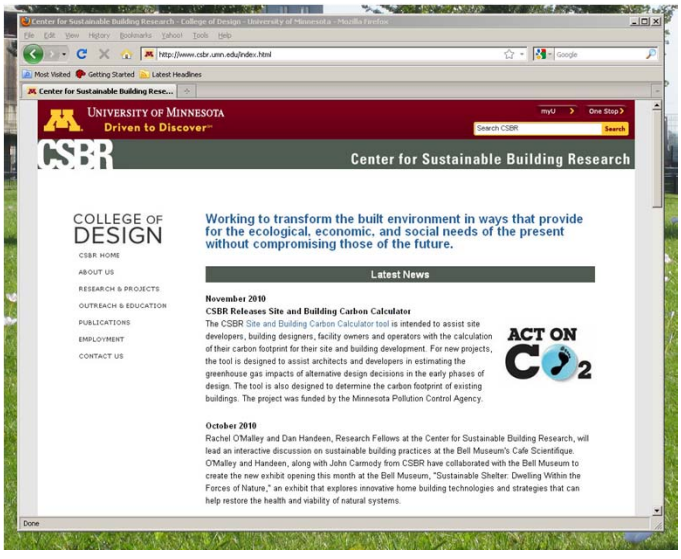
Richfield Housing Visioning Workshop

Sustainable Affordable Housing Overview

William Weber
wmweber@umn.edu

Center for Sustainable Building Research



Center for Sustainable Building Research

CSBR Activities

Sustainable Guidelines, Standards and Tools

- Sustainable Buildings 2030
- Buildings, Benchmarks & Beyond (B3) Project: The State of Minnesota Sustainable Building Guidelines (MSBG)
- City of St. Paul Green Building Policy
- Life Cycle Assessment of Materials—Athena EcoCalculator
- Minnesota Building Materials Database
- Greening the College and the University

Windows and Glazing

- *"Residential Windows: A Guide to New Technologies and Energy Performance"*
- Efficient Windows Collaborative web site and selection tool
- *"Window Systems for High Performance Buildings"*
- Commercial Windows web site and selection tool

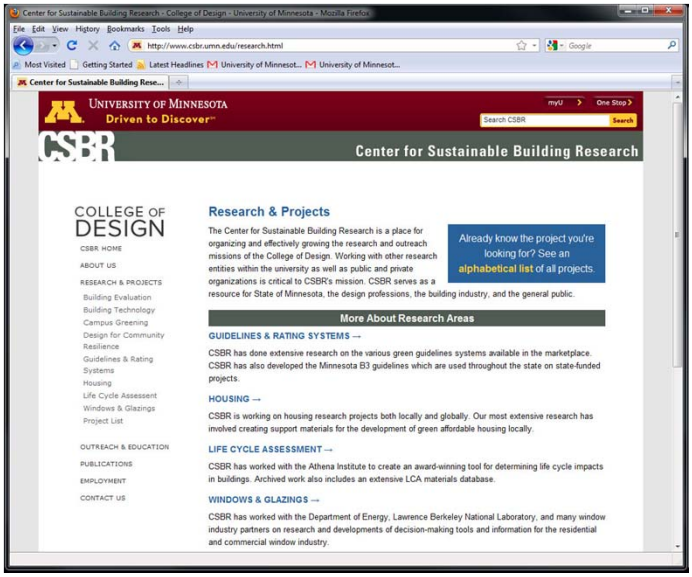
CSBR Activities

Affordable Housing

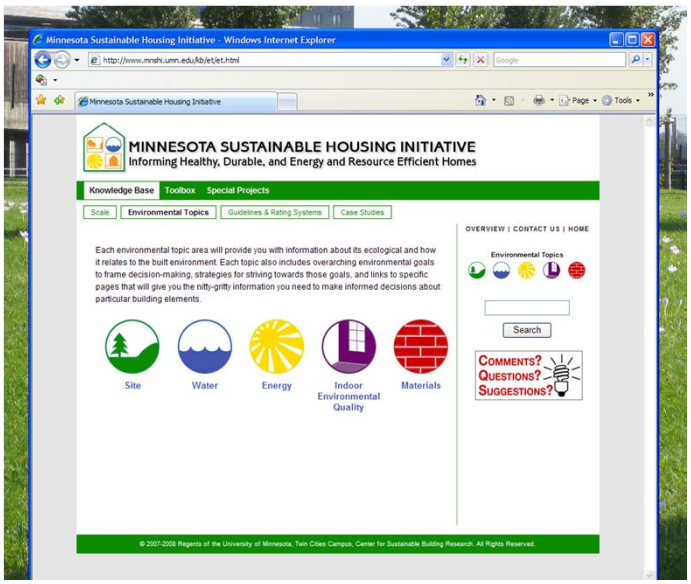
- Minnesota Sustainable Housing Initiative (McKnight Foundation)
- Sustainable Housing Research for Korea
- HUD Communities Outreach Partnership Center (Includes Department of Architecture, Metropolitan Design Center, and Cold Climate Housing Program)
- Demonstration Homes in the Frogtown Neighborhood
- Green Communities Program

Building Evaluation

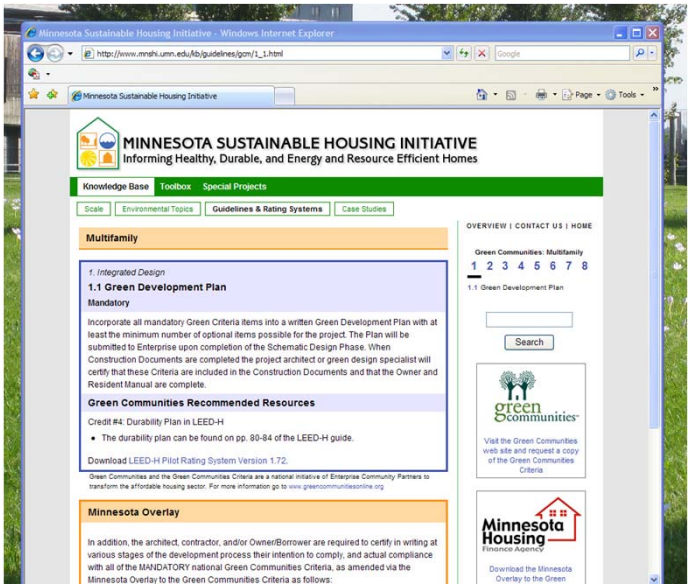
- Post Occupancy Evaluations of buildings for MNSCU, University of Minnesota, Departments of Natural Resources and Transportation
- Post Occupancy Evaluations of sustainable pilot projects for Hennepin, Ramsey, Dakota, Carver and Washington Counties
- Evaluation of Green Community Pilot Projects


Center for Sustainable Building Research - College of Design - University of Minnesota - Mozilla Firefox
http://www.csbr.umn.edu/research.html
UNIVERSITY OF MINNESOTA
Driven to Discover℠
Search CSBR
Search
CSBR
Center for Sustainable Building Research
COLLEGE OF DESIGN
CSBR HOME
ABOUT US
RESEARCH & PROJECTS
Building Evaluation
Building Technology
Campus Greening
Design for Community Resilience
Guidelines & Rating Systems
Housing
Life Cycle Assessment
Windows & Glazings
Project List
OUTREACH & EDUCATION
PUBLICATIONS
EMPLOYMENT
CONTACT US
Research & Projects
The Center for Sustainable Building Research is a place for organizing and effectively growing the research and outreach missions of the College of Design. Working with other research entities within the university as well as public and private organizations is critical to CSBR's mission. CSBR serves as a resource for State of Minnesota, the design professions, the building industry, and the general public.
Already know the project you're looking for? See an alphabetical list of all projects.
More About Research Areas
GUIDELINES & RATING SYSTEMS →
CSBR has done extensive research on the various green guidelines systems available in the marketplace. CSBR has also developed the Minnesota B3 guidelines which are used throughout the state on state-funded projects.
HOUSING →
CSBR is working on housing research projects both locally and globally. Our most extensive research has involved creating support materials for the development of green affordable housing locally.
LIFE CYCLE ASSESSMENT →
CSBR has worked with the Athena Institute to create an award-winning tool for determining life cycle impacts in buildings. Archived work also includes an extensive LCA materials database.
WINDOWS & GLAZINGS →
CSBR has worked with the Department of Energy, Lawrence Berkeley National Laboratory, and many window industry partners on research and developments of decision-making tools and information for the residential and commercial window industry.

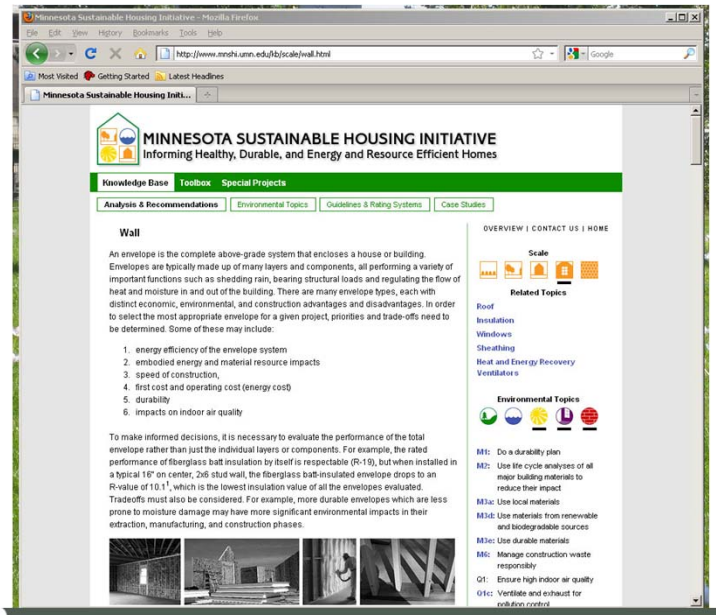

Minnesota Sustainable Housing Initiative - Mozilla Firefox
http://www.mnshi.umn.edu/
Minnesota Sustainable Housing Initi...
MINNESOTA SUSTAINABLE HOUSING INITIATIVE
Informing Healthy, Durable, and Energy and Resource Efficient Homes
Knowledge Base
Toolbox
Special Projects
Analysis & Recommendations
Environmental Topics
Guidelines & Rating Systems
Case Studies
Welcome
Welcome to the Minnesota Sustainable Housing Initiative website. This website is a portal for information and research being conducted by the Center for Sustainable Building Research to inform and support the creation of affordable, health, durable, and resource and energy efficient homes throughout the state and region.
Our goal is to provide accurate, helpful, and insightful information to the community of developers, architects, and the construction industry. In response to the critical challenges facing the affordable housing industry over the next ten years, CSBR is creating a clearinghouse for information and research on best practices and new technologies in sustainable affordable housing. This information is often fragmented and not widely shared. CSBR's efforts will be to consolidate knowledge, create a feedback loop for local successes in order to encourage cross-pollination, and develop tools for the benefit of the housing construction sector in the region.
This site is intended to be a living resource and guide; it will evolve and change to address shifts in the market place and the concerns of its users. To that end, please let us know if there are particular research areas that you would like to see addressed.
News:
A new report from Wilder Research commissioned by the Blue Cross and Blue Shield of Minnesota Foundation outlines the inequity of health in the Twin Cities. Titled, "The unequal distribution of health in the Twin Cities," the report examines socioeconomic and environmental factors that contribute to health and life expectancy. The report can be download from Minnesota Compass.
U of MN's ICON Solar House will be part of the Bell Museum of Natural History exhibit entitled Sustainable Shelter: Dwelling within the Forces of Nature. The exhibit will show the many ways that animals and humans create shelter, and explain how shelters relate to the environment. The ICON House will be open for visitation during Bell Museum hours as an example of some of the techniques and technologies that are presented in the exhibit. The exhibit opens October 16, and runs through May 15, 2011.
Recent updates:
House Height
Basement
Condensation Resistance
http://www.mnshi.umn.edu/kb/kb.html

