Senate Bill 668 – *The Sequel!*

32nd Annual State Construction Conference

The Case Studies

March 28th, 2013

Senate Bill 668 – A Case Study

Senate Bill 668 – *The Sequel!*

Refresher

What is Senate Bill 668?

- Purpose is to promote energy and water savings in state owned and state supported buildings.

Senate Bill 668 – *The Sequel!*

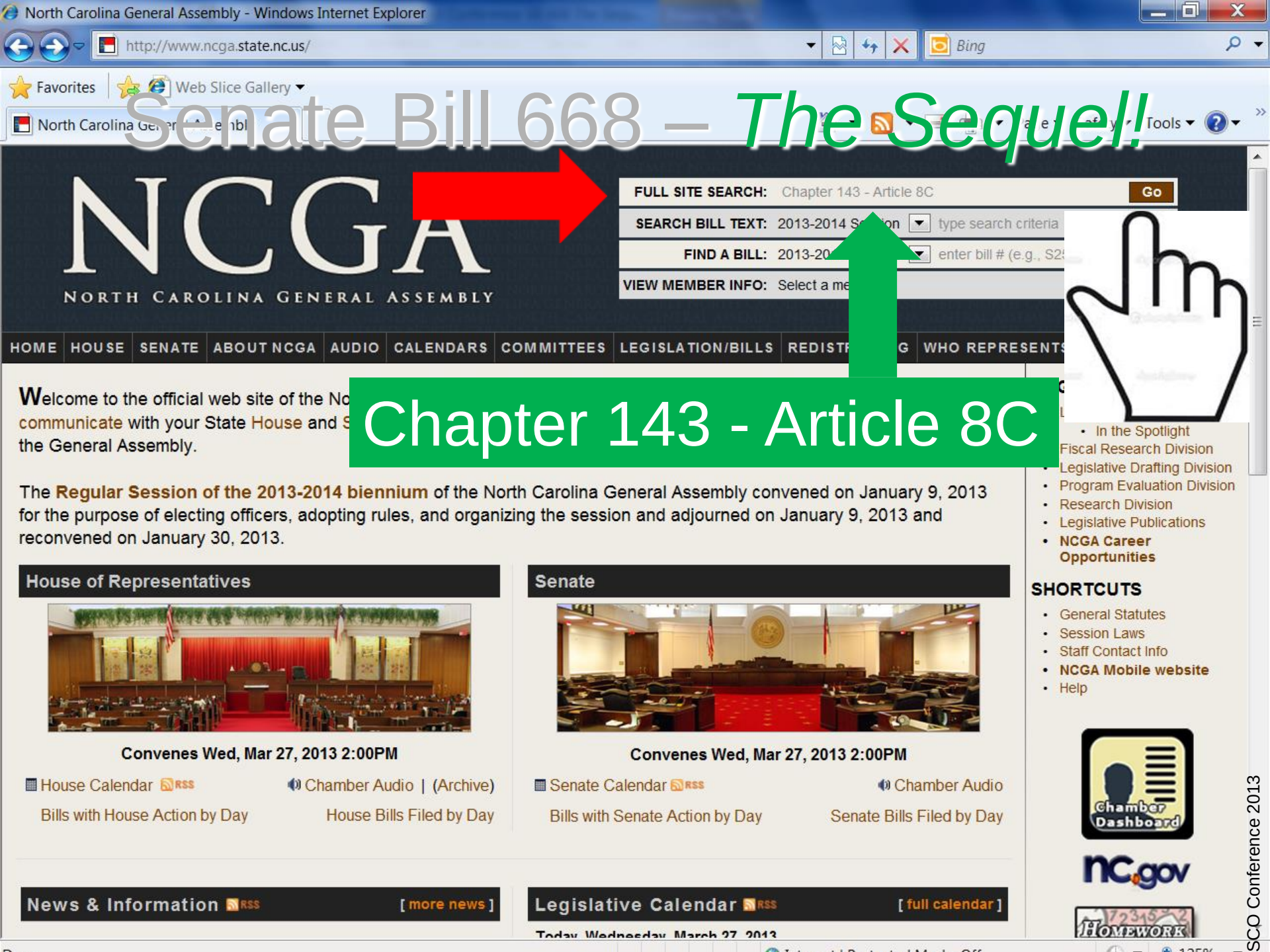
The official title of Senate Bill 668 is

Performance Standards for Sustainable, Energy-Efficient Public Buildings.

The legislation can be found under NCGS 143-135.35 through 143-135.40.

(Chapter 143 – Article 8C)

Senate Bill 668 – *The Sequel!*



SCO Conference 2013

Senate Bill 668 – *The Sequel!*

New projects require:

- 30% less energy usage than a building complying with ASHRAE 90.1-2004
- 20% less indoor water usage than a building complying with the 2006 NC Plumbing Code

Senate Bill 668 – *The Sequel!*

Renovation projects require:

- 20% less energy usage than a building complying with ASHRAE 90.1-2004
- 20% less indoor water usage than a building complying with the 2006 NC Plumbing Code

Senate Bill 668 – *The Sequel!*

2012

2009

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The 2012 NCECC requires:

- 20% less energy usage than a building complying with ASHRAE ***90.1-2007***

OR

- Meet the prescriptive requirements of chapter 5 of the 2012 NCECC

(Reference section 501.1)

Item D – 9 **Request by Joe Mattingly, Air-Conditioning, Heating, and Refrigeration Institute, to amend the 2012 NC Energy Conservation Code, 501.1 Scope. The proposed amendment is as follows:**

Senate Bill 668 – *The Sequel!*

501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. These commercial buildings shall either:

1. Meet the requirements contained in this chapter, or

2. ~~Comply with the mandatory provisions of 2007 ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low Rise Residential Buildings* and exceed the minimum level of energy efficiency it prescribes by 20% following the procedure in ASHRAE/IESNA Standard 90.1, Appendix G.~~ Meet the requirements of ASHRAE/IESNA Standard 90.1-2010.

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1971 Tullie Circle, NE	
St re nu		
11 14 14 AN St 13		
90.1—~~2007~~ 2010	(ANSI/ASHRAE/IESNA 90.1-2004) Energy Standard for Buildings Except Low-rise Residential Buildings (ANSI/ASHRAE/IESNA 90.1-~~2007~~ 2010)	501.1, ~~501.2, 502.1.1, Table 502.2(2)~~
ASHRAE—2005 ASHRAE—2004	ASHRAE Handbook of Fundamentals ASHRAE HVAC Systems and Equipment Handbook-2004	402.1.4, Table 405.5.2(1) 503.2.1

http://www.ncdoi.com/OSFM/Engineering_and_Codes/Documents/BCC_Minutes/2012%2012%2010~December%2010,%202012_.pdf

Motion – Ralph Euchner/Second – Al Bass/Granted with modifications.

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NCDOI OSFM | Engineering and Codes - BCC - Minutes-Building_Code_Council - Windows Internet Explorer

http://www.ncdoi.com/OSFM/Engineering_and_Codes/Default.aspx?field1=BCC_-_Minutes&user=Build

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Meeting Dates | Agendas | Minutes

Building Code Council

BCC - Minutes

December 10, 2012

e Vinyl Siding Report

ing Proposal

(Item B-3, NCECC Chapter 4,
ict Leakage

porary Rules (June 11, 2012 -

RESOURCES

- Code Enforcement Resources
- Office of Administrative Hearings

NC Department of Insurance
Office of the State Fire Marshal - Engineering Division
[illegible] Mail Service Center, Raleigh, NC [illegible]
919-661-5880

Senate Bill 668 *The Sequel!*

Commercial Energy Code Compliance Options-ASHRAE 90.1-2010

Code: 2012 NC Energy Conservation Code **Date:** March 18, 2013
Section: 501.1

Question:

Wh
new
buil

http://www.ncdoi.com/OSFM/Engineering_and_Codes/Documents/Interpretations4/2012%20Energy%20Conservation/501.1%20-%20Commercial%20Energy%20Code%20Compliance%20Options-ASHRAE%2090.1-2010.pdf

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not being replaced by the ASHRAE 90.1-2010 standard. The other compliance pathways include: 501.1 Item 1, NC specific COMcheck, and Section 507.

Senate Bill 668 – The Sequel!

