Sustainable Development at the University of Regina

Tom Atkins, P.Eng., LEED AP
Vice President - Mechanical
Stantec Consulting

Jared Larson, P.Eng.
Associate
MacPherson Engineering

Neil Paskewitz, P.Eng.
Director, Planning, Design & Construction
University of Regina
Overview

• Our discussion today will include:
  – Prominent research initiatives at the U of R.
  – Examples of leadership in sustainable design, construction and retrofit of facilities that house this research.
  – Plans for the future.
Campus in a Park
Campus in a Park

- Student Population – 12600
- 1200 staff
- 2.4 million square feet
Campus in a Park

- Student Population – 12600
- 1200 staff
- 2.4 million square feet
Specialized Programs

- Journalism
- Social Work
- Petroleum Engineering
- Media Production
- Actuarial Science
- Software Systems
- Education
- Police Studies
- Health Studies
- Public Policy
Our Strategic Emphasis

– Energy and Environment
– Health
– Culture and Heritage
– Informatics
– Public Safety, Security and Social Justice
Going Green - Historical Campus Research

- 1979 – Regina Geothermal Project
  - Wellhead temperature of 140 Deg F
  - Potential of 16 million Btu/hr
  - Technical and funding issues stopped the project
Going Green - Current Campus Research

- 2000 - The International Test Centre For Carbon Dioxide Capture

- Saskatchewan firsts:
  - Infrastructure to evaluate climate changes & technology
  - World leader in CO2 Capture & Storage (CCS)
  - Instrumental in developing federal provincial climate change discussions
  - Prairie Adaptation Network (model for PARC & the Canadian Impacts & Adaptation Research Network)
Creating and Environment for Success

- 10880 heating degree days, 262 cooling degree days
- 300 days of sunshine

Design conditions:
- Summer: 32 C, 29% RH
- Winter: -40 C, 50 %RH
Utility Stats

Total utility budget; $5.0 million

Electrical:
- Rates:
  - $.0455/kWh
  - $5.251/kVA
- Power purchased at 72 kV
- Distributed at 25 kV
- Essential power also distributed at 25 kV.
- First Sask. purchaser of Green Power
Utility Stats

Natural Gas:
- Rate: $7.00/GJ
- Direct purchase of natural gas.
- Purchasing strategies include gas storage and interruptible service.

• Central Heating Plant capacity:
  - 150,000 pph steam
  - 4800 tons cooling
Going Green - Campus Planning

The University intends to provide community leadership in responsible and effective environmental action through sustainable developments that are land, energy and waste efficient.

University of Regina
Campus Plan for Long Range Development
Going Green - Campus Planning

• 1990 Cogeneration Feasibility
• 1994 Central Plant Linear Infrastructure Capacity Analysis and Utilities Review
• 1996 Chilled Water System Study and Master Plan development
• 1998 Electrical Systems Planning Study
• 2005 Campus Energy Audit
• Ongoing sustainable design and commissioning practices
Going Green - Results!

• During a 10 year period when our campus area grew by 76%, our energy usage grew by less than 10%.

• Unit utility costs in 2009 were $1.60/sq.ft. This is roughly the same as our unit cost paid in 1994, despite inflationary increases such as 267% in natural gas.
Chilled Water Plant

• Phased Replacement and Enhancement
• Phase 1 - 1998
  – Modified the plant to primary/secondary with variable flow secondary circuit
  – Increased plant capacity from 2000 to 3400 TR
  – Installed cooling towers and secondary pumps for ultimate 4800 TR plant capacity
  – Installed extensive metering
  – Replaced cooling plant controls
  – Upgraded plant electrical systems
Chilled Water Plant

• Phase 2 - 2000
  – Improved Chilled Water Flow Controls
    • Replaced over-sized control valves
    • Improved valve authority and rangeability
    • Installed automatic flow control valves
    • Established guidelines for new installations with high ΔT’s
  – Resulted in an overall improvement to the plant ΔT from 8.5 °F to 12 °F
Chilled Water System

- **Phase 3 - 2004**
  - Installed third chiller increasing plant to ultimate 4800 ton capacity

- **2007 - New Lab Building – Heat Recovery/Free Cooling**
Chilled Water System

• Overall Results
  – Increased plant capacity from 2000 TR to 4800 TR
  – Building Improvements resulted in a consistent ΔT of 12°F (from 8.5°F).
  – All-in annual plant efficiency of < 0.7 kw/ton (from 1.2 kw/ton).
2005 Canada Summer Games

• City of Regina selected as host site in July 2001
• The University of Regina campus was selected to host:
  – The Athlete’s Village
  – The administrative, social and cultural center for the games
  – The site for Basketball, Volleyball, and Cycling
New Facilities

- New Residences
  - The Residences and the Dr. Lloyd Barber Academic Green

- New Sporting Facilities
  - The Center for Kinesiology, Health and Sport (CKHS) and Artificial Turf Field
Tree Relocation Project

- More than 500 mature trees were relocated from the building sites and distributed around the campus and neighboring affiliate colleges
Center for Kinesiology Health and Sport

- 265,000 gross ft²
- Construction Cost $26,800,000
- New Three-court Gymnasium capable of seating 2000 spectators
- Elevated 4-lane running track
- Fitness and Lifestyle Areas
- Lecture Theatres, Labs and Classroom Spaces
CKHS Sustainability Initiatives

• Focused on:
  – Optimized Energy Performance
  – Water Use Reduction
  – Additional Commissioning
  – Carbon Dioxide Monitoring
  – Indoor pollutant and source control
  – Occupancy Sensors for ventilation and lighting control
Energy Modeling

