Generation

The self-generation portfolio of the campus is based on available renewable natural resources. The most readily available and the easiest to scale are solar power and wind power. Both of these resources can provide a long, stable and prosperous future supply of energy.

The University will also explore acquiring additional fuel cells and other emerging technologies over time to expand its portfolio.

Offsets

To move closer toward carbon neutrality, the University can explore purchasing carbon offsets or renewable energy credits. Refer to the Carbon section for further information.

1 Center for Renewable Energy Sources, "Bio-climatic Design and Passive Solar Systems," 12 October 2008 <http://www.cres.gr/kape/energeia_politis/energeia_politis_bioclimatic_eng.htm>.

Water

Vision and Goals

Cal State East Bay has developed ambitious goals and targets for water consumption that will usher the campus towards a sustainable future. The goals for water are to reduce potable water consumption by between 35% and 60% compared to a business-as-usual scenario and reliance on water from the City of Hayward. The more modest target (35% reduction) is based on implementation of design efficiency and fixture retrofit measures while the more aggressive target (60%) requires the introduction of a recycled water system. Figure 13 describes water consumption projections relative to existing conditions and business-as-usual development benchmarks. The strategies are described in depth in the Water Approach section that follows.

Existing Conditions

Water is supplied to the campus by the City of Hayward, the source for which is the City and County of San Francisco's system. This system is primarily supplied by the Hetch Hetchy Reservoir, operated by the San Francisco Public Utilities Commission (SFPUC).

The climate at the site is coastal, with an average yearly rainfall of 26.3 inches. The majority of rain falls between November and March, with January being the wettest month (See Figure 14). At 50 inches per year, evapotranspiration (ETo) - the amount of water evaporated and transpired by the landscape - is significantly higher than precipitation, resulting in a need to frequently irrigate non-adapted vegetation such as turf lawns between April and October.

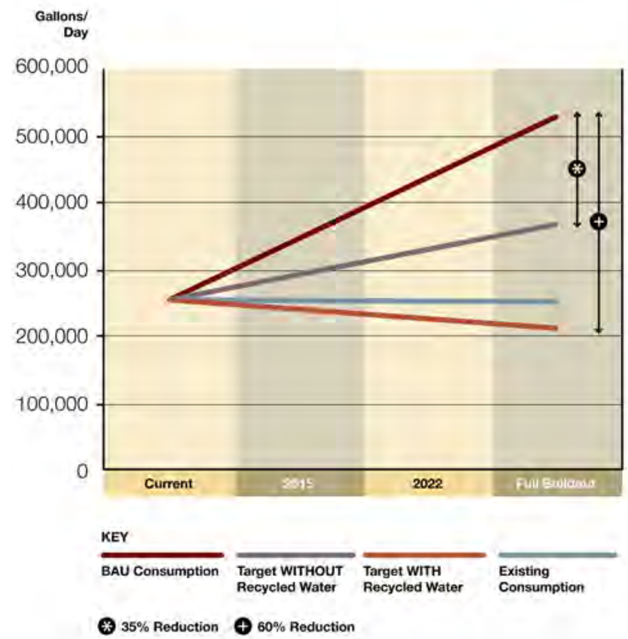


Figure 13
Target Water Consumption

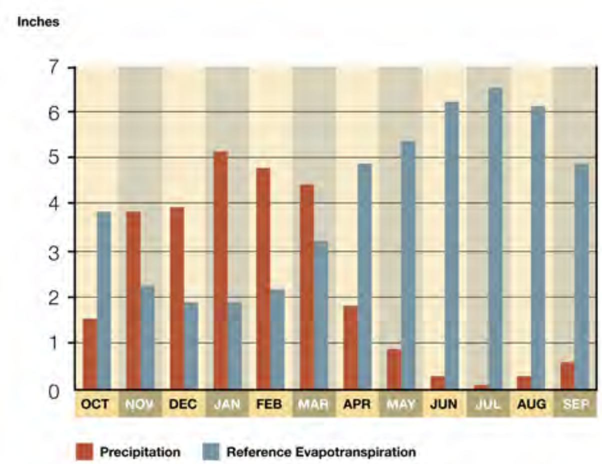
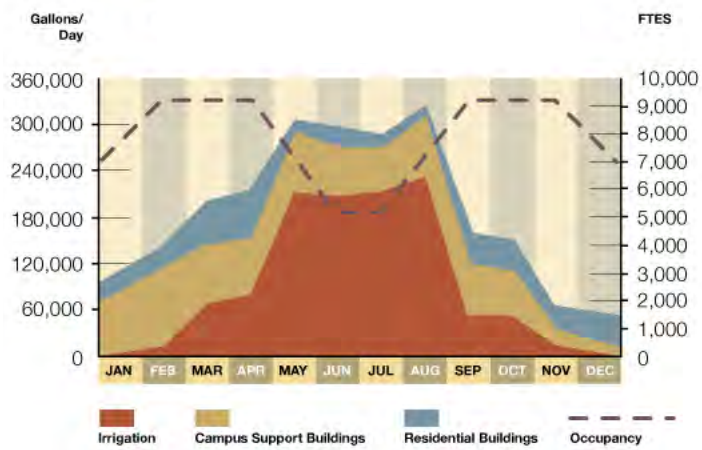


Figure 14
Average Monthly Precipitation and Evapotranspiration

Figure 15
Existing Water Consumption and Occupancy



As shown in Figure 6, irrigation consumption accounts for a large portion of campus' total water consumption. Though campus occupancy declines in the summer months, overall consumption increases due to irrigation demands.

2008 has brought about significant changes in the way water is used and provided in California. Lower average rainfall and snow pack in the Sierra Nevada has exacerbated endangered species issues in the Bay Delta region and resulted in recent drought declarations. In May 2008, the East Bay Municipal Utilities District (EBMUD) declared a drought, mandating water rationing of 19% for residential users because of supply shortages. In June, Governor Schwarzenegger declared a state-wide drought, solidifying the drought as a regional dilemma. Within this context, it is essential that Cal State East Bay plan for a future in which water continues to become an increasingly scarce resource.

Current Initiatives

The Hayward campus is currently implementing retrofits to fixtures in existing buildings, primarily upgrading to water-efficient toilets and urinals. Retrofits are being undertaken during the natural course of maintenance and as funds are available.

The City of Hayward is currently studying the feasibility of a recycled water program in the Hayward service area. Phase I of this program includes a recycled water distribution system in the vicinity of the wastewater treatment plant, while Phase II would see expansions, potentially including Cal State East Bay. A connection to the campus within the build-out period of this master plan would be likely if this option were pursued with the City. Once available from the City, recycled water would be available for both existing and new buildings.

References and Codes

There are several nationally-recognized standards and rating systems that provide water guidelines and performance assessments. The International Plumbing Code (2003) establishes maximum flow rates for fixtures. The U.S. Environmental Protection Agency (EPA) has a program called WaterSense that establishes efficiency requirements for fixtures and labels those compliant with the requirements. In addition, appliances that qualify for the EPA's Energy Star program can provide considerable water savings over non-qualifying models. The LEED™ rating system also has guidelines on water use and applies to existing buildings and to new construction.