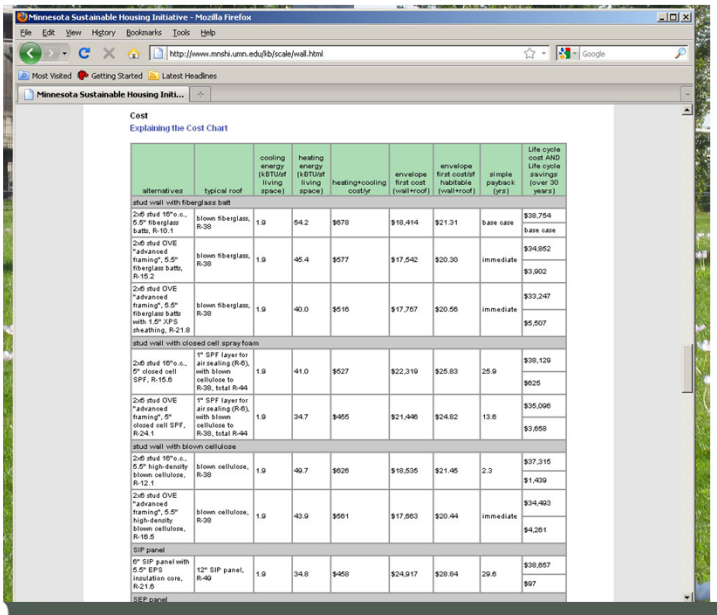


CSBR Center for Sustainable Building Research



CSBR Center for Sustainable Building Research





alternatives	typical roof	cooling energy (kBTU/sf living space)	heating energy (kBTU/sf living space)	heating+cooling cost/yr	envelope first cost (wall+roof)	envelope first cost/sf habitable (wall+roof)	simple payback (yrs)	Life cycle cost AND Life cycle savings (over 30 years)
stud wall with fiberglass batt								
2x6 stud 16"o.c., 5.5" fiberglass batts, R-19.1	blown fiberglass, R-38	1.9	54.2	$678	$19,414	$21.31	base case	$39,754
								base case
2x6 stud OVE "advanced framing", 5.5" fiberglass batts, R-15.2	blown fiberglass, R-38	1.9	46.4	$577	$17,542	$20.30	immediate	$34,852
								$3,902
2x6 stud OVE "advanced framing", 5.5" fiberglass batts with 1.5" XPS sheathing, R-21.8	blown fiberglass, R-38	1.9	40.0	$516	$17,767	$20.56	immediate	$33,247
								$5,507
stud wall with closed cell spray foam								
2x6 stud 16"o.c., 5" closed cell SPF, R-15.6	1" SPF layer for air sealing (R-6), with blown cellulose to R-39, total R-44	1.9	41.0	$527	$22,319	$25.83	25.9	$38,129
								$625
2x6 stud OVE "advanced framing", 5" closed cell SPF, R-24.1	1" SPF layer for air sealing (R-6), with blown cellulose to R-38, total R-44	1.9	34.7	$455	$21,446	$24.82	13.6	$35,096
								$3,658
stud wall with blown cellulose								
2x6 stud 16"o.c., 5.5" high-density blown cellulose, R-12.1	blown cellulose, R-38	1.9	49.7	$626	$19,535	$21.46	2.3	$37,315
								$1,439
2x6 stud OVE "advanced framing", 5.5" high-density blown cellulose, R-16.5	blown cellulose, R-38	1.9	43.9	$561	$17,663	$20.44	immediate	$34,493
								$4,261
SIP panel								
6" SIP panel with 5.5" EPS insulation core, R-21.5	12" SIP panel, R-49	1.9	34.8	$458	$24,917	$28.84	29.6	$38,657
								$97
SEP panel								

"Sustainable development involves… meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Report, United Nations, 1987

CSBR Center for Sustainable Building Research

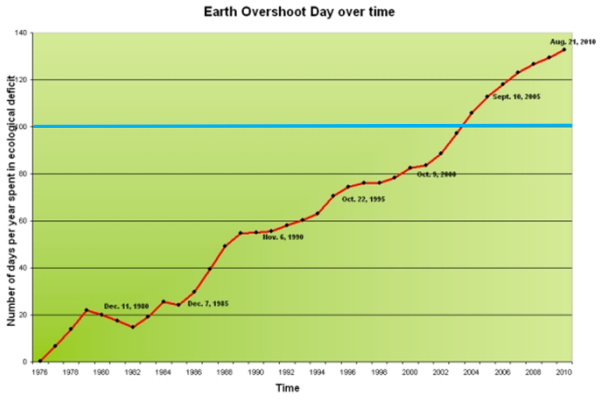
Impact of Buildings on People and the Natural Environment

- *Buildings use one-sixth to one-half of the world's wood, minerals, water, and energy. Buildings generate 40% of the waste going to land fills.*
- *Blame for much of the environmental damage occurring today, from destruction of forests and rivers to air and water pollution and climate destabilization, must be placed on modern buildings.*
- *Many buildings do harm on the inside as well making us both less healthy and less productive than we are capable of being: 30% of the commercial buildings constructed since the 1960's are unhealthy.*

From the U.S. Environmental Protection Agency (EPA), National Resource Defense Council (NRDC), and World Watch Institute

CSBR Center for Sustainable Building Research

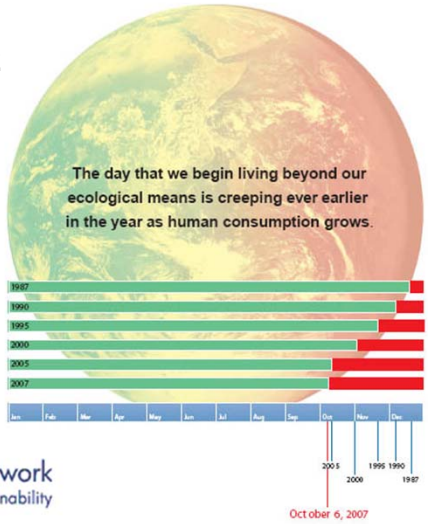
We are consuming to much.



CSBR Center for Sustainable Building Research

WORLDWATCH INSTITUTE

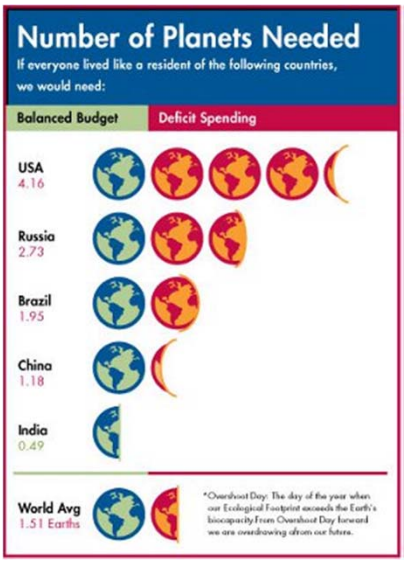
August 22, 2012



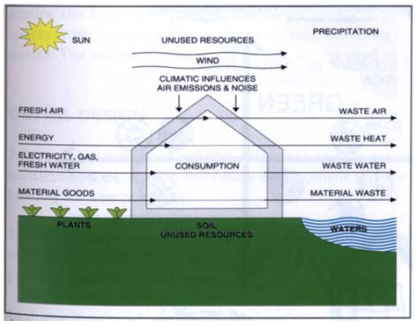
Global Footprint Network
Advancing the Science of Sustainability

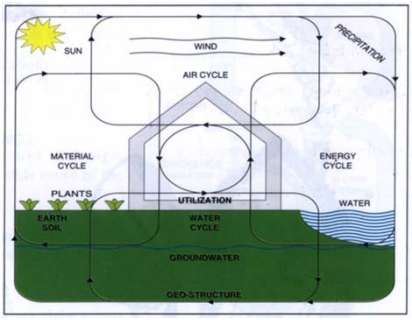
http://www.footprintnetwork.org/gfn_sub.php?content=overshoot

CSBR Center for Sustainable Building Research



CSBR Center for Sustainable Building Research





CSBR Center for Sustainable Building Research

Sustainable Building Guidelines
North America

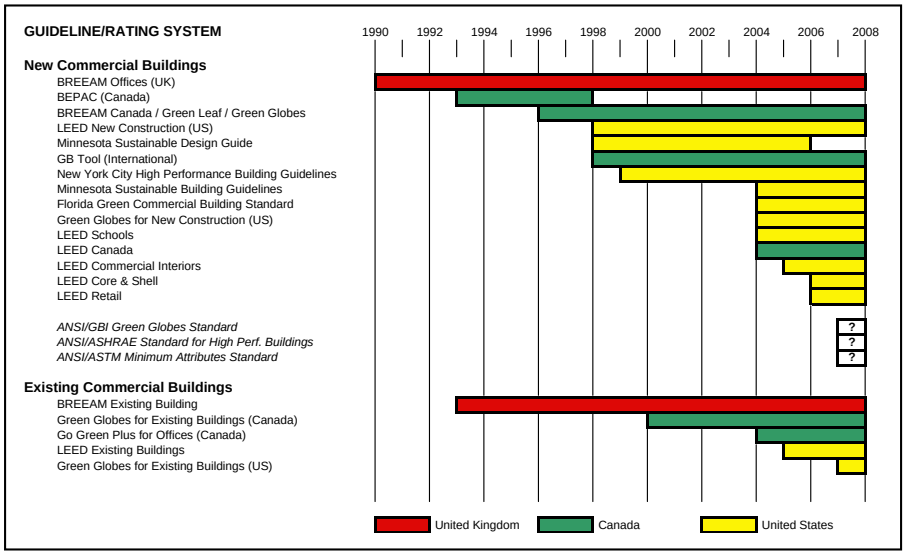
LEED
US Green Building Council
www.usgbc.org

Green Globes
Green Building Initiative
www.thegbi.org

Minnesota Sustainable Building Guidelines
www.csbr.umn.edu/B3

Living Building Challenge
www.cascadiagbc.org/lbc/

Center for Sustainable Building Research



Sustainable Housing Guidelines
North America

LEED for Homes
www.usgbc.org

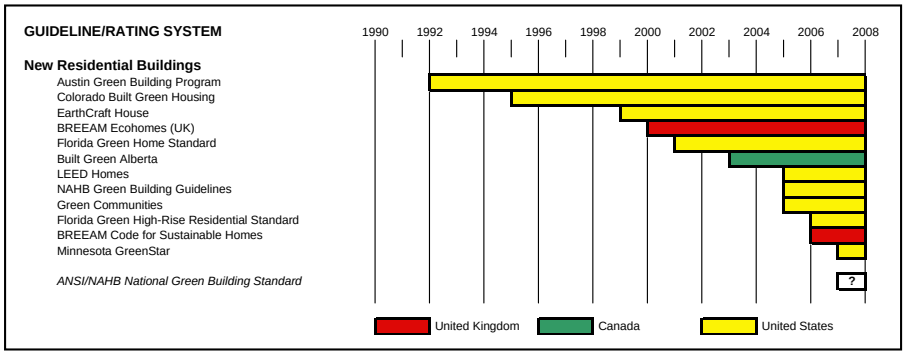
NAHB Green Home Building Guidelines
www.nahbrc.org/greenguidelines/

Green Communities Program
www.greencommunitiesonline.org

Austin Energy Green Building
www.austinenergy.com

Minnesota GreenStar
www.mngreenstar.com/

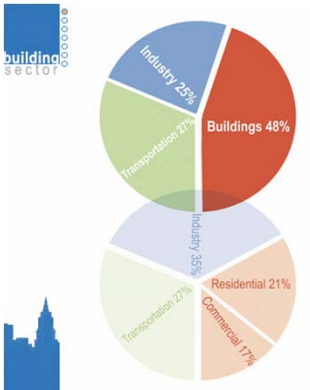
Center for Sustainable Building Research



Center for Sustainable Building Research

Recent North American Trends

- A diverse set guidelines and rating systems are continually evolving in response to the scale of development, building type and regional issues
- Guidelines are being adopted by states and cities as basis for codes, standards and incentives
- There is a movement away from simple point-based checklists alone toward more requirements and a focus on performance outcomes such as carbon emissions and energy
- Life cycle assessment of materials is beginning to be included in guidelines and ratings
- There is increased focus on actual performance during operation and the need for a feedback loop and continuous improvement

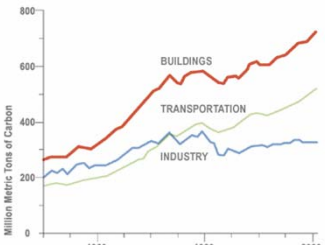


U.S. ENERGY CONSUMPTION BY SECTOR

Source:
U.S. Energy Information Administration statistics
Graphic Published first in Metropolis Magazine, October 2003 Issue.

