

2008-2009  
Building Communities Educational Series  
Focus on Sustainability:  
ENERGY EFFICIENCY

Brought to you by the Center for Community & Economic Development  
Co-sponsored by the Sustainability and Energy Teams  
University of Wisconsin-Extension



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### Today's Presenters



**Ingrid Kelley**  
Energy Center of Wisconsin



**Manus McDevitt**  
Sustainable Engineering Group LLC



**Sherrie Gruder**  
University of Wisconsin-Extension

### Ingrid Kelley, LEED AP, Energy Center of Wisconsin

Ingrid Kelley has promoted renewable energy, energy efficiency, permaculture, and sustainable community design for over twenty years. She holds a Masters degree in Community and Regional Planning from the University of New Mexico and is a LEEDTM Accredited Professional. Currently a project manager at the Energy Center of Wisconsin, she serves as chair of the Environment, Natural Resources, and Energy Division of the American Planning Association. Her book, *Energy in America: A Tour of Our Fossil Fuel Culture and Beyond* will be published by the University of Vermont Press in November 2008.

### Manus McDevitt, P.E., LEED AP, Principal, Sustainable Engineering Group LLC

Manus has extensive experience with energy efficiency in many commercial building types including hospitals, research laboratories, corporate campuses, schools, government buildings, and art and entertainment complexes. His firm, Sustainable Engineering Group, has a client list that ranges from the University of Iowa and the University of Minnesota to the Department of Interior and the Bureau of Indian Affairs. Sustainable Engineering Group is also a technical consultant for Focus on Energy, performing energy modeling and high performance building consultation.

Manus has been involved extensively in obtaining LEED certification for many commercial buildings and is currently a LEED accredited professional. Manus is also a board member of the ASHRAE Madison Chapter and the Wisconsin Geothermal Association.

### Sherrie Gruder, Sustainable Design Specialist, LEED Accredited Professional, Distinguished Lecturer, Energy Program Coordinator

Sherrie Gruder is a Sustainable Design Specialist for the University of Wisconsin-Extension. Sherrie provides statewide education and technical assistance on green building, sustainable community development, energy conservation and renewable energy.



Sherrie is on the renewable energy board of the Wisconsin Focus on Energy Program. Sherrie is a LEED™ Accredited Professional by the US Green Building Council and is serving a second term on its Government Core Committee. Sherrie has served on the education committee of the Wisconsin Green Building Alliance, the advisory council for the Habitat ReStore and on the technical advisory committee of the Wisconsin Green Built Home Program.

Sherrie is trained in The Natural Step and is a founding member of the North American EcoMunicipality Network. She is an author of the UW-Extension publication "*Toward a Sustainable Community: A Toolkit for Local Government*".

Sherrie chairs the City of Madison Sustainable Design & Energy Committee, co-chairs the Madison Mayor's Energy Task Force and co-authored the blueprint to make Madison a green capital city with sustainable design and energy supporting its economic vitality. Sherrie is also part of the MadISUN Solar America Cities program awarded by US DOE.

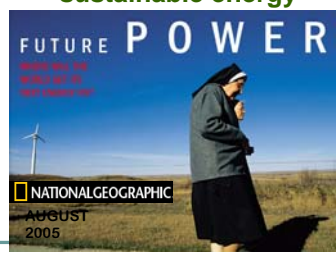

## U.S. Energy Use

- The US consumes 20% of the world's energy annually, with only 5% of its population
- The US holds less than 2% of the world's known oil reserves
- The US imports 2/3 of its oil
- Americans pay ~ \$700,000 /minute to foreign countries supplying oil for their gasoline
- WI spends \$13B each year to import fossil fuels or \$5,800 per household
- The transportation sector consumes 70% of the petroleum the US uses for fuel
- More than half the electricity U.S. buildings consume comes from coal, the single largest producer of CO2 emissions among fossil fuels
  - 70% of WI electricity from utilities comes from coal





## Sustainable Energy

Energy efficiency + renewable energy = **sustainable energy**





## Ten Things You Need to Know About Sustainable Energy




## ~TEN~

The cleanest energy is the energy we don't use.