NCDOI OSFM | Engineering and Codes - Code Interpretations-Code_Enforcement_Resources - Windows Internet Explorer

http://www.ncdoi.com/OSFM/Engineering_and_Codes/Default.aspx?field1=Code_Interpretations&user

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Engineering and Codes

ENGINEERING AND CODES » CODE ENFORCEMENT RESOURCES

orcement Resources

Code Interpretations

RESOURCES

- Pyrotechnics
- Crowd Manager Training
- Online Code Enforcement Continuing Education

TO SEARCH INTERPRETATIONS ENTER TEXT BELOW THEN CLICK THE APPROPRIATE COLUMN'S SEARCH BUTTON BELOW

Search:

Search All	Search	Search	Search	Search
Accessibility	2002	2004		
Administrative	2002	2006	2009	2012
Building	2002	2006	2009	2012

Internet | Protected Mode: Off


ANSI/ASHRAE/IESNA Standard 90.1-2010
(Supersedes ANSI/ASHRAE/IESNA Standard 90.1-2007)
Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F
ASHRAE STANDARD
Energy Standard for
Buildings Ex
Low-Rise
Buildin
-2010
mittee, the ASHRAE Board of Directors,
rds Institute.
g Standard Project Committee (SSPC) for which
program for regular publication of addenda or revi-
sensus action on requests for change to any part of
and deadlines may be obtained in electronic form from
orm from the Manager of Standards. The latest edition of
ASHRAE Web site (www.ashrae.org) or from ASHRAE
, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-
or toll free 1-800-527-4723 (for orders in US and Canada).
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www.iesna.org
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and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org
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RAE/IESNA Standard 90.1-2004)
NA Addenda listed in Appendix F
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E/IESNA Standard 90.1-2004
HRAE/IESNA Standard 90.1-2001)
NA Addenda listed in Appendix F
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Heating, Refrigerating
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ullie Circle NE, Atlanta, GA 30329
www.ashrae.org
The Sequel

Senate Bill 668 – *The Sequel!*

How do you meet both requirements?

- SB 668 = 30% < ASHRAE **90.1-2004**
- ~~2012 NCECC = 20% < **90.1-2007**~~
- **2012 NCECC = ASHRAE 90.1-2010**

Senate Bill 668 – *The Sequel!*

90.1-2010 is 30% better than 90.1-2004

OR

SB 668 = ASHRAE 90.1-2010

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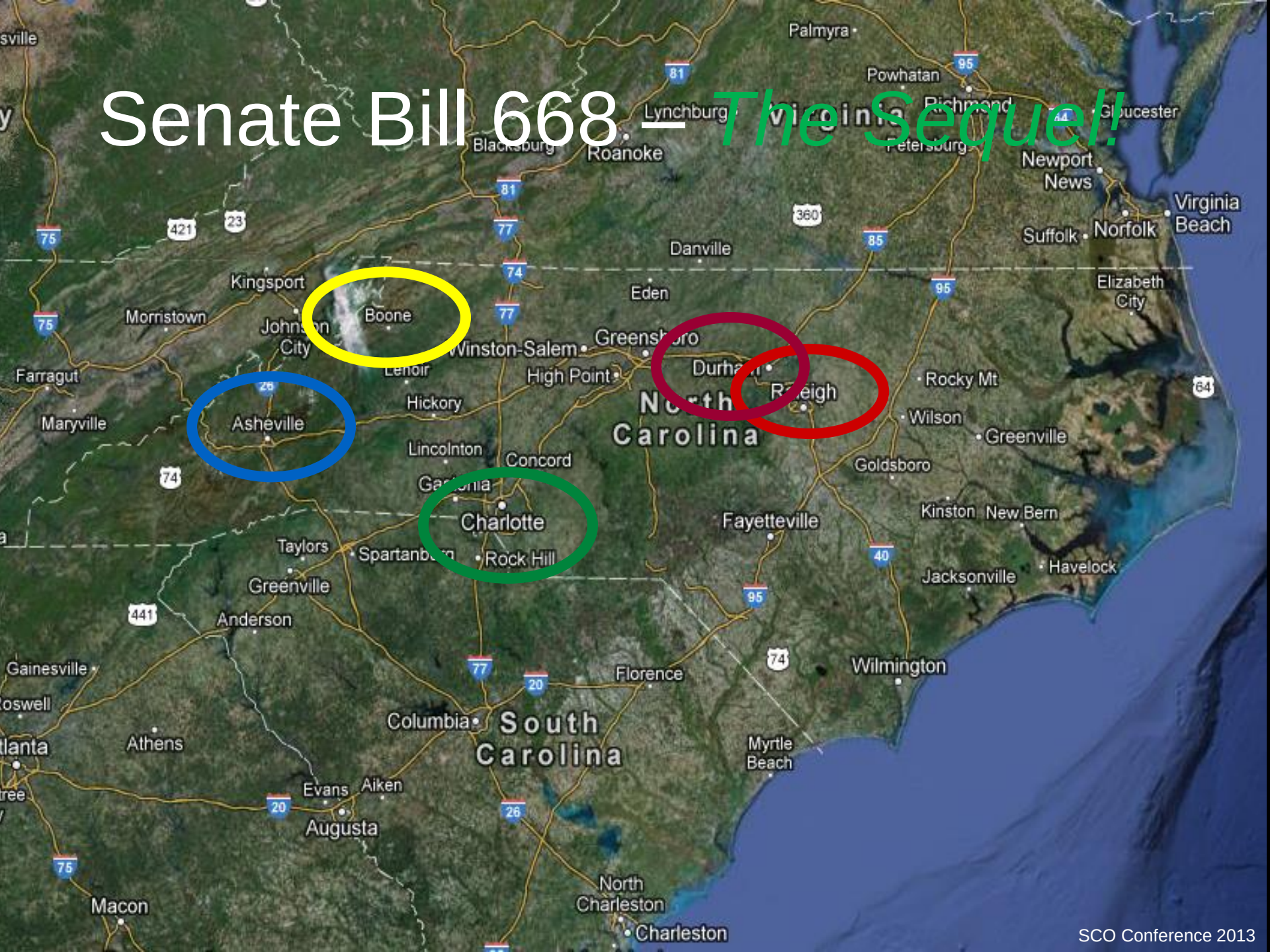

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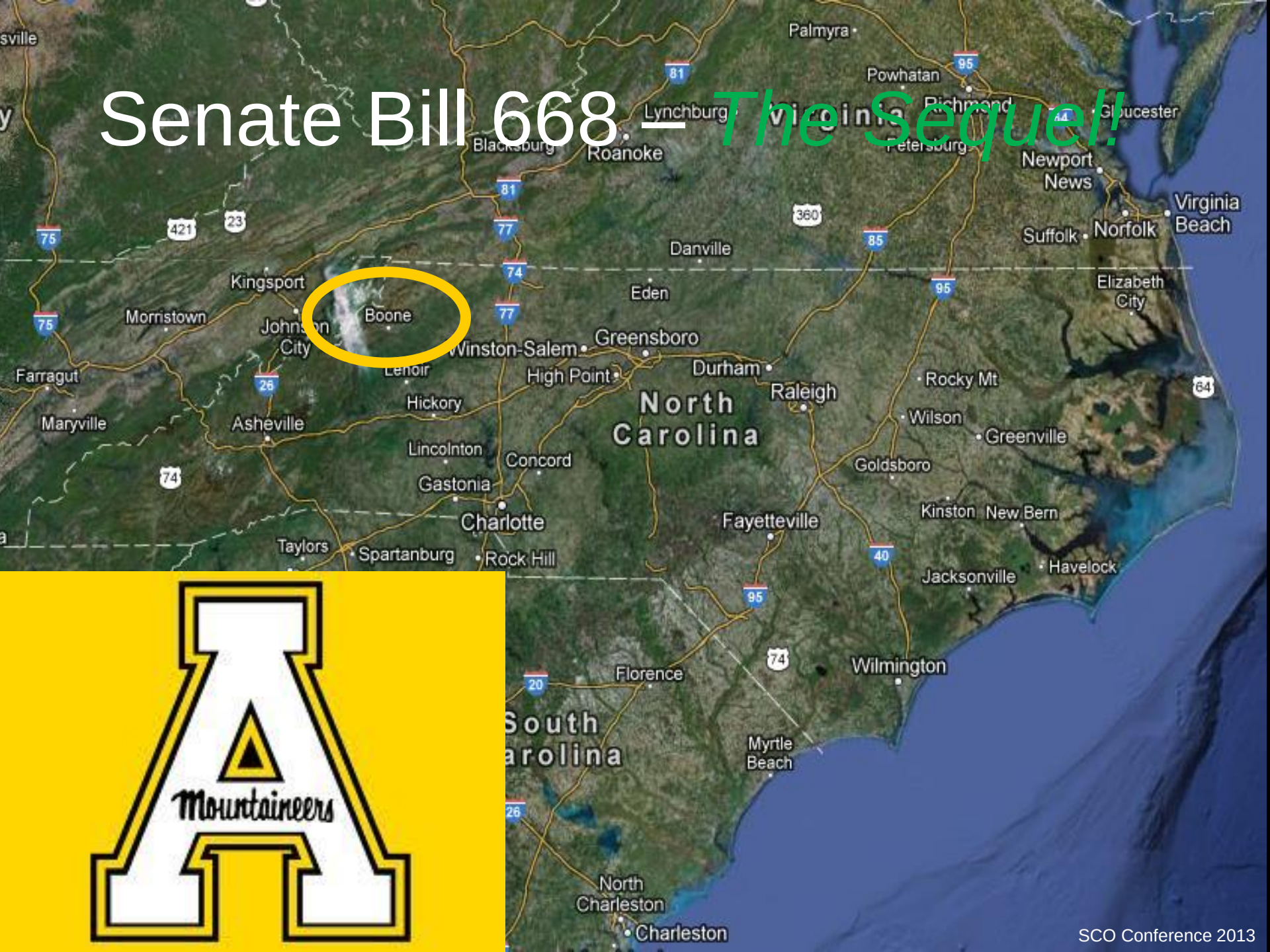

Mountaineers

Senate Bill 668 – *The Sequel!*

Appalachian State University
Cone Residence Hall

Senate Bill 668 – *The Sequel!*

Appalachian State University

Cone Residence Hall


Senate Bill 668 – The Sequel!