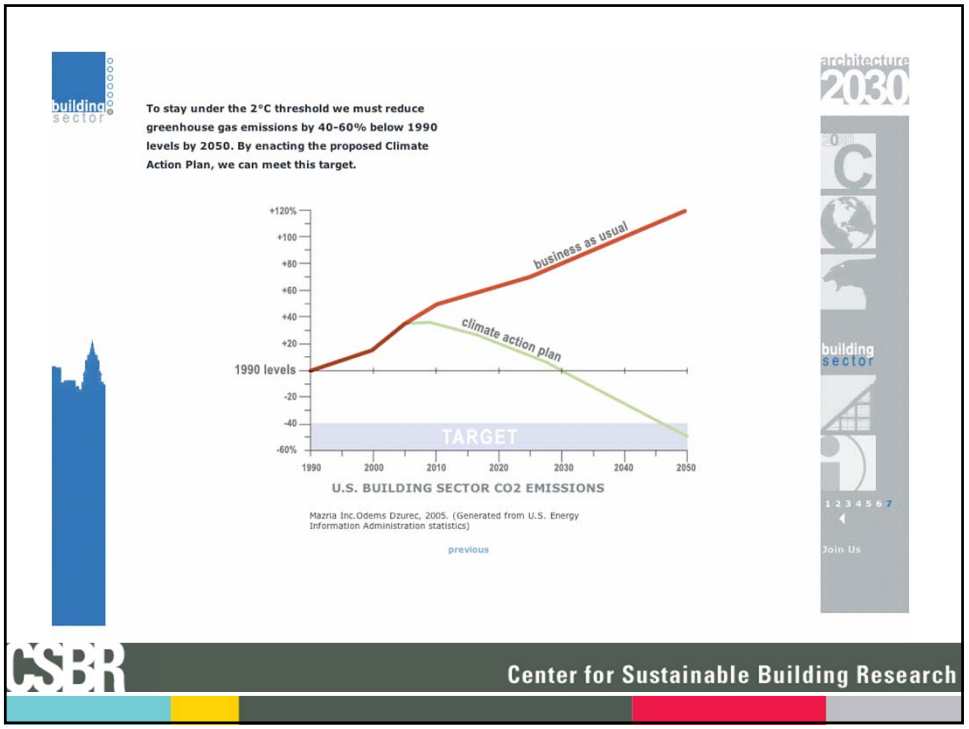
"Unknowingly, the architecture and building community is responsible for almost half of all U.S. greenhouse gas emissions annually. Globally the percentage is even greater."

Combining the annual energy required to operate residential, commercial, and industrial buildings along with the embodied energy of industry-produced building materials like carpet, tile, glass, and concrete exposes buildings as the largest energy consuming and greenhouse gas emitting sector.



U.S. CO_2 EMISSIONS BY SECTOR

Source: U.S. Energy Information Administration statistics



Key Issues

- Biocentric versus anthropocentric approach
- Relative versus absolute targets
- Performance versus prescriptive guidelines
- Voluntary market-based approach versus code-based requirements
- Self assessment versus third party certification
- Design phase only versus actual monitoring
- Point-based versus requirement approach
- Adaptability to different project types
- Focus on energy and water only versus broader scope

CSBR Center for Sustainable Building Research

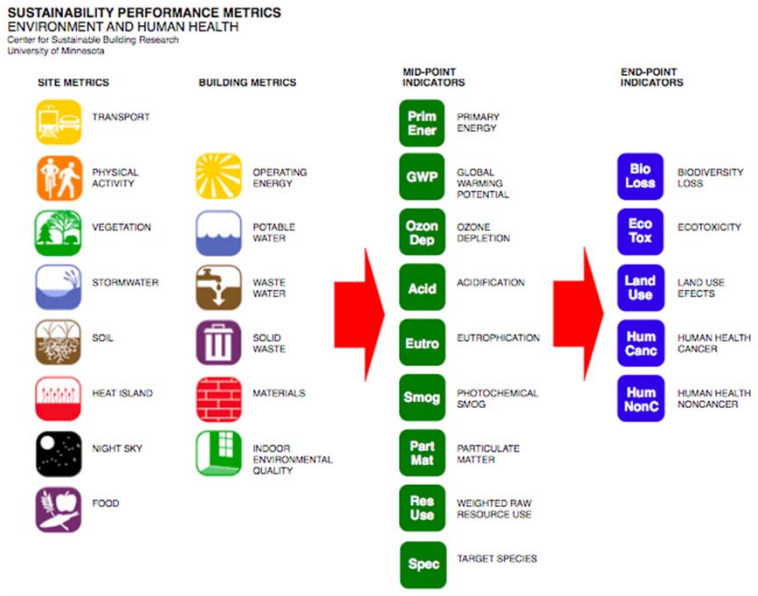
Living Building Challenge

The Living Building Challenge
In Pursuit of True Sustainability in the Built Environment
Version 1.3
August 2009

Summary of Prerequisites

Number	Petal	Prerequisite
One	Site	Responsible Site Selection
Two	Site	Limits to Growth
Three	Site	Habitat Exchange
Four	Energy	Net Zero Energy
Five	Materials	Materials Red List
Six	Materials	Construction Carbon Footprint
Seven	Materials	Responsible Industry
Eight	Materials	Appropriate Materials/Services Radius
Nine	Materials	Leadership in Construction Waste
Ten	Water	Net Zero Water
Eleven	Water	Sustainable Water Discharge
Twelve	Indoor Quality	A Civilized Environment
Thirteen	Indoor Quality	Healthy Air: Source Control
Fourteen	Indoor Quality	Healthy Air: Ventilation
Fifteen	Beauty & Inspiration	Beauty and Spirit
Sixteen	Beauty & Inspiration	Inspiration and Education

CSBR Center for Sustainable Building Research



CSBR Center for Sustainable Building Research

Background – by the numbers

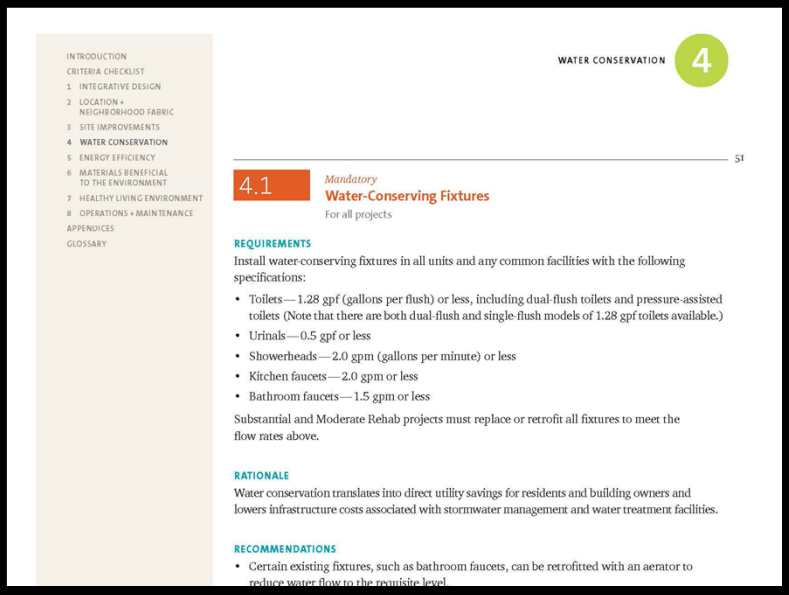
2005 Minnesota Green Communities Pilot Program launched
2007 Minnesota Housing requires green criteria for multifamily new construction
2008 Minnesota Housing expands requirement to single family

Other programs—LEED, LEED for Homes, Living Building Challenge

Other Users –
St. Paul Policy
Minneapolis Green Homes North

30

1. Integrated Design
2. Location + Neighborhood Fabric
3. Site Improvements
4. Water Conservation
5. Energy Efficiency
6. Materials Beneficial to the Environment
7. Healthy Living Environment
8. Operation + Maintenance



INTRODUCTION
CRITERIA CHECKLIST
1 INTEGRATIVE DESIGN
2 LOCATION + NEIGHBORHOOD FABRIC
3 SITE IMPROVEMENTS
4 WATER CONSERVATION
5 ENERGY EFFICIENCY
6 MATERIALS BENEFICIAL TO THE ENVIRONMENT
7 HEALTHY LIVING ENVIRONMENT
8 OPERATIONS + MAINTENANCE
APPENDICES
GLOSSARY

WATER CONSERVATION 4

51

4.1 *Mandatory*
Water-Conserving Fixtures
For all projects

REQUIREMENTS

Install water-conserving fixtures in all units and any common facilities with the following specifications:

- Toilets—1.28 gpf (gallons per flush) or less, including dual-flush toilets and pressure-assisted toilets (Note that there are both dual-flush and single-flush models of 1.28 gpf toilets available.)
- Urinals—0.5 gpf or less
- Showerheads—2.0 gpm (gallons per minute) or less
- Kitchen faucets—2.0 gpm or less
- Bathroom faucets—1.5 gpm or less

Substantial and Moderate Rehab projects must replace or retrofit all fixtures to meet the flow rates above.

RATIONALE

Water conservation translates into direct utility savings for residents and building owners and lowers infrastructure costs associated with stormwater management and water treatment facilities.

RECOMMENDATIONS

- Certain existing fixtures, such as bathroom faucets, can be retrofitted with an aerator to reduce water flow to the requisite level.

32

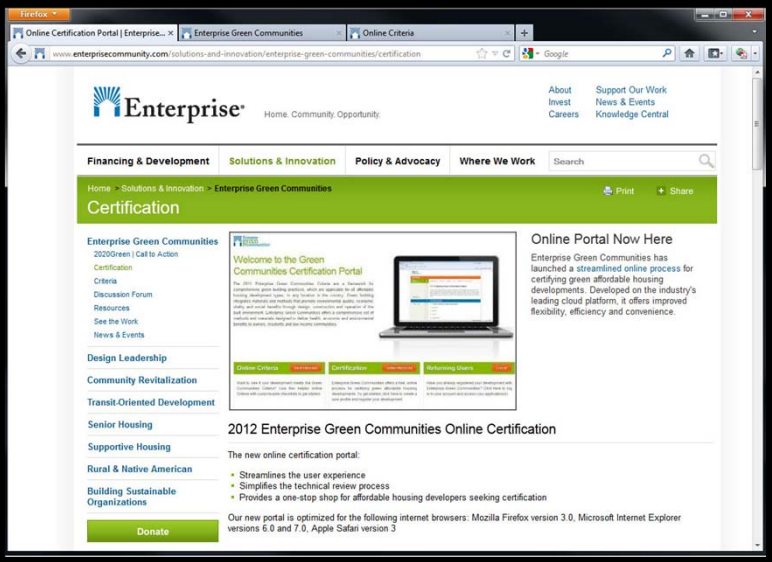
Who? – (almost) all projects funded by MN Housing.

Mandatory and Optional Criteria Table

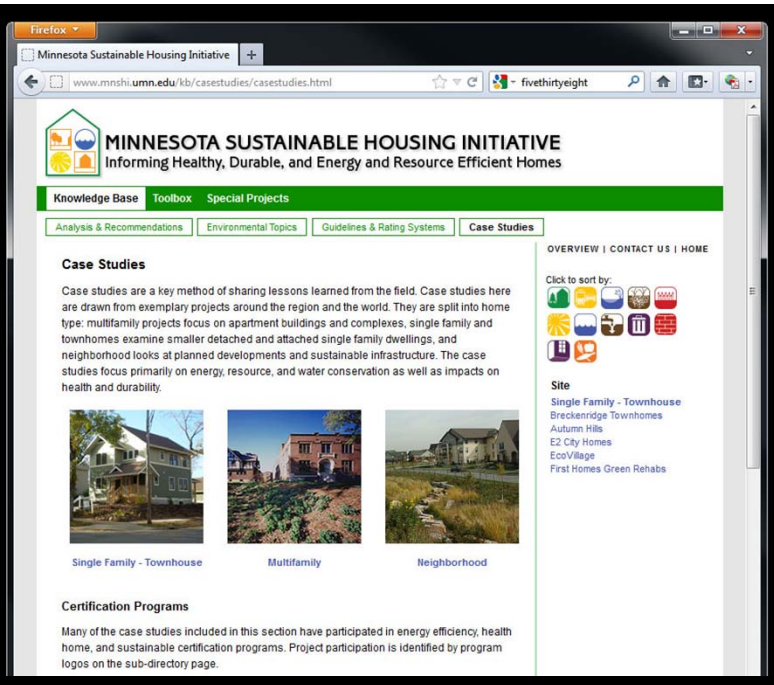
Construction Type	Required Mandatory Criteria	Required Optional (points) Criteria	Certification
MF New Construction	Yes	Yes, at least (35)	Encouraged, but not required.
MF Substantial Rehab	Yes	Yes, at least (15)	Encouraged, but not required.
MF Moderate Rehab	Yes	No	Encouraged, but not required.
SF New Construction	Yes	No	Encouraged, but not required.
SF (All acquisition/rehab)	Yes	No	Encouraged, but not required.