U.S. DOE Building America Partner Program, Albuquerque, New Mexico  
photo by Warren Gretz

## ~NINE~



There is no magic sustainable energy bullet

## ~EIGHT~

It's not about the technology.



15kW Solar Concentrator at University of Nevada-Las Vegas.  
U.S. DOE photo

~SEVEN~



Charles Darwin painted by George Richmond in the late 1830s

There is no such thing as technical Darwinism.

~SIX~



The greatest new innovations will not be technological.

~FIVE~



Clean energy is the biggest investment opportunity in the world for the foreseeable future.

~FOUR~

We have the technology to start right away.



~THREE~

Sustainable energy is the key to overall sustainability.



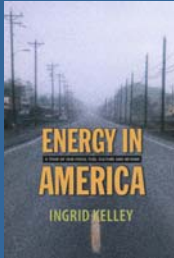
~TWO~

We will be participating globally, but energizing locally.



~ONE~

We can do this.

**Ingrid Kelley, LEED AP**  
**Project Manager**  
**Energy Center of Wisconsin**  
 455 Science Drive, Ste 200  
 Madison, WI 53711  
 608-238-8276 x136  
[ikelley@ecw.org](mailto:ikelley@ecw.org)  
[www.ecw.org](http://www.ecw.org)

**Energy in America:**  
 A tour of our fossil fuel culture and beyond  
 University of Vermont Press  
<http://www.uvm.edu/~uvmbooks/>

# Retro-Commissioning

Manus McDevitt P.E.  
 Sustainable Engineering Group, LLC

11/14/2008

## What is Retro-Commissioning?

**Retro-Commissioning (Retro-Cx) is -**

- A systematic process for improving and optimizing a building's operations and maintenance
- Usually focused on energy-using equipment such as HVAC, controls, and lighting
- Can be performed on a single building, a campus or government building portfolio
- Can be coupled with seeking a LEED for Existing Buildings green building certification

## Goals of Retro-Cx Process

- To identify and fix existing problems, such as indoor air quality and to improve the energy efficiency of the building
- To provide a facility that meets the current needs of the building owner and occupants
- To provide training for facility operators on optimizing the operation and maintenance of the existing building systems

## When to Retro-Cx

- If the building is experiencing:
  - occupant comfort complaints
  - indoor air quality problems
  - higher energy costs
  - numerous operation and maintenance problems
- If the original usage of the building has changed

## Things to Consider

- Do not assume a building with very few too hot/ too cold calls is operating efficiently
- Many occupants simply “adapt” and no longer complain
- Many complaints are not submitted through proper channels and are never documented
- Occupants are very creative and find ways of making their space temperatures acceptable

## Costs of Retro-Cx

- \$0.40 to \$1.20 per square foot depending on the complexity, size and location of the building
- General housekeeping (cleaning coils, filter changes, etc.) done before commissioning is started can help reduce costs
- Assigning maintenance staff to assist the commissioning agent can also help reduce the cost and it provides a good training opportunity

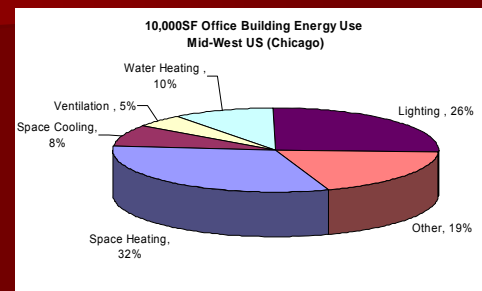


## Savings from Retro-Cx

- 5% - 20% reduction in operating costs
  - 1.5 – 7.5 year simple payback typically
- Based on:
- lower energy usage
  - reduced operational problems
  - improved occupant comfort



## Building Energy Usage



Source: US Department of Energy

## Retro Cx Process

- 1.) Planning Phase
- 2.) Investigation Phase
- 3.) Implementation Phase
- 4.) Operating Phase



## Planning Phase

- Hire a Retro-Cx engineer
  - Provider lists, for example: [www.focusonenergy.org](http://www.focusonenergy.org)
- Identify key players
  - Building Owner/Manager
  - Building Systems Engineer
  - Building Operators/Mechanics
  - Building's controls representative

## Planning Phase

- **Benchmark** past performance
  - Data available from gas and electric utility companies
- Identify problem areas
- Develop Retro-Cx plan

## Investigation



I'm not feeling well!!!