Water Approach

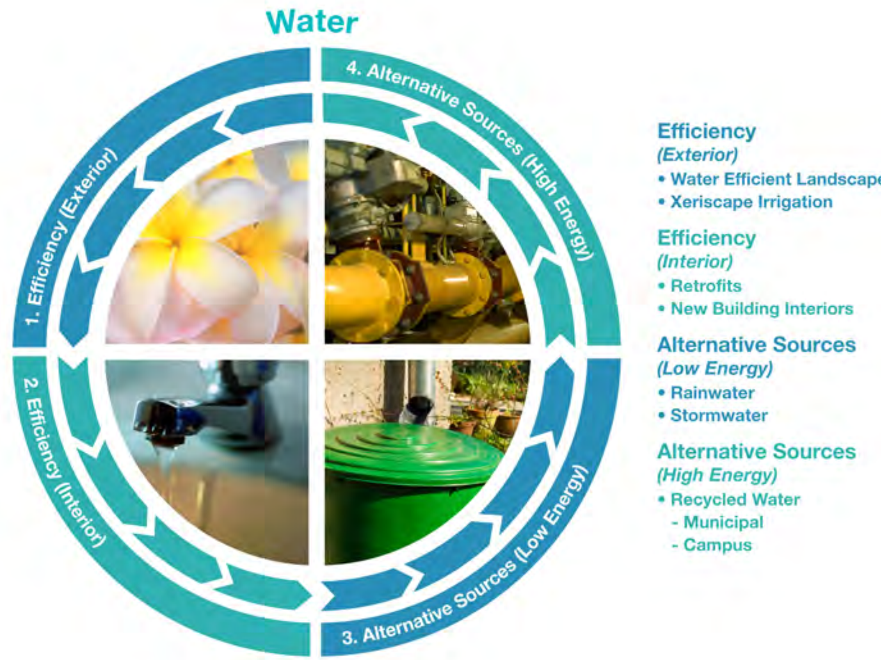
The water approach shown in Figure X provides guidance for designing and developing strategies to minimize water consumption. The target goals set for the campus can be achieved through two categories of sustainable strategies: water efficiency and alternate sources. To maximize the improvements in the water cycle, efficiencies should be undertaken before seeking alternate sources.

Efficiency (Exterior)

Water efficient landscape strategies such as xeriscaping will be employed to reduce the overall water consumption of the campus. Xeriscaping is the practice of managing landscapes in dry areas with drought-tolerant plants and trees. If properly applied, xeriscaping can require between 1/5 and 1/8 of the water required by typically landscaped areas. To further improve water efficiency, micro-irrigation strategies such as subsurface and drip irrigation are typically used with xeriscaping. Xeriscapes prioritize the use of native species and allow for threatened and endangered species regeneration and repopulation. It is estimated that, if applied to all landscaped areas on campus excluding sports fields, xeriscaping would reduce water consumption by 8% over time.

A significant component of the irrigation consumption is associated with the irrigation of sports fields. While this area cannot be xeriscaped, installing artificial turf can eliminate irrigation needs. Utilizing artificial turf in the existing and future sports fields is projected to reduce water consumption by 3%.

Figure 16
The Water Approach



Efficiency (Interior)

Efficient fixtures are becoming the normal practice for new development. New international and state plumbing codes are being written which incorporate requirements to use, for example, 1.6 gallons/flush toilets rather than the 2.5 to 3.5 gal/flush toilets typically used in the past. At Cal State East Bay, new buildings will be required to use ultra-efficient fixtures including 1.28 gal/flush toilets, 0.125 gal/flush urinals, 20 gal/cycle clothes washing machines and 1.5 gal/minute faucets. Through incorporation of these measures in the new buildings, about 13% of the projected water consumption could be saved.

The water consumed by building air cooling systems accounts for about 3% of the total water consumption for Cal State East Bay. Strategies that improve building thermal performance (reducing the required cooling load of buildings) and building cooling systems efficiency, so that the required loads can be met with less water consumption, will significantly contribute to reducing water consumption.

Alternate Sources (Low Energy)

The next step in reducing potable water demand is to use alternate sources. This strategy is most effective after demands have been reduced to a large degree through efficiencies. At Cal State East Bay, rainwater will be available for use in landscaping and would decrease potable or recycled water needed for irrigation. Downspouts from building roof areas will not connect to sewer or storm drains, but will be directed to landscape or designed stormwater devices such as rain gardens or swales. In addition to supplying a portion of site's irrigation, this strategy will mitigate peak discharge during large storm events.

Alternate Sources (High Energy)

There are two basic options for providing recycled water. Water may be supplied by the City of Hayward's recycled water infrastructure discussed in the existing conditions section. The second option is an on-site recycled water plant supplied by either greywater or blackwater. A detailed feasibility study should be undertaken to determine the most appropriate means for providing recycled water to the campus.

Once established on campus, recycled water should be used for irrigation, cooling, and toilet flushing, while standard drinking water should be used only for potable requirements. Recycled water distribution lines will be needed to serve toilets and laundry facilities in new buildings as well as irrigation. All future buildings should be designed for dual piping to serve recycled water when available on campus.

Waste

Vision and Goals

The vision for waste is to develop a campus that leads the regional and global efforts for closed material loops, landfill diversion and self-sustenance. This requires a balanced approach that involves design, policy and active involvement from the students, faculty, and staff.

The waste goals are:

- 75%-100% diversion of solid waste from landfills by full build-out
- 100% green waste to be composted on the campus.

Existing Conditions

While campus activities generate the full range of waste (garbage, cardboard and paper, bottles and cans, and green waste), the academic activity – classrooms and offices – generates the majority of waste on campus, a large proportion of which is paper.

Waste generated on campus is currently source separated into the following streams:

Garbage

The University operates collector carts and trolleys that pick solid waste up from receptacles distributed across campus and deliver it to a centrally located compactor. As detailed in the current contract with Waste Management of Alameda County (WMAC), this allows for WMAC trucks to pick up solid waste from a single location on campus every 1 to 2 days. Student housing has separate collection bins for which pick-ups are scheduled more frequently.

Cardboard and Paper

Receptacles in academic and residential buildings are clearly marked and divert paper and cardboard to a centrally located bin near the field-house for recycling pick-up. This is also contracted out to WMAC.

Bottles and Cans

Receptacles for bottles and cans are clearly marked and distributed across campus in order to separate them from other recyclables. In partnership with East Bay Conservation Corporation, the bottles and cans are taken off campus bi-weekly for recycling.

Green Waste

The grounds staff currently sends green waste generated from landscape maintenance to a pit located near the field house for composting.

City of Hayward Initiatives

The City of Hayward has set an aggressive goal of achieving 75% diversion of solid waste from the landfill by the year 2010. To achieve its goal, the City offers one of the most progressive recycling services in the Bay Area. Several of the commercial, residential and educational programs implemented by the City to achieve this target provide Cal State East Bay with working examples of waste mitigation measures.

The City collects mixed recyclables - paper, cardboard, bottles and cans - at no extra charge. Food and green waste is collected separately, at half the charge of garbage collection. The City's Public Works department offers free waste collecting containers for desk-side and mailroom applications, and offers free educational posters informing the users of best practices.

References and Codes

The California Integrated Waste Management Board (CIWMB) implements comprehensive laws regulating solid waste disposal for the State of California. Under its leadership, the state is nearly two-thirds of the way toward achieving the ambitious waste diversion goals set forth by the Legislature. These are detailed below.