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<th>Natural Gas (MJ)</th>
<th>Total (MJ)</th>
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<tr>
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<th>Electricity (kWh)</th>
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<th>Energy Cost ($)</th>
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<td>487,111</td>
<td>225,247</td>
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University of Regina’s Centre for Kinesiology, Health and Sport building is 38.8 % better than the MNECB reference building

Annual reduction of 467,685 kilograms of carbon dioxide emissions
Actual Energy Performance

- The Residences use similar mechanical systems and had similar attention paid to envelope and lighting design and other energy optimization features.
- The combined total increase in building area for the campus for the two projects was 36%.
- The increase in energy use for the campus after occupancy of the two buildings was less than 5%
  - Steam Consumption increased 1.77%
  - Electrical Energy Consumption increased 6.51%
  - Electrical Demand increased 4.49%
What Worked

- Project Partnering
  - University Physical Plant
  - Stakeholders
  - Architects
  - Engineers
  - Construction Manager
- University’s acceptance of risk and risk management
- Disassociation of Design and CM fees from construction costs
- Project Management
- Low Construction Costs ($102/GSF for the Residence, $101/GSF for the Kinesiology).

Construction Owners of America Association 2005 Project Leadership Award Recipient
Lessons Learned

• Ask for performance guarantees on critical energy recovery products
  – Performance of the cross flow air-to-air heat exchangers has been sub-par
• Push harder for buy-in by the lighting design team to optimize lighting energy performance
  – Even with extensive efforts some light levels appear to be higher than necessary
• Look at further reductions in mechanical systems energy
Research and Innovation Centre

• Complete December, 2009
• 160 seat state of the art teaching theatre
• Dry bench lab space
• Wet bench research lab space
• Teaching lab space
• Central Service areas and floor support (NMR, isolated floor labs, etc.)
• Research integrated into facility
  – Green Roof
  – Grey Water Recovery
Research and Innovation Centre
Sustainable Goals

• Produce a flexible laboratory environment
• Provide a flexible building that will respond to the changing needs of research both in terms of discipline and building longevity
• Beat CBIP Energy reduction requirement of 35-40%
• High performing envelope
• Sustainable Showcase
• Utilize Labs 21 as a benchmark for the design
Research and Innovation Centre
Labs 21 Environmental Performance Criteria

• A rating system for use by laboratory building project stakeholders to assess the environmental performance of laboratory facilities. To facilitate widespread use and to avoid "re-inventing the wheel" this effort builds on the U.S. Green Building Council (USGBC) LEED™ Rating System 2.0.
Research and Innovation Centre
Envelope

- Maximize daylighting
- External shading
- Integrated design of insulation requirements and mechanical heating & cooling
Research and Innovation Centre
Wind Tunnel Analysis

- Reduction in power consumption resulting from wind dispersion analysis
- Achieved safe dispersion through regular style stacks and centrifugal fans
Research and Innovation Centre

Mechanical System

- Steam, chilled water from Central Plant
- Variable Flow pumping
- Variable Air Volume
- Manifold Exhaust
- Once thru supply
- Terminal heating & cooling
- No reheat/recool
Heat Recovery

- New Lab requirement: Heat Recovery
- Central Plant requirement: Free Cooling
Heat Recovery

- Utilize heat presently rejected through cooling towers to heat the outside air for the new Lab
- Reduce motor power required for cooling tower operation
- Eliminate winter cooling tower operation
- Net capital cost saving > $250,000
- Operational savings >$10,000 in RIC alone
Research and Innovation Centre
Occupant Safety with Reduced Airflow Rates

- Variable air volume
- Lab occupancy sensor
  - 8 ACH occupied
  - 4 ACH unoccupied
- Fume hoods equipped with Zone Presence Sensor
  - 100 fpm face velocity
  - Reduces by 40% when not in use
Research and Innovation Centre
Displacement Ventilation

• Air supplied below seats
• Air flow rate reduced
• Cooling requirement reduced
• Noise reduced
• Energy reduced – additional 50 days of free cooling
• Ventilation rate reset based on CO2 measurement
Research and Innovation Centre
CBIP Results – compared to MNECB Base

<table>
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<tr>
<th></th>
<th>Electrical (MJ)</th>
<th>Natural Gas (MJ)</th>
<th>TOTAL (MJ)</th>
<th>Annual Cost</th>
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<td>Savings</td>
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<td>10,060,914</td>
<td>12,949,718 (38%)</td>
<td>$65,420</td>
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Commissioning Process
Campus Energy Audit

- Potential to save 21% in energy consumption by updating systems in existing buildings
  - Building Lighting upgrades
  - Building Mechanical Systems
  - Central Plant Systems
  - Water Use Reduction
  - Building Envelope Enhancements
  - Training and Energy Awareness

- Implementation Cost: $5.6 M
- Annual savings of $880,000
- First phase ($2 million project) is complete.

- Boiler Upgrade funded by Student Union
New Project Development

• Continued Emphasis on Energy Savings and Sustainability
  - Reduced lighting and other electrical loads
  - Enhanced envelope design

• Mechanical System Design
  - Disassociating ventilation and thermal loads
  - Use of non-reheating systems
  - Increasing delta T’s in hydronic systems
  - Using building thermal mass

• Energy Recovery and Re-use
  - Heat recovery
  - Use of low grade heat

• Building Energy Modeling
Questions?

Thank you!