Senate Bill 668 – *The Sequel!*

Agency/Institution	ASU
Project Name and Description	Cone Residence Hall Renovation
	278 Beds
Total Project Cost	$ 8,538,280
Project Size (Square Feet)	58,803
Square Foot/Bed	212
Cost/Square Foot	$ 145

Senate Bill 668 – *The Sequel!*

Envelope Improvements

- Replaced single glazed metal frame windows with low E insulated windows
- Added R-19 insulation to exterior walls
- Added sun screens to lounge windows on south facade

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HVAC Improvements

- Energy reclamation from exhaust air for ventilation
- Heating and cooling by 4 pipe fan coil units
- Low flow shower heads result in less hot water use and lower energy consumption

Senate Bill 668 – *The Sequel!*

Lighting Improvements

- 28 watt T8 fixtures with advanced electronic ballasts
  - Occupancy sensors
  - Dual level switching

Senate Bill 668 – *The Sequel!*

Cone Residence Hall

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	3,467	59		
Proposed	1,993	34	43	1,474
Meter ’11	4,479	76	-29	-1,012
Meter ‘12	4,896	83	-41	-1,429

Senate Bill 668 – *The Sequel!*

Cone Residence Hall

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 72,840	$ 1.07		
Proposed	$ 42,637	$ 0.63	41	$ 30,203
Meter ‘11	$ 97,911	$ 1.67	-20	$ -16,081
Meter ‘12	$ 117,135	$ 1.99	-43	$ -35,305

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Cone Residence Hall

Water Usage					
	Gallons/Year	% Improvement	Savings Gallons	Gal/Res/Yr	Gal/Sq Ft/Yr
Baseline	2,000,376			7,176	34
Proposed	1,397,116	30	603,260	5,026	24
Meter ’11	1,196,000	40	804,376	4,302	20
Meter ‘12	1,381,000	31	619,376	4,968	23

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Cone Residence Hall

Lessons Learned

- Baseline and proposed models low
- Actual energy consumption less than national averages

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DOE Commercial Building Benchmarks – New Construction
Energy Use Intensities (EUIs) [kBtu/ft^2/yr]
October 2009

City	Miami	Houston	Phoenix	Atlanta	Los Angeles	Las Vegas	San Francisco	Baltimore	Albuquerque	Seattle	Chicago	Denver	Minneapolis	Helena	Duluth	Fairbanks	Benchmark Weighted Avg
Climate Zone	1A	2A	2b	3A	3B	3B	3C	4A	4B	4C	5A	5B	6A	6B	7	8	
Large Office	38	40	38	38	32	34	35	40	34	37	43	36	46	40	47	39	39
Medium Office	39	42	40	41	33	37	38	45	38	42	48	41	54	48	57	77	43
Small Office	44	44	43	41	33	39	35	46	41	42	51	45	57	51	61	83	45
Warehouse	30	19	19	18	14	18	15	21	20	18	24	23	29	27	33	52	21
Stand-alone Retail	62	63	60	61	44	56	50	72	61	65	81	69	93	83	104	145	69
Strip Mall	56	58	57	62	44	57	53	74	64	69	85	72	99	89	111	156	70
Primary School	57	57	55	55	46	52	51	61	54	54	65	58	75	66	79	113	60
Secondary School	56	57	55	57	42	54	50	68	58	61	76	64	89	77	97	141	66
Supermarket	158	167	159	170	153	158	166	184	168	181	195	179	208	197	223	266	179
Quick Service Restaurant	535	549	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	657	604	713	663	765	949	596
Full Service Restaurant	404	423	[illegible]	440	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	527	481	570	532	617	763	471
Hospital	145	147	138	142	137	135	142	148	127	[illegible]	148	130	153	137	155	185	145
Outpatient Facility	280	279	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	271	271	280	275	279	324	273
Small Hotel	71	71	69	71	62	68	64	75	70	69	80	74	87	80	92	112	73
Large Hotel	99	108	100	116	105	105	113	127	119	124	138	131	150	144	163	196	122
Mid-Rise Apartment	39	39	38	38	31	36	33	42	37	38	47	41	54	48	59	76	n/a

80 kBtu/ft2/yr

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U.S. Energy Information Administration

CONSUMPTION & EFFICIENCY

OVERVIEW DATA ANALYSIS & PROJECTIONS GLOSSARY

Home > Households, Buildings & Industry > Energy Efficiency > Commercial Buildings Energy Intensities > Table 5b

U.S. Commercial Buildings Energy Intensity

100 kBtu/ft2/yr

Released Date: December 2004
Page Last Modified: Jan 2007

Table 5b. U.S. Commercial Buildings Energy Intensity Using Site Energy[1] by Census Region and Principal Building Activity, 1992-2003
(Thousand Btu per Square Foot)

Principal Building Activity and Census Region	Survey Years			
	1992[2]	1995	1999	2003
U.S. Total	80	91	85	91
Education	75	79	75	83
Food Sales	182	214	202	200
Food Service	206	245	241	258
Health Care	228	240	176	
Lodging	160	127	99	100
Mercantile and Service	71	76	83	
Office	96	97	90	93
Public Assembly	68	114	82	94
Public Order and Safety	110	97	87	116
Religious Worship	29	37	32	43
Warehouse and Storage	41	38	44	45
Other[3]	150	172	144	164
Vacant	28	21	16	21

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	1992	1995	1999	2003
Total Midwest	91	105	90	99
Education	82	87	79	86
Food Sales	194	Q	Q	219
Food Service	216	173	203	219
Health Care	290	309	167	206
Lodging	152	150	103	109
Mercantile and Service	77	101	81	97
Office	105	112	96	109
Public Assembly	86	113	79	102
Public Order and Safety	Q	99	Q	Q
Religious Worship	35	52	34	53
Warehouse and Storage	60	51	73	75
Other [3]	Q	Q	Q	Q
Vacant	38	Q	Q	Q