AB 939 - Recycling

In 1989, AB 939 established the organization and mission of the CIMWB. The purpose was to direct attention to the increasing waste stream and decreasing landfill capacity, and to mandate a reduction of waste being disposed. Jurisdictions were required to meet diversion goals of 25% by 1995 and 50% by the year 2000. The City of Hayward aims to achieve 75% diversion by 2010.

AB 2020 - The California Bottle Bill

AB 2020 took affect in 1987 as litter prevention legislation. Currently, the minimum refund value established for each type of eligible beverage container is 5 cents per container under 24 ounces and 10 cents per container 24 ounces or greater.

SB 20 - Electronics Recycling

SB 20 was signed in September of 2003. It establishes a system to recycle computers, TVs, and other video display devices when they reach the end of their lifespans.

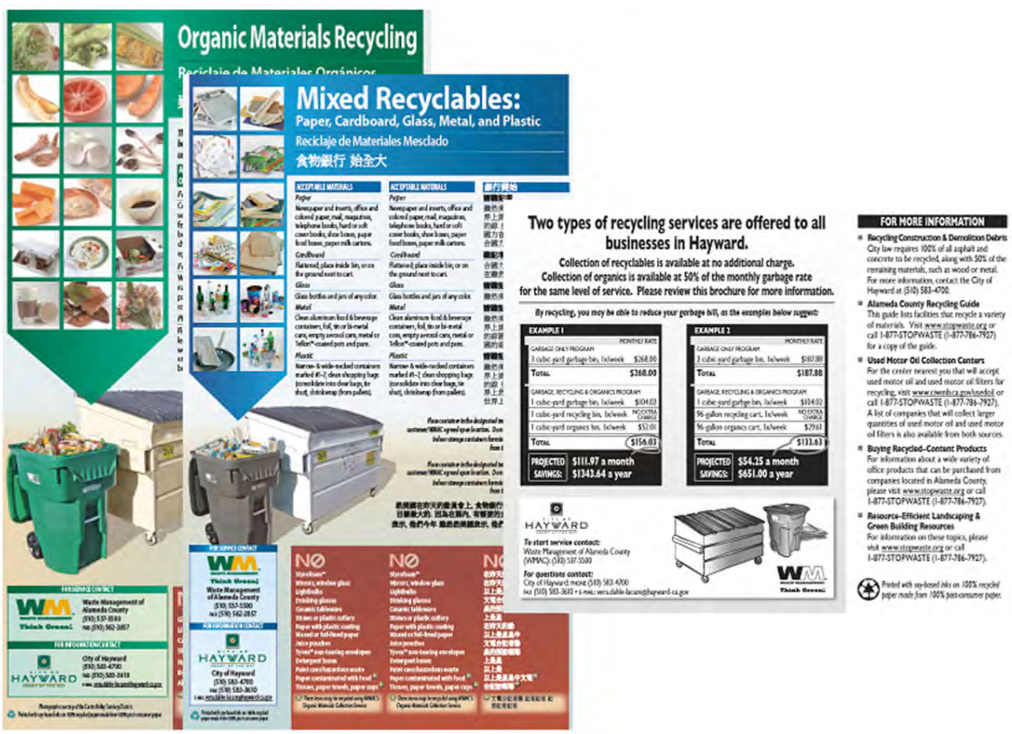
The California Universal Waste Law, 2006.

Universal wastes include a wide variety of hazardous wastes such as batteries, fluorescent tubes, and some electronic devices that contain mercury, lead, cadmium, copper or other substances hazardous to human and environmental health. Universal wastes may not be discarded in solid waste landfills, but instead are recyclable and can be managed under less stringent requirements than those that apply to other hazardous wastes.

LEED™

The LEED™ rating system provides a useful framework for the topic of waste minimization. These range from reuse of building elements for existing buildings to soil erosion and management of construction and demolition debris for new construction.

Figure 17
City of Hayward Recycling and Organics Collection Services Flyers
Summer 2008.



Waste Approach

The waste approach illustrated in Figure X aligns with the goals, policies and operations of the City of Hayward. The intent is to actively contribute to and exceed the city's aggressive goal of 75% waste diversion by 2010.

Purchasing: Prevention and Minimization

Sustainable purchasing policies can significantly reduce campus waste production. Cal State East Bay will evaluate a purchasing policy for retailers and food vendors to encourage a reduction in packaging, and the use of recycled-content and recyclable products.

Public Relations: Prevention and Minimization

The University will actively engage the students, faculty, staff, and the community by implementing the following initiatives:

- Educational programs
- Zero-waste events and workshops
- Signage on campus
- Increased availability of collection infrastructure.

An educated and conscious campus community will have a positive influence on the neighboring community, peer institutions and visitors, thus contributing to the University's vision of being a leader in sustainable growth.

Reuse and Recycle: Construction Debris, Paper, Metal

A plan for the reuse and diversion of construction and demolition debris will be adopted. With the exception of hazardous and toxic materials requiring appropriate

Figure 18
The Waste Approach

off-site treatment, this debris will be separated and sorted on-site into the following streams:

- Reusable construction aggregate (e.g., crushed concrete, interlocking pavers)
- Landscape (e.g., timber, wood demolition)
- Salvage (e.g., doors, windows).

Several buildings on campus are older than their design life cycle and potentially contain a considerable amount of asbestos. A detailed inventory of asbestos and other such contaminants will be carried out on a case-by-case basis, as part of the demolition plan, to prepare for effective and healthy segregation and transfer off-site.

The University already has an impressive cardboard and paper as well as a bottle and can recycling program in place. With the growth of academic, recreational and student housing programs, an increase in collection coverage and a more centralized operation will be pursued to maintain the successful separation and effective transfer to off-site recycling facilities.

Reuse and Recycle: Organics

Green waste will be used as a resource to produce compost and mulch for the campus landscape. The current composting pit located near the field house has the flexibility to ensure that no green waste leaves the campus. As feasible, trees and other plants at development sites will be relocated in order to prevent or minimize generation of green waste.

Food waste will be properly separated into the following two streams:

Edible Food

The “Emergency Shelter Program” in Hayward, as well as other non-profits in the region, accepts edible food donations. Participation in such initiatives will reaffirm the University’s commitment to the welfare of the community.

Food Scraps

Non-edible food and waste scraps will be collected for off-site composting. The California Integrated Waste Management Board study of single family residential waste streams in the City of San Francisco estimates that 50% of household waste is organic, and amounts to 1lb/resident/day. The master plan for Hayward will have around 5,000 resident students potentially producing 2.5 tons a day at full build-out. Recovery is typically 75- 80%, depending on the collection and separation system used. The typical amount of compost produced by the commercially available systems is approximately 50% of the input load, or in this case 1.25 tons a day. Compost increases the organic content of the soil, water holding capacity, and aeration and would therefore add to the health of the soils on campus.

Though the City of Hayward does not currently have a composting facility, the cities of Stockton and San Francisco, as well as Waste Management of Alameda County, offer food scrap collection and recycling services. This provides the University with a unique opportunity to partner with neighboring cities in order to be a part of the regional waste diversion effort.

Carbon

Vision and Goals

The vision for carbon emissions is for the University to achieve operational carbon neutrality.

The goal for the Hayward campus is to achieve a 45% reduction in carbon emissions compared to business-as-usual projections at full build-out through operational, policy and design strategies. This target is based on the extent of potential impact the plan will have on each of the current emission causing activities, such as energy and transportation. This reduction could be followed by offsets and other off-site opportunities, thus moving the University toward the carbon-neutrality goal.

