



Sustainability Overview



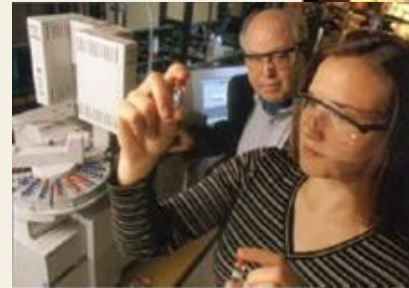
Georgia Institute
of Technology®

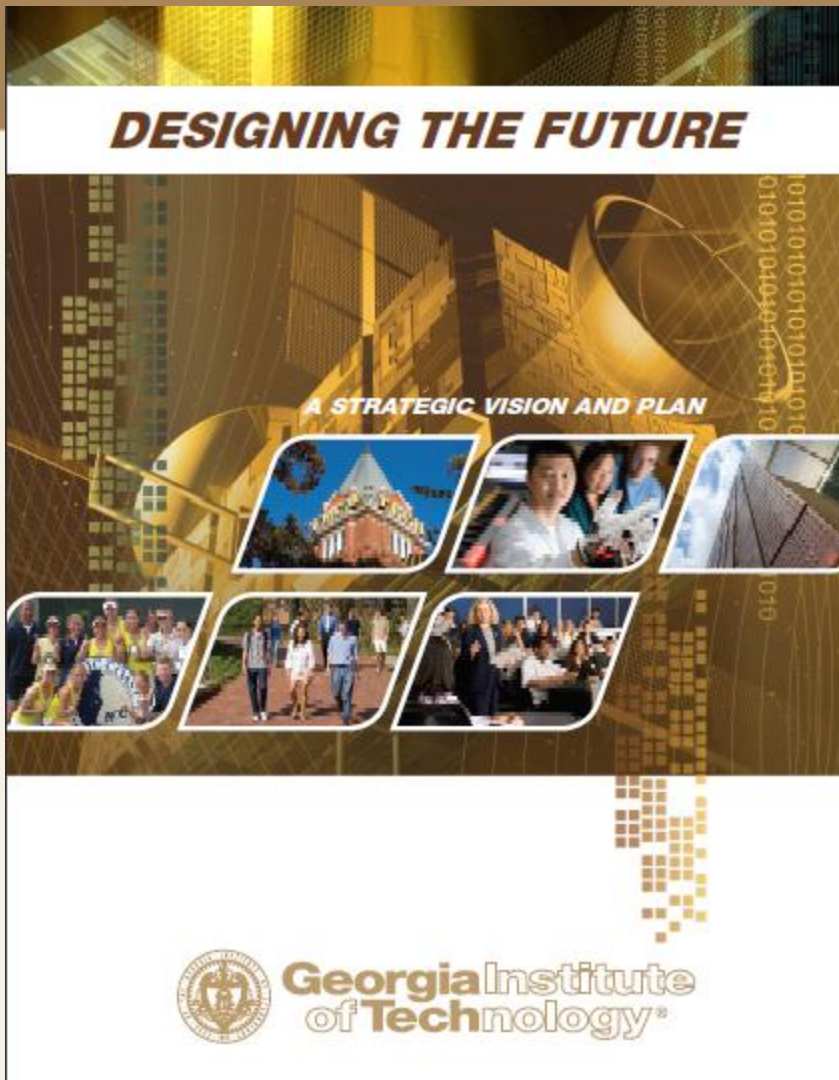
April, 2011

Philosophical Approach

Comprehensive approach
to sustainability:

- Learning in classroom
- Discovery in the research lab
- Campus as a role model





Define the technological research university of the 21st century

Be leaders in influencing major technological, social, and policy decisions that address critical global challenges

Be leaders in improving the human condition in Georgia, the United States, and around the globe

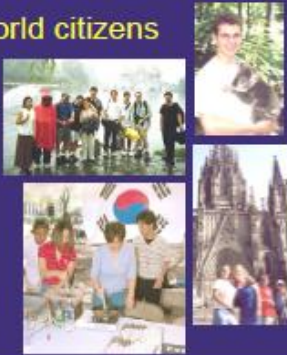
Realize our motto of “Progress and Service” through effectiveness and innovation in teaching and learning, our research advances, and entrepreneurship in all sectors of society

“Tangible symbol: international education, world citizens, working in a global economy and across a sustainable world”

Educating world citizens

⇒ A third of Tech students now study abroad

⇒ Over 2,900 international students are enrolled in Atlanta



Doing business in a global economy



Georgia Tech student team wins logistics business plan competition in Singapore last year

Georgia Tech Center for International Business Education and Research has 26 international partner universities



What does that mean?

- ⇒ Become one of the world's great and truly international universities
- ⇒ Contribute to shaping the technology-based global economy
- ⇒ Build a campus that expresses our intent
- ⇒ Engage our neighbors to improve the quality of the community we share



Technology Square

- Built on vacant lots, abandoned property
- Models sustainability
- Atlanta's technology nexus:
 - ▷ Incubates new companies
 - ▷ Houses Georgia Tech's business programs
 - ▷ Space for companies that want to be near campus
- Shops and cafes invigorate the neighborhood



Georgia Tech College of Management building,
13th LEED certified building in U.S.,
1 of 5 Tech Square buildings
Designed to LEED Silver standards in 2003

Recent Sustainability Recognition

Princeton Review Green Honor Roll Top 2%



Cool Schools Sierra Club - #18

Forbes Green Colleges 1 of 13 in US



Green Report Card Campus Sustainability Leader



Governor's Energy Challenge

Conserve Georgia Natural Resource Stewardship Award

UI Green Metric Ranking of World Universities 8th



National Wildlife Federation Exemplary Green Campus

Upper Chattahoochee Riverkeeper's First Annual Sustainability Award



Hobart Center for Food Service Sustainability Award



Tree Campus USA



National Recycling Coalition

American School & University Green Cleaning



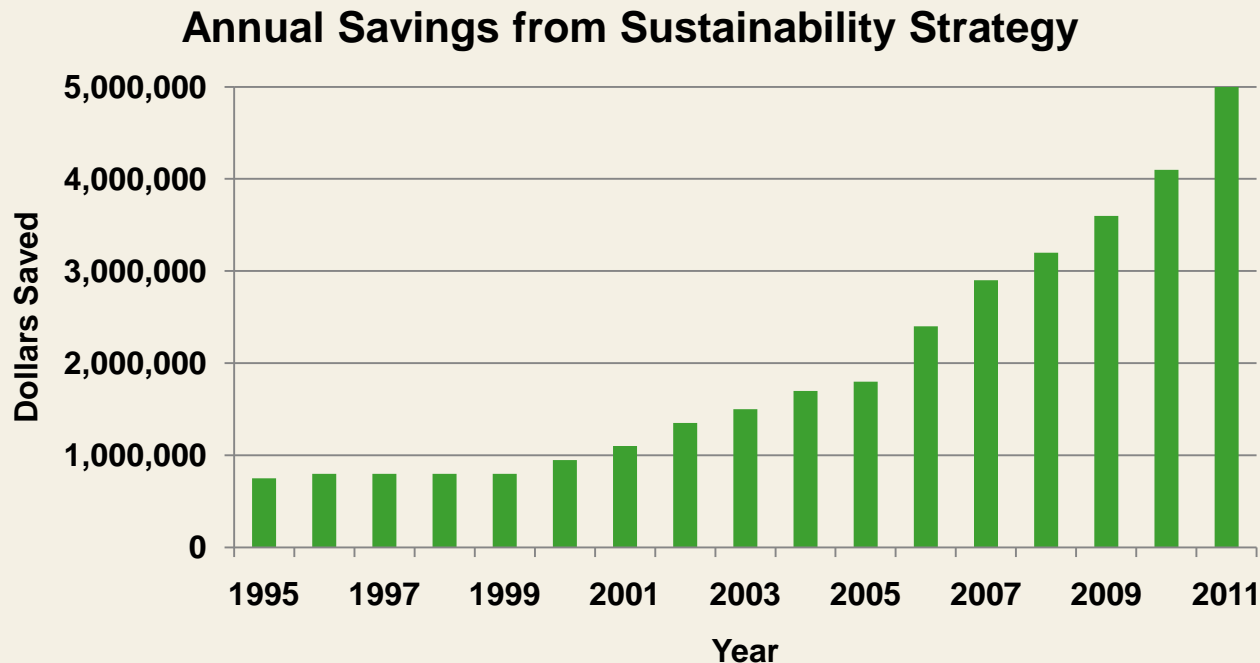
American Forest & Paper Association

American Forest and Paper Recycling Award

National Recycling Coalition Outstanding College Program



Economic Sustainability



Georgia Tech's Sustainability Investment Strategy and Green Revolving Funding helps bridge the disconnect between Capital and Operating Budgets to ensure our campus continues to model our commitment to sustainability. This has been, and is, an ongoing, long term approach to continuous improvement, as required for a public university.

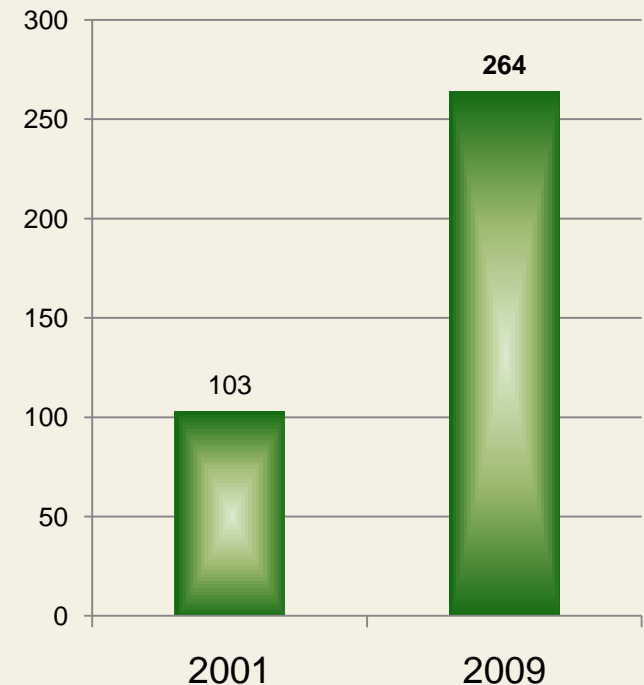
Energy savings generated are tracked through metering and other data analysis to justify and support the annual funding allocations.

Sustainability in the Curriculum

GOAL: Every Student to take at Least One Course in Sustainability.

- Across all 6 College
- 23+ Degree programs
- Core Courses
- Advanced Courses
- Advanced Degrees
- Continuing Education

Courses with Sustainability Focus



Solving Problems. Innovating.

