United Nations

Capacity Building for Sustainable Urbanization in Asian Countries

Shanghai Manual:

A guide for sustainable urban development in the 21st Century

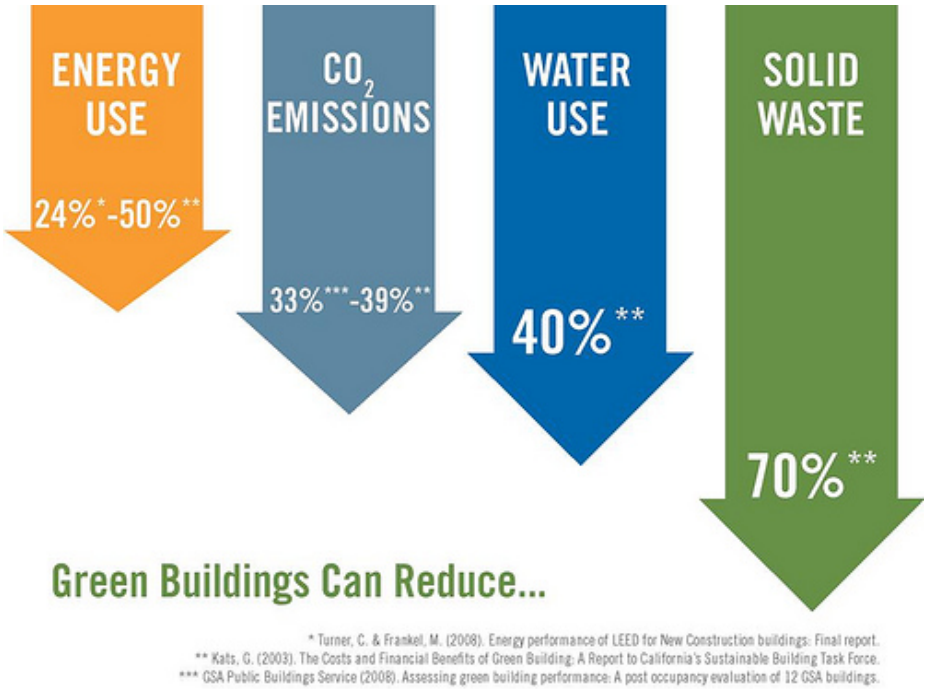
Green Buildings for a resource efficient future

- Why is this important?

- Economic benefits
- Productivity benefits

Economic benefits

- Upfront investment of 2% in green building design, results in life cycle savings of 20 per cent of total construction costs – more than 10X initial investment.
- Compared to average commercial buildings: 8-9% decreased operating costs, 7.5% increase in building value, 6.6% improvement on return on investment, 3.5% increase in occupancy ratio, and 3% increase in rent ratio.