Based on emission projections at full build-out of the campus, a 45% reduction translates into approximately 7,100 tons of carbon, or the equivalent of taking 1,180 cars off the road. This also equates to a reduction from the current 2,000 lb./FTES to approximately 1,100 lb./FTES by full build-out. As a result, the plan should exceed the requirements of AB32 (discussed later in this chapter) by reducing emissions to 40% below 1990 levels by 2020, and setting the stage for the 2050 requirements of a 50% reduction of 1990 emissions levels by full build-out.

Figure 19 illustrates the projected carbon emissions of the campus with no changes (business as usual or BAU), and the goal which targets a 45% reduction in emissions.

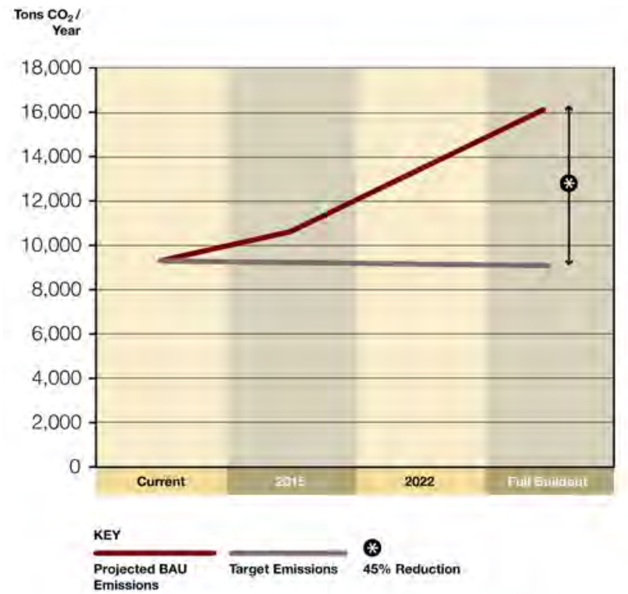


Figure 19
Target Carbon Emissions

Existing Conditions

Carbon emission sources at the Hayward campus encompass building and site-level design, student and faculty behavior, and elements not in the University's direct control, such as the nature of purchased electricity. Of these, the following sources are tracked by the University dating back to 1990 and have been included in the carbon footprint exercise carried out for this master plan effort:

- Purchased electricity
- Stationary combustion – natural gas
- Mobile combustion – campus owned vehicles

Based on the information available for each of these factors, the analysis suggests that the current carbon footprint of the Hayward campus is on the order of 9,300 tons annually. This is projected to rise to approximately 16,150 tons annually under business as usual conditions when the campus builds out to an enrollment of 18,000 FTES.

Current Initiatives

The growing awareness and urgency associated with carbon and other greenhouse gas (GHG) emissions has spurred discussion on the topic; recent Executive Orders have been adopted by CSU and there has also been interest among the University faculty to include carbon evaluation studies, climate neutrality and sustainability as part of the academic curriculum. In addition the University is re-evaluating its energy contract with Arizona Public Services Corporation (APS).

References and Codes

California has taken a leadership role in the effort to reduce greenhouse gas and carbon emissions by committing to long-term, statewide emission reductions through the Global Warming Solutions Act of 2006. Referred to as AB32, this act enforces a legally binding emissions cap like no other in the world.

The target for California under this act is to:
- Reduce GHG emissions to 1990 levels by 2020.
- Reduce GHG emissions to 80% below 1990 levels by 2050.

As a State University in California, Cal State East Bay will be directly affected by AB 32, in that it will be responsible for monitoring and reducing its own GHG emissions. Several established reporting frameworks and methodologies can be adopted to track the emissions associated with the construction of academic, recreational and student housing buildings, on and off campus transit, and the provision of energy to the campus.

The General Reporting Protocol (GRP), developed by the California Climate Action Registry (CCAR) is a comprehensive emission tracking and reporting mechanism. It provides a well-established and recognized methodology for qualifying GHG emissions, and with the AB32 statewide cap on the horizon, the GRP has the potential to identify the University's geographic boundaries and critical operational and growth elements, thus allowing for pre-compliance activities.

Carbon Approach

The approach to reducing carbon emissions encompasses general building guidelines, energy efficiency measures, transportation strategies, and policy and climate neutrality-focused leadership. The model illustrated in Figure 20 shows the design strategies aimed at ensuring the greatest cumulative reduction in carbon emissions.

The first two steps in the model deal with emissions and embodied carbon reductions through smart growth and design, and are applicable to the new development. Table 1 provides examples of such strategies.

The remaining steps in the model are applicable to new development and existing buildings, and to landscape and infrastructure on the campus. Table 2 provides examples of these strategies.

In addition to building and infrastructure design and transportation considerations, certain policy and/or long-term contractual decisions will be required to meet the carbon goals. In particular, the current energy contract between Cal State East Bay and Arizona Public Services Corporation is a key parameter affecting long-term, campus-wide emissions.

Figure 20
Carbon Approach

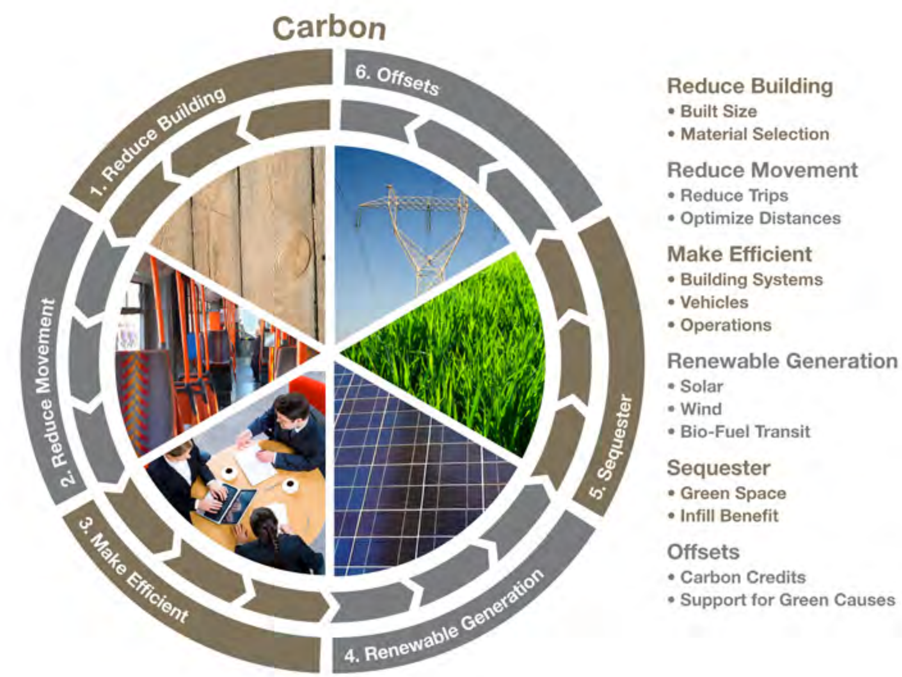


Table 8
Carbon Emissions Strategies for New Development

Step	Focus	Strategies	Benefits
Reduce Building Carbon Emissions	Built Size	Obtain thorough understanding of space types and needs and use to optimize program square footage	Reduction in overall built size and site disturbance
			Additional area for open and green spaces
	Material Selection	Reuse materials	No new embodied carbon introduced
		Use local and regional materials	Avoid carbon emissions resulting from transportation activities
	Equipment Right-sizing	Obtain thorough understanding of space types and use to optimize required systems	Reduction in heat gain to space. Subsequent reduction in energy use
	Design for Flexibility	Develop multi-use or flexible-use spaces	Reduction in overall built size and site disturbance
			Further construction avoided in future
Reduce Movement	Reduce Trips	Bring amenities closer	Reduction in transportation emissions
	Optimize Distances	Co-locate buildings with complementary uses Locate student housing on campus	