109 kBtu/ft2/yr

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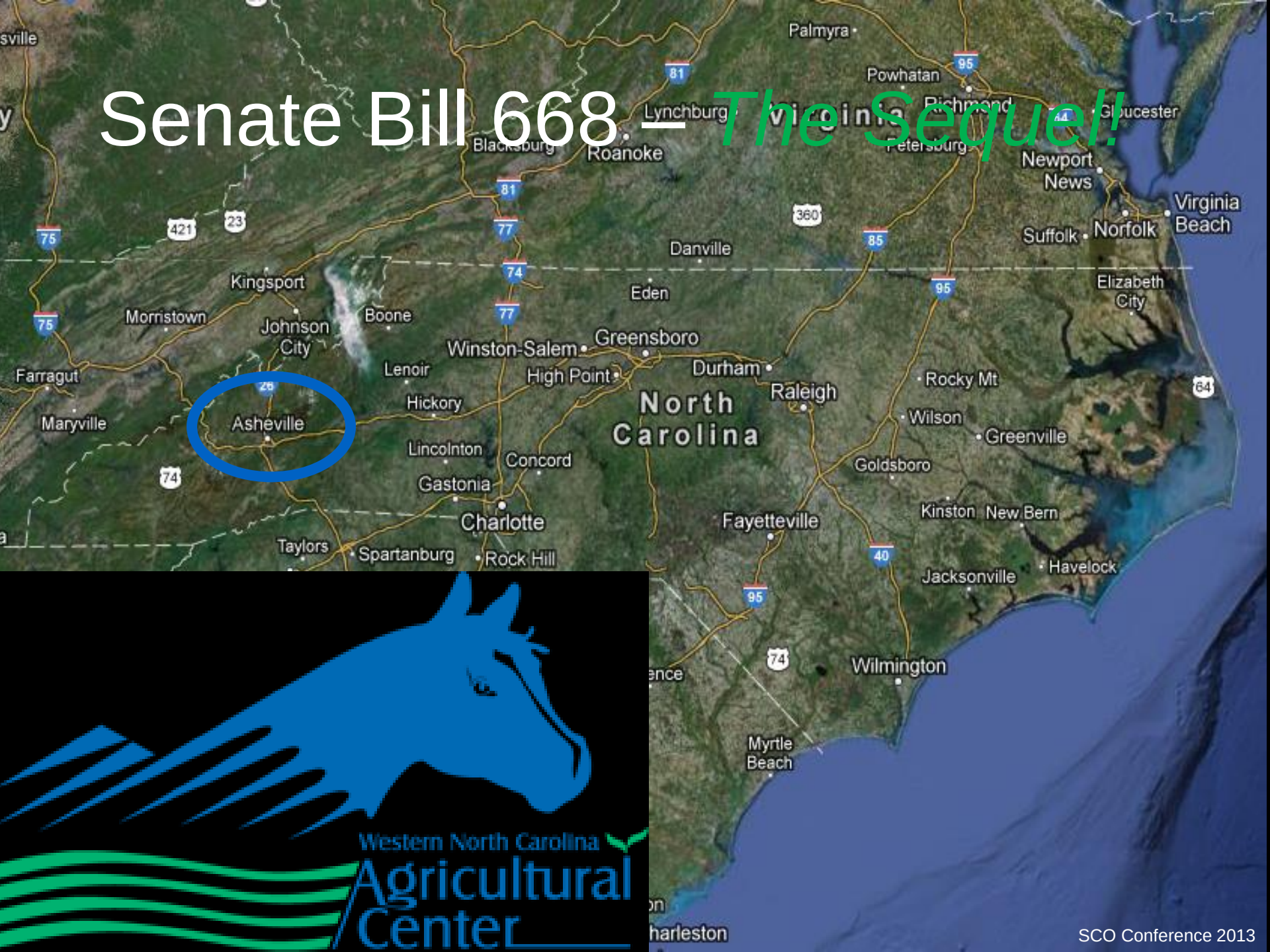


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Cowboy Church
Highway Patrol
Boyston Hwy
280
Boone Bldg
SCO Conference 2013

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NC Department of Agriculture & Consumer Services

Davis Event Center

Senate Bill 668 – *The Sequel!*

Senate Bill 668 – *The Sequel!*

Agency/Institution	Ag&CS
Project Name and Description	Davis Arena Addition & Renovation
Total Project Cost	$ 6,053,240
Project Size (Square Feet)	67,904
Cost/Square Foot	$ 89

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Envelope Improvements

- Low-E glazing for new storefront and windows
- Continuous R-30 roof insulation
- 2” rigid XPS continuous wall insulation

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HVAC Improvements

- Packaged variable volume rooftop air conditioning unit with DX cooling, gas fired heat and energy recovery wheel

Senate Bill 668 – *The Sequel!*

Lighting Improvements

- Lower lighting density
- T5 and T8 fixtures

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Davis Arena

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	2,961	44		
Proposed	1,736	26	41	1,225
Metered	3,354	49	-13	-393

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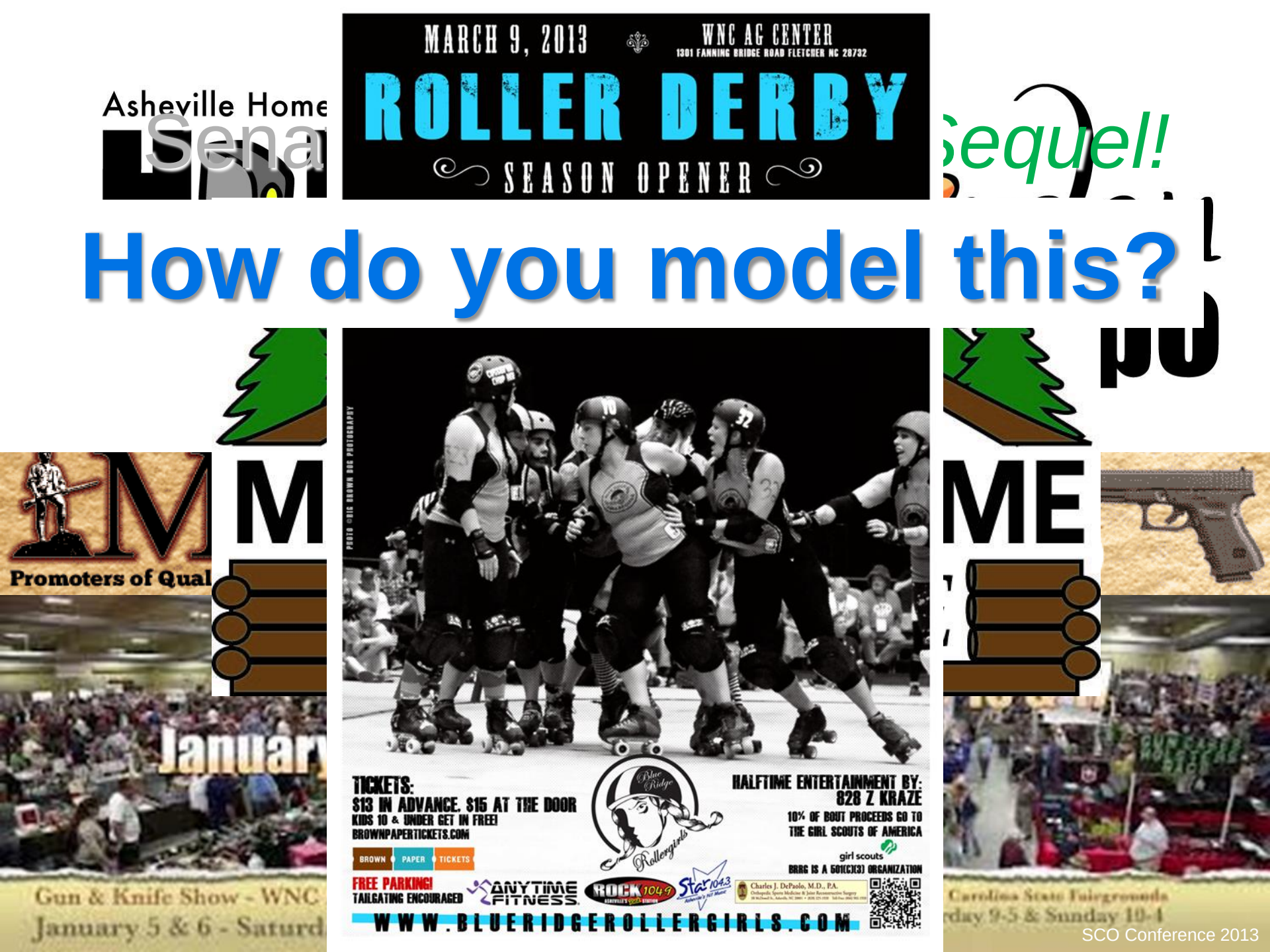
Davis Arena

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 72,840	$ 1.07		
Proposed	$ 42,637	$ 0.63	41	$ 30,203
Metered	$ 61,917	$ 0.91	15	$ 10,923

Senate Bill 668 – *The Sequel!*

Davis Arena

Water Usage					
	Gallons/Year	% Improvement	Savings Gallons	Gal/Res/Yr	Gal/Sq Ft/Yr
Baseline	109,500			N/A	2
Proposed	87,313	20	22,187	N/A	1
Metered	329,868	-201	-220,368	N/A	5


Asheville Home
Sena
MARCH 9, 2013
WNC AG CENTER
1301 FANNING BRIDGE ROAD FLETCHER NC 28732
ROLLER DERBY
SEASON OPENER
Sequel!
How do you model this?
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Gun & Knife Show - WNC
January 5 & 6 - Saturd
Carolina State Fairgrounds
day 9-5 & Sunday 10-4

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Davis Event Center

Lesson Learned

- Verify correct energy rates are used in the model
- Accurately model the use or occupancy of the space