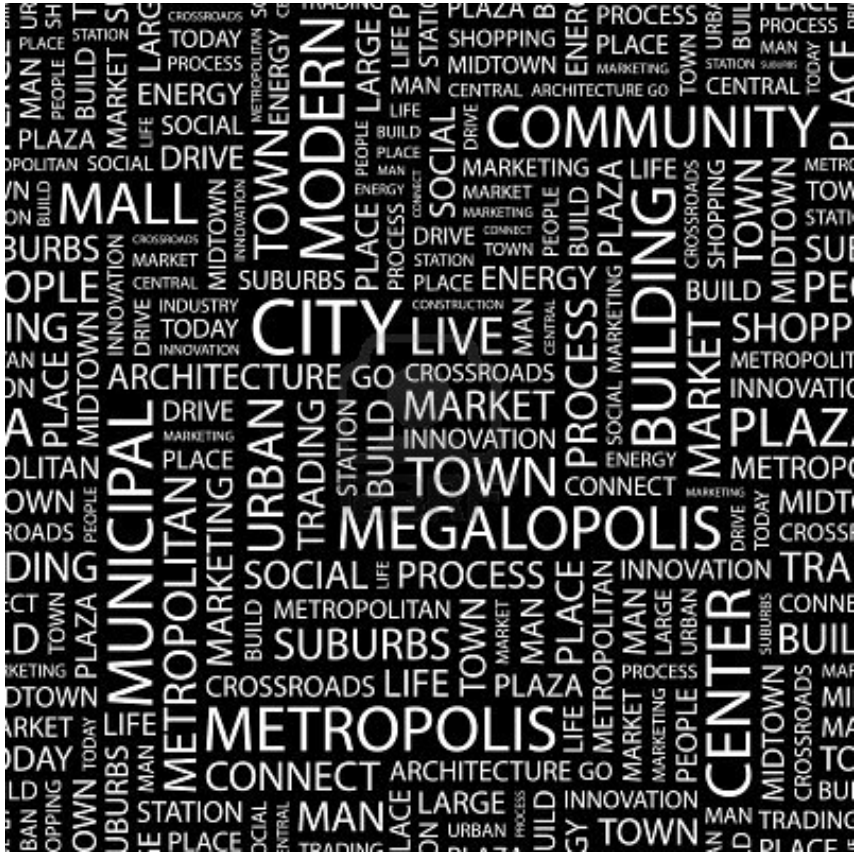
Productivity benefits

For the United States alone, estimated potential annual savings and productivity gains are $6-14 billion from reduced respiratory disease, $1-4 billion from reduced allergies and asthma, $10-30 billion from reduced sick building syndrome symptoms, and $20-160 billion from direct improvements in worker performance unrelated to health.

"Well no wonder why they're more productive than us!"

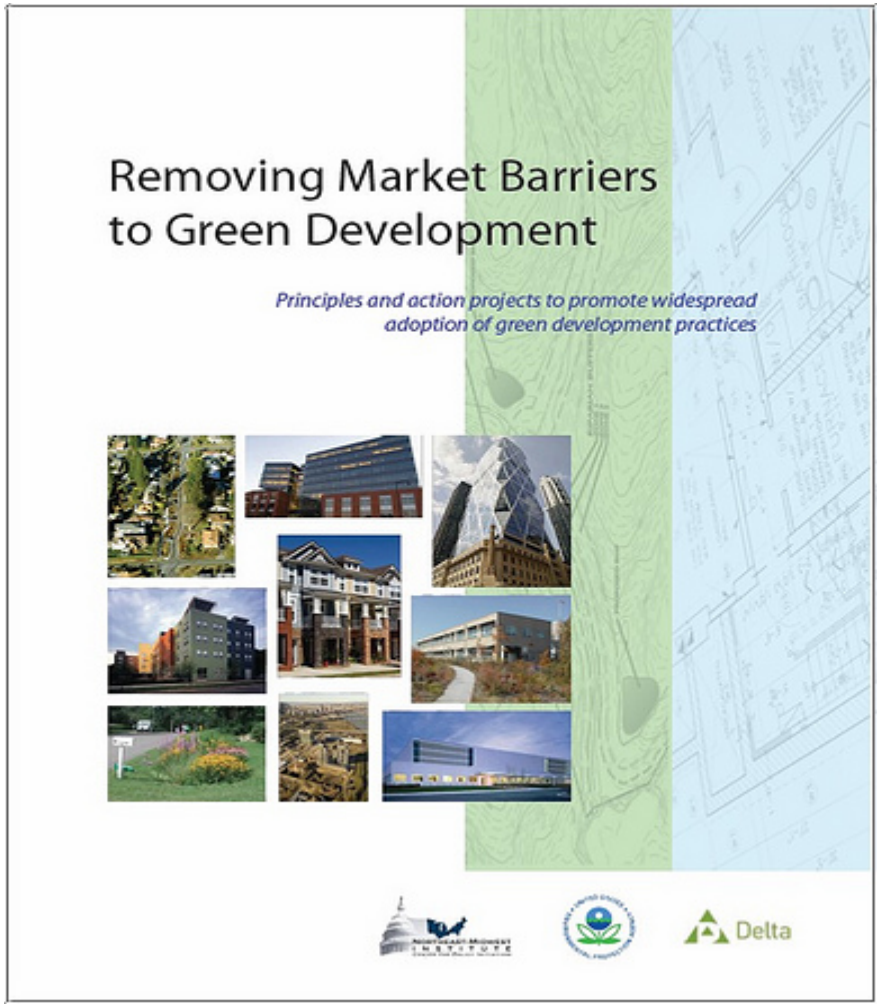
Urban management issues

- City operating budgets are always tight and allow little tolerance for investing in building upgrades, even those with good payback and return on investment.
- A city's limited capital budget generally skews decisions based on first cost rather than life cycle cost.
- Lack of interdepartmental communication often prevents collaborative decision-making that would justify the investment in green building for best long-term interests of the city.