Table 9
Carbon Emissions Strategies for New and Existing Development

Step	Focus	Strategies	Benefits
Make Efficient	Building Systems	Incorporate progressive HVAC technologies	Reduction in energy use
		Incorporate centralized heating and cooling systems	
		Recommission existing building systems	
	Vehicles	Offer transit	Reduction in transportation emissions
		Encourage carpools	
		Operate bio-diesel or other alternative fuel vehicles	
Renewable Generation	Solar	Roof & building integrated photovoltaics	Reduction in energy consumed from grid. Educational impact
		Solar water heaters	
	Wind	Open space and building-integrated wind turbines	
Sequester	Green Space	Encourage open and green spaces on campus	Carbon uptake through natural processes maximized. Load reduction and subsequent reduction in energy use
		Green roofs	
Offsets	Carbon	Identify preferred vendors	Move closer to carbon neutrality

Figure 21 compares the carbon footprint projection with no change (business as usual) against reductions that can be achieved through design efforts (24%) and by entering into a long term energy contract with PG&E, which has a strong renewables portfolio.

Benchmarking

The effectiveness of the plan can be measured in conjunction with the benchmarks laid out by AB32. Since the campus will be growing in built size, as well as in the number of students, faculty and staff it serves, a normalized metric, such as lbs or Tons of Carbon emissions per FTES, or per square feet, can be compared against 1990 levels to measure performance. Figure 22 shows each of the following full build-out projections and their performance relative to 1990 levels:

- BAU projections (Normalized by FTE's)
- BAU projections (Normalized by sq-ft)
- Target projections (Normalized by FTE's)
- Target projections (Normalized by sq-ft).

As Figure 22 suggests, current and BAU full build-out emission levels are expected to be smaller than 1990 levels. This can be largely attributed to the compactness of the campus as well as several energy efficiency initiatives it has adopted in recent years. The target normalized emission levels at full build-out result in an estimated 60% reduction from 1990 levels. The plan therefore goes above and beyond the AB32 requirement of reducing emissions to 1990 levels by 2020 and sets the stage for the required 80% reduction by 2050.

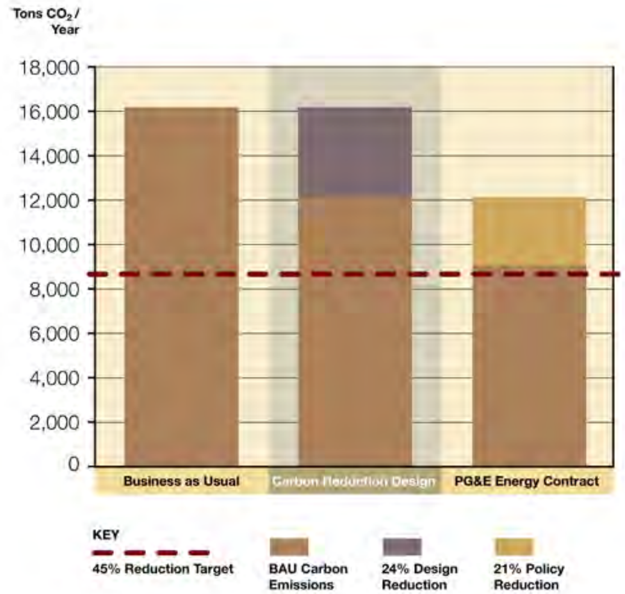


Figure 21
Carbon Emissions at Full Build-out

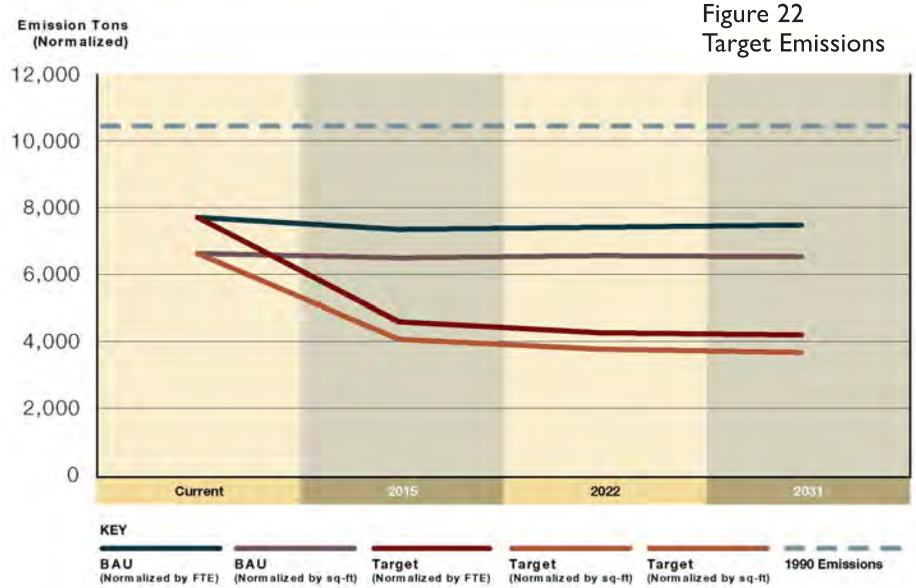


Figure 22
Target Emissions

The final aspect of the carbon approach deals with pursuing off-campus opportunities aimed at bridging the gap between policy and design strategy emission reductions, and true operational carbon neutrality. There are several well-established programs offering customers the capability to offset carbon emissions through the purchase of renewable energy. These include:

Green-e

Green-e is the nation's leading independent consumer protection program for the sale of renewable energy and greenhouse gas reductions in the retail market. Green-e offers certification and verification of renewable energy and greenhouse gas mitigation products.

Native Energy

Native Energy leverages market demand for carbon offsets to bring on line new Native American, family farmer and community-owned renewable energy projects. Native Energy offers third-party verified and certified renewable energy credits (RECs) and offsets from a variety of operating projects across America and internationally

Climate Trust

In addition to offering offsets to power plants, regulators, businesses and individuals, the Climate Trust has a strong, working relationship with leading climate policy groups and are a key contributor to regional, national and international offset policy discussions.

Through participation in such programs, the Hayward campus can establish a strong position in the emerging carbon marketplace and be recognized as a forward thinking and environmentally conscious University.

Transportation

This section summarizes the approach to sustainable transportation at Cal State East Bay. More detail can be found in the Access, Circulation and Parking Framework chapter of this master plan.

Vision and Goals

The transportation vision for Cal State East Bay is to transition from a highly auto-dependent institution to one that provides, supports and encourages a wide range of transportation options.

The transportation goal for the Hayward campus is to reduce the percentage of drive alone vehicle trips from its existing 79% to 64%, through the implementation of various transportation demand management (TDM) programs and policies. This will concurrently be accompanied by an increase in public transit ridership from the existing 16% to 29%.