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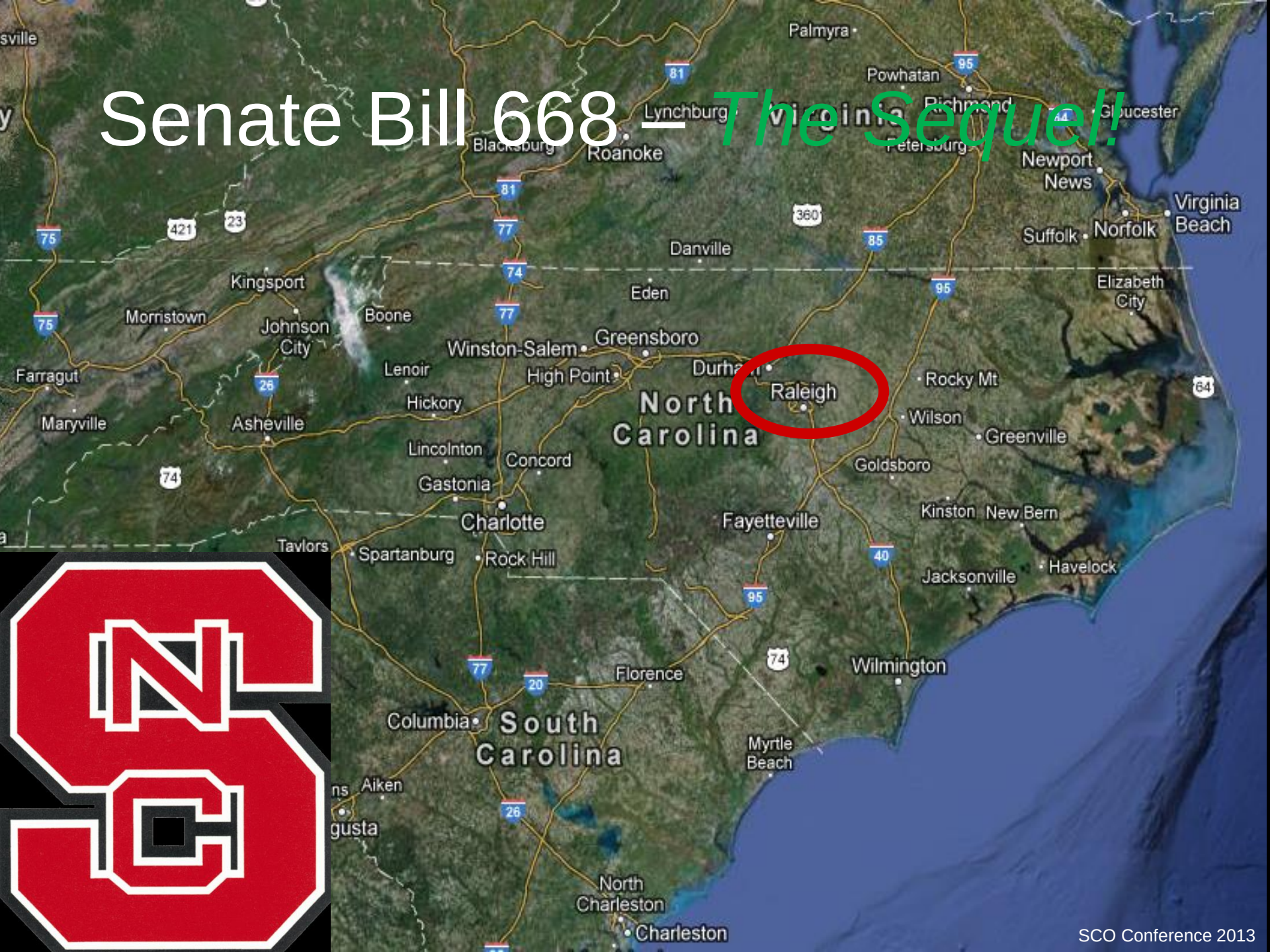


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Yarbrough Dr
Thomas Hall
Geographic Information Systems Education Laboratory
West Dunn Bldg
Dan Allen Dr
Dabney Hall
Cox Hall
Bragaw Residence Hall
NCSU Housing Office
Pullen Hall
Harris Hall
Bowen Residence Hall
Carroll Residence Hall
Nc State University Student Health Svs
Student Health Center
Tucker/ Owen Beach
Tucker Residence Hall
Turlington Residence Hall
Cates Ave
North Carolina State University Intramural Field
Cates Avenue Steam Plant
Price Music Center
Stewart Theatre
Carmichael Gymnasium
Rocky Branch Trail
Basketball and Tennis Courts
Miller Fields
Carmichael Recreation Center
Morrill Dr


Senate Bill 668 – The Sequel!
NCSU
Student Health Center
Renovation
Addition
Cates Ave
Cates Ave
Dan Allen Dr
Cates Ave
Cates Ave
SCO Conference 2013

Senate Bill 668 – *The Sequel!*

Senate Bill 668 – *The Sequel!*

Agency/Institution	NCSU
Project Name and Description	Student Health Center Addition & Renovation
Total Project Cost	$ 6,758,383
Project Size (Square Feet)	51,663
Cost/Square Foot	$ 131

Senate Bill 668 – *The Sequel!*

Envelope Improvements

(addition only)

- Continuous Rigid Insulation, R=12.5, with assembly value of R=17.3
- Low E, Clear, High Performance, Solar Glass, Solarban 70 XL

Senate Bill 668 – *The Sequel!*

HVAC Improvements

- Central station VAV AHUs
- Air side economizer
- Ventilation reset
- Demand control ventilation

Senate Bill 668 – *The Sequel!*

Lighting Improvements

- Lower lighting density
- Occupancy sensors
- Day lighting control

Senate Bill 668 – *The Sequel!*

Student Health Center Addition

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	2,746	111		
Proposed	1,547	63	44	1,199
Metered	5,810	236	-112	-3,064

Senate Bill 668 – *The Sequel!*

Student Health Center Addition

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 69,316	$ 2.81		
Proposed	$ 38,688	$ 1.57	44	$ 30,628
Metered	$ 166,676	$ 6.76	-140	$ -97,360

Senate Bill 668 – *The Sequel!*

Student Health Center Addition

Water Usage					
	Gallons/Year	% Improvement	Savings Gallons	Gal/Res/Yr	Gal/Sq Ft/Yr
Baseline	320,198			NA	13
Proposed	87,313	28	89,240	NA	9
Metered	304,227	5	15,971	NA	12


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METER
66,128 SF
24,663 SF
Cates Ave
Cates Ave
Cates Ave
Cates Ave
Cates Ave
Dan Allen Dr
Student
Center
SCO Conference 2013

Senate Bill 668 – *The Sequel!*

Student Health Center Addition

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	2,746	111		
Proposed	1,547	63	44	1,199
Metered **Addition**	5,810	5,810kBtu/22,463= **259**	-112	-3,064
Metered **Exist+Add**	5,810	5,810kBtu/66,128= **88**		

Senate Bill 668 – *The Sequel!*

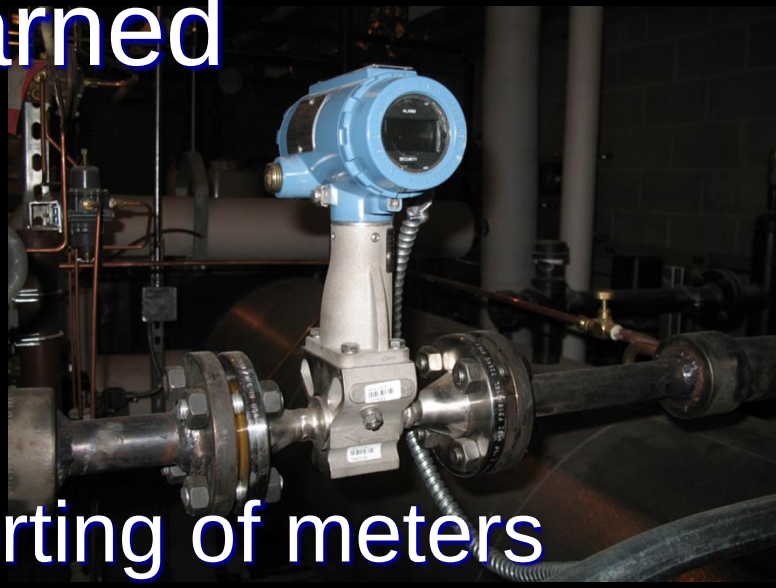
Student Health Center Addition

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 69,316	$ 2.81		
Proposed	$ 38,688	$ 1.57	44	$ 30,628
Metered **Addition**	$ 166,676	$166,676/22,463SF= **$ 6.76**	-140	$ -97,360
Metered **Exist+Add**	$ 166,676	$166,676/66,128SF= **$ 2.52**		