ISyE's Senior Design program allows business and government organizations a unique opportunity to engage and interact with ISyE students and faculty. Organizations benefit from innovative and stimulating new ideas while students gain practical knowledge as they work on real world projects.

iMPACT
SPEAKER SERIES

**Georgia Tech's
Premier Speaker Series**

**Bringing You Inspiring Leaders from
the Business & Social Sector**



Developing World Pump

iNVENTU@RE PRIZE™



SERVE
Socially &
Environmentally
Responsible Value
Enhancement



CAPSTONE DESIGN

Mechanical Engineering

STUDIO | SPONSORS | STUDENTS



BPC



**Business Plan Competition:
Strength-building Shirt
Most Prepared for Market**

Endowed Research Chairs

21 Endowed chairs and professorships related to sustainability

Natural Systems
Anderson/Interface
Chair in Industrial and
Systems Engineering



U.S. Presidential
Chemistry Award
Winners

Charles Liotta and
Chuck Eckert, Love
Chair in Chemical
Engineering



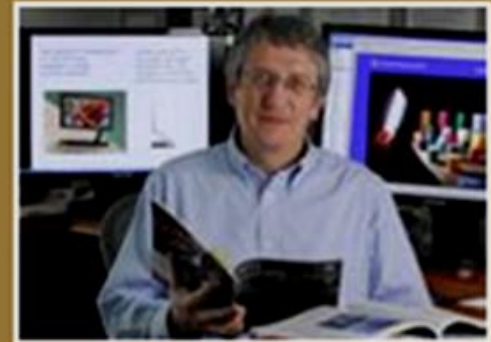
Environmental
Biology
Mark Hay, Teasley
Chair in Biology



Enlarging Tech's International Profile



Bill Koros: \$10 million KAUST grant for research on advanced membranes



Jean-Luc Bredas: One of world's most-cited chemists



European Union Center of Excellence 2008-2011



Arthur Ragauskas:
Fulbright Distinguished
Chair in Alternative
Energy in Sweden



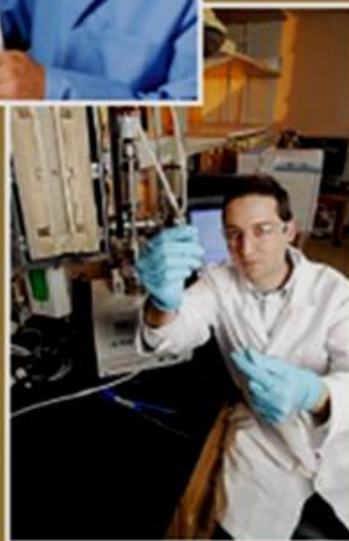
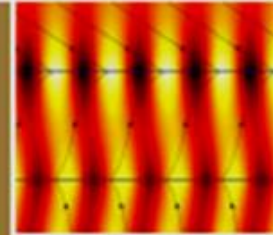
Georgia Tech Lorraine:
International conference
on recent advances in
material processing

Integrating a Wide Range of Solutions

Maximizing the opportunity



Developing new energy sources



Understanding Climate Change, Shaping Energy Policy



Marilyn
Brown



Rong Fu



Robert
Dickinson



Modeling, Another Mode of Discovery



Manipulating massive data sets



Refining simulations
with real data



Modeling communities



Ramping up
to exascale
computing



Modeling atoms



Modeling social
systems with games

Economic Engine for Georgia

- Produced more than 300 invention disclosures annually
- One of the state's top patent producers, ranks 3rd
- Spins off an average of 10 new companies a year
- ATDC has incubated more than 120 start-up companies
- Has generated more than \$13 billion in revenue and \$100 million in profits
- In the past decade, companies have attracted more than \$1 billion in venture capital
- In the past year, Georgia Tech programs for existing industries assisted more than 3,000 Georgia companies, saving or creating 20,000 jobs.

Example services available:

- Energy Management System
- ISO 1401 and 50001 services

Georgia Tech worked with state government to attract NCR to Georgia – drawn by our talented workforce and opportunities for research partnerships.



Planning for Campus Sustainability

Campus Master Plan

Education

- Open spaces for recreation
- Research neighborhoods to promote inter-disciplinary

Ecology

- Green buildings
- Eco-Commons
- Native vegetation systems
- Reduce impervious surface

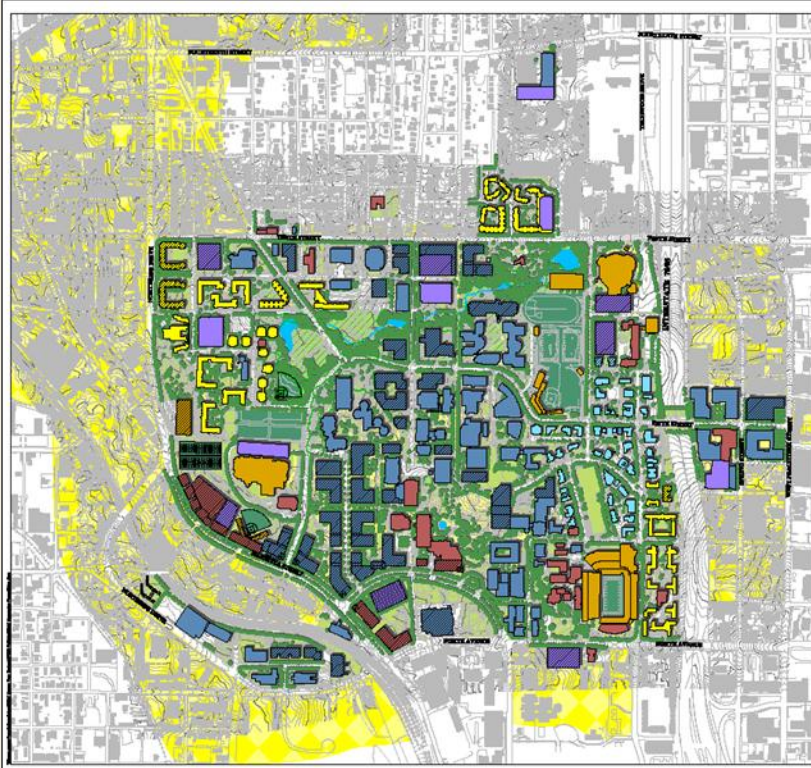
Economy

- Effective use of Physical and Fiscal Resources
- Environmental Stewardship
- Historic Districts

- Campus Master Plan -1997
- Land Use – CMP 2004 & Update
- Landscape Master Plan - 2006
- Irrigation Master Plan - 2008



Master Plans



2004 Campus Master Plan Update

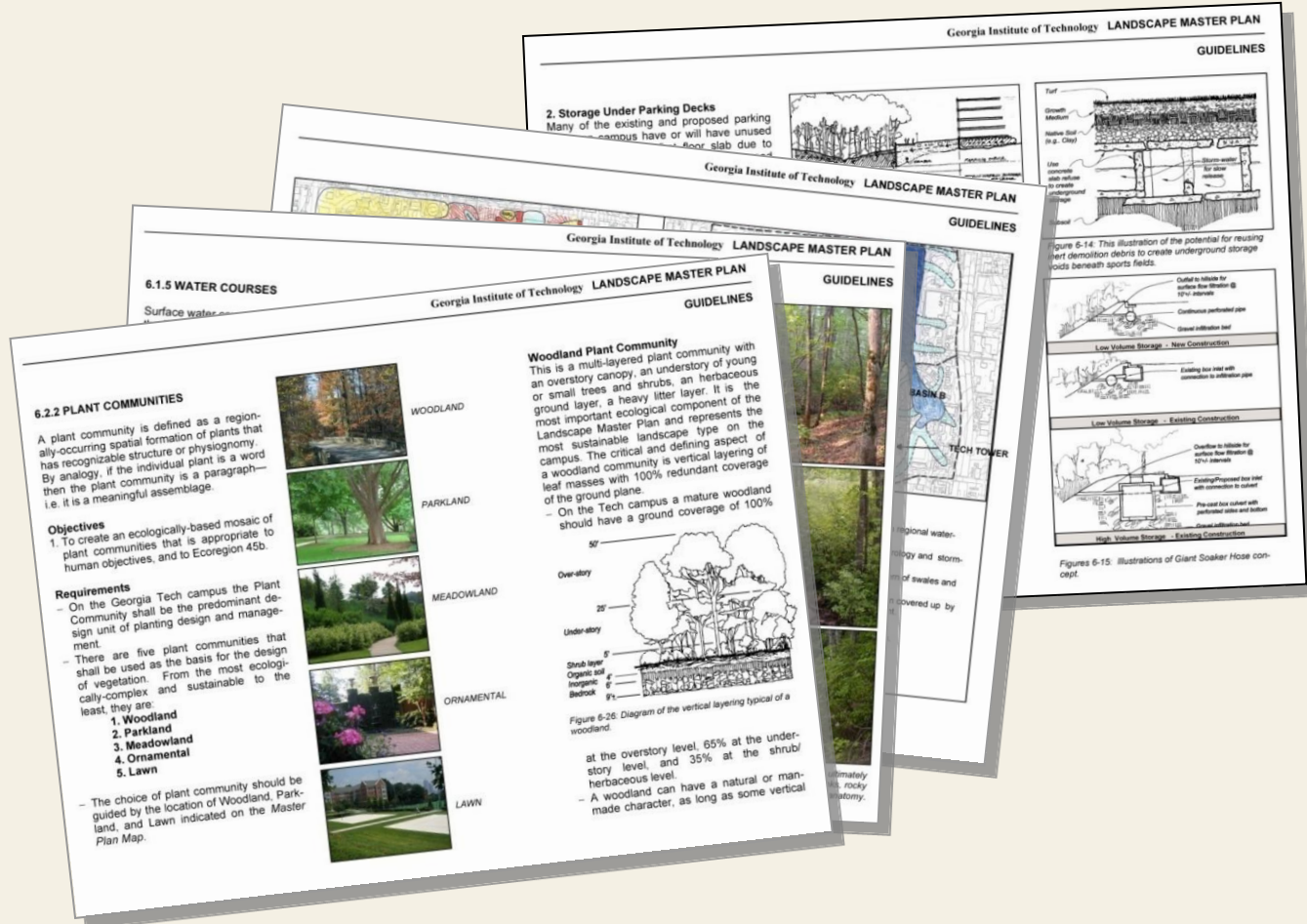
The 2004 Master Plan Update recommended that open space on the Georgia Tech campus play a significant role in achieving our goals of sustainability and livability.

2006 Landscape Master Plan - Open Space and Eco-Commons Concept:

The total Eco-Commons equals approximately 80 acres, lying within two drainage basins.

How can campuses improve design?

- Ecological Landscape – soils, water, plant communities, etc.
- Human Landscape – paving, walls, bicycles, etc.



...Green Book guidelines that encourage creative applications of ecology, technology and design.