Existing Conditions

Today, the Hayward campus is accessed nearly exclusively by private automobile. While there is shuttle and bus service that reaches the campus from downtown Hayward and although a BART station lies less than two miles away, an abundance of parking, low parking rates and a campus location that deters access by walking or bicycle all encourage a vehicle-oriented transportation system.

On campus, however, the compact nature of the site and historic development that includes peripheral roads and parking, results in a campus that is easy to traverse between classes, despite significant topographic changes in certain areas. These topographic changes do, however, create significant issues for disabled access.

References and Codes

Several recently released documents provide sustainable transportation strategies with regard to climate change. The Draft Climate Change Proposed

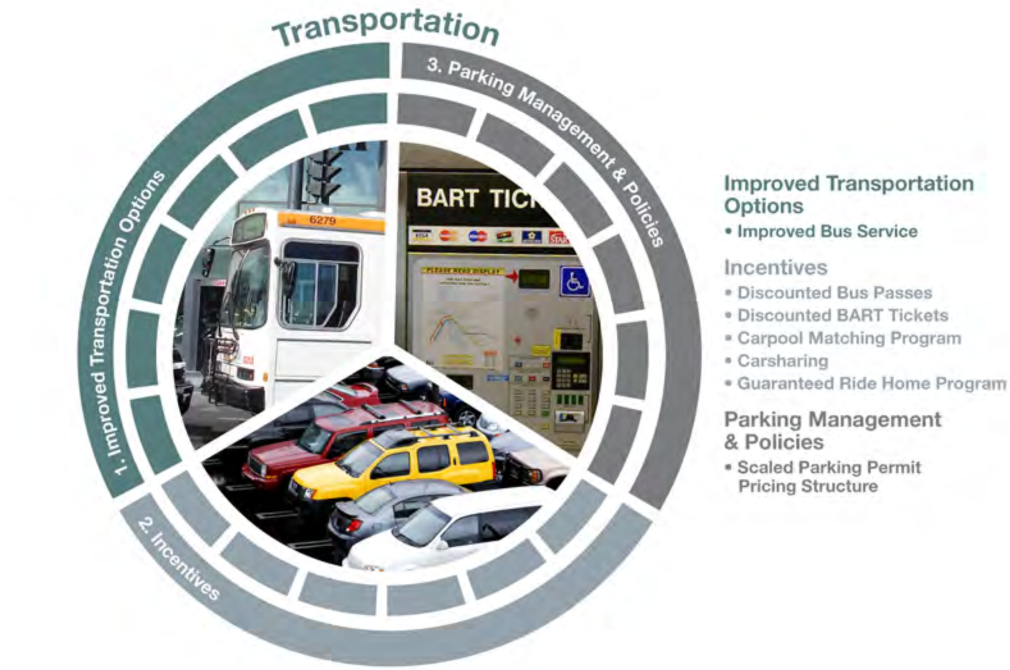


Figure 23
Transportation Approach

Scoping Plan by the California Air Resources Board proposes a comprehensive set of actions designed to reduce green house gas emissions in California pursuant to Assembly Bill 32. The Scoping Plan establishes targets for reducing transportation-related greenhouse gas emissions, and policies and incentives to reach those targets. A Technical Advisory regarding the California Environmental Quality Act (CEQA) and climate change, released by the California Governor's Office of Planning and Research, provides technical methodologies for calculating greenhouse gas (GHG) emissions and addressing the environmental impacts through CEQA review. Transportation-related examples of GHG reduction measures include programs to reduce vehicle miles traveled, energy conservation policies and actions, and land use and transportation strategies.

The Metropolitan Transportation Commission (MTC)'s report called Reforming Parking Policies to Support Smart Growth is intended to serve as a guide or a handbook for communities interested in planning and implementing parking policies and programs that are supportive of Smart Growth and Transit Oriented Development (TOD). The handbook includes a "toolbox" of proven parking management initiatives and actions which can be applied to address a given issue or objective.

The Victoria Transport Policy Institute provides detailed information on a full range of transportation demand management (TDM) strategies. A chapter on campus transportation management strategies provides information specific to college and university campuses.

Transportation Approach

The transportation approach (Figure 23) is a comprehensive transportation demand management (TDM) program, which implemented incrementally over time, has the potential to significantly change travel patterns on campus. Shifting commuters out of single occupant vehicles will reduce congestion, contribute to better air quality, and reduce the need for parking and the cost of providing parking, releasing these funds for other uses.

Improved Transportation Options

- Enhanced AC transit service - frequent headways, and a more direct route to campus from downtown Hayward and BART.

Alternative Mode Use Incentives

- Discounted or free AC Transit passes
- Discounted BART tickets
- Carpool matching service and vanpool programs
- Preferential parking for carpools and vanpools
- Provision of a flexible car rental service (carsharing) program on campus
- Participation in the Alameda County Congestion Management Agency's Guaranteed Ride Home program for alternative mode users
- Provision of single-day parking permits for participants in alternative mode programs to allow for commute flexibility for those who may occasionally need to use a car.

Parking Management and Policies

- Provide a scaled parking permit pricing structure
- Discourage on-campus residents from bringing cars to campus, and encourage the use of transit service(s) and the flexible rental car service (when instituted) for off-campus travel.

Materials

The nature and source of building materials is a very important component of sustainable design. The production of building materials requires extraction, processing and transportation, activities which have the potential to pollute air and water, deplete natural resources, and destroy habitat.

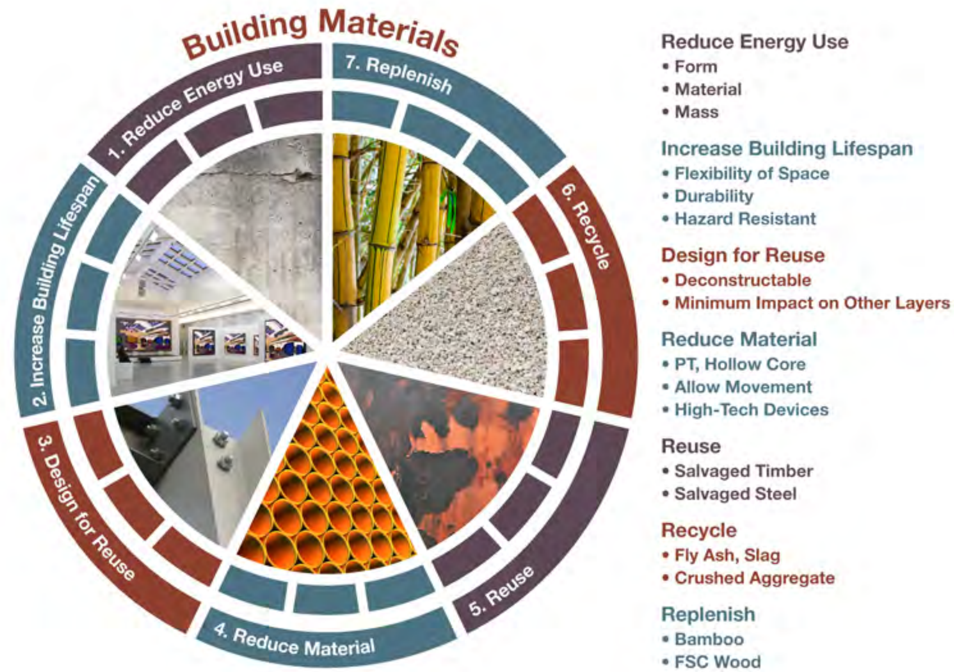
Vision and Goals

The vision for materials at Cal State East Bay is to include sustainability criteria for the selection of building materials and for decisions regarding the reuse, renovation and demolition of buildings. Reusing existing buildings is an effective way to reduce the need for new bulding materials. When new materials are needed, the University should consider salvaged, recycled content, and rapidly renewable materials. In addition, sourcing building materials locally supprts the local economy and reduces the impacts of transportation.