Publicly Owned Housing Program (POHP) funded projects follow the State of Minnesota Sustainable Building Guidelines (B3/MN2030)

33



34



Multifamily Case Studies

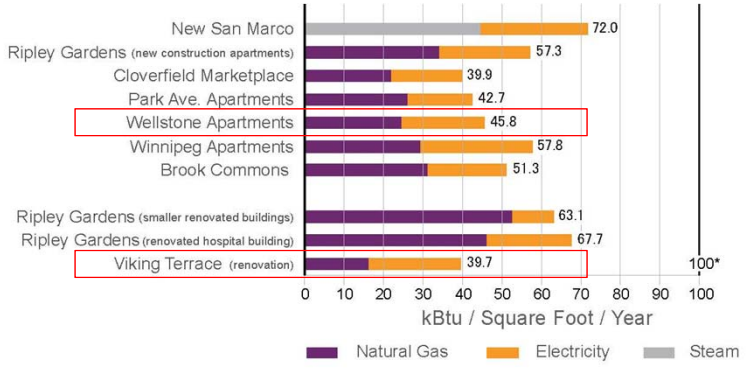
Multifamily Case Studies: Owner and Tenant data

- Brook Commons *
- Park Avenue Apartments *
- Winnipeg Apartments *
- Wellstone Apartments *
  - Additional solar thermal monitoring

* *All new construction projects followed Green Communities Criteria*

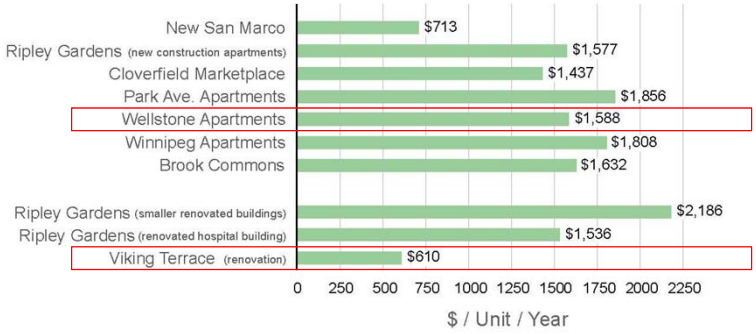
36

Energy Use



37

Cost



38

Wellstone

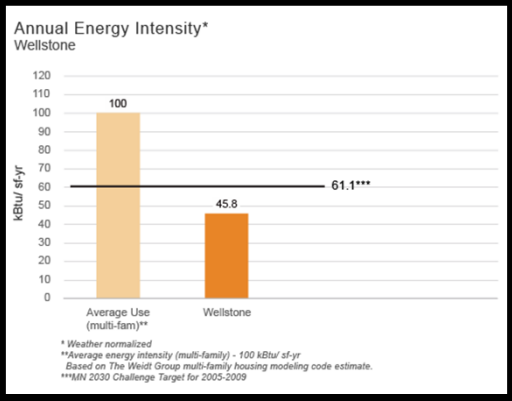
Hope Community and Aeon, Minneapolis, MN

- 49 mixed use unit building, 1, 2, 3 bedroom units
- In-unit gas-fired magic-paks
- Fiberglass batt filled stud cavity R-19 wall, full truss blown insulation at roof.
- Solar hot-water system with supplementary gas-fired units

39

Wellstone Energy

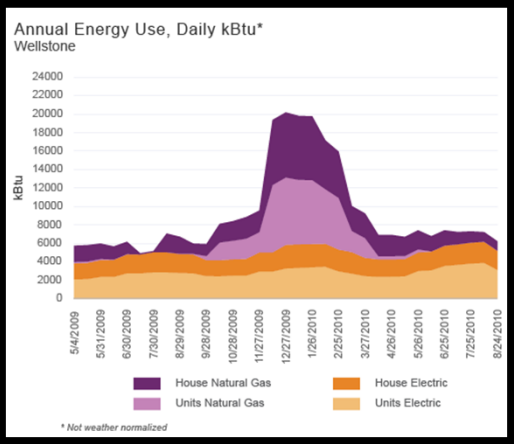
- 29.1% is apartment unit-metered electricity lighting and plug loads
- 21.9% is unit metered gas
- 20.4% is common areas electricity
- 28.6% is common areas gas and domestic water heating



40

Wellstone Energy

Typical breakdown of energy use



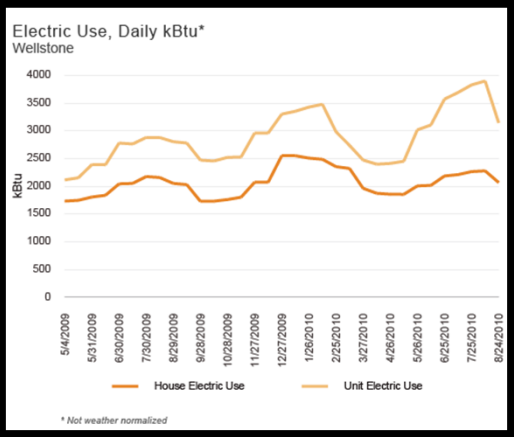
41

Wellstone Energy

Breaking out individual uses, double peak in electricity use in unit electricity consumption

Process load for heating?

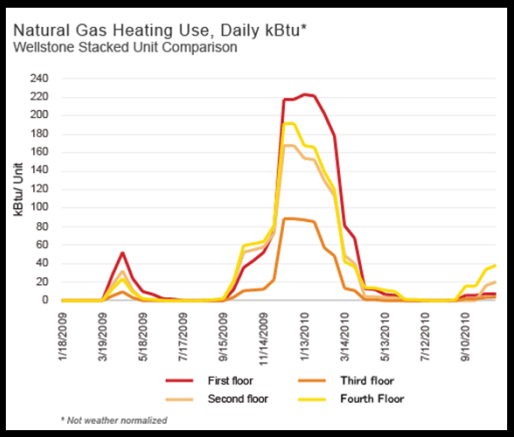
Further investigation ongoing



42

Wellstone Energy

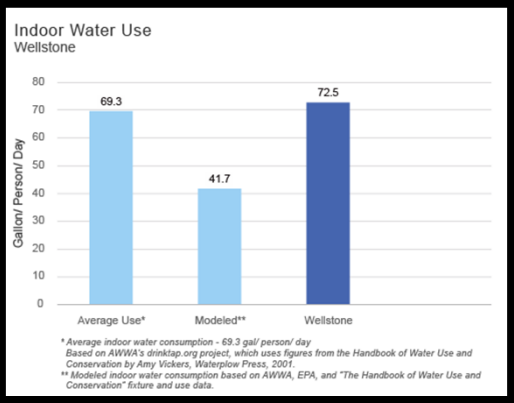
- Stacked unit comparison reveals high first floor use, somewhat high peak in fourth floor use
- Danger of over-simplification? Stacked unit comparison relies on limited number of units, effect of individuals may be seen through the data.



43

Wellstone Water

- Significant difference between measured use and predicted (74%)
- Across population served by Hope Community, shows improvement over typical consumption patterns
- Some other factor(s) at work?
- Similar consumption amounts in other years of study



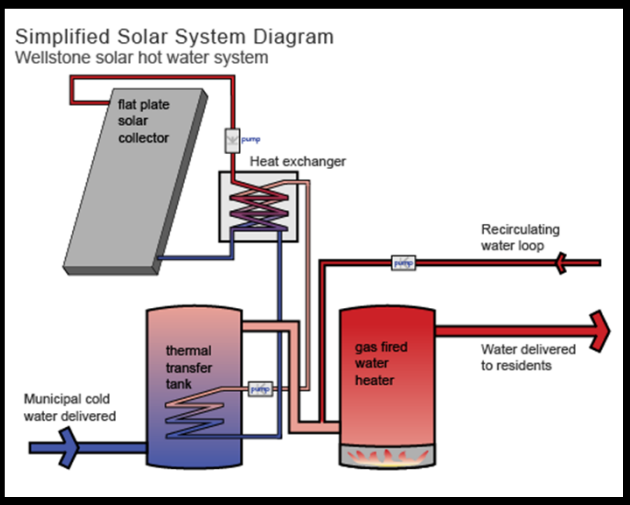
44

Wellstone Solar Hot Water system

24 4’ by 10’ Solar Skies flat plate collectors
Two 505-gallon thermal storage tanks
Three supplementary gas-fired units

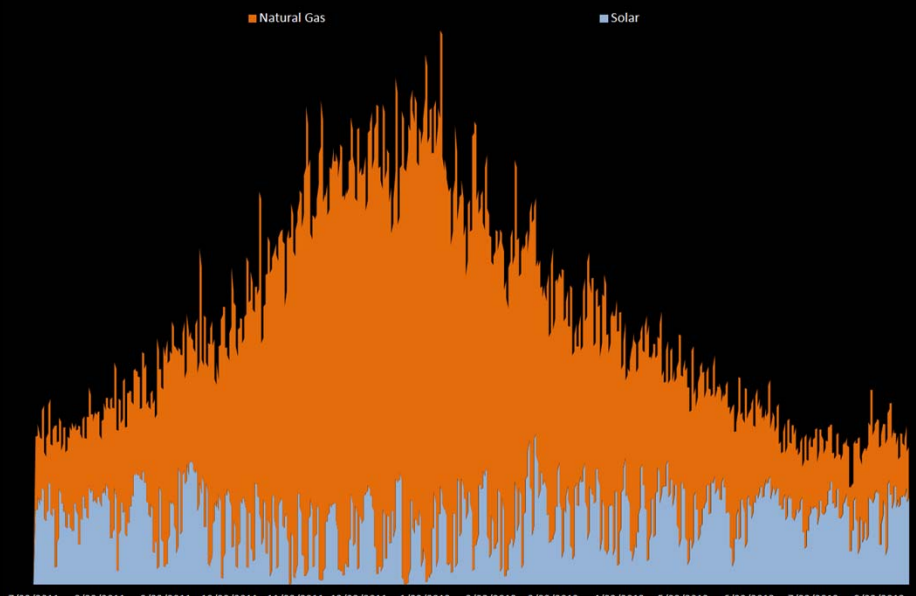
45

Wellstone Solar Hot Water system



46

7/23/11 to 8/6/12



47

Analysis – 1 year study

Designed to accommodate half of the hot water consumption of the Wellstone in the summer

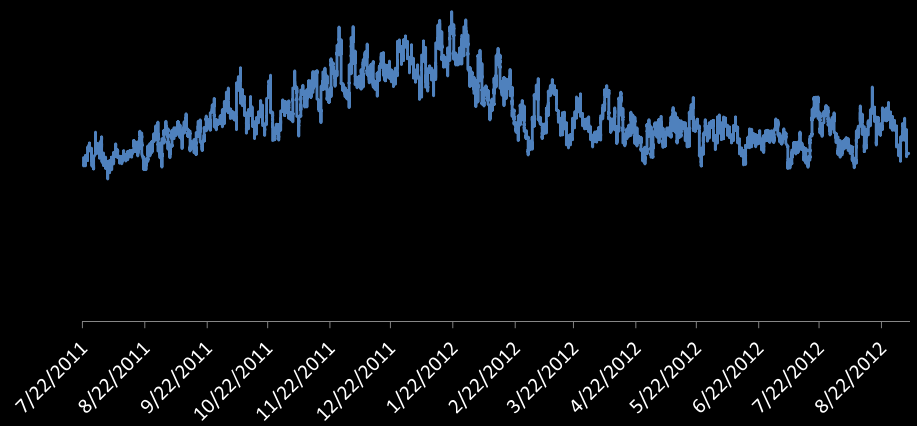
pretty close – 46.6% of the Summer hot water consumption

Winter – 17.3% of total winter hot water consumption

Annualized: 26.2% of hot water consumption

48

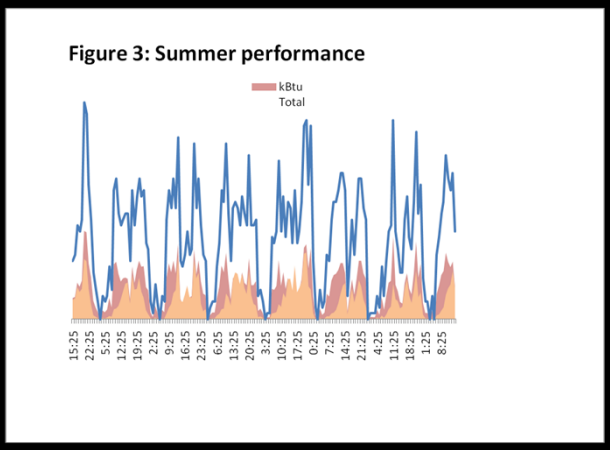
Variable hot water consumption



49

Results

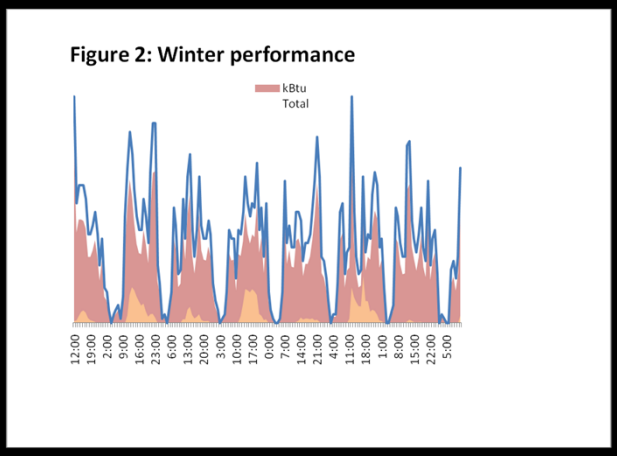
Summer performance: 46.6% of total



50

Results

Winter performance: 17.3% of total



51

Results

Expected performance: approximately 50% of total hot water use annually

Actual performance – *maximum* expected to be around 45 – 50% of demand during summer (due to much lower temperature difference between supplied water and output)