Barriers in building sector

- Benefits of green buildings accrue over long term.
- Benefits accrue to final owners and users, not to builder.
- Additional construction costs for green buildings, 2-5%, cannot be easily passed on to owners and therefore are a financial disincentive to builders.



Barriers (cont.)

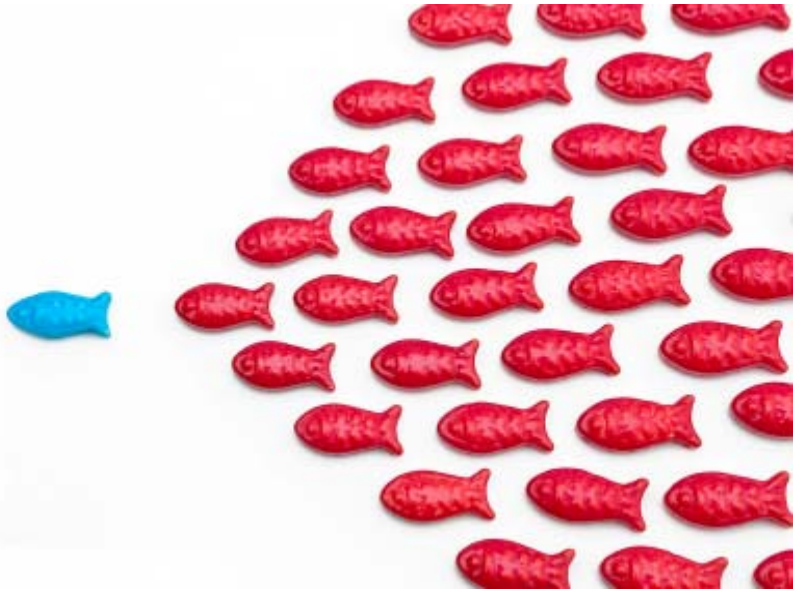
- Lack of information and sourcing for green building products.
- Lack of information about performance and cost
- Skepticism from municipal building and safety departments.
- Challenge is to inform and educate the marketplace.

Objectives for high performance sustainable buildings

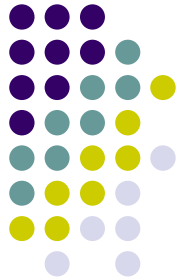
- Maximize natural resource efficiency and human health benefits
- Optimize energy performance
- Conserve and re-use water
- Enhance indoor air quality and lighting
- Reduce environmental impact of materials
- Must examine whole life-cycle of a building from siting through design, specification, construction, operation, maintenance, renovation, and demolition

Policies for executive leadership

- Lead by example, implementing green strategies on city facilities
- Encourage a value system that rewards decisions which make the city green and sustainable
- Audit city facilities for energy and water performance
- Develop benchmarks and goals
- Hold departments accountable for achievement of goals
- Encourage professional development focused on sustainability for city's engineers, architects, and building code officials



Policies for executive leadership



- Implement policies and training in the use of life cycle costs evaluation for decision-making.
- Drive integrated planning across departments – example Finance and Water Depts work together to establish requirement for permeable parking lots and sidewalks that absorb rain water to avoid need for massive stormwater infrastructure investment.
- Change budgeting process so every city facility and department is responsible for paying own utilities from their respective operating budgets. Savings should accrue to the facility or department to reward responsible behavior.

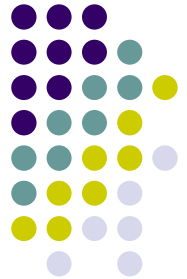
Measures to catalyze investments in green buildings

- Develop favourable tax policies to incentivize construction of new green buildings.
- Real estate finance and investment is inhibited by lack of information, perception of higher costs, and inadequate under-writing, valuation and risk management protocols.
- Develop information and awareness-raising programs to overcome barriers and facilitate flow of debt and equity investment among investors, lenders, developers, technology experts, building owners and managers

Measures to promote renewable energy applications and energy efficiency

- Provide direct cash incentives to customers willing to invest in renewable energy applications
- Offer soft loans (lower interest rates, better terms, lower transaction costs)
- Adopt feed-in tariffs to assure investors about future revenue and to drive more capital into the RE market
- Create a property assessed clean energy financing programme. Because these programmes can be structured to fully leverage private investment, a city can implement such a programme with almost zero budget impact.