Existing Conditions

Enrollment growth at the Hayward campus will require both the renovation of existing buildings as well as the construction of new buildings. As the campus grows, it will need to review each building to determine which are suited to renovation, can meet contemporary teaching requirements, and can match growing discipline areas and which are simply too inflexible or costly to update.

Figure 24
Materials Approach



References and Codes

LEED™-NC offers useful information and criteria for selection of building materials and for decisions regarding the reuse, renovation and demolition of buildings.

Materials Approach

The approach to the selection and use of materials is depicted in Figure 24 and summarized below:

Reduce Energy Use

The first step in achieving a sustainable materials portfolio is to minimize the embodied energy - energy spent in material extraction, production, and transportation - of buildings. This can be achieved through the optimization of built size (right-sizing buildings), careful selection of materials formed from low energy processes and by specifying local and regional materials. Right-sizing buildings ensures that the building will be sized appropriately for its programmed uses, but not overbuilt. Specifying local and regional materials greatly reduces the energy consumed through transportation, and can help support the regional economy.

Increase Building Lifespan and Design for Reuse

New construction should be designed for long lifespans in order to diminish its overall environmental impact. The lifespan of buildings determines the amount of materials used in buildings over time. The use of durable building components results in a reduced need for maintenance, repair and premature replacement. Smart design that allows for prolonged life through strategies such as moveable elements and flexible internal spaces can also prolong the lifespan of the building by making it adaptable to changing program needs.

Buildings should also be designed for reuse, using strategies such as deconstructable frames, which can then be used in a subsequent building project.

Reduce and Reuse Materials

Material reduction can be achieved in both structural and non-structural building elements. Hollow cores and exposed floors, ceilings and ductwork will not only save on building materials, but will also serve as an educational medium on the topic of sustainable building materials.

Reusing salvaged materials such as timber and steel reduces the need for virgin materials, and will be explored during building projects.

Recycle and Replenish

Materials with high recycled material content reduces the need for virgin building materials, and will be considered for all building projects. A commonly used recycled material is recycled aggregate, typically used for engineered fill or site concrete work. Another example is the use of fly-ash (a waste product from coal combustion) in lieu of cement in concrete, which prevents the fly-ash from entering landfills, saves energy needed to produce cement, and reduces the amount of CO_2 created from cement production.

Rapidly renewable materials, such as bamboo, wool and linoleum, are those that require substantially less inputs of land, natural resources, and time. They provide the opportunity to displace raw materials that have greater environmental impacts.

Landscape

This section summarizes the approach to a sustainable landscape at Cal State East Bay. More detail can be found in the Open Space and Landscape chapter of this Master Plan.

Vision and Goals

The sustainable landscape vision for Cal State East Bay is to evolve campus vegetation, over time, to a landscape that is suited to the unique characteristics of the region. This landscape will:

- Create a visually pleasing and sustainable campus
- Mimic the surrounding vegetation and landforms
- Simulate plant community diversity
- Encourage biologically healthy soils
- Allow water to infiltrate, not run off
- Save energy in adjoining buildings through shading
- Decrease or eliminate dependence on inorganic, toxic products and compounds.

Existing Conditions

Historically the Hayward campus included the oak grassland, riparian, and hard chaparral plant communities. As the region and immediate area of the campus have developed, much of this original landscape has been lost. On campus, it has been replaced with a landscape that while lush and green, is typical of an American university campus, and does not strongly reflect native or climate-suited plantings. In addition, since the campus and many of the original plantings were established over 40 years ago, much of the tree cover is reaching the end of its life cycle, and erosion and use have ravaged many slopes, edges and highly used corridors.

References and Codes

The LEED™ rating system provides a useful guide for landscape-related topics such as water use reduction and stormwater management.

Figure 25
Landscape Approach

The Sustainable Sites Initiative has developed a set of standards and guidelines for sustainable land development and management practices, and a rating system to recognize achievement. This collection of standards and guidelines is an excellent reference for sustainable landscape planning.

The California Stormwater Quality Association has produced a Stormwater Best Management Practice Handbook. Best Management Practices (BMPs) are defined as "any program, technology, process, siting criteria, operating method, measure, or device which controls, prevents, removes, or reduces pollution."[2] BMPs include such landscape strategies as detention ponds, infiltration trenches, vegetated swales and constructed wetlands.

Landscape Approach

The Landscape Approach shown in Figure 25 illustrates the key strategies for creating a sustainable landscape.

Educate Students, Faculty, Staff and Visitors

An awareness and appreciation of the native landscape requires education, interpretation and adjustment of maintenance practices. The University will develop a program of education and interpretation to communicate the intent and long-term benefits of the sustainable campus landscape.

Create Plant Palettes Emphasizing Drought-tolerant and Low Water Needs Plants, Suited to the Local Climate

Native trees, shrubs and groundcovers as well as non-native species well-adapted to the climate will be selected for the campus landscape. This will reduce irrigation needs and ensure a healthy, beautiful, low maintenance landscape.

Minimize Lawn Areas

Some areas on campus will continue to be planted in turf as is appropriate for a campus setting. These areas will be strategically designated so as to be kept to a minimum to reduce irrigation demand.

Collect and Treat Stormwater

The stormwater in all improved areas will be collected and treated on-site with green roofs, planting areas, vegetated swales and detention basins. Green roofs should be considered with all new construction as well as with retrofits of existing buildings (such as the library) to reduce the amount of stormwater requiring treatment. Rain water from building roofs will be directed to surrounding planting areas. Permeable paving will be used wherever feasible to further reduce stormwater runoff.

Avoid Use of Herbicides and Pesticides

The University should decrease or eliminate its dependence on herbicides and pesticides in the landscape. The use of native plants will reduce this need.

Implement Recycled Water Systems for Irrigation.

All irrigation needs should be met with recycled water when that capability is established on campus.

2 California Stormwater Quality Association (CASQA), *California Stormwater BMP Handbook*, January 2003.

Land Use and Site Development

Vision and Goals

The approach to land use and site development sets the foundation for sustainability at Cal State East Bay. The development pattern of the campus can support many aspects of sustainability such as minimizing the need for auto use and encouraging transit use, maximizing opportunities to design low-energy use, climate-responsive buildings, and developing a low water use landscape that celebrates the historic landscape of the East Bay.

The goal for the campus is to establish a long term land use and development pattern that supports achievement of all of the sustainable campus elements.

Existing Conditions

The currently developed portion of the Hayward campus, containing the academic, residential, fields and parking uses of the Hayward campus benefits from having been laid out in a compact pattern with close proximity among uses. Beyond these developed areas, most of the remaining campus is too hilly to feasibly develop and will remain in a natural open space condition. There remains adequate space within the developed areas for further expansion and growth to 18,000 FTES can be readily accomplished.