## Investigation Phase

- Determine how the system is supposed to operate
  - Look for design documents from the original construction
  - Determine operating schedule requirements
- Determine how the system is actually operating
  - There is no substitute for field verification



## Investigation Phase

- Document all findings in a Retro-Investigative report
  - Results of initial evaluation
  - List of recommended opportunities and deficiencies
  - Implementation costs and estimated savings

## Implementation Phase

- Prioritize by potential energy savings and costs which systems (and buildings) to upgrade
- Implement recommended opportunities and correct any operational deficiencies
- Verify that changes/ modifications are working correctly
- Monitor building performance to verify energy savings

## Operating Phase

- Operational staff **MUST** be trained in order to sustain efficient operation
- Document/ update the new sequence of operations
- Track monthly building energy use
- Verify correct operation of all energy conservation control strategies

### Case Study

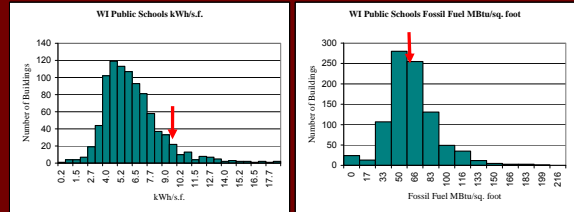
- South Central WI School built in 1960's
- Several additions in 1980's and 1990's
- Total area of 250,000 ft<sup>2</sup>
- Mix of Constant Volume and VAV
- 30 Air Handling Units
- 7 Boilers and 2 Chillers

Main concern is energy consumption



### Case Study

**Annual consumption:**  
 State School Average: 5.5 kWh/sq. foot; 50 MBtu/sq. foot  
 Case Study School: 9.5 kWh/sq. foot; 62 MBtu/sq. foot



### Case Study

- A heating system controller was installed to allow for proper sequencing of all boiler units
- The hot water system has been modified to allow for variable flow operation
- Schedules have been modified to reflect space occupancy patterns for each air-handling unit zone
- Economizer modes have been modified to improve comfort and energy efficiency



### Case Study

- Existing roof-mounted chilled water pipe insulation is badly deteriorated
- Replaced with thicker aluminum shielded, weather-resistant insulation



Savings due to improved insulation

	OLD	NEW
Electric Use (kWh)	11,000	1,900
Electric Demand (kW)	18	3

Savings of about \$500 / year

### Case Study

- Existing chillers are being replaced with more efficient, variable flow and smaller capacity models.
- Computer labs and the IT room have been removed from main chilled water system and are now cooled by independent cooling units, which results in a shorter seasonal operating window for the chillers and improves comfort in winter.



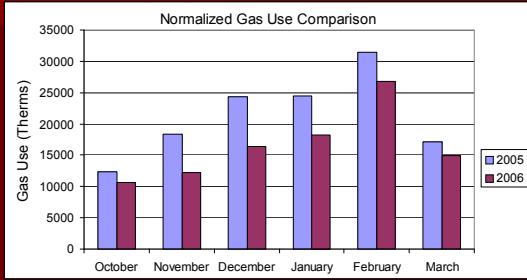
### Case Study

- Staff have reported problems with "stiffness" in several spaces
- Perimeter areas of Office and Guidance spaces too cold in winter



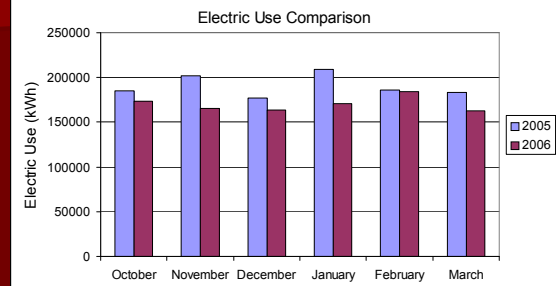
Airflow checking and rebalancing results in enhanced occupant comfort and potentially lower operating costs