Actual water use - much higher than anticipated

- Project uses around 50% more water than expected
- Information from utility bills can be used to reevaluate original assumptions

52

Viking Terrace Apartments
Southwest Minnesota Housing Partnership
Worthington, Minnesota

60 units renovation
40 units at 31-50% of AMI
11 units at 60% AMI

developer: Southwest Minnesota Housing Partnership
architect: I & S Architects and Engineers
contractor: Wilcon Construction

completed: 2007
total cost: $4,676,216

GCI Incremental cost –
$691,700 ($15.04/sf) or **14.75%**

CSBR Center for Sustainable Building Research

Viking Terrace Apartments
Southwest Minnesota Housing Partnership
Worthington, Minnesota

Green Communities (version 1)

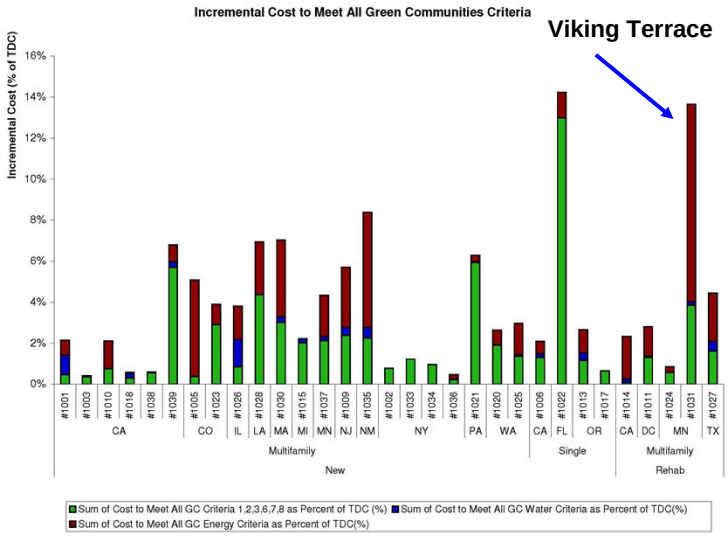
all criteria	$691,700 or $15.04/sf (14.75%)
mandatory criteria only	$664,200 or $14.44/sf (14.08%)

cost due to sustainable features

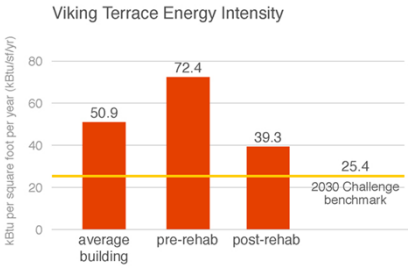
4.1 Water Conserving Appliances and Fixtures		$7,500
5.1 Efficient Energy Use	$452,000	
6.1 Recycled Content Material		$27,000
7.6 Ventilation		$120,000
7.11 Radon Mitigation		$33,200

Total Project Financing $4,676,216 or $77,937/unit

CSBR Center for Sustainable Building Research



CSBR Center for Sustainable Building Research



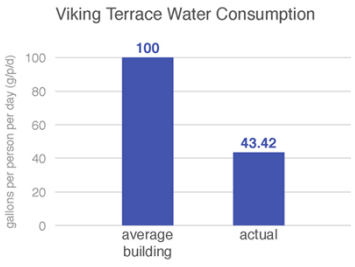
ENERGY

High efficiency geothermal heating and cooling system
Enhanced insulation of the building envelope
Energy Star appliances
Energy-efficient lighting and occupancy sensor controls

46% reduction in energy use

39% reduction in CO_2

CSBR Center for Sustainable Building Research



WATER

Water conserving appliances
Dual flush toilets
Flow restrictors on faucets and showers

56% less water use per person

CSBR Center for Sustainable Building Research

Viking Terrace Apartments
Parallel Studies

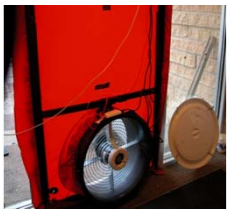
Heath Outcome Study
National Center for Healthy Housing

Building Evaluation and Monitoring
CSBR

Viking Terrace Apartments
Parallel Studies

research team

Center for Sustainable Building Research
National Center for Health Housing
Southwest Minnesota Housing Partnership
Greater Minnesota Housing Fund



research funding

US Environmental Protection Agency
Enterprise Community Partners
Blue Cross Blue Shield Foundation of Minnesota
McKnight Foundation

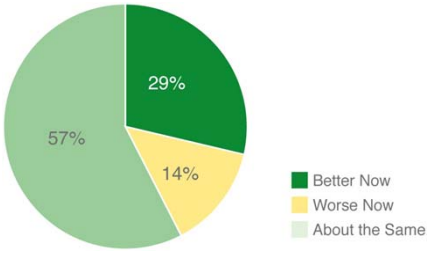
CSBR Center for Sustainable Building Research

CSBR Center for Sustainable Building Research

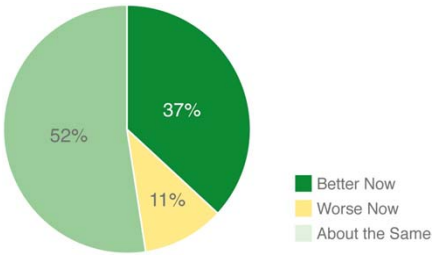
preliminary health outcome

Health compared to when in old home

children



adults



CSBR Center for Sustainable Building Research

Building Evaluation and Monitoring

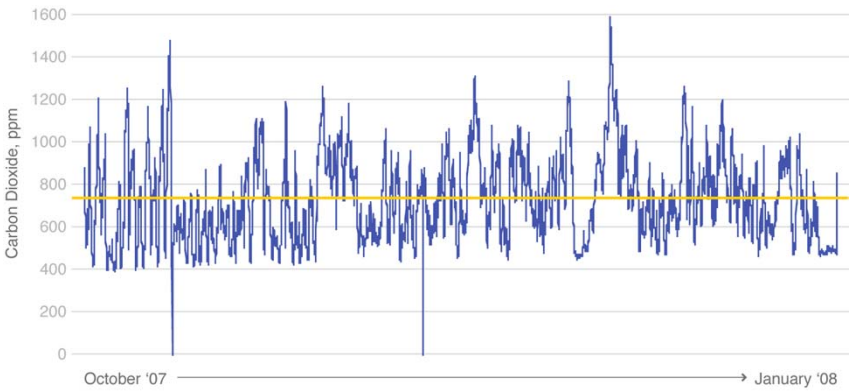
- **Testing**
  - building envelope tightness
  - unit to unit air leakage
  - interstitial pressure readings
  - duct tightness
  - exhaust fans flow
  - fresh air flow
  - TVOC
  - Radon
- **Monitoring**
  - temperature and relative humidity
  - CO_2
- **Utility bill collection**
  - electric
  - water
- **Life Cycle Analysis**

Building performance testing results

Ventilation System	Before Renovation	After Renovation	Design Standard
Fresh Air Supply	None Infiltration Only	21-27 cfm	70% ASHRAE 62.2
Duct Leakage	NA	71% @ 25 Pa	
Duct Return Air Flow	NA	345 cfm	Within ± 10% of mfg spec
Kitchen Exhaust	Yes low flow rate unknown	80 cfm 160 cfm fans specified	100 cfm AHRAE 62.2
Bath Exhaust	Yes low flow rate unknown	66 cfm 80 cfm fans specified	50 cfm AHRAE 62.2
Building Envelope Leakage	Very High Drafty Conditions	0.38 cfm/ft² @ 25 Pa	0.24 cfm/ft² @ 50 Pa MN SF

CSBR Center for Sustainable Building Research

CO_2 as measure of ventilation effectiveness



CSBR Center for Sustainable Building Research

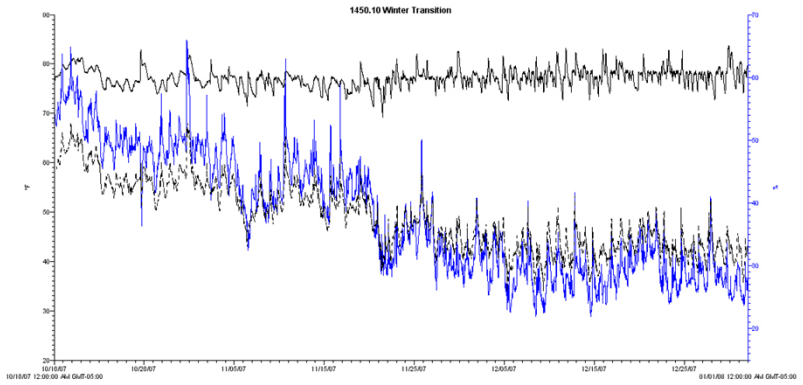


Figure 1: 1450.10 Viking Terrace 10/07 – 12/08
(dotted line is temp, blue is relative humidity, and dash is dew point)

Center for Sustainable Building Research

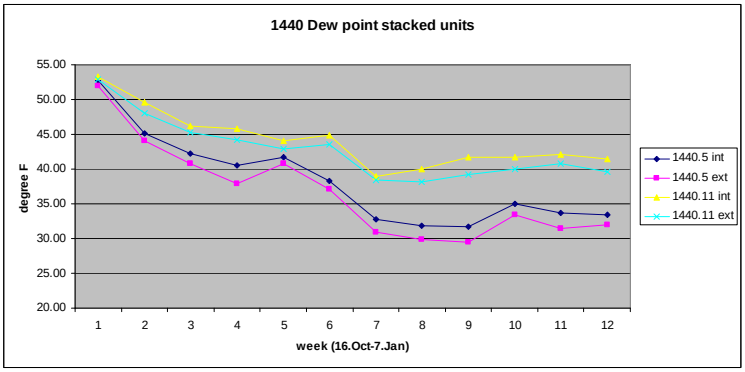
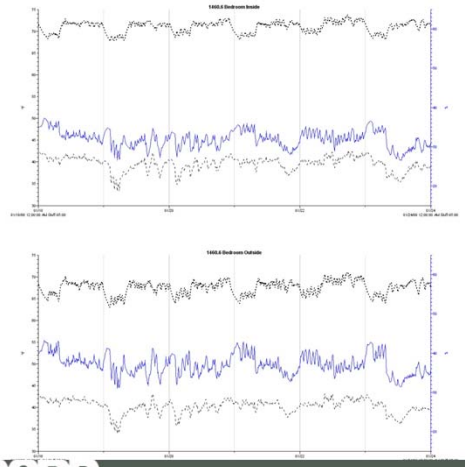


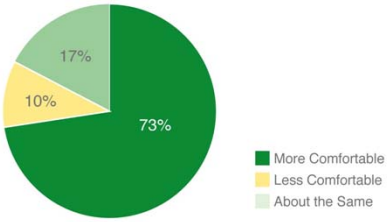
Figure 2: Dew point comparison of stacked units in building 1440 measured at interior walls

Center for Sustainable Building Research

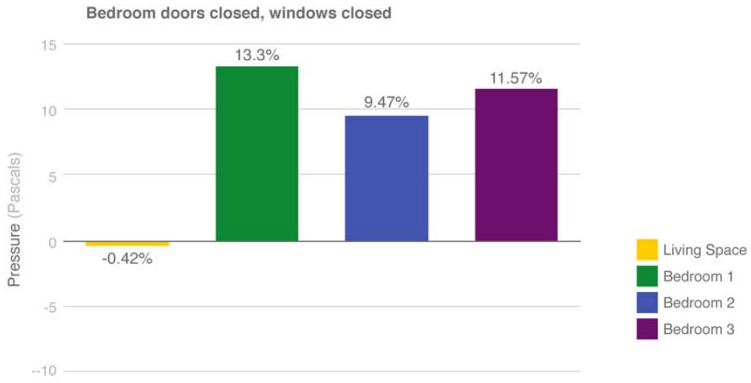
Comfort in apartment compared to old home

building performance and preliminary health outcome

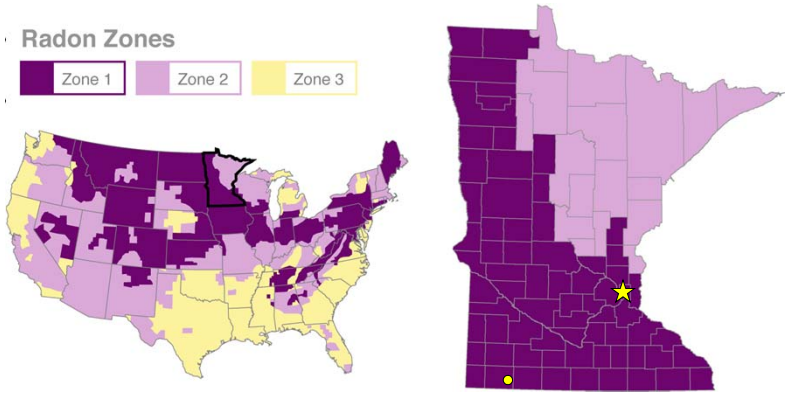




Interstitial pressure within unit



radon – Minnesota



CSBR Center for Sustainable Building Research

radon –Viking Terrace

2 rounds of pre-renovation 3 day tests

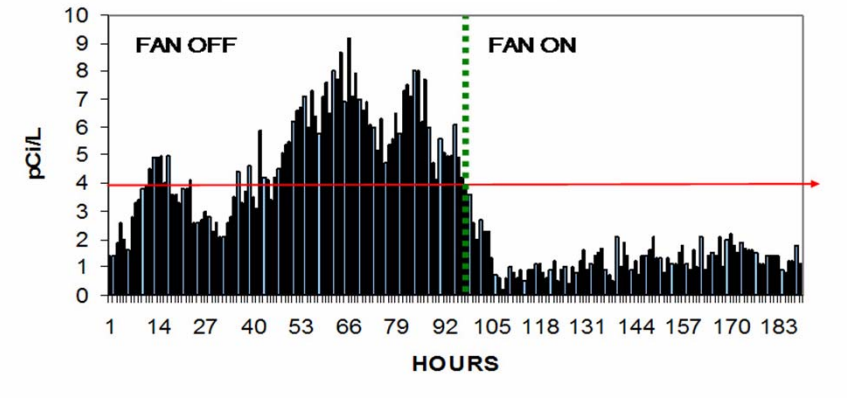
- round 1: 29 kits. range 1.0-6.8 pCi/L; 9 results at of above 4 pCi/L
- round 2: 8 kits. range 2.3-4.0 pCi/L; 1 result above 4 pCi/L
- average: 3.4-5.2 pCi/L; 5 results above 4 pCi/L

post-renovation 90 day tests

- 22 tests placed. 17 recovered. range 0.6-4.5 pCi/L; 2 results at or above 4 pCi/L