Measures to promote renewable energy applications and energy efficiency in the built sector



- Improve building energy efficiency codes to achieve city-wide energy use reductions and energy cost-savings.
- Streamline renewable energy permitting processes to encourage RE installations, save time and money, and benefit installers by providing a standard set of operating procedures.
- Strengthen installer licensing and certification programmes. Everyone benefits from high-quality RE & EE installations.
- Improve utility net-metering rules. This will encourage customer investment in renewable energy by allowing customers who install such systems to receive credit for excess electricity generation, improving their return on investment.
- Optimize rate structures for renewable energies: Work with utility to create rate structures optimized for RE technologies to improve economics.

Policy measures for reduced water use

- Promote low impact development by capturing stormwater runoff instead of polluting nearby waterways.
- Reuse stormwater onsite to replenish groundwater supplies or for graywater uses, like landscape irrigation and toilet flushing.
- Encourage recycling and reuse of wastewater as a low-energy form of water supply.
- Fix leaking water pipes. Many city water systems lose as much as 20% of water each year due to leaks in pipe networks. Improving infrastructure would save water and energy.

Policy measures for water efficiency

- Promote and expand water efficiency regulations in building codes
- Local governments can: i) offer rebates for the purchase of labeled water-efficient products; ii) offer tax credits for purchasing such labeled products; iii) require labeled water-efficient products in new construction and in government buildings
- Provide incentives for agricultural water-use efficiency. Cities often compete with regional farming for water supply, so its important to include agriculture in regional water planning

Policies for improved internal air quality

- Strengthen building codes to mandate that construction industry choose only better building materials and interior finish products with zero or low emissions to improve indoor air quality.
- Building codes can also require more daylighting, better quality lighting products, as well as enhanced ventilation and air filtration.

Productivity benefits of daylighting

- Link between improved lighting design and a 27% reduction in the incidence of employee headaches.[1]
- Sales in stores with skylights were up to 40% higher compared to similar stores without skylights.[2]
- Students with most daylighting in their classrooms progressed 20 per cent faster on math tests and 26 per cent faster on reading tests in one year than those with less daylighting.[3]
- Carnegie Melon University's Intelligent Workplace design studio found that daylighting improves worker productivity by 5 – 25%
- Improvements in indoor environments are estimated to save $17-48 billion in total health gains and $20-160 billion in worker performance in the US on an annual basis.[5]

[1] Aaras, A. et al. (1998) Musculoskeletal, Visual and Psychosocial Stress in VDU Operators Before and After Multidisciplinary Ergonomic Interventions. Applied Ergonomics, p. 335-354
[2] Heschong Mahone Group (1999). Skylighting and Retail Sales: An Investigation into the Relationship Between Daylighting and Human Performance.
[3] Heschong Mahone Group (1999). Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance.
[4] McGraw-Hill Construction (2007) Greening of Corporate America SmartMarket Report.
[5] Fisk, W. (2000) Health and productivity gains from better indoor environments and their relationship with building energy efficiency. Annual Review of Energy and the Environment: 25, 537-66

Case study: HafenCity, Hamburg,Germany

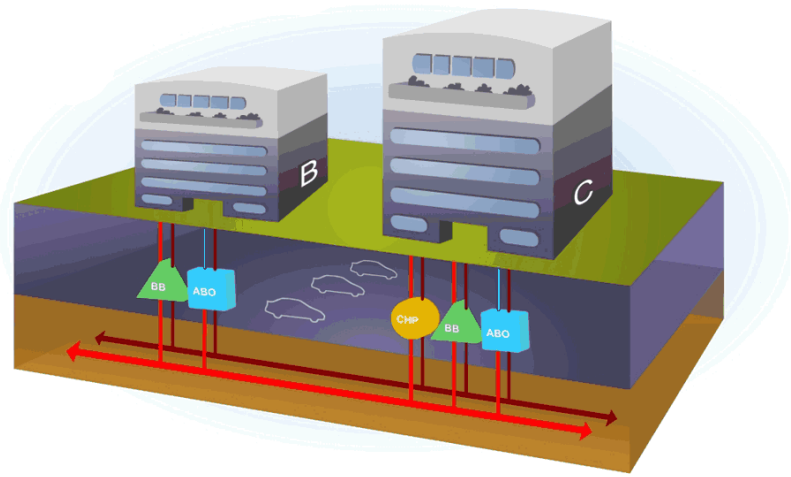
- New community development in heart of city's industrial port
- Brownfields to greenfields: rehabilitation of old industrial lands in the heart of the city
- Eco-labels for sustainable building construction encourages leading-edge standards for sustainability and use of resources.
- Includes homes, workplaces, cultural and recreational opportunities, high-quality public spaces