Senate Bill 668 – *The Sequel!*

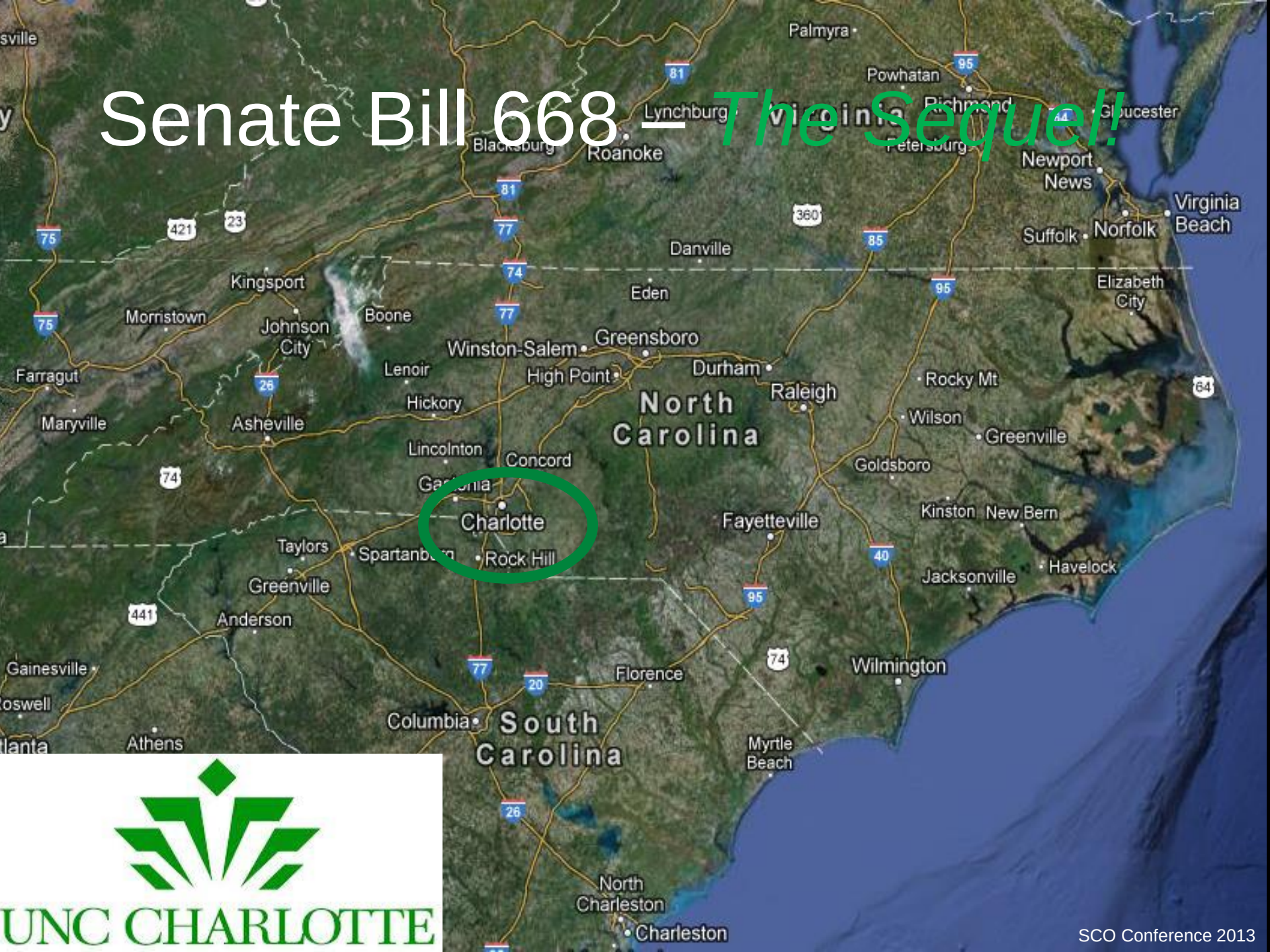
Student Health Center Addition

Lessons Learned



- Model what is metered
- Meter what is modeled
- Steam meter operation
- Verify operation and reporting of meters

Senate Bill 668 – *The Sequel!*



UNC CHARLOTTE


Senate Bill 668 – The Sequel!
Craver Rd
Craver Rd
Craver Rd
Mary Alexander Rd
McMillan
College of Education
The University of North Carolina at Charlotte
Burson
Cameron Hall
Auxiliary Services Bldg
Lot 16A
McEniry Ln
Library Ln
Library Ln
McEniry
Smith
Prospector
US Post Office
Miltimore - Wallis Center
James H. Barnhardt Student Activity Center
Friday
The Belk College of Business
Fretwell
Kennedy
J Murrey Atkins Library
Macy
Barnard
Belk Tower
Denny
Cone University Center
After Hours
King
Winningham
Garinger

Senate Bill 668 – *The Sequel!*

UNC-Charlotte
Prospector Hall
Partial Renovation

Senate Bill 668 – *The Sequel!*

Senate Bill 668 – *The Sequel!*

Agency/Institution	UNCC
Project Name and Description	Prospector Hall Renovation
Total Project Cost	$ 4,389,300
Project Size (Square Feet)	22,705
Cost/Square Foot	$ 193

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Envelope Improvements

- Exterior re-cladding
- Wall U=0.067 vs U=0.124
- Roof U=0.034 vs U=0.063
- Fenestration
  - U=0.26 vs U=1.11
  - SHGC=0.38 vs SHGC=0.87

Senate Bill 668 – *The Sequel!*

HVAC Improvements

- Central station VAV AHUs
- Air side economizer
- Energy recovery
- Demand control ventilation
- Central plant chilled water

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Lighting Improvements

- Lower lighting density
- T5 and T8 fixtures
- Daylighting

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Prospector Hall Renovation

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	2,082	92		
Proposed	1,447	65	29	605
Metered	2,815	124	-35	-733

Senate Bill 668 – *The Sequel!*

Prospector Hall Renovation

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 30,538	$ 1.34		
Proposed	$ 21,943	$ 0.97	28	$ 8,595
Metered	$ 60,182	$ 2.65	-97	$ -29,644

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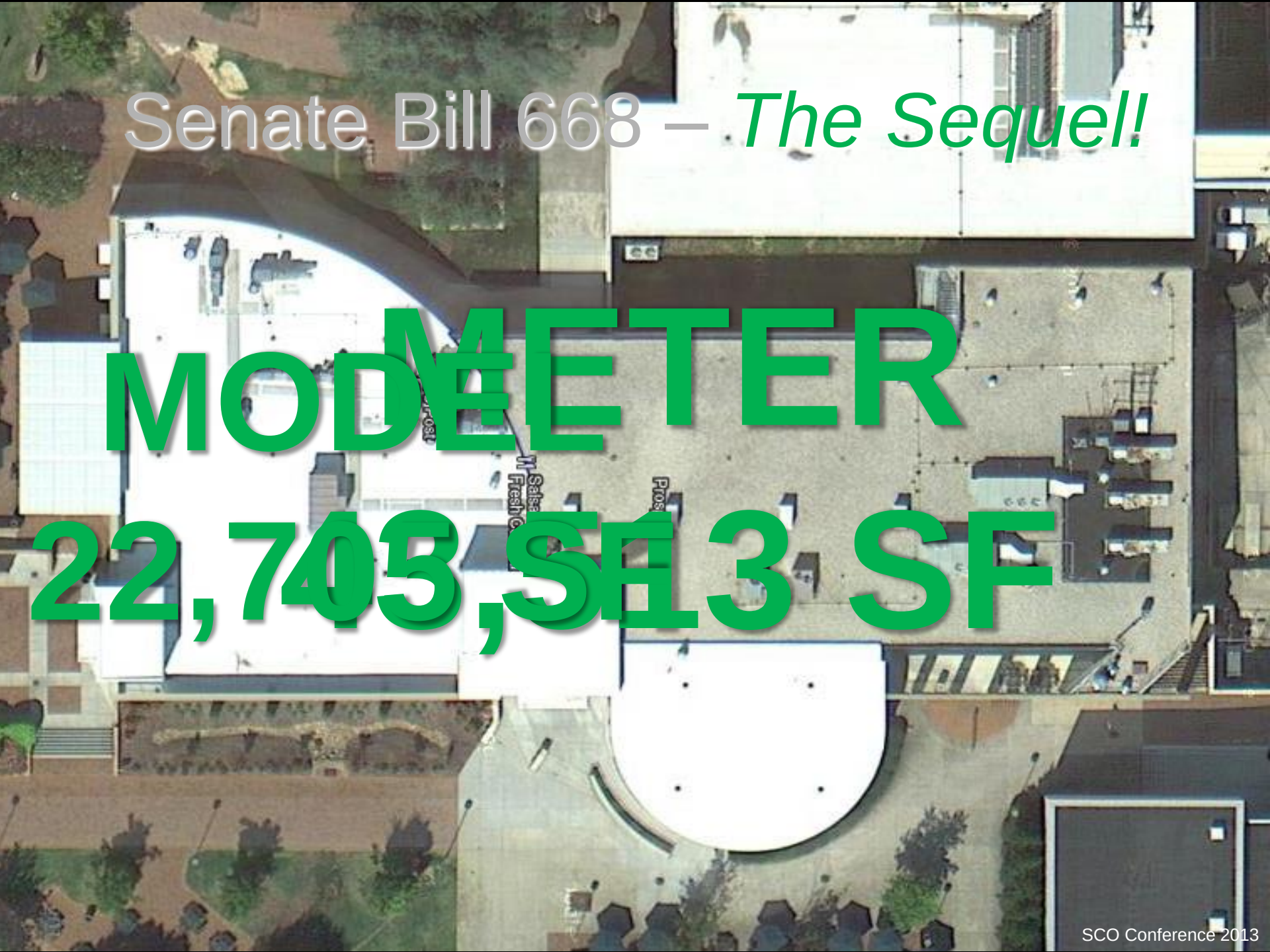
Prospector Hall Renovation