### Case Study



Savings of about \$30-50,000 / year in gas

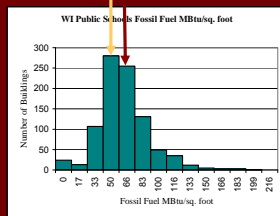
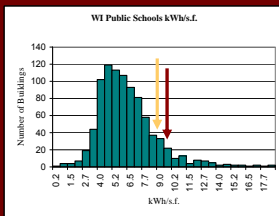
### Case Study



Savings of about \$10-20,000 / yr in electricity

### Case Study

Annual consumption:  
 State School Average: 5.5 kWh/sq. foot; 50 MBtu/sq. foot  
 Case Study School before: 9.5 kWh/sq. foot; 62 MBtu/sq. foot  
 Case Study School after: ~8.5 kWh/sq. foot; ~50 MBtu/sq. foot



### Case Study

Annual estimated savings: **\$40,000 to \$70,000**

Estimated cost to realize savings: **~\$35,000**

Payback period: **6-10 months**

Bonus: Improved comfort and operation!

### Retro Cx Resources



<http://www.peci.org/>



<http://www.cacx.org/>



[http:// www.bcxa.org](http://www.bcxa.org)



<http://www.ashrae.org>

### Sustainable Energy: Programs, Policies & Resources

Sherrie Gruder, LEED AP  
 Sustainable Design Specialist  
 UW-Extension

[www.shwec.uwm.edu](http://www.shwec.uwm.edu)

Building Communities: Focus on Sustainability Webinar  
 November 18, 2008



## Sustainability and Energy Wisconsin Trends

### UW-Ex Agent Survey

(32 counties responded)

- 75%- Local interest in sustainability
- 81%- Energy drives municipal interest in sustainability
- Renewable Energy being considered locally
  - Biofuels – 72%
  - Energy C&E: 60%
  - Wind – 44%
  - Solar Electric – 28%

### WI Local Government Resolutions

- 21 Eco-municipalities
- 30 Energy Independent Communities
  - goal to generate 25% of electricity and transportation fuels from renewable energy locally by 2025



## Community Planning UW-Extension

### Toward a Sustainable Community: A Toolkit for Local Government

January, 2007

[www.shwec.uwm.edu/sustk](http://www.shwec.uwm.edu/sustk)

#### Government Spheres of Influence

- Energy
- Buildings & Development
- Transportation
- Purchasing

Toward a Sustainable Community:  
A Toolkit for Local Government



## Building Opportunities

*Buildings consume 72% of US electricity & account for 36% of U.S. greenhouse gas emissions related to energy use*

### Programs, Policies & Goals

#### • LEED = Leadership in Energy & Environmental Design

Green Building Rating System  
LEED-NC, -ND, -EB, -CI  
\* Government Green Building Programs Inventory, UW-Ex database

**Reducing energy use by 30% = 5% increase in net operating income**

Creating green buildings & neighborhoods goes straight to the bottom line- the triple bottom line of people, planet and profits



## Wisconsin Green Buildings

**Kettle Foods** Beloit, WI  
ACS, Design-build  
LEED Gold

Kettle LEED  
MSNBC

73,000 SF

- 18 wind turbines
- Highly energy efficient, \$200,000/yr savings
- Daylighting, views, nontoxic
- Offsetting 100% of electricity with renewable wind power (16M pounds CO2)
- Converting used cooking oil into biodiesel
- Reusing 3M gal water
- Dedicating five acres to restoration of native prairie land



## Building Opportunities

### Policies, Goals, Procedures

- Zero net energy buildings
- 2030 challenge
- Upgrade building and zoning codes
- Upgrade purchasing specifications
- Improve operations practices
- Measure & report baseline & results



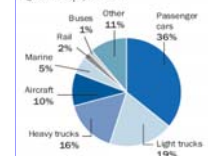
Johnson Controls performance contracting



## Transportation Opportunities

Transportation sector consumes 70% of the petroleum the US uses for fuel

Emissions of greenhouse gases in transportation by sector  
Figures are from year 2000.