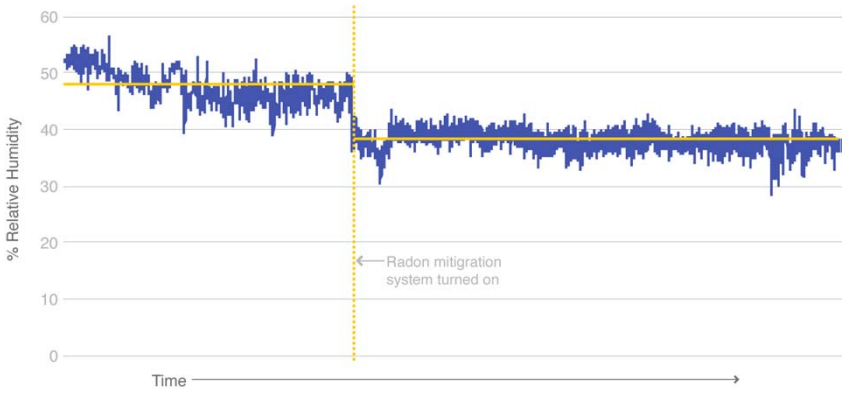
CSBR Center for Sustainable Building Research

radon - mitigation



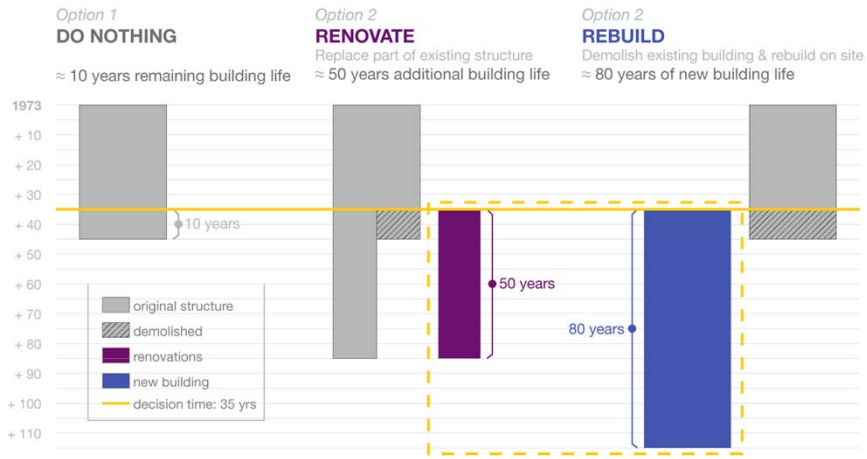
Center for Sustainable Building Research

radon – mitigation consequences

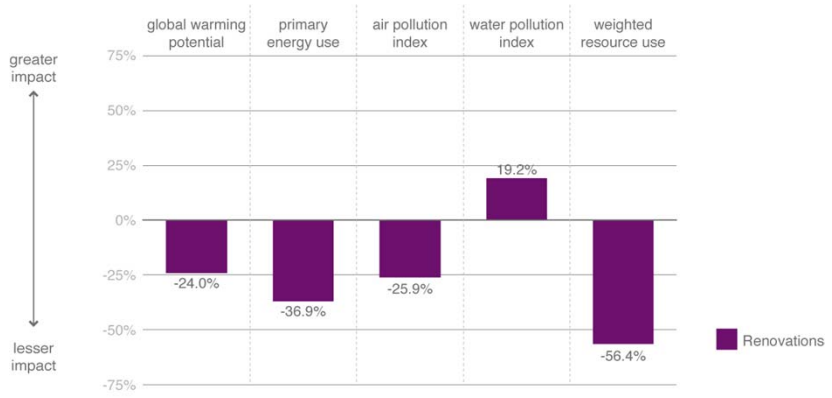


Center for Sustainable Building Research

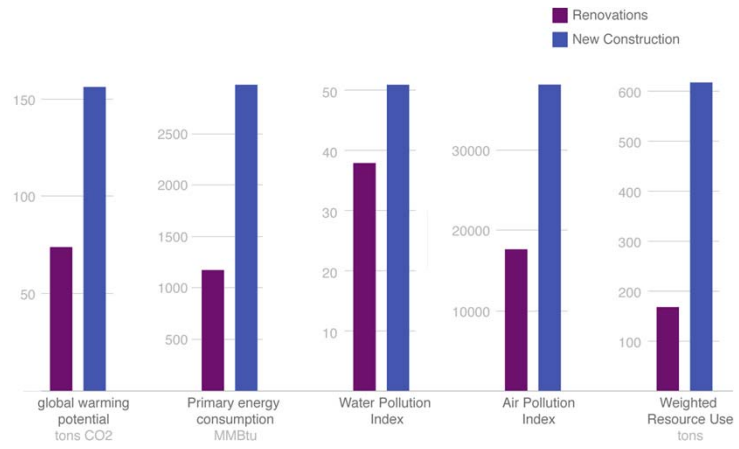
Life Cycle Analysis



Center for Sustainable Building Research



Center for Sustainable Building Research



Center for Sustainable Building Research

Lessons learned Viking Terrace:

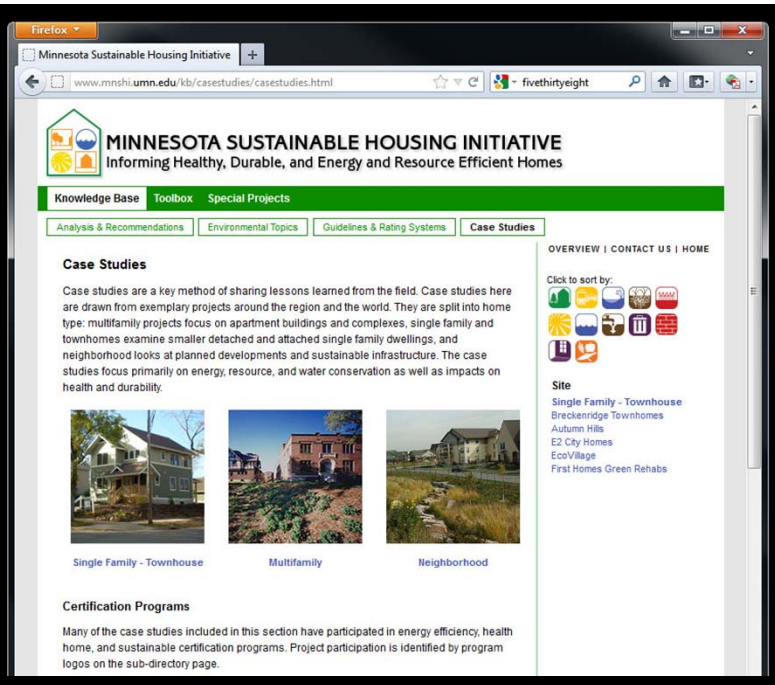
- Commissioning is a critical step
- Pre-testing remodels leads to improved energy and IEQ outcomes
- Specifications should include performance criteria for all systems
- Design matters
- Resident and operations education matters

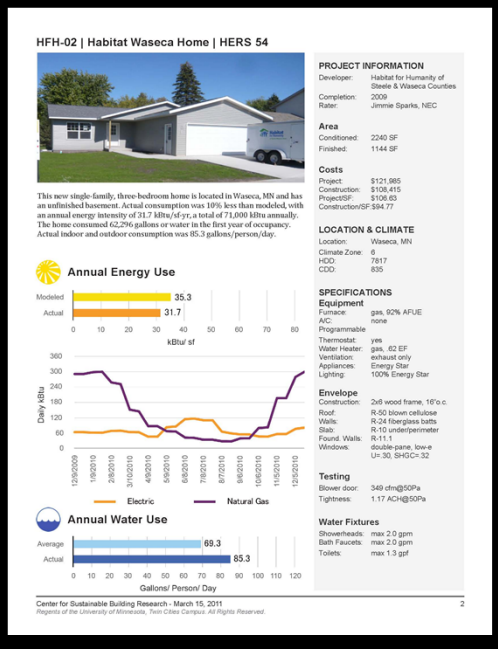
Center for Sustainable Building Research

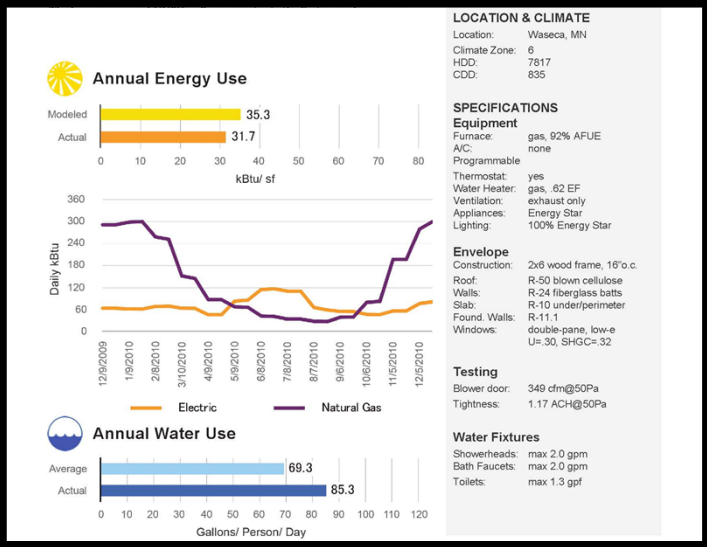


- Green Affordable Housing is about more than $ cost
  - improved quality of life
  - improved continued affordability
  - improved indoor environmental quality
- Better Benchmarks are needed for assessment of progress as well as to inform policy and design

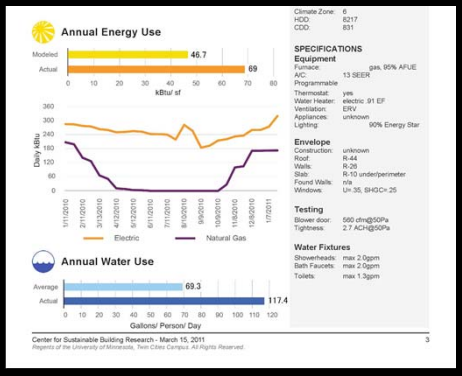
CSBR Center for Sustainable Building Research

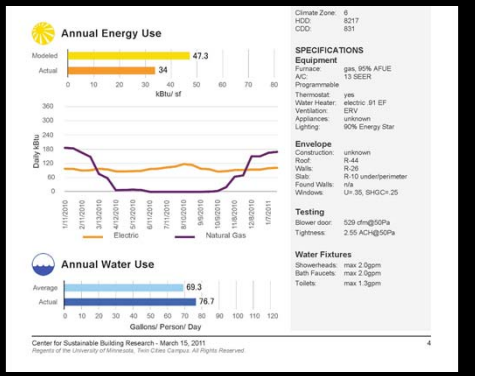


Firefox
Minnesota Sustainable Housing Initiative
www.mnshi.umn.edu/kb/casestudies/casestudies.html
fivethirtyeight
MINNESOTA SUSTAINABLE HOUSING INITIATIVE
Informing Healthy, Durable, and Energy and Resource Efficient Homes
Knowledge Base
Toolbox
Special Projects
Analysis & Recommendations
Environmental Topics
Guidelines & Rating Systems
Case Studies
OVERVIEW | CONTACT US | HOME
Case Studies
Case studies are a key method of sharing lessons learned from the field. Case studies here are drawn from exemplary projects around the region and the world. They are split into home type: multifamily projects focus on apartment buildings and complexes, single family and townhomes examine smaller detached and attached single family dwellings, and neighborhood looks at planned developments and sustainable infrastructure. The case studies focus primarily on energy, resource, and water conservation as well as impacts on health and durability.
Click to sort by:
Site
Single Family - Townhouse
Breckenridge Townhomes
Autumn Hills
E2 City Homes
EcoVillage
First Homes Green Rehabs
Single Family - Townhouse
Multifamily
Neighborhood
Certification Programs
Many of the case studies included in this section have participated in energy efficiency, health home, and sustainable certification programs. Project participation is identified by program logos on the sub-directory page.