Water Usage					
	Gallons/Year	% Improvement	Savings Gallons	Gal/Res/Yr	Gal/Sq Ft/Yr
Baseline	48,654				2
Proposed	27,934	43	20,720	N/A	1
Metered	1,833,483	-3,668	-1,805,549	N/A	81


Senate Bill 668 – The Sequel!
METER
22,703 SF

Senate Bill 668 – *The Sequel!*

Prospector Hall Renovation

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	2,082	92		
Proposed	1,447	65	29	605
Metered **Renov.**	2,815	2,815kBtu/22,705= **124**	-35	-733
Metered **Total**	2,815	2,815kBtu/43,513= **65**		

Senate Bill 668 – *The Sequel!*

Prospector Hall Renovation

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 69,316	$ 2.81		
Proposed	$ 38,688	$ 1.57	44	$ 30,628
Metered **Renov.**	$ 166,676	$166,676/22,705= **$ 6.76**	-140	$ -97,360
Metered **Total**	$ 166,676	$166,676/43,513= **$ 3.83**		

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Prospector Hall
Lessons Learned

- Model what is metered
- Meter what is modeled
- Account for process energy loads
- Account for process water loads
- Verify operation and reporting of meters

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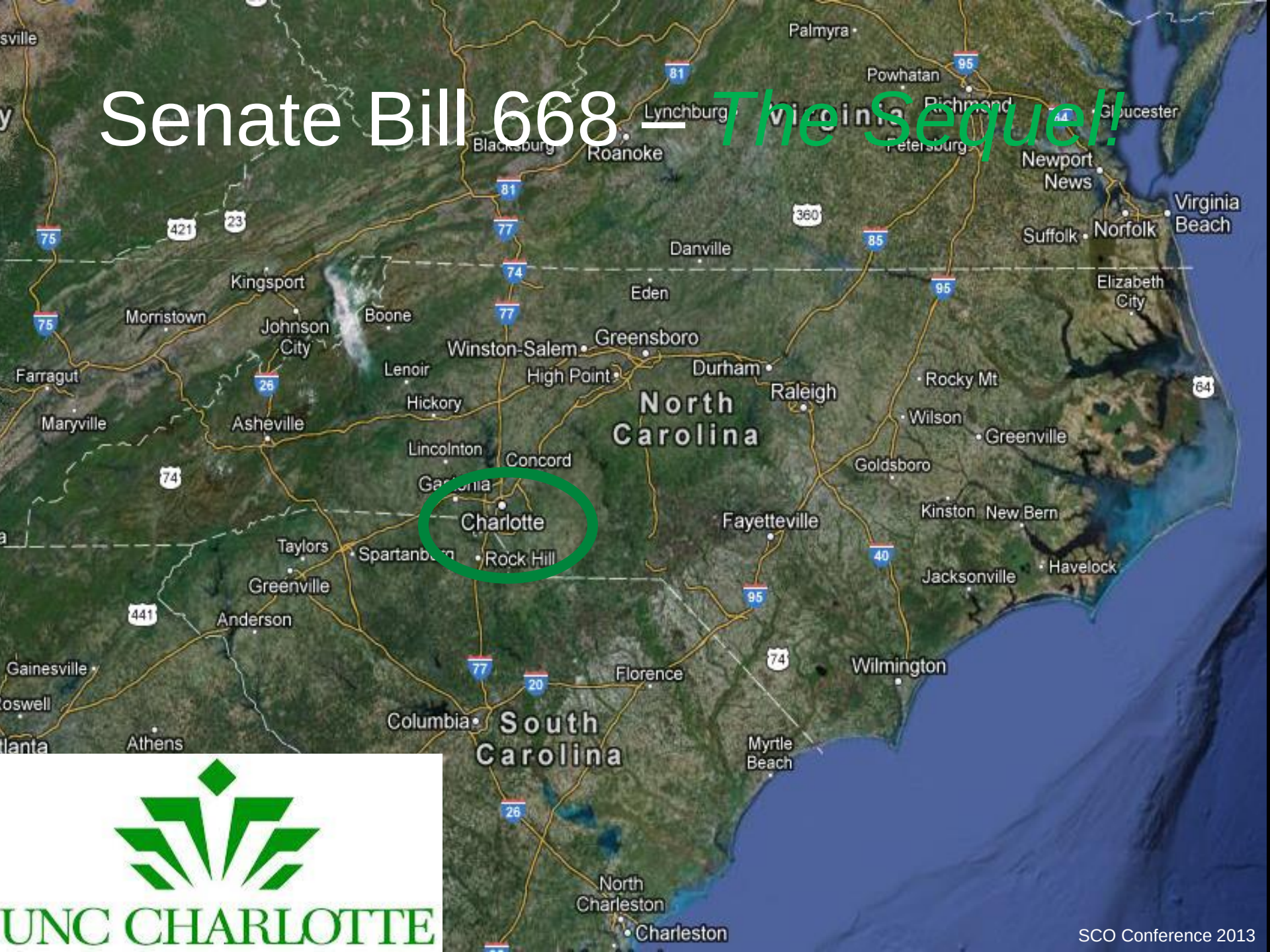

UNC CHARLOTTE

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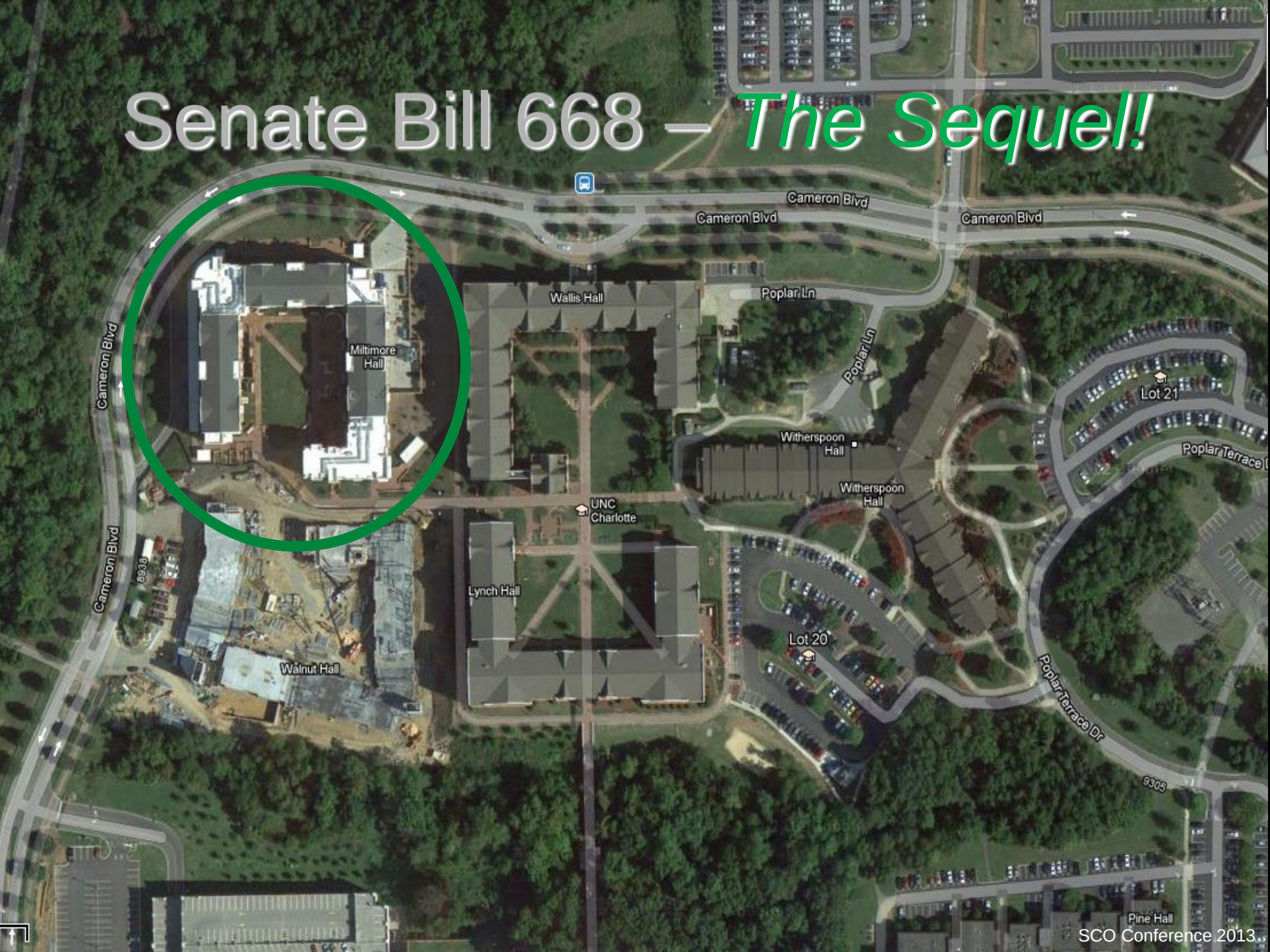