Source: US EPA



## Energy Independent Communities



### Governor's Energy Independence Goals

- Generate 25% of electricity and transportation fuels from renewable resources by 2025
- Capture 10% of the emerging bioindustry and renewable energy market by 2030
- Become national leader in groundbreaking energy research

### Office of Energy Independence

Energy Independent Communities Program is the local bridge to those statewide goals

- contact: Brian Driscoll (608) 261-8146  
[brian.driscoll@wisconsin.gov](mailto:brian.driscoll@wisconsin.gov)



## Energy Independent Communities



\$500,000 grant program 2009 will fund:

- 5-10 WI Communities
- Request for applications due December 15, 2008

to accomplish:

- an energy assessment of government buildings, infrastructure and fleet;
- a strategic energy planning process;
- development of a plan to achieve energy independence goal of 25x'25



## Energy Resources

- **Energy Center of Wisconsin**
  - [www.ecw.org](http://www.ecw.org)
- **Focus on Energy** - new construction, government, business, industrial, residential, renewables 800 762-7077
  - Fact sheets, incentive applications [www.focusonenergy.com](http://www.focusonenergy.com)
- **UW-Extension, Solid & Hazardous Waste Education Center**
  - [www.shwec.uwm.edu](http://www.shwec.uwm.edu)
- **WI Green Building Alliance**
  - [www.wgba.org](http://www.wgba.org)
- **WI Office of Energy Independence**
  - <http://power.wisconsin.gov>
- **Architecture 2030**
  - [www.architecture2030.org](http://www.architecture2030.org)
- **ENERGY STAR**, US EPA & US DOE
  - <http://www.energystar.gov/>
- **Enterprise Green Communities** - affordable housing
  - <http://www.greencommunitiesonline.org/>
- **ICLEI** Local Governments for Sustainability
  - [www.iclei.org](http://www.iclei.org)
- **US Green Building Council** - LEED, Tools for government & schools
  - [www.usgbc.org/DisplayPage.aspx?CMSPageID=1780](http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1780)



## Energy Resources

- **A Sustainable Energy Checklist for Green Communities**
  - [http://www.focusonenergy.com/files/Document\\_Management\\_System/Renewables/sustainable\\_checklist.pdf](http://www.focusonenergy.com/files/Document_Management_System/Renewables/sustainable_checklist.pdf)
- **Building a Green Capital City: The Natural Step to Madison's Sustainable Design and Energy Future**, Gruder, Sherrie, *ACEEE Proceedings Summer Study 2008*
  - [www.shwec.uwm.edu/publications/](http://www.shwec.uwm.edu/publications/)
- **Government Green Building Programs Inventory**
  - [www.shwec.uwm.edu/government/green/](http://www.shwec.uwm.edu/government/green/)
- **On-site Renewable Energy in LEED Buildings: Case Study Compendium, Focus On Energy Fact Sheet**
  - <http://www4.uwm.edu/shwec/publications/publications.cfm>
- **Playbook for Green Buildings + Neighborhoods**
  - <http://www.wisconsin.gov/playbook.pdf>
- **The Energy Efficient Renewable Home**
  - [http://www.focusonenergy.com/files/Document\\_Management\\_System/Renewables/W\\_RW\\_MKFS\\_EnergyEfficientRenHome.pdf](http://www.focusonenergy.com/files/Document_Management_System/Renewables/W_RW_MKFS_EnergyEfficientRenHome.pdf)
- **Toward a Sustainable Community: A Toolkit for Local Government**
  - Toolkit, links [www.shwec.uwm.edu/sustk/](http://www.shwec.uwm.edu/sustk/)
  - <http://www2.uwsp.edu/sustainability/>



## Next session

December 16, 2008, 11:30 - 12:30 P.M., C.T.

### Renewable Energy

Presenters: Don Wichert, Director, Focus on Energy Renewable Energy Program

Renewable energy is part of a strategic approach to energy that reduces carbon emissions, improves energy reliability and may protect against escalating fuel costs. This webinar examines the renewable energy technologies available and how to choose the options best for your community or your site. Questions to be considered by the presenters include: Is it affordable? Who are the service providers in my area? How do I proceed? What renewable installations are already operating?

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## Archive Access

To access an archived version of today's program, go to:  
<https://www.livemeeting.com/cc/wislineweb/view>

- Enter Name
- Recording ID: **Bldg Comm-081118**
- Recording Key: (Leave Blank)
- Click View Recording
- Click the ICON for either Microsoft Office Live Meeting High Fidelity Presentation OR Microsoft Office Live Meeting Replay
- This archive will remain for two weeks on the web



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