The Hayward campus was largely developed in the 1960s and 1970s. Some of the original buildings were designed to be inherently climate-responsive, but lack the appropriate systems and elements to aid in achieving energy savings. While the campus is highly dependent on auto access at this time, it is well configured to allow good transit access to all parts of the campus and is also highly walkable due to its compactness.

The growth envisioned for the Hayward campus will result in the construction of many new buildings and in the development or redevelopment of many sites. These will provide excellent opportunities to further enhance campus performance in all aspects of sustainability.

Figure 26
Land Use and Site Development Approach

References and Codes

Many jurisdictions, including the City of Hayward, are increasingly promoting growth through infill in already urbanized areas. Compact development, walkable districts, good transit access, and adequate densities are all aspects of "Smart Growth," a concept that is being implemented throughout the country. Information on this can be found through numerous web sites and organizations such as the American Planning Association.

The LEED™ (Leadership in Energy and Environmental Design), sponsored by the U.S. Green Building Council has developed rating systems applying to sustainable development. LEED™ for Neighborhood Development, or LEED™-ND, identifies multiple criteria that address aspects of sustainable site development.

Land Use and Site Development Approach

The Land Use and Site Development Approach (Figure 26) illustrates key components of development decisions that can support Cal State East Bay's Hayward campus in evolving as a fully sustainable campus.

Environmental Preservation

While much of the campus has been disturbed through the development of facilities such as buildings or parking lots, a considerable area of the campus is unlikely to be developed due to its significant slopes and relative inaccessibility. These areas will be conserved as natural open space and can continue to support important species and ecological communities, protect steep slopes, and assist in reducing stormwater runoff and other offsite impacts.

Compact Development

A university campus always benefits from compact development in its day-to-day operations, and Cal State East Bay is already set up in a sustainable pattern. Infilling new facilities within this framework will continue to support a walkable, convenient layout of uses.

As the amount of student housing provided on site is increased, more activities and amenities for students, faculty and staff will be supported. This will reduce the need for travel off campus and, in conjunction with carpooling and other transit options, will help reduce commute trips.

Transit Oriented and Supportive

The campus layout, with peripheral roads and parking lots, already allows convenient transit access with multiple bus and shuttle stops around the entire campus core area. This layout will support additional transit service and frequency. Other methods may be necessary, however, to discourage auto use, such as providing on campus car share programs and subsidized transit passes.

Resource Efficiency

The compact nature of the campus will support many aspects of resource efficiency by making it relatively easy to orient buildings for energy efficiency; minimize heat island effect through landscaping, green roofs and structured parking; and implement efficient utility systems including water recycling and a central utility plant.

Table 10
Sustainability Strategies Summary

Focus Area	Goals	Strategies	Targets	Benefits
Energy	Achieve a sustainable energy balance that is resilient, efficient, and leads to carbon neutrality by the year 2030.	**1.** Existing Building Retrofits and Re-commissioning **2.** Energy Load Reduction (orientation, right-sizing) **3.** Passive Energy Efficiency Strategies (bio-climatic design approach) **4.** Active Energy Efficiency Strategies (radiant systems, under floor air distribution) **5.** Energy Recovery (heat pipe, heat wheel) **6.** Renewable Energy Generation (PVs, wind, fuel cell) **7.** Offsets	• Achieve 30% energy savings in existing buildings by 2030. • Achieve 50% energy savings in new buildings.	• Reduced peak demand. • Reduced costs. • Reduced carbon emissions. • Improved occupant comfort.
Water	Reduce future potable water needs to a level lower than existing use.	**1.** Water Efficiency (Exterior) **2.** Water Efficiency (Interior) **3.** Alternate Water Sources (Low Energy) **4.** Alternate Water Sources (High Energy)	• Reduce water by 35% without the introduction of recycled water supply, or 60% with recycled water supply by full build-out of campus.	• Reduced water consumption. • Reduced wastewater flows.
Solid Waste	Develop a campus that leads the regional and global efforts for closed material loops, landfill diversion and self-sustenance.	**1.** Minimize Waste Generation **2.** Maximize Recycling **3.** Reuse Buildings and Demolition Materials **4.** Compost Green Waste on Campus **5.** Engage Students, Faculty, Staff and Visitors	• Achieve 75% - 100% solid waste diversion from landfills by 2030. • Compost 100% of campus organic waste on-site.	• Increase landfill diversion. • Conservation of energy in production of new materials. • Creation of organic compost for campus use. • Reduction in greenhouse gas production.
Carbon	Achieve operational carbon neutrality.	**1.** Right-size buildings **2.** Reduce movement (vehicle trips) **3.** Minimize energy use (buildings and vehicles) **4.** Maximize use of renewables (solar, wind) **5.** Sequester Carbon **6.** Offsets	• Achieve a 45% carbon emissions reduction through operational, policy and design strategies. • Pursue off-site regenerative and credit programs to offset the balance of emissions.	• Reduced greenhouse gas emissions.

Focus Area	Goals	Strategies	Targets	Benefits
Transportation	Reduce overall vehicle trips to and from campus, by housing more students on campus, and supporting and encouraging a wide range of transportation options.	**1.** Provide highly accessible and frequent bus and shuttle transit services **2.** Promote transit use through incentives **3.** Discourage auto use by residents and commuters through campus parking policies	• Reduce trip generation rates for commuters, faculty and staff from 79% to 64% • Increase transit ridership from 16% to 29% • Reduce parking supply per FTE to encourage alternative forms of transportation.	• Reduced greenhouse gas emissions • Less congestion on campus and regional roads.
Materials	Minimize overall resource use and choose materials according to their contents and source.	**1.** Reduce energy use **2.** Increase building lifespan **3.** Reduce and reuse materials **4.** Recycle and replenish	• Minimize resource use by retaining and reusing buildings whenever possible • Use materials high in recycled content, and those that are rapidly renewable • Salvage materials from demolition for reuse. • Locally source materials whenever possible.	• Reduced use of virgin materials • Create markets for recycled and rapidly renewable materials • Reduced greenhouse gas emissions from production and transportation • Less solid waste produced.
Landscape	Create a beautiful and sustainable campus setting to enhance the life of the University through a landscape that is suited to the unique characteristics of the region.	**1.** Understand soil and plant conditions **2.** Utilize a plant palette with an emphasis on drought-tolerant and low water use plants **3.** Minimize lawn **4.** Manage stormwater in the landscape **5.** Avoid using herbicides and pesticides **6.** Use recycled water for irrigation	• Provide landscape improvements to all high visibility areas • Create a diverse community of drought-tolerant and low water use plants • Reduce toxic chemical use and increase organic product use.	• Enhanced aesthetic value • Long lived plant communities • Reduced water use • A teaching tool for faculty • Reduced maintenance requirements.
Land Use & Site Development	Create a robust learning community that creates many opportunities for interaction. Keep the campus compact and walkable with abundant usable open space. Develop at adequate densities to ensure long term flexibility.	**1.** Develop academic uses within a walkable core area **2.** Locate residential neighborhoods in close proximity **3.** Locate parking on periphery **4.** Provide generous and well furnished open spaces	• Provide 5,000 student resident beds on campus • Provide appropriate balance of built and open space • Provide convenient access to public transit.	• A vital and energizing campus community • A critical mass of activity which supports the learning environment • A compact academic environment • Flexibility for long term program growth or change.