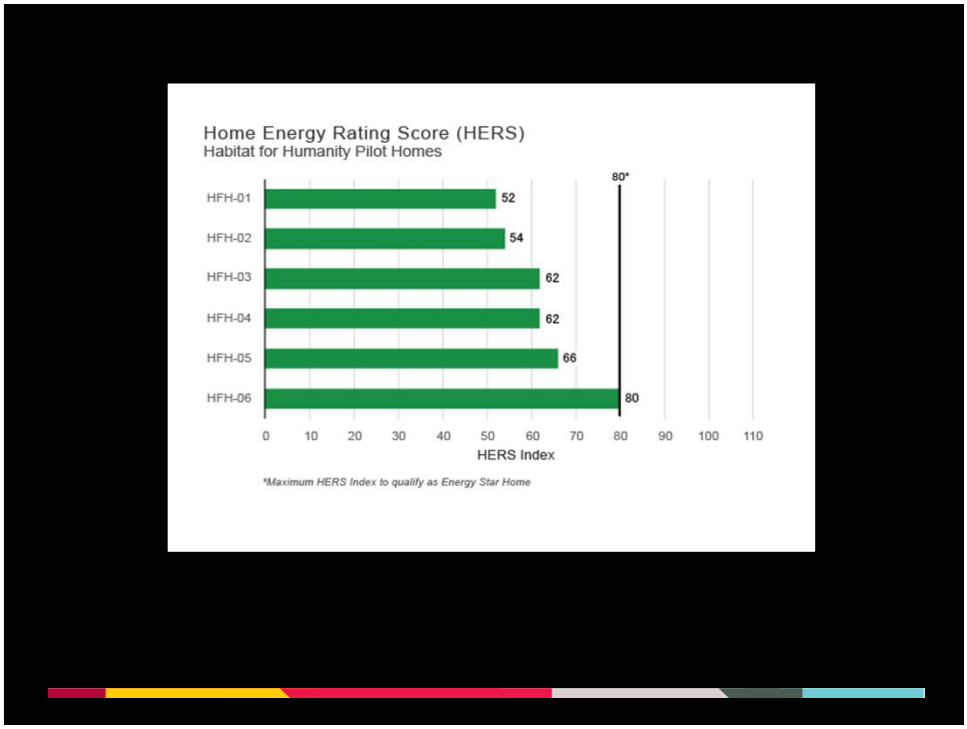

HFH-02 | Habitat Waseca Home | HERS 54
This new single-family, three-bedroom home is located in Waseca, MN and has an unfinished basement. Actual consumption was 10% less than modeled, with an annual energy intensity of 31.7 kBtu/sf-yr, a total of 71,000 kBtu annually. The home consumed 62,296 gallons or water in the first year of occupancy. Actual indoor and outdoor consumption was 85.3 gallons/person/day.
Annual Energy Use
Modeled
Actual
35.3
31.7
kBtu/ sf
Daily kBtu
Electric
Natural Gas
Annual Water Use
Average
Actual
69.3
85.3
Gallons/ Person/ Day
PROJECT INFORMATION
Developer: Habitat for Humanity of Steele & Waseca Counties
Completion: 2009
Rater: Jimmie Sparks, NEC
Area
Conditioned: 2240 SF
Finished: 1144 SF
Costs
Project: $121,985
Construction: $108,415
Project/SF: $106.63
Construction/SF: $94.77
LOCATION & CLIMATE
Location: Waseca, MN
Climate Zone: 6
HDD: 7817
CDD: 835
SPECIFICATIONS
Equipment
Furnace: gas, 92% AFUE
AIC: none
Programmable Thermostat: yes
Water Heater: gas, .62 EF
Ventilation: exhaust only
Appliances: Energy Star
Lighting: 100% Energy Star
Envelope
Construction: 2x6 wood frame, 16"o.c.
Roof: R-50 blown cellulose
Walls: R-24 fiberglass batts
Slab: R-10 under/perimeter
Found. Walls: R-11.1
Windows: double-pane, low-e U=.30, SHGC=.32
Testing
Blower door: 349 cfm@50Pa
Tightness: 1.17 ACH@50Pa
Water Fixtures
Showerheads: max 2.0 gpm
Bath Faucets: max 2.0 gpm
Toilets: max 1.3 gpf
Center for Sustainable Building Research - March 15, 2011
Regents of the University of Minnesota, Twin Cities Campus. All Rights Reserved.
2

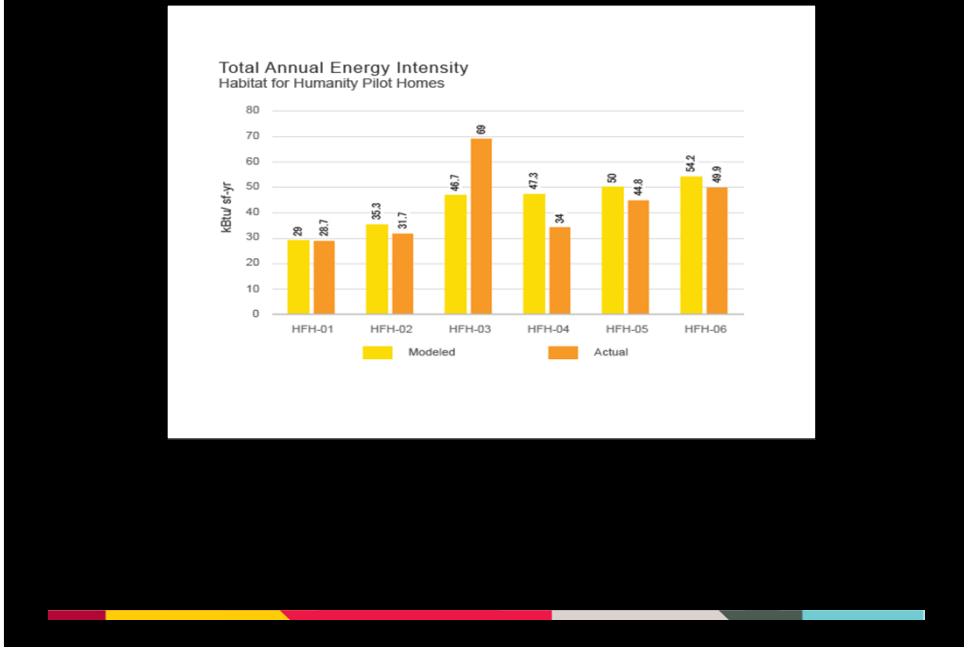

Annual Energy Use
Modeled
Actual
35.3
31.7
0 10 20 30 40 50 60 70 80
kBtu/ sf
360
300
240
180
120
60
0
Daily kBtu
12/9/2009
1/9/2010
2/8/2010
3/10/2010
4/9/2010
5/9/2010
6/8/2010
7/8/2010
8/7/2010
9/6/2010
10/6/2010
11/5/2010
12/5/2010
Electric
Natural Gas
Annual Water Use
Average
Actual
69.3
85.3
0 10 20 30 40 50 60 70 80 90 100 110 120
Gallons/ Person/ Day
LOCATION & CLIMATE
Location: Waseca, MN
Climate Zone: 6
HDD: 7817
CDD: 835
SPECIFICATIONS
Equipment
Furnace: gas, 92% AFUE
A/C: none
Programmable
Thermostat: yes
Water Heater: gas, .62 EF
Ventilation: exhaust only
Appliances: Energy Star
Lighting: 100% Energy Star
Envelope
Construction: 2x6 wood frame, 16"o.c.
Roof: R-50 blown cellulose
Walls: R-24 fiberglass batts
Slab: R-10 under/perimeter
Found. Walls: R-11.1
Windows: double-pane, low-e
U=.30, SHGC=.32
Testing
Blower door: 349 cfm@50Pa
Tightness: 1.17 ACH@50Pa
Water Fixtures
Showerheads: max 2.0 gpm
Bath Faucets: max 2.0 gpm
Toilets: max 1.3 gpf

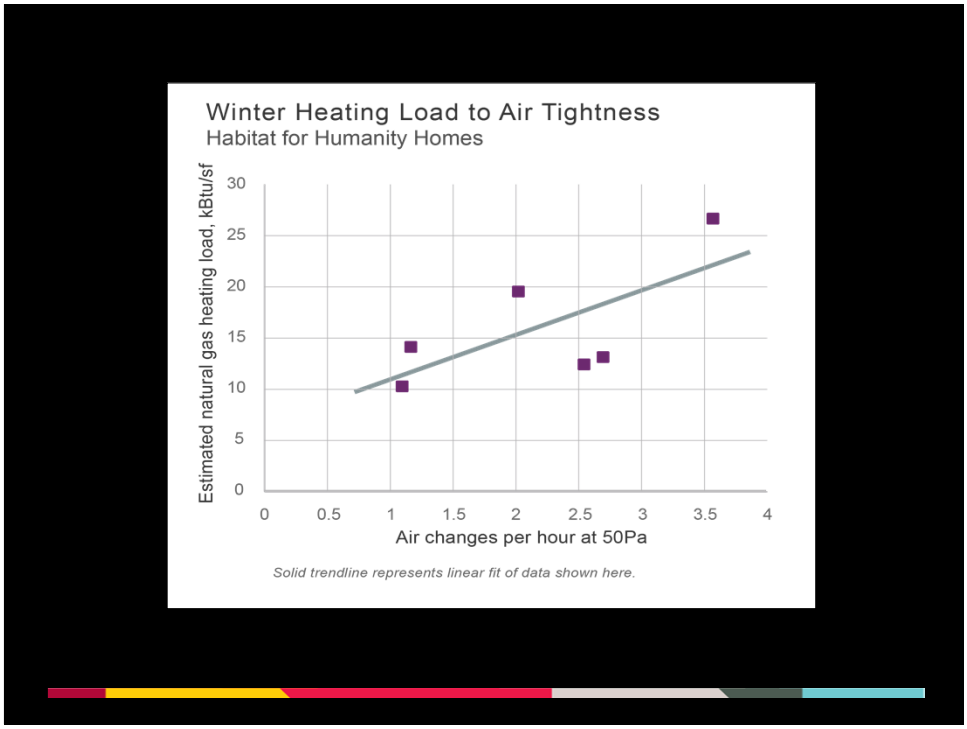
83

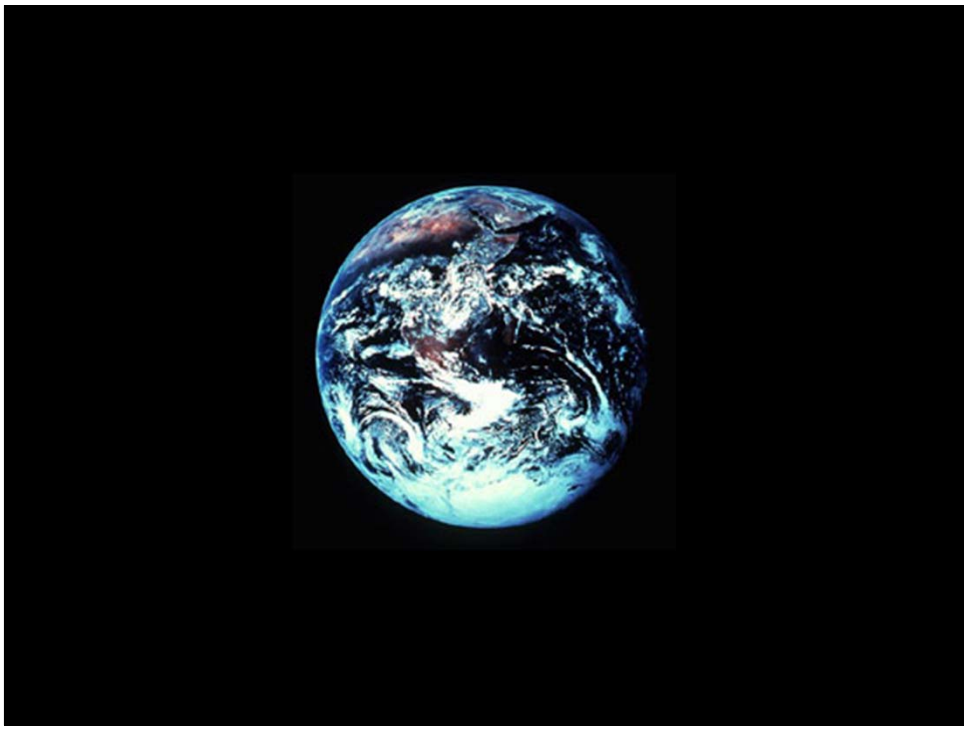

Annual Energy Use
Modeled
Actual
46.7
69
0 10 20 30 40 50 60 70 80
kBtu/ sf
360
300
240
180
120
60
0
Daily kBtu
1/1/2010
2/1/2010
3/3/2010
4/2/2010
5/2/2010
6/1/2010
7/1/2010
8/1/2010
9/9/2010
10/9/2010
11/8/2010
12/8/2010
1/7/2011
Electric
Natural Gas
Annual Water Use
Average
Actual
69.3
117.4
0 10 20 30 40 50 60 70 80 90 100 110 120
Gallons/ Person/ Day
Climate Zone: 6
HDD: 8217
CDD: 831
SPECIFICATIONS
Equipment
Furnace: gas, 95% AFUE
A/C: 13 SEER
Programmable
Thermostat: yes
Water Heater: electric .91 EF
Ventilation: ERV
Appliances: unknown
Lighting: 90% Energy Star
Envelope
Construction: unknown
Roof: R-44
Walls: R-26
Slab: R-10 under/perimeter
Found Walls: n/a
Windows: U=.35, SHGC=.25
Testing
Blower door: 560 cfm@50Pa
Tightness: 2.7 ACH@50Pa
Water Fixtures
Showerheads: max 2.0gpm
Bath Faucets: max 2.0gpm
Toilets: max 1.3gpm
Center for Sustainable Building Research - March 15, 2011
Regents of the University of Minnesota, Twin Cities Campus. All Rights Reserved.
3


Annual Energy Use
Modeled
Actual
47.3
34
0 10 20 30 40 50 60 70 80
kBtu/ sf
360
300
240
180
120
60
0
Daily kBtu
1/1/2010
2/1/2010
3/3/2010
4/2/2010
5/2/2010
6/1/2010
7/1/2010
8/1/2010
9/9/2010
10/9/2010
11/8/2010
12/8/2010
1/7/2011
Electric
Natural Gas
Annual Water Use
Average
Actual
69.3
76.7
0 10 20 30 40 50 60 70 80 90 100 110 120
Gallons/ Person/ Day
Climate Zone: 6
HDD: 8217
CDD: 831
SPECIFICATIONS
Equipment
Furnace: gas, 95% AFUE
A/C: 13 SEER
Programmable
Thermostat: yes
Water Heater: electric .91 EF
Ventilation: ERV
Appliances: unknown
Lighting: 90% Energy Star
Envelope
Construction: unknown
Roof: R-44
Walls: R-26
Slab: R-10 under/perimeter
Found Walls: n/a
Windows: U=.35, SHGC=.25
Testing
Blower door: 529 cfm@50Pa
Tightness: 2.55 ACH@50Pa
Water Fixtures
Showerheads: max 2.0gpm
Bath Faucets: max 2.0gpm
Toilets: max 1.3gpm
Center for Sustainable Building Research - March 15, 2011
Regents of the University of Minnesota, Twin Cities Campus. All Rights Reserved.
4


Home Energy Rating Score (HERS)
Habitat for Humanity Pilot Homes
HFH-01
HFH-02
HFH-03
HFH-04
HFH-05
HFH-06
52
54
62
62
66
80
80*
0
10
20
30
40
50
60
70
80
90
100
110
HERS Index
*Maximum HERS Index to qualify as Energy Star Home


Total Annual Energy Intensity
Habitat for Humanity Pilot Homes
kBtu/ sf-yr
0
10
20
30
40
50
60
70
80
29
28.7
35.3
31.7
46.7
69
47.3
34
50
44.8
54.2
49.9
HFH-01
HFH-02
HFH-03
HFH-04
HFH-05
HFH-06
Modeled
Actual

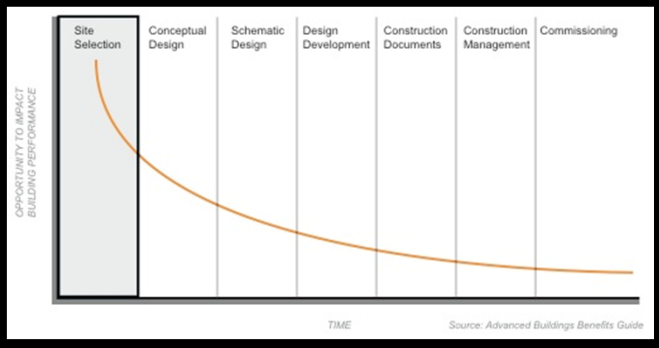

Winter Heating Load to Air Tightness
Habitat for Humanity Homes
Estimated natural gas heating load, kBtu/sf
30
25
20
15
10
5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
Air changes per hour at 50Pa
Solid trendline represents linear fit of data shown here.



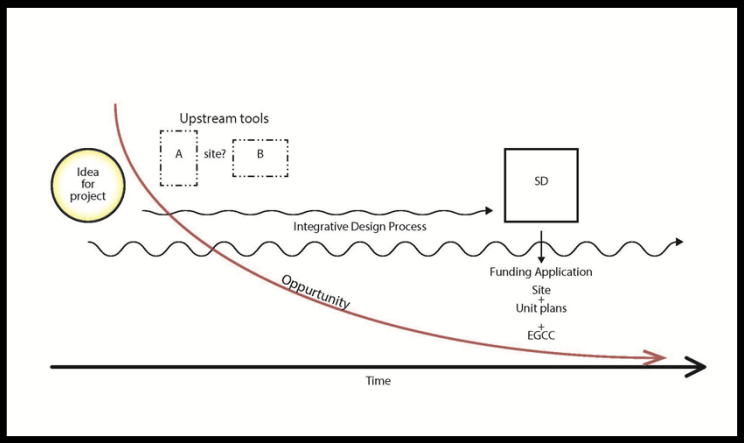
Upstream Capacity Building:
TOOLS, RESOURCES AND TRAINING TO INFORM EARLY DECISION MAKING

Programming and building specifications in early design… determine up to **80%** of pollution output [and] building operation cost."

–Ulrich Bogenstatter



90



91

Key Goals of Upstream:

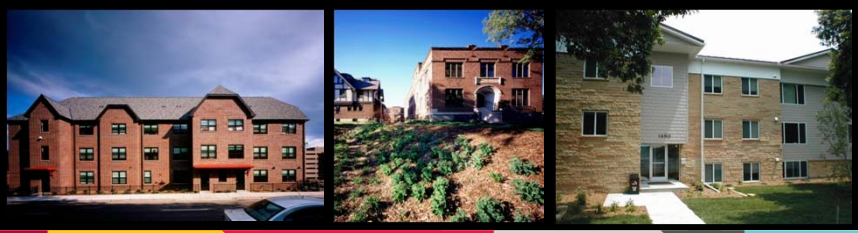
- Target audience – developers and their architects (future - HRA, EDA)
- Support Green Communities Criteria 2 and 3
- Improve sustainability outcome with little to no additional cost
- Build sustainability capacity in non-profits

92

Upstream Tool Kit

- Site Selection – 10 MINUTES (!)
  - quick evaluation
  - rules of thumb
- Site Optimization Worksheet

- Curriculum to build understanding of the broad context, issues and thinking



93

Module:
Overview
Approach

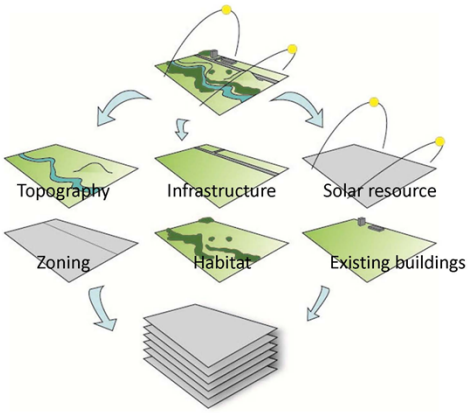
Toolbox:
Upstream Tools

GCC criteria:
Sections 2 & 3

CSBR
Center for Sustainable Building Research

Site analysis

Layers are analyzed separately, and then reassembled to identify optimal siting.



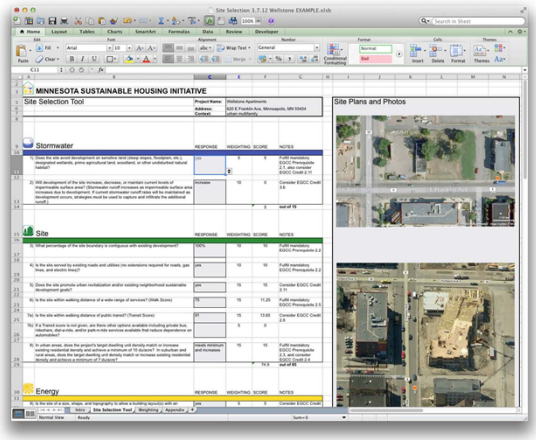
15

Module:
Overview

Toolbox:
GCC Criteria
MN GCC overlay
GCC checklist

CSBR
Center for Sustainable Building Research

MNSHI Site Selection Tool



23

Module:
Water
Stormwater
Site
Energy
H&H

GCC criteria:
2.1, 2.2, 2.5
(2.4), (2.11)

CSBR
Center for Sustainable Building Research

Site Assessment Module 1: WATER

Site Selection Tool q.2 → GCC 3.6 (how does development affect amount of impermeable surface)

	Stormwater	RESPONSE	WEIGHTING	SCORE	NOTES
11	1) Does the site avoid development on sensitive land (steep slopes, floodplain, etc.), designated wetlands, prime agricultural land, woodland, or other undisturbed natural habitat?	yes	5	5	Fulfill mandatory EGCC Prerequisite 2.1, also consider EGCC Credit 2.11
13	2) Will development of the site increase, decrease, or maintain current levels of impermeable surface area? (Stormwater runoff increases as impermeable surface area increases due to development. If current stormwater runoff rates will be maintained as development occurs, strategies must be used to capture and infiltrate the additional runoff.)	increase	10	0	Consider EGCC Credit 3.6
14				5	out of 15

ArcGIS soil maps, topo maps [layers here]
Google area calculator (daftlogic area calculator)

39

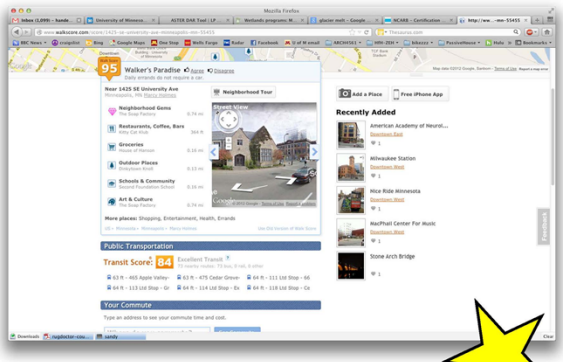
Module:
Water
Site
Energy
H&H

Toolbox:
Google or Bing Maps
Google Streetview
Bing Street
Walkscore

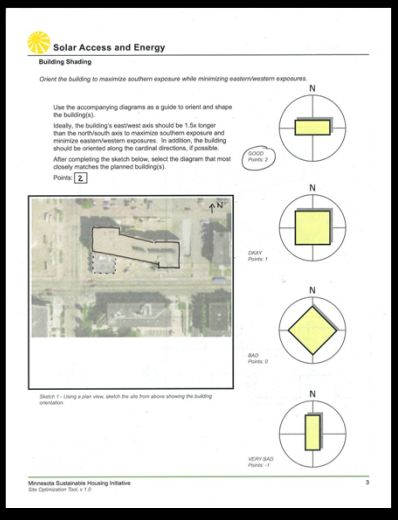
CSBR
Center for Sustainable Building Research

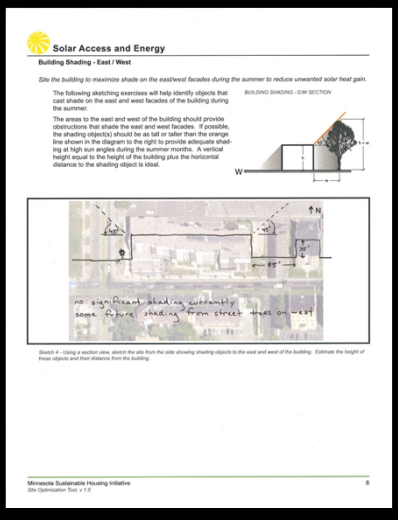
Site Assessment Module 4: H&H

Walkscore



78





New Casestudies
GREAT Study



99

Questions?



CSBR Center for Sustainable Building Research
College of Design
University of Minnesota

100