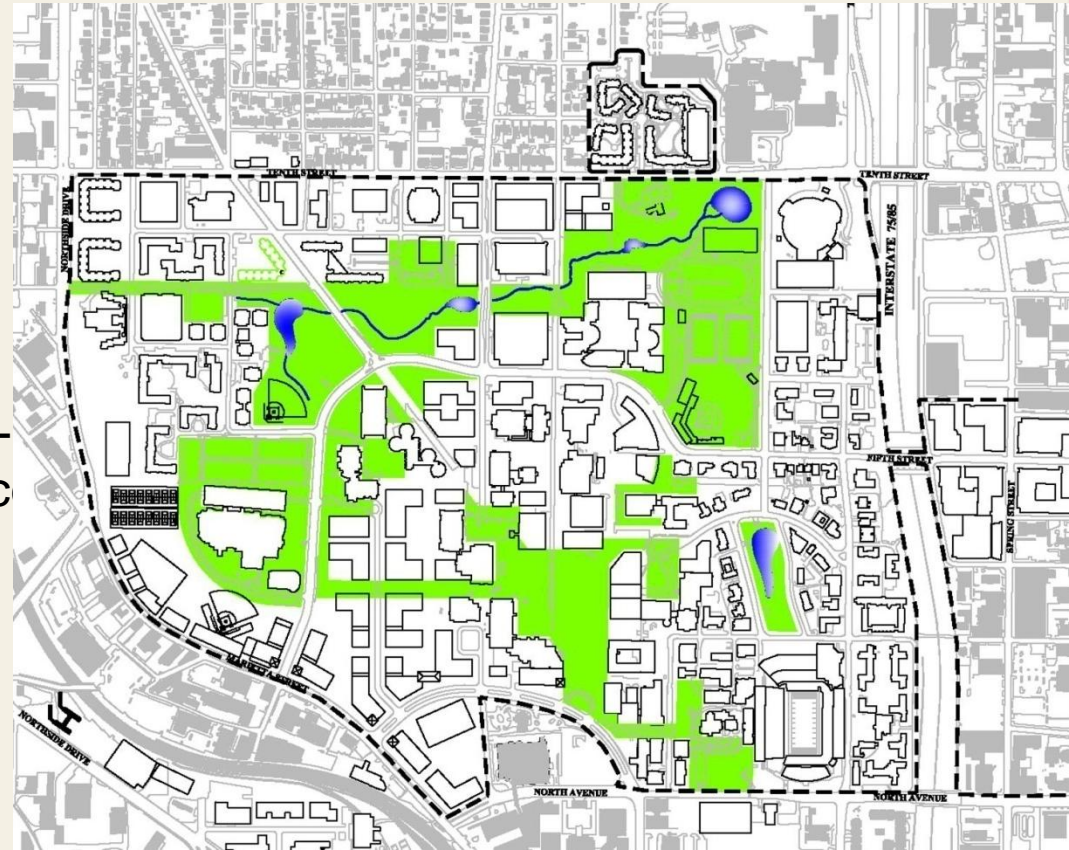
Landscape Master Plan

Key Concepts:

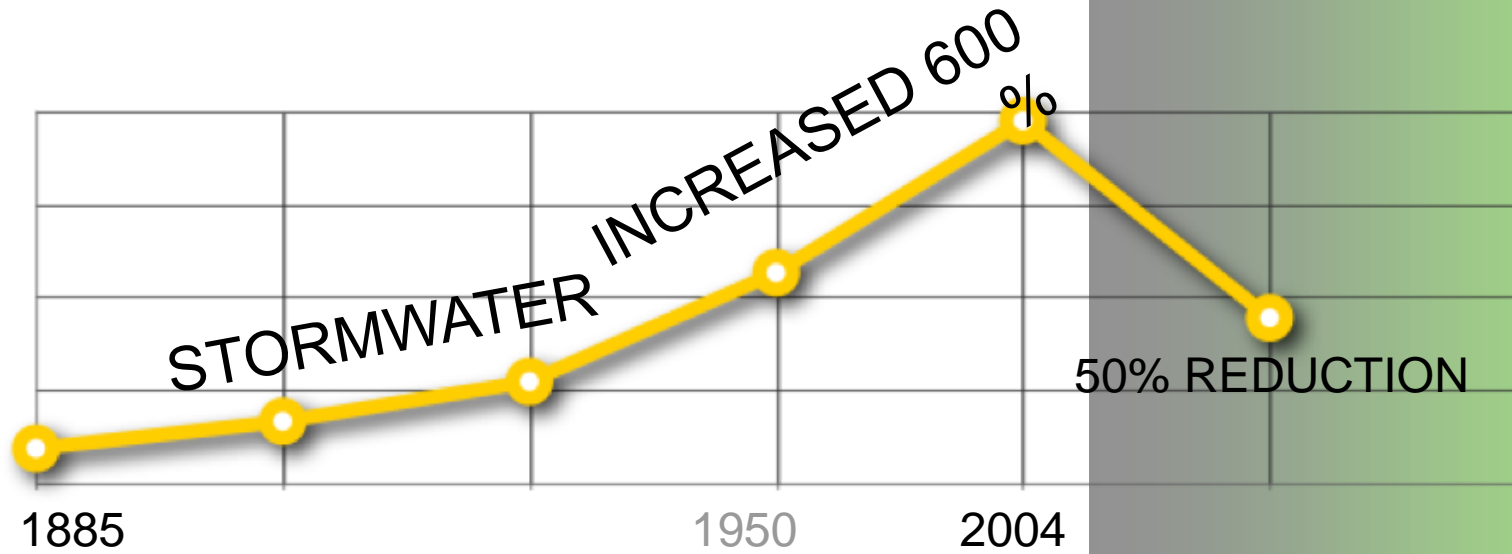
- *Ecological Landscape*
- *Human Landscape*

Goals:

- Develop integrated, ecologically-based landscape and open space systems (storm water management).
- Enhance living, working and learning environment.
- Unify the campus with a distinct sense of place.
- Increase tree canopy.



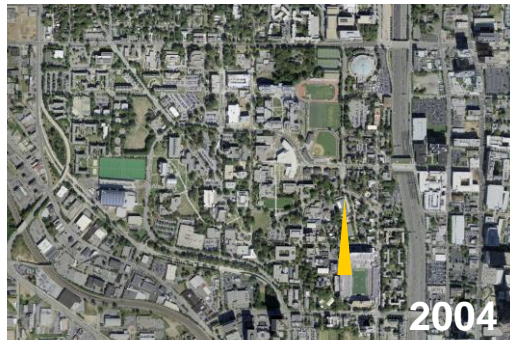
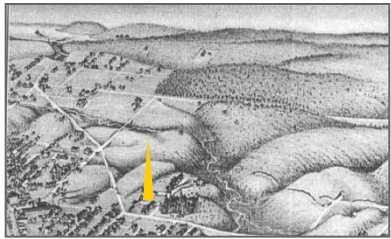
What are the results of the Landscape Master Plan?



GT Founded

120 Years of Campus Development

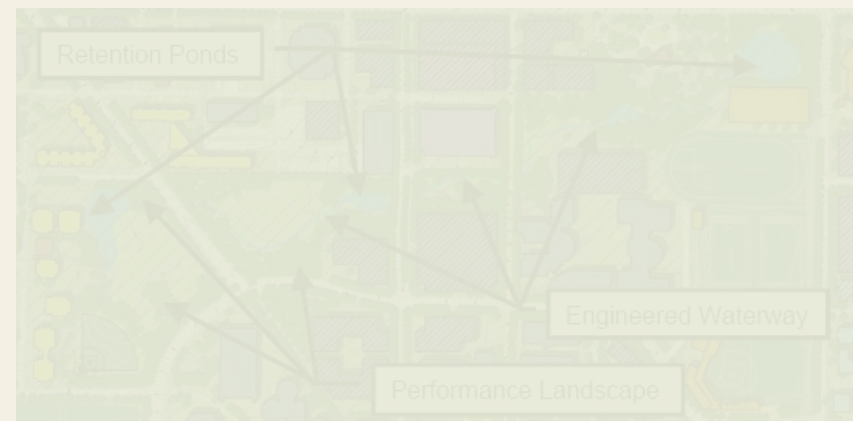
Landscape Master Plan



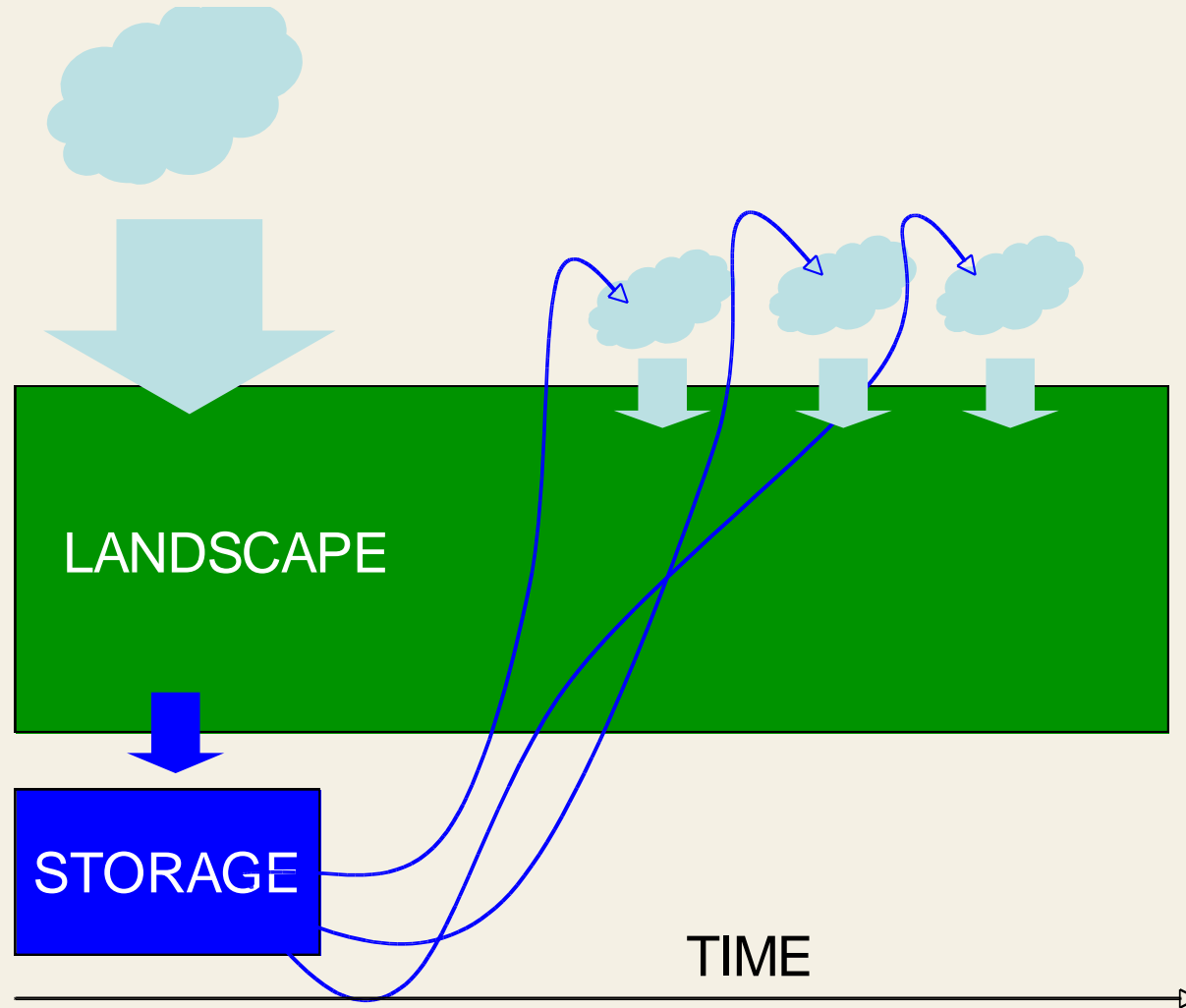
Eco-Commons

Storm Water Management:

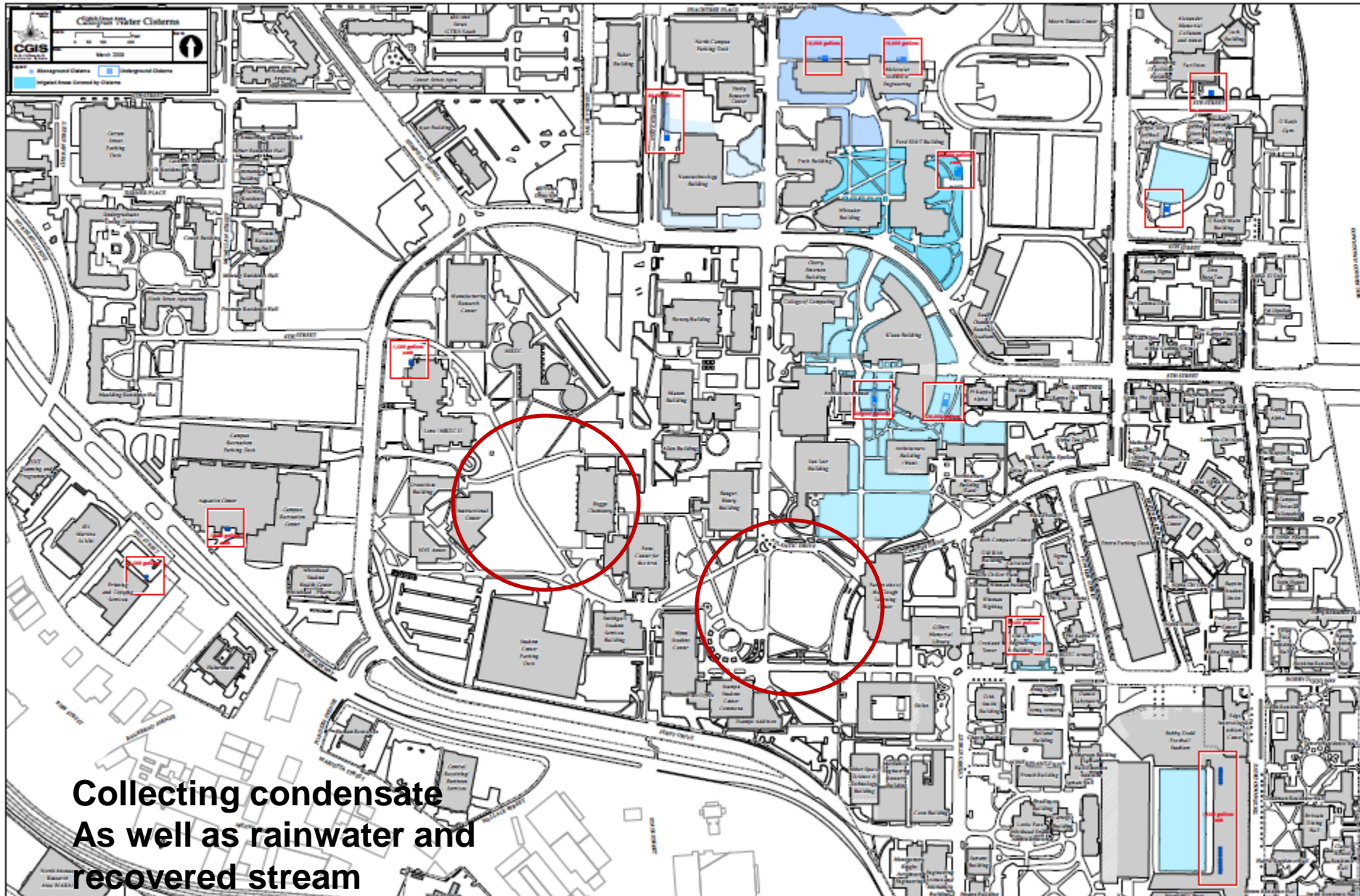
- Engineered Waterway
- Replicates the storm water management of a natural stream.
- Approximates the original route of the stream.
- Surrounded by performance landscape.
- Passive and active recreation areas.
- Will be maintained in perpetuity.
- Reduce Georgia Tech's contribution to the Atlanta storm sewer to early 1950's.



Sustainable Approach to Stormwater



Cistern Master Plan

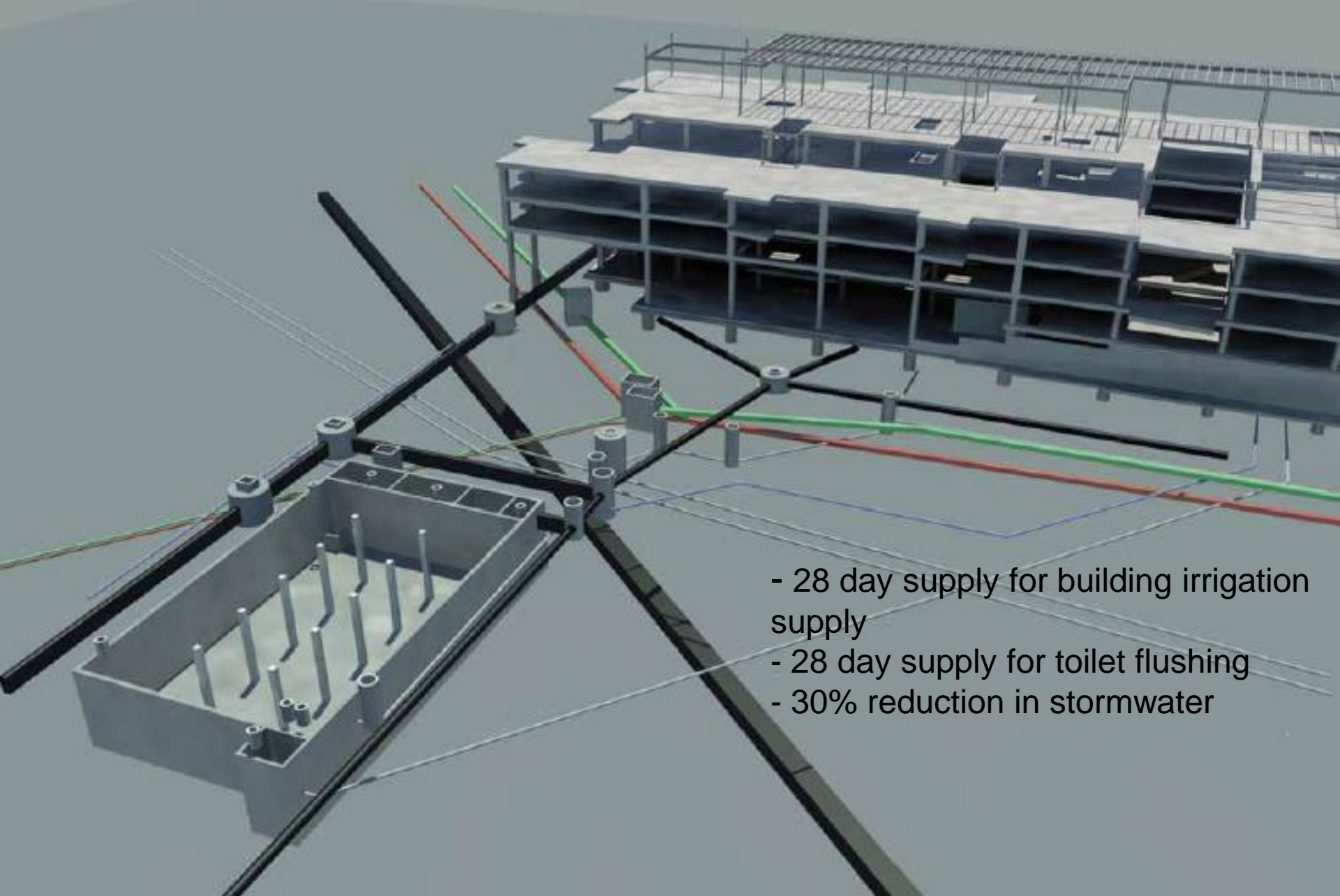


View from Tech Green Walkway



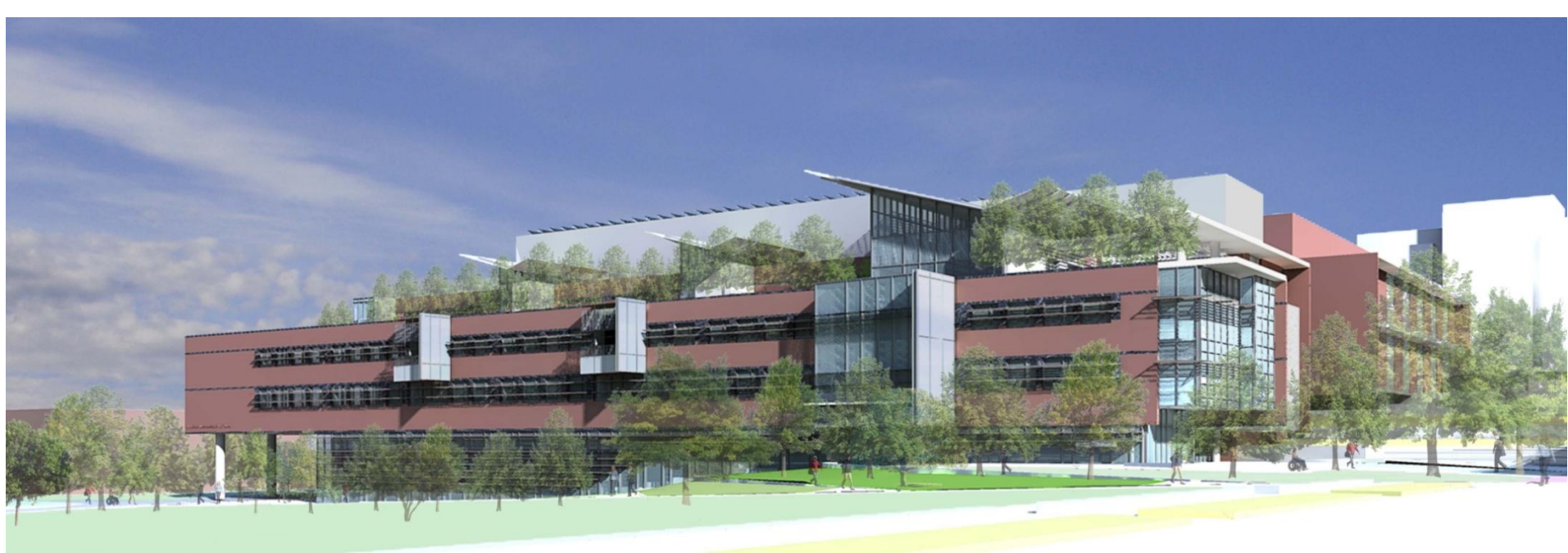
G. Wayne Clough Undergraduate Learning Commons