HafenCity

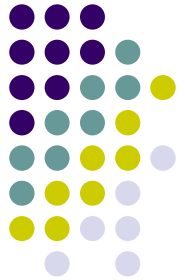
- Mixed use development of commercial, retail, restaurants, and residential buildings ensures short distances to travel.
- Private motor vehicles are discouraged through limited parking and car-sharing.
- Publicly available bicicles
- Network of foot and bicycle paths, gives pedestrians two and a half times as many kilometers of pathway as motorists.

Innovative energy/heating systems

- Innovative energy and heat supply yield low CO2 emissions
- Energy sources include woody biomass combustor, geothermal heat pump, biomethane fuel cell, and natural gas
- Decentralized district heating from above sources and solar thermal



Lessons learned



- Urban redevelopment projects that convert brownfields to greenfields can capture the imagination of a city and help recast its image as an innovative, creative and livable space.
- Integrated approaches to rethinking a community can solve multiple urban challenges related to land use, housing shortages, energy supply, transportation and access to cultural services.

Case study: US Green Business Council's LEED Programme

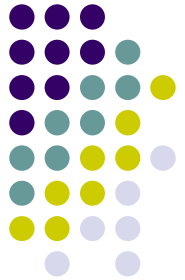
- Internationally recognized green building certification system designed to improve performance across number of metrics
- Metrics include: energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, stewardship of resources and sensitivity to impacts.
- Flexible framework that can be applied to all building types – commercial and residential.
- Applied throughout the building lifecycle – design and construction, operations and maintenance, and retrofit.

Engages all building sector stakeholders

- Practitioners include architects, real estate professionals, facility managers, engineers, interior designers, landscape architects, construction managers, lenders and government officials

- Currently being applied in U.S., Canada, Brazil, Mexico and India.

Lessons learned



- Building standards with measurable criteria are a good basis around which communities of practitioners can come together to design and build more sustainable buildings.
- A framework should allow enough flexibility for its application across all manner of buildings.
- Different levels of certification – silver, gold, platinum -- allow builders to pursue certification levels commensurate with their level of available financing.

Case study: Green Building Construction in a Hot Climate -- Masdar City

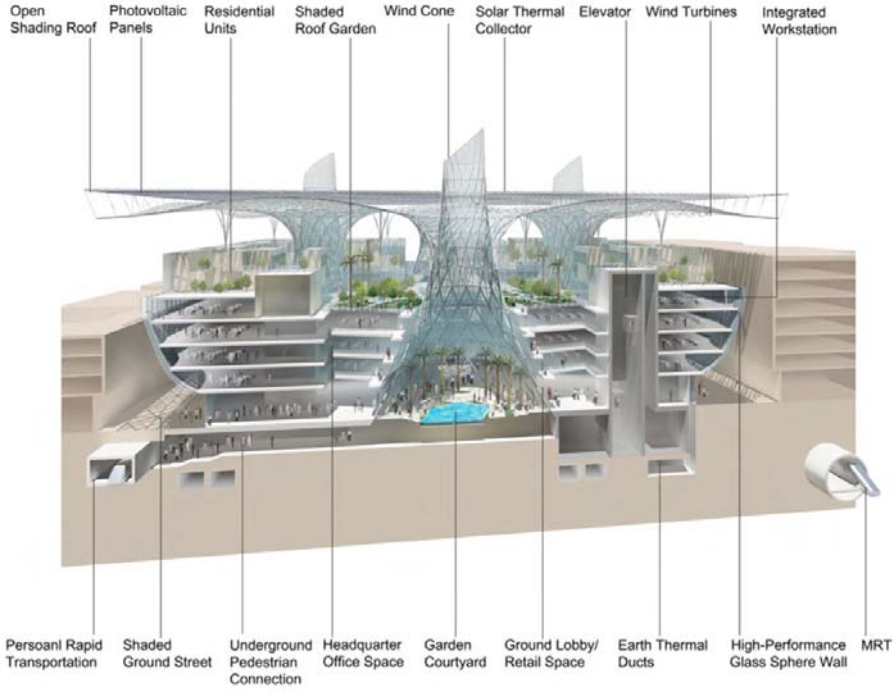
- Will be a carbon-neutral, zero-waste city for 40,000 inhabitants powered entirely by renewable energy.
- Building performance indicators cover design, construction, and operation.
- Specifications cover performance requirements for buildings, building structure, components, systems, materials, finishes and supply chains.