Senate Bill 668 – *The Sequel!*

~~UNC-Charlotte~~
~~Miltimore~~
~~Residence~~
~~Hall~~

SB 668

Compliance Not Required

Senate Bill 668 – *The Sequel!*

Senate Bill 668 – *The Sequel!*

Agency/Institution	UNCC
Project Name and Description	Miltimore Residence Hall
	431 Beds
Total Project Cost	$ 35,920,170
Project Size (Square Feet)	173,086
Square Foot/Bed	402
Cost/Square Foot	$ 208

Senate Bill 668 – *The Sequel!*

Envelope Improvements

- Exterior wall R-15 cavity plus R-3.8 continuous
- Roof R-38
- Windows single hung aluminum with thermal break, low-e glazing

Senate Bill 668 – *The Sequel!*

HVAC Improvements

- Heating and cooling by 4 pipe fan coil units
- Water cooled chiller
- Condensing boilers
- Energy reclamation from exhaust air for ventilation

Senate Bill 668 – *The Sequel!*

Lighting Improvements

- Reduced lighting density
- 28 watt T8 lamps
- Occupancy sensors in common areas

Senate Bill 668 – *The Sequel!*

Miltimore Residence Hall

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/yr)	% Improvement	Savings kBtu
Baseline *	38,283	221		
Proposed *	32,882	190	14	5,401
Metered	10,327	60	73	27,956
*Model data from Cx M&V Plan (LEED)				

Senate Bill 668 – *The Sequel!*

Miltimore Residence Hall

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 478,677	$ 2.77		
Proposed	$ 411,144	$ 2.38	14	$ 67,533
Metered	$ 129,125	$ 0.75	73	$ 349,552

Senate Bill 668 – *The Sequel!*

Miltimore Residence Hall

Water Usage					
	Gallons/Year	% Improvement	Savings Gallons	Gal/Res/Yr	Gal/Sq Ft/Yr
Baseline*	6,961,135			16,151	40
Proposed*	5,188,175	25	1,772,960	12,038	30
Metered	3,852,357	45	3,108,778	8,938	22
*Data from Walnut Residence Hall					

Cooling tower make up water was not included in the indoor water consumption work sheet.

Washing machine use was not included in the indoor water consumption work sheet.

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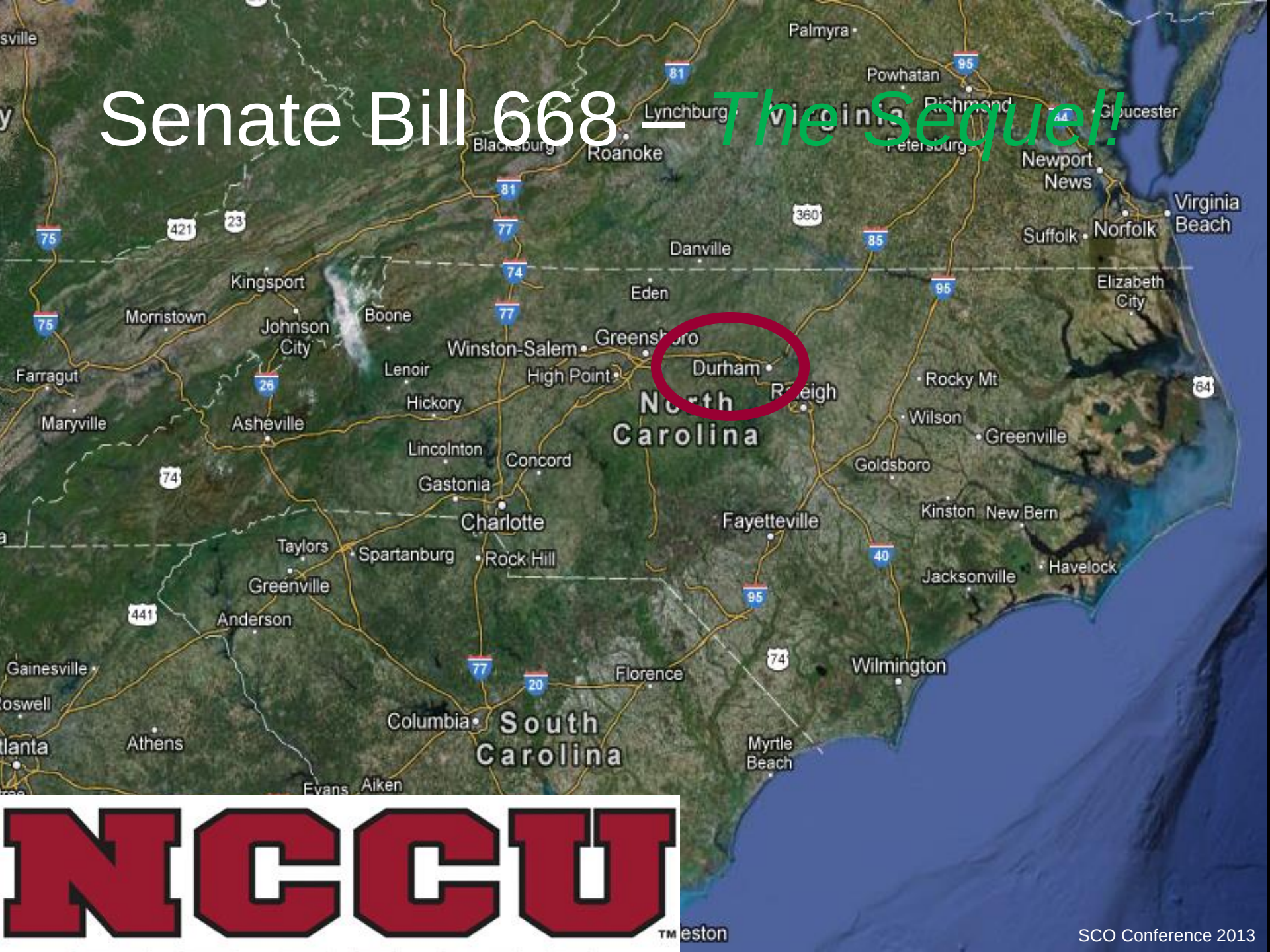
Miltimore Residence Hall

Lessons Learned

- Fully analyze models during design
- Baseline and proposed models high
- Metered energy consumption much less than national averages
- Account for process water loads
- Verify operation and reporting of meters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Palmyra
Powhatan
Lynchburg
Blacksburg
Roanoke
Newport News
Virginia Beach
Suffolk
Norfolk
Danville
Kingsport
Morristown
Johnson City
Boone
Eden
Elizabeth City
Winston-Salem
Greensboro
Durham
Lenoir
High Point
Rocky Mt
Farragut
Hickory
Asheville
Maryville
North Carolina
Wilson
Greenville
Lincolnton
Concord
Gastonia
Goldsboro
Charlotte
Fayetteville
Kinston
New Bern
Taylors
Spartanburg
Rock Hill
Havelock
Jacksonville
Greenville
Anderson
Gainesville
Florence
Wilmington
Columbia
South Carolina
Athens
Myrtle Beach
Aiken
NCCU
SCO Conference 2013


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