Opens Fall 2011

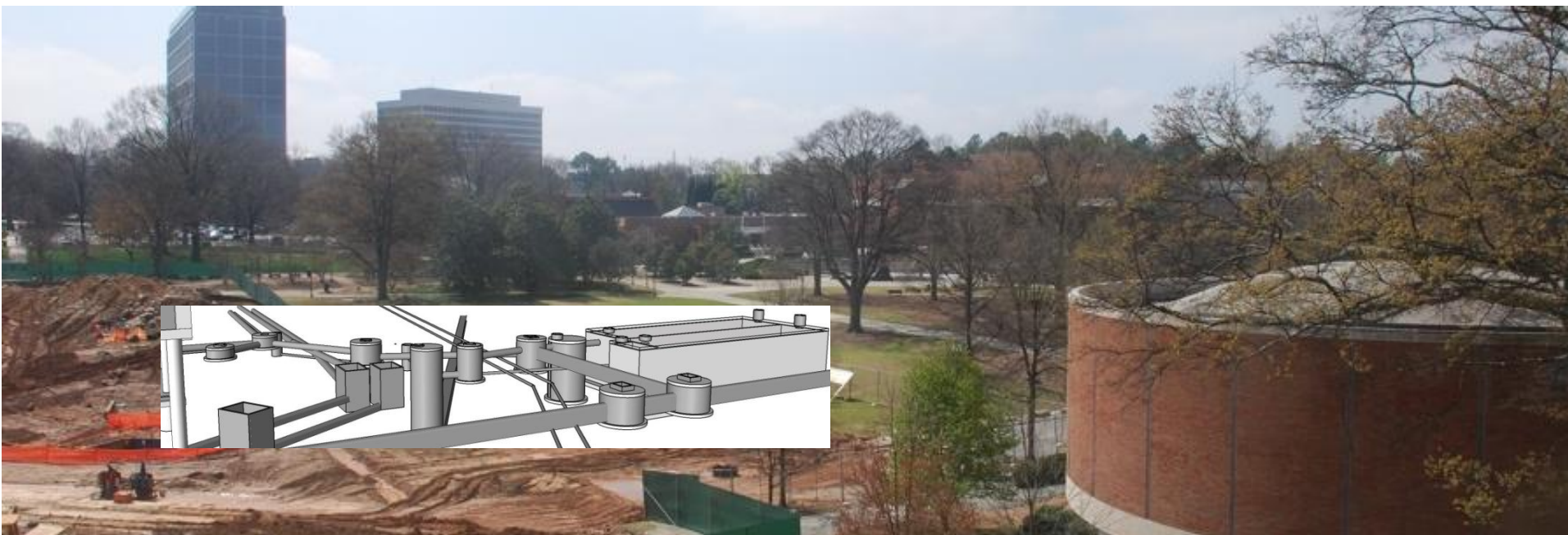


- 28 day supply for building irrigation supply
- 28 day supply for toilet flushing
- 30% reduction in stormwater

Adding 1.4 million gallon cistern – largest in US.
Existing cistern capacity is 500,000 gallons, with 500,000 gallons more in design phase



LANDSCAPE + ECOLOGY + TECHNOLOGY + ARCHITECTURE



Performance Landscape

Woodland Cover:

- Trees are renewable
- Enhance ecosystem performance
- Retain water on site
- Store more carbon
- Foster biological diversity
- Provide human delight

Goal:

- *50% Canopy Coverage*



Reforestation Projects since 2006

GEORGIA TECH IS INCREASING ITS TREE CANOPY BY 300%



- The Landscape Master Plan began with a tree survey
- Since then GT has executed 13 major tree projects

Tree Canopy Pilot (Before)



Tree Canopy Pilot (After 2 years)



Tree Campus USA

Goals:

- Effectively manage their campus trees.
- Develop connectivity with the community beyond campus borders to foster healthy, urban forests.
- Strive to engage their student population utilizing service learning opportunities centered on campus, and community, forestry efforts.



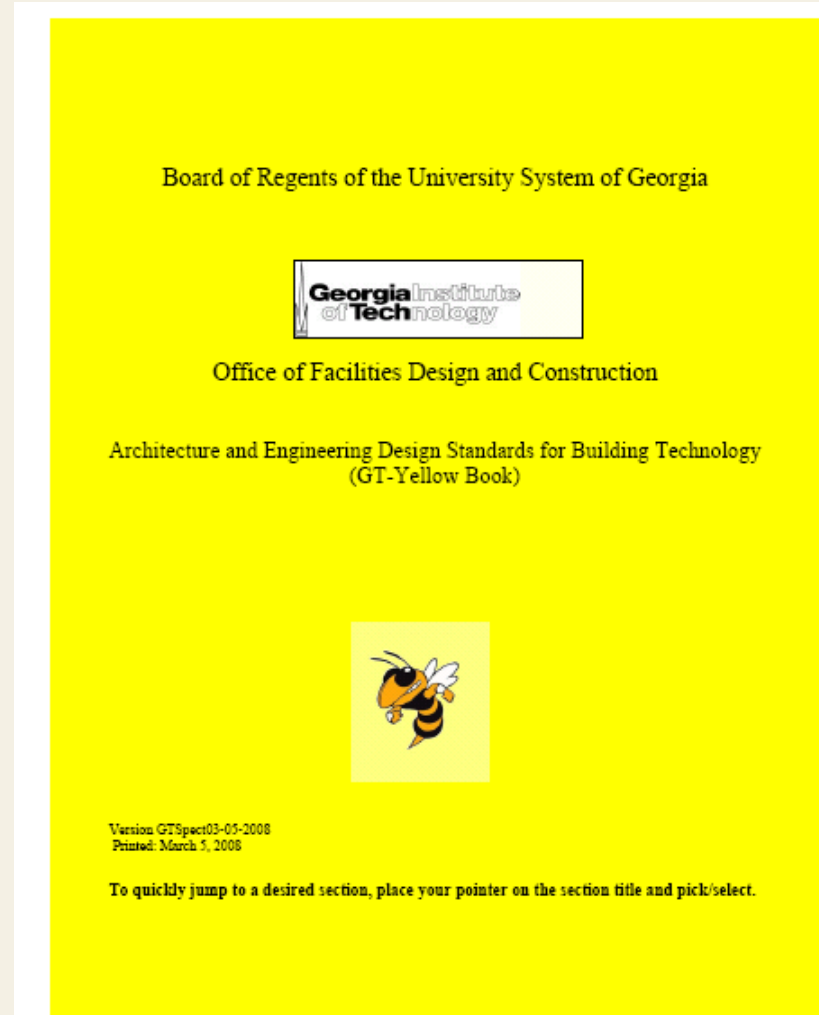
Urban Campus – Downtown Atlanta



Sustainable Benchmarks

Georgia Tech Yellow Book

- Goal is a sustainable building and site
- Policy requires LEED Gold certification, or higher
- Energy criteria
 - exceeds California Energy Code 2005 by 20%
 - exceeds Georgia Energy Code by 40%
- Water criteria
 - exceeds Georgia Code
 - meets California water conservation code



LEED Certified Projects (721,867 SF)



College of Management Building: LEED Silver



Christopher W. Klaus Advanced Computing Building: LEED Gold



Old Civil Engineering Building Renovation: LEED Gold



Shirley Clements Mewborn Women's Softball Field: LEED Gold

Energy Efficient Components

- **Variable Frequency Speed pumps and fans**
- **100% airside economizers**
- **Thermostat management/DDC Controls**
- **Heat recovery system on exhaust air**
- **CO2 based demand ventilation**
- **Retrofit/Re-commissioning HVAC and controls**
- **Premium efficiency electric motors and pumps**
- **Efficient lighting systems**
- **Efficient wall and window sidewall construction**
- **Reflective, insulated roof systems**
- **HVAC condensate collection for irrigation**
- **Low Flow water fixtures**



LEED Gold Building



LEED Gold Renovation



LEED Gold Sports Stadium

Sustainable Buildings

68+ Sustainable Buildings representing 7,000,000 sf

- 4 LEED Certified Buildings
- 25 Campus buildings renovated, constructed or in process of design/build meeting LEED standards but not certified
- Policy since 2002
 - Yellow Book Design Standard and also:
 - LEED Silver or Higher 2002-2007
 - LEED Gold or Higher 2008-present
- Energy Retrofit 64 Buildings completed between 1994-2004
 - 11% reduction in energy used
- Water Retrofit entire campus 2007 for low flow fixtures
- ARRA funding for 44+ Buildings - lighting efficiency, automation, steam insulation to reduce their energy consumption 15%



North Avenue (Green) Dining Facility
Opens in Fall 2011

1st LEED Existing Building (LEED EB) Certification on campus performance period ends 1Q2011

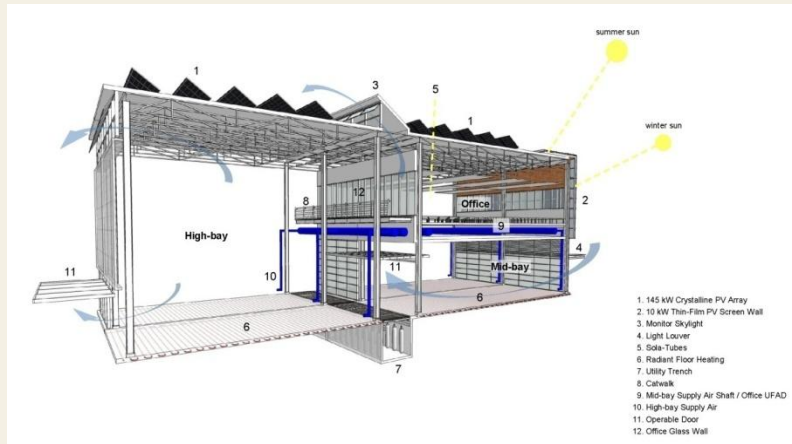


Savings:

- 25% Carbon
- 30% Water
- 15% Energy



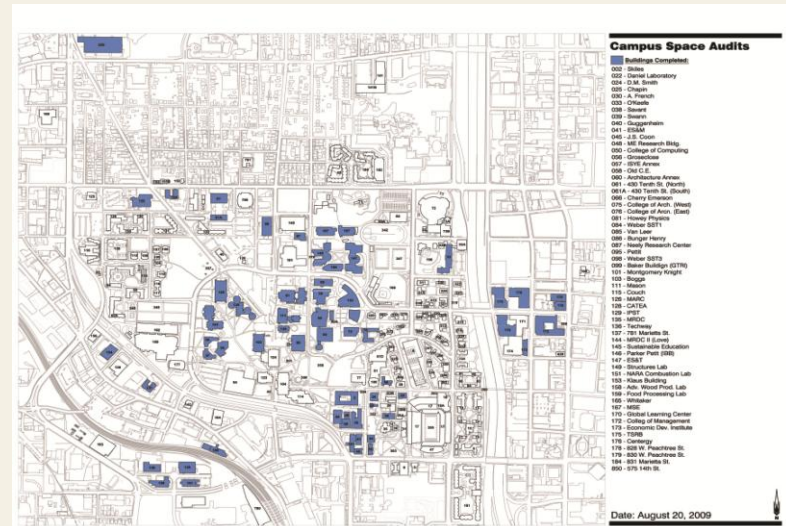
Carbon-Neutral Energy Solutions (C-NES) Laboratory Building



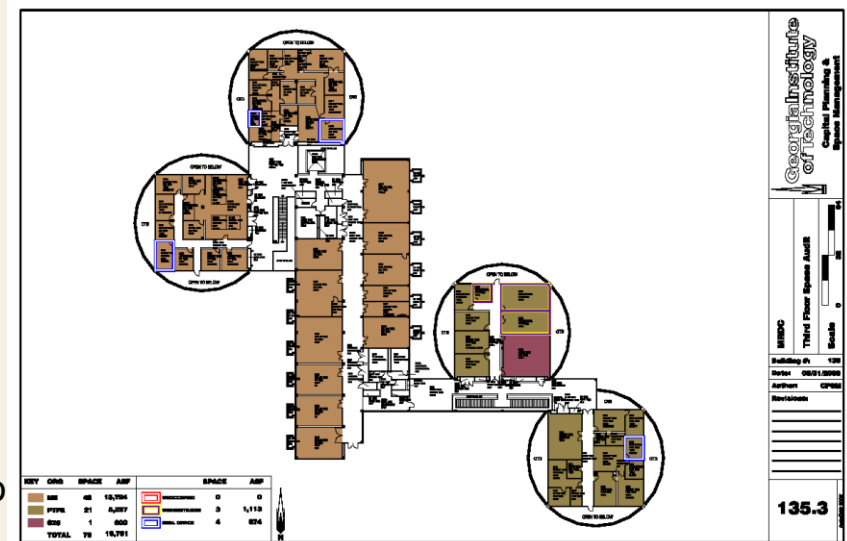
Ground Breaking Mid 2011

Space Audit - Goals

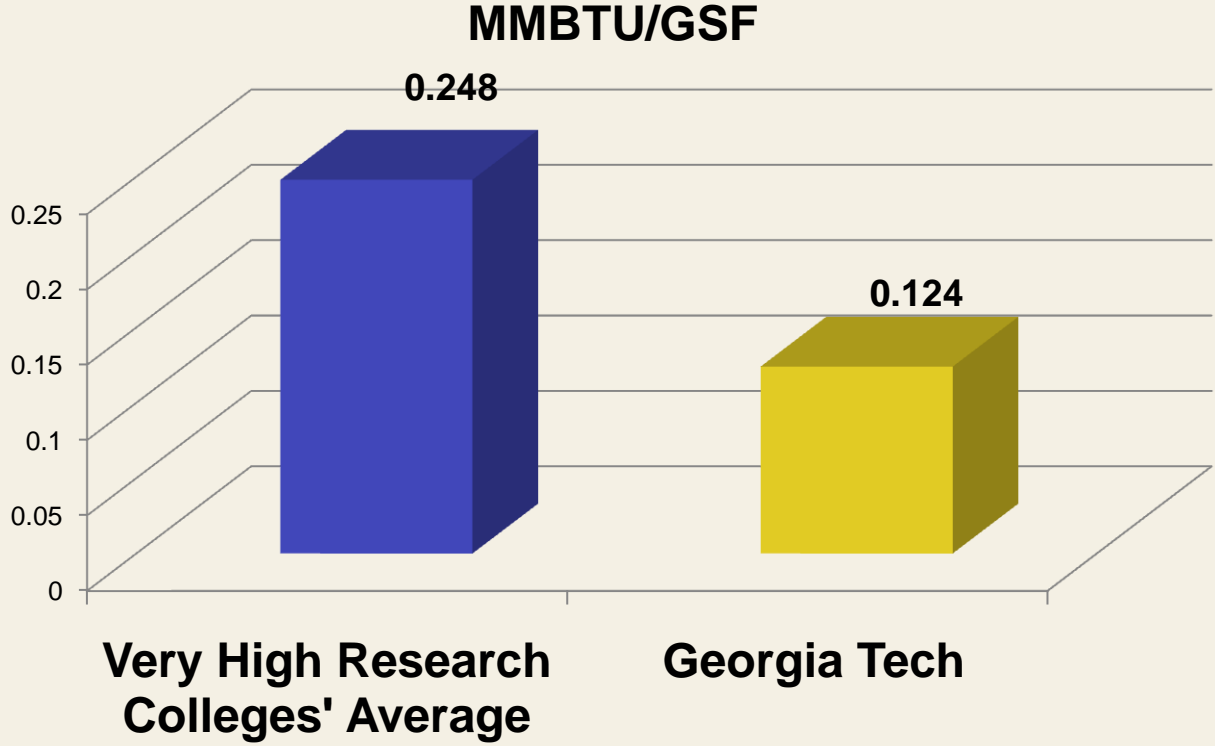
- To accurately represent existing space use, assignment and utilization.
- To share information with all units so they have a useful tool to help make informed decisions about space allocations.
- Ensure space is appropriately assigned based on funding, employment status, etc.



Decision Support



Energy Usage for Peer Very High Research Universities



District Energy Systems



- Electricity
 - 80 Megawatt Substation



- 10th Street Chiller Plant (6)
 - 12,000 tons
- Holland Chiller Plant (6)
 - 8,000 tons



- Holland Steam Boilers (4)
 - 110,000 LB/HR (electric)
 - 210,000 LB/HR (natural gas)



- Backup Propane Fuel Storage
 - 350,000 gallon
 - 5-day supply

Purchased Utilities

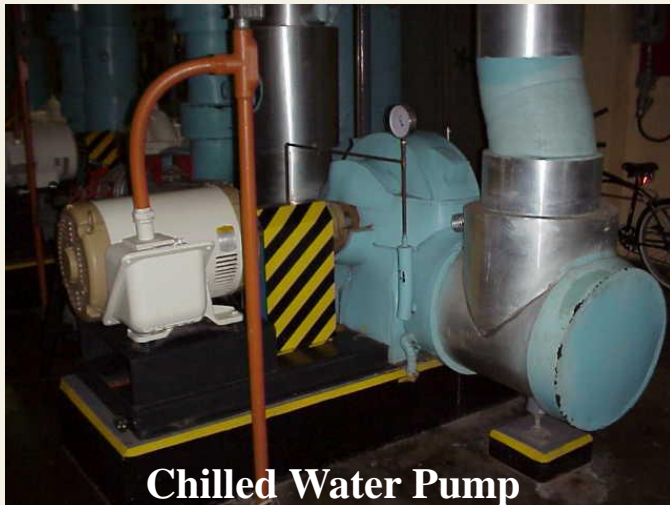
- Georgia Power Company
 - Real-time pricing
 - One hour ahead
 - SLM base rate
 - \$0.056/KWh (avg)
- Scana Energy – Natural Gas
 - Statewide contract
 - NYMEX pricing
 - Fixed / variable
 - \$0.89/Therm (avg)
- Amerigas Company
 - Statewide contract
 - Fixed pricing

Campus Chilled Water Plants



Centrifugal Chiller

- Replaced/added ten 0.65 KW/Ton chillers
- used environmentally friendly refrigerant
- *30% more Energy efficient than 0.95 KW/Ton chillers*



Chilled Water Pumps

- Upgraded campus chilled water distribution pumps to variable speed
- *35% more Energy efficient than constant volume pumps*

Campus Heat Plant



**New Boiler Rigged
through Roof of
Holland Plant**

New Boilers

A 1948 and a 1952 boilers were replaced with new boiler

- Boiler meets new EPA Standards for the Atlanta area
- New boiler is 24% more Energy efficient than older boilers
- A new Electric Boiler is scheduled to come online in Fall 2009



**New Electronic Thermostat
With Setback Override**

Building Automation Controls

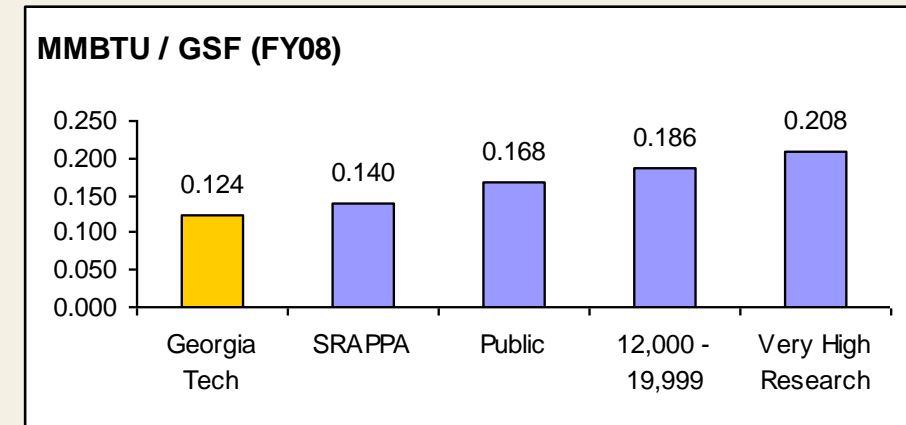
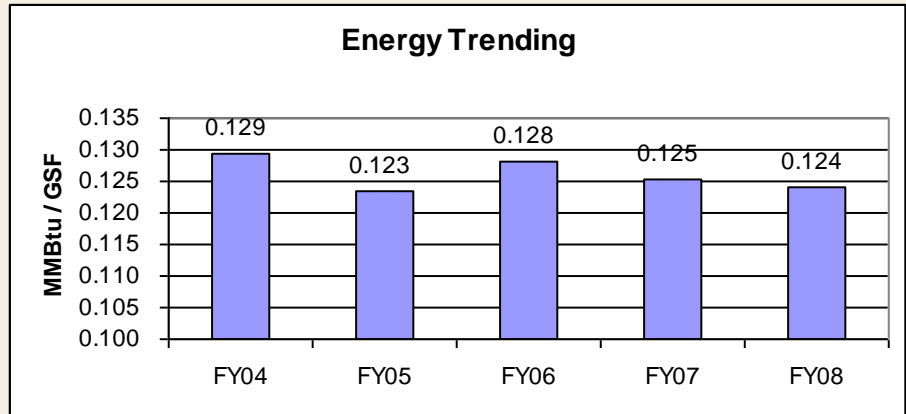
- Energy Management – 92 buildings
- Night, Weekend ($\pm 9^{\circ}$ F) and Load Shedding ($\pm 5^{\circ}$ F) Temperature Setback
 - Setback does not affect labs, computer rooms or other critical areas
 - Occupant can override for three hour periods

Energy Consumption

Energy consumption has remained consistent (per GSF)

- despite increase in GSF (15 %),
- suggesting initial success in sustainability investments
- Components of 26 buildings have been retrofitted to LEED standards, reducing energy consumption

- Current energy management methods have allowed Georgia Tech to remain ahead of peers
- All government organizations in Georgia have been asked to reduce energy consumption (BTU/GSF) by 15% by 2020 (Governor's goal)

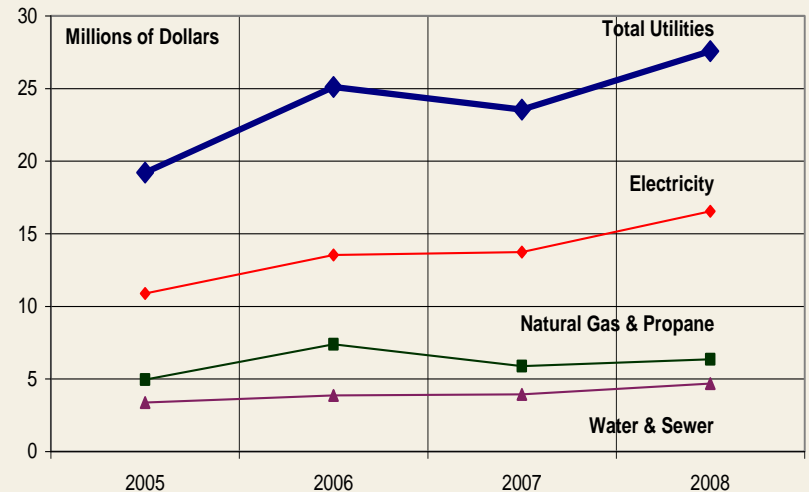


Utility Costs

Purchased Utilities (\$)

Georgia Tech has experienced substantial increases in energy rates over the past several years

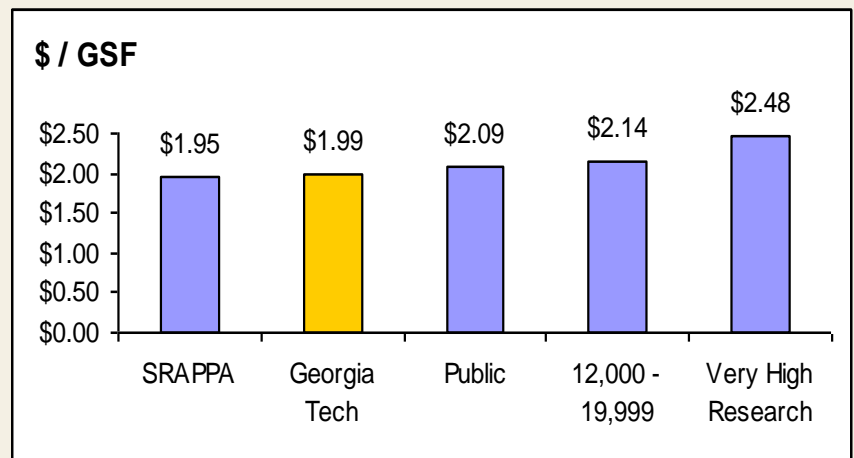
- Electricity rates increased 34% since 2005
- Natural Gas rates increased 13% since 2005
- Water and sewer rates increased 10% since 2005



Purchased Utilities (\$/GSF FY08)

Through utility contracts and consumption measures, Georgia Tech has effectively managed its energy expenditures. Energy audit confirmed:

- \$7.3 million dollars avoided by Georgia Tech's actions
- Overall average Energy reduction was 11% using DOE2 simulation program
- Investments in 2 main Chiller Plants are yielding \$480,000 a year savings

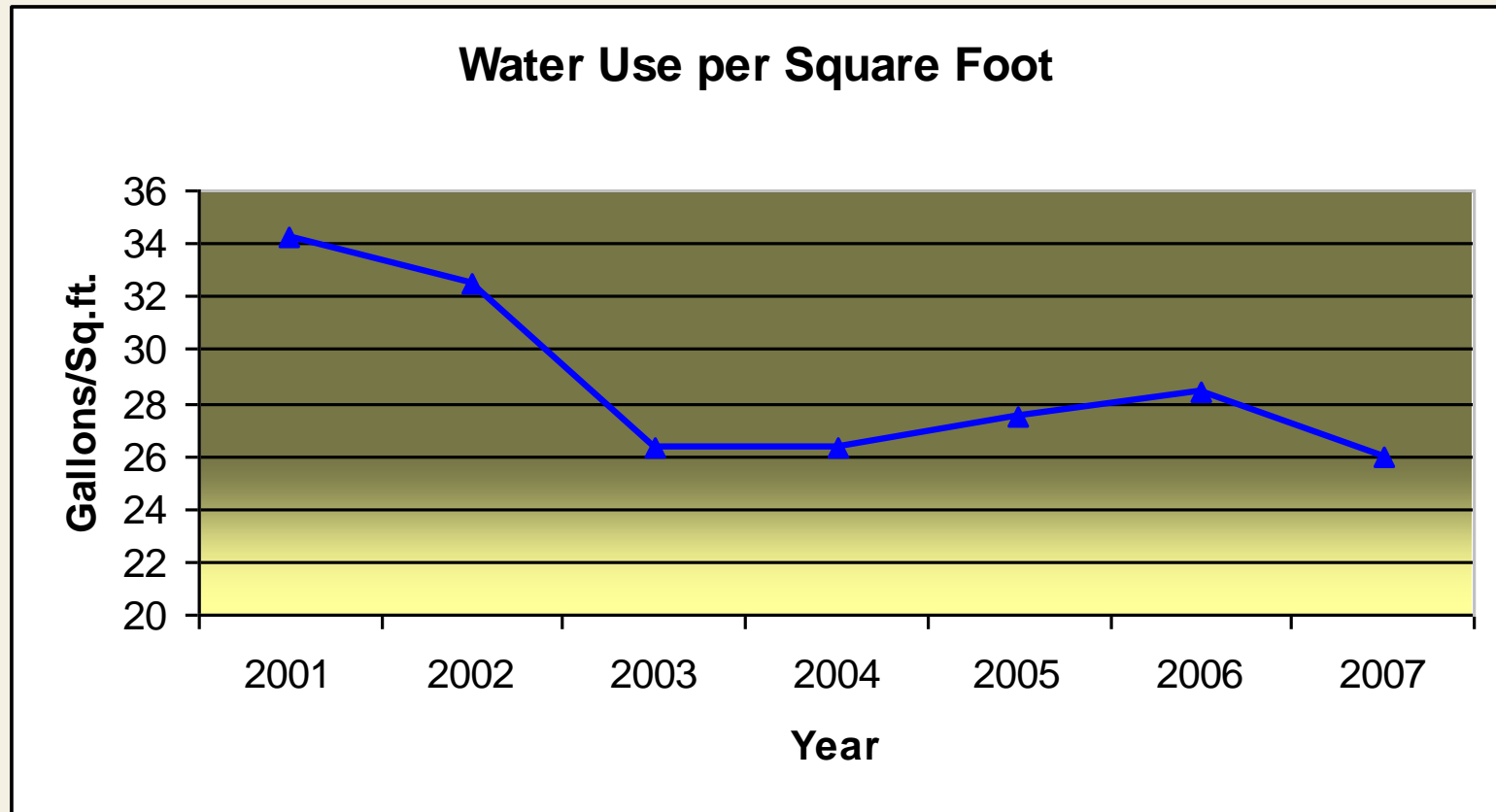


Energy Awareness, Education, Strategies

- **Design for Energy and Water Efficiency, and build to it
(Yellow Book, LEED, GA Code, CA Code, pilot programs etc.)**
- **Retrofits**
- **Commissioning and Retro-commissioning**
- **Energy Efficiency, EnergyStar, etc.**
- **Avoided watts (Negawatts, Negative Watts)**
- **Smart Buildings, Smart Grid, etc.**
- **Renewables**
- **Preventative Maintenance**
- **Education and Awareness**
- **Continuous Improvement**

Water Use

23% reduction in water use per sq ft 2001-2007



**30% reduction in water use since 11/07
Governor asked for 10% cut**

Water Conservation Programs



Low Flow:

Housing 100%

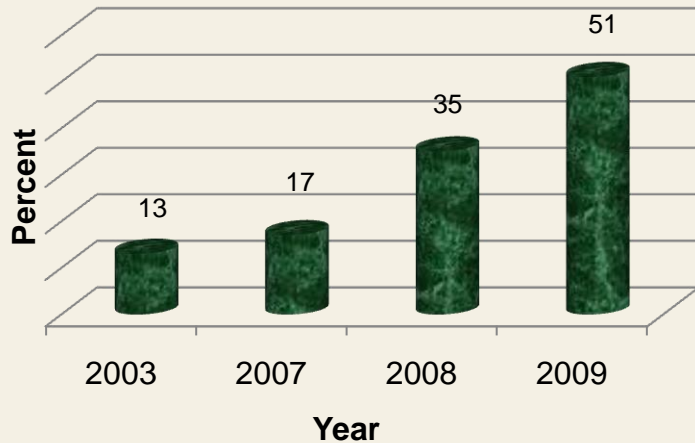
Facilities 95%

Tray-less Dining Halls

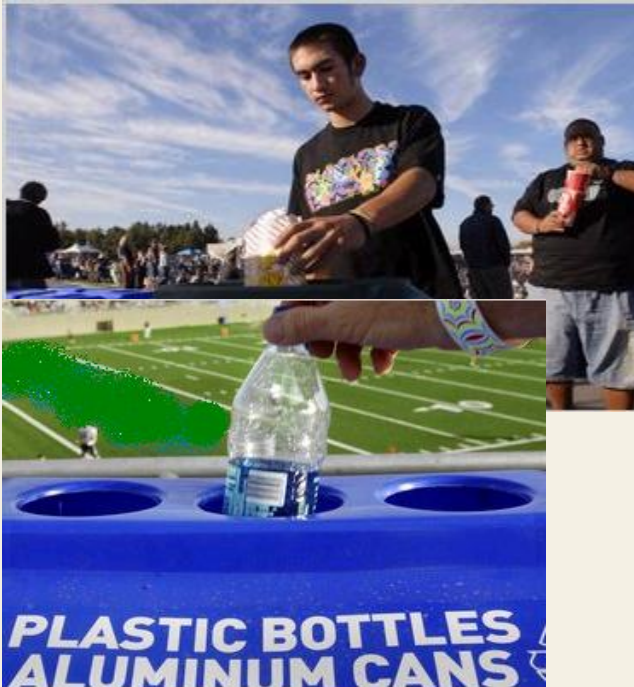
- Low Flow Fixtures
- Sustainable Buildings
- Performance Landscaping
 - Xeriscaping, native plants
- Landscape Master Plan
- Recovered Stream
- Cisterns
 - Rainwater
 - Condensate
- Irrigation Master Plan
- Central Plant Improvements
- Laboratory Water Conservation

Recycling

Diversion Rate

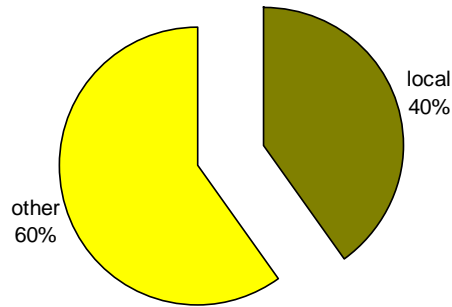


- Largest Earth Day in SE
 - 1st e-waste recycling in GA - 2003
- Paper recycling in every building
 - 6 tons/week
- Recycling contact person in every dept/building
- Student Move In/Out
- Game Day Recycling
- Demolition & Construction 97%
- Green Purchasing – since 2003



2008 American Forest & Paper Award – Paper Recycling
2009 National Recycling Coalition Award – College Campus

Sustainable Dining



- Trayless Dining saves 3K gal/day
- Local, Organic, Fair Trade
 - 41% local
 - Organic in 2008
- Vegetarian/Vegan Brochure
- Composting
- Used oil to biodiesel
- Donated 4000+ lbs food 2007
- Less Packaging
- Reusable utensils and dishware
- Sustainable Food Committee
- Farmers Markets, CSA
- Green Cleaning with Steam
- Moving to Waste Neutral (98% today)
- Reducing energy use

Georgia Tech's Office of Environmental Stewardship signed the **ALFI** (Atlanta Local Food Initiative) supporting locally based food systems

Alternative Transportation



- Tech Trolley & Stinger
- Van Pools
- Marta
- Zipcar (1st in GA)
- SmartPark
- Bike Paths
- Pedestrian Friendly
- Parking & Transportation Master Plan



The U.S. Environmental Protection Agency selected Georgia Tech as one of the first annual “Best Places for Commuters.”

Georgia Tech: Early Adapter of Renewable Energy in Research

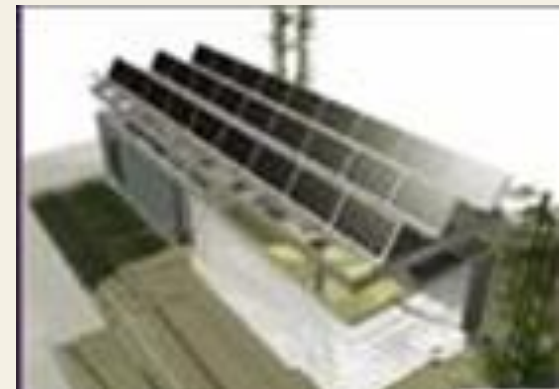
Solar energy research GT began 1970s:

A 325 kW, 500 mirror solar thermal test facility the second largest of its kind in the United States constructed at GT in 1977

- **National Center of Excellence in Photovoltaic's (UCEP) at GT in 1992**
- **Designed and built Georgia Tech's Solar Car – 2003 American Solar Challenge**
- **Designed a zero-emissions home for the 2007 Solar Decathlon**



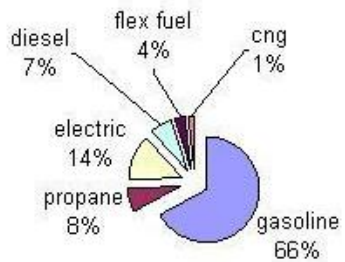
**GTRI's Solar
Furnace 1979**



Recent Renewables and Alternative Energy



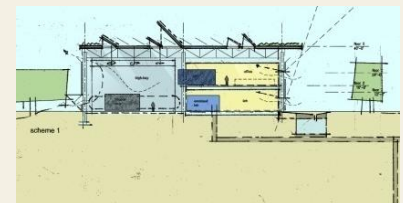
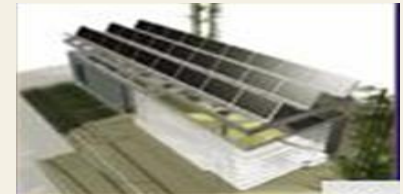
GT Campus Operations' Vehicles in
 FY2007



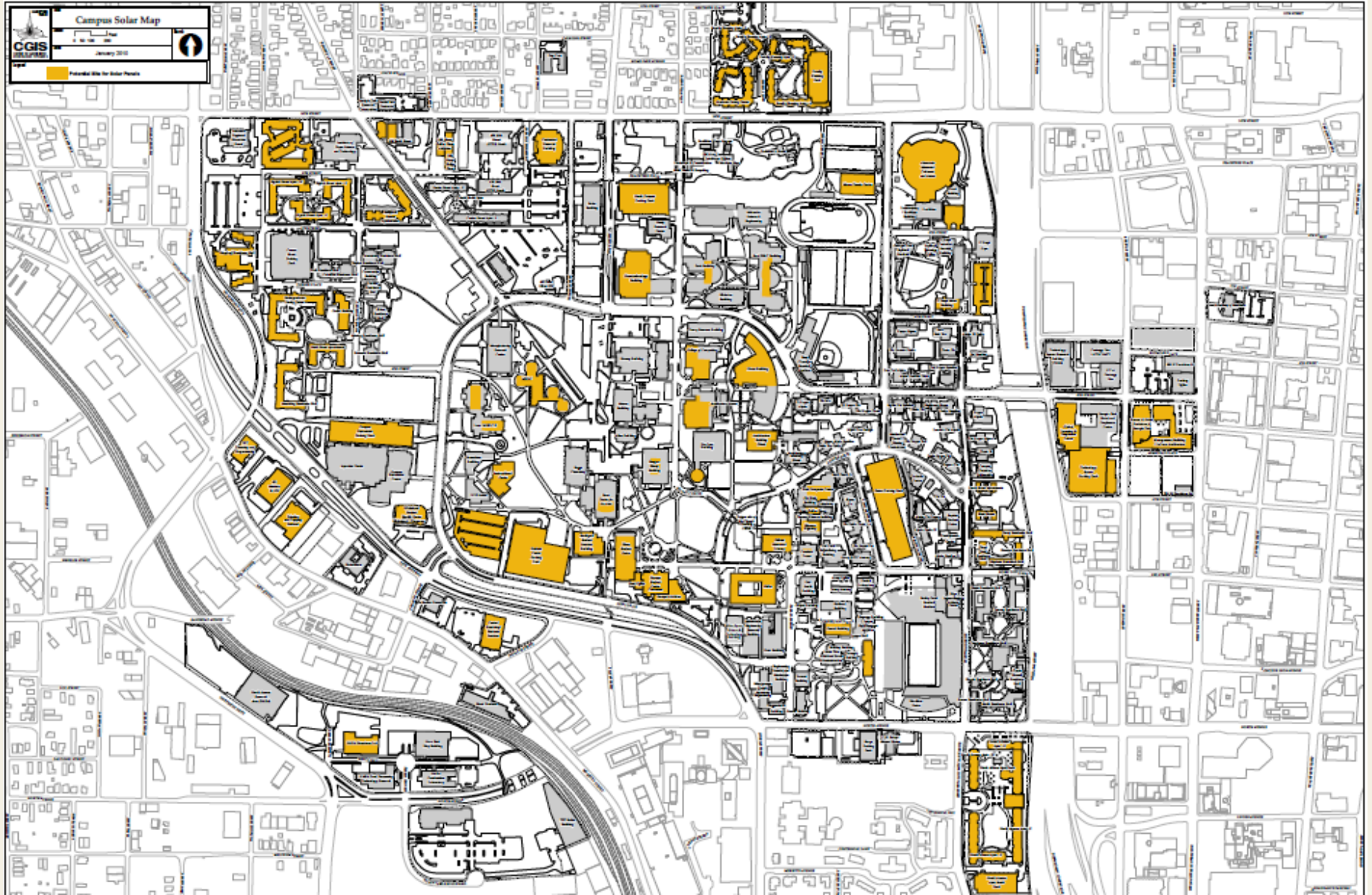
Total Alternative Fuel = 27% (all but gas and diesel)

Georgia Tech: Early Adapter of Renewable Energy in Operations

- 1995
 - Campus Recreation Center
World's largest roof top grid connected grid connected PV array – 342KW, 4000 MWH (1996-2010)
(largest solar PV implementation in GA until 2010)
 - 811 Marietta St
Geothermal System – 250 tons
- 2007
 - Solar Decathlon House
1st Carbon Neutral, 7.5 KW
- 2010-11
 - Clough Undergraduate Learning Commons
220,000 sf PV field generates 60kw
 - Carbon-Neutral Energy Solutions Laboratory Building –
45,000 sf PV field generates 12kw



Campus Solar Opportunities



A way of life, not a separate degree or program



Practical Hands On - Theoretical

- Campus Operations
- Campus Master Plan
- Academics
- Research
- International
- Tech Transfer
- Alumni
- Partners Corporate, NGO, GO, etc

Economic Development

Questions, Comments, Follow-up

www.stewardship.gatech.edu

www.gatech.edu/greenbuzz

www.space.gatech.edu

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