Measures at Masdar Headquarters Building

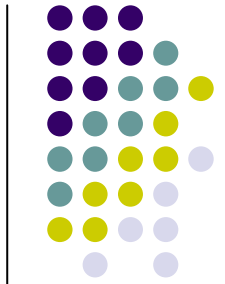
- Designed to be world's first mixed-use, positive-energy building, producing more energy than it consumes
- Aims at producing zero solid and liquid wastes, and reducing its water needs by 70 per cent.
- Design dominated by adaptations of traditional wind towers which draw hot air upwards during the day, and at night draw cool night air downwards to cool the building structure.
- 7-acre roof canopy with wide overhang shades entire building structure to reduce solar heating
- Roof canopy incorporates PV and solar thermal arrays, producing electricity and thermal energy for solar cooling.

Measures at Masdar Headquarters Building

- Earth ducts under the building reduce the building temperature through subterranean passages and connect building with mass transit system.
- Grey water from showers, laundries, and lavatories used to irrigate roof garden and to flush toilets.
- Recycled materials and rapidly renewable materials were specified wherever possible.
- Flexible, modular, prefabricated materials and furniture were also specified to make the process of recycling them easier.



Lessons learned



- Green buildings in temperate climate zones focus on efficient energy systems to reduce heating loads.
- This resulted in preeminence of engineering concerns over passive design elements in architectural designs.
- In tropical regions, sustainable design process aims to block heat away rather than generating it efficiently, so contribution of passive strategies is larger.

Case study: Water Efficiency in green buildings and green spaces

- George Washington University (US) wanted to convert underutilized parking space and trash collection area into an urban, multi-functional, sustainable plaza.
- Completed in 2010, it now serves as an urban plaza with a central open space and an outdoor classroom for the university's Sustainable Landscapes programmes

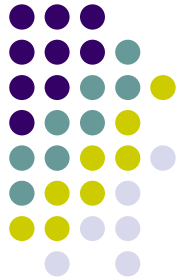
Elements of water efficiency

- **Rainwater Harvesting -** The plaza design implements numerous practices to clean, store and reuse the harvested rainwater

- **Native Plants** - Majority of plants used are native species well-adapted to regional soils and climate.

- Trees, shrubs, grasses and groundcover do not require irrigation, so harvested rainwater can be completely allocated to the open lawn.

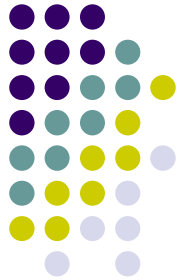
Elements of water efficiency



Permeable Paving –

- Conventional impervious paving causes water to quickly flow into gutters and storm drains, often causing flooding during heavy rain.
- Permeable paving allows water to move vertically through the paving material to slowly infiltrate and recharge groundwater.
- Excess water that does not infiltrate the soil below is collected into a drain and channeled to an underground cistern for storage and reuse on site.
- Permeable paving in urban settings yields savings on costly stormwater infrastructure and filtration systems.

Elements of water efficiency

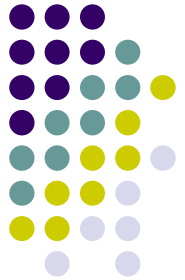


- **Roof Water Collection** - Utilizing existing gutter and downspout systems, rainwater is collected in rain barrels and cisterns. Overflow from the rain barrel is piped to the underground cistern, while water in the 300-gallon rain barrel is used for routine maintenance.
- **Cisterns** - Using cisterns for rainwater harvesting makes it possible to eliminate reliance on potable water.

Elements of water efficiency

- **Bioswale** - A bioswale is a shallow planting bed depressed six to eight inches with a slight gradient. It captures surface water during a rain storm.
- **Rainwater Irrigation** – The Square is irrigated using filtered rainwater from on-site collection via drip irrigation
- **Rainwater for Fountain** - The rainwater fountain sources 100% of its water from on-site rainwater harvesting collected in a cistern

Lessons learned



- Intelligent, water-efficient designs for public green spaces can obviate the need for the use of potable water for landscape irrigation
- Creative redesign of urban spaces like parking lots into small parks can enhance the livability of the urban environment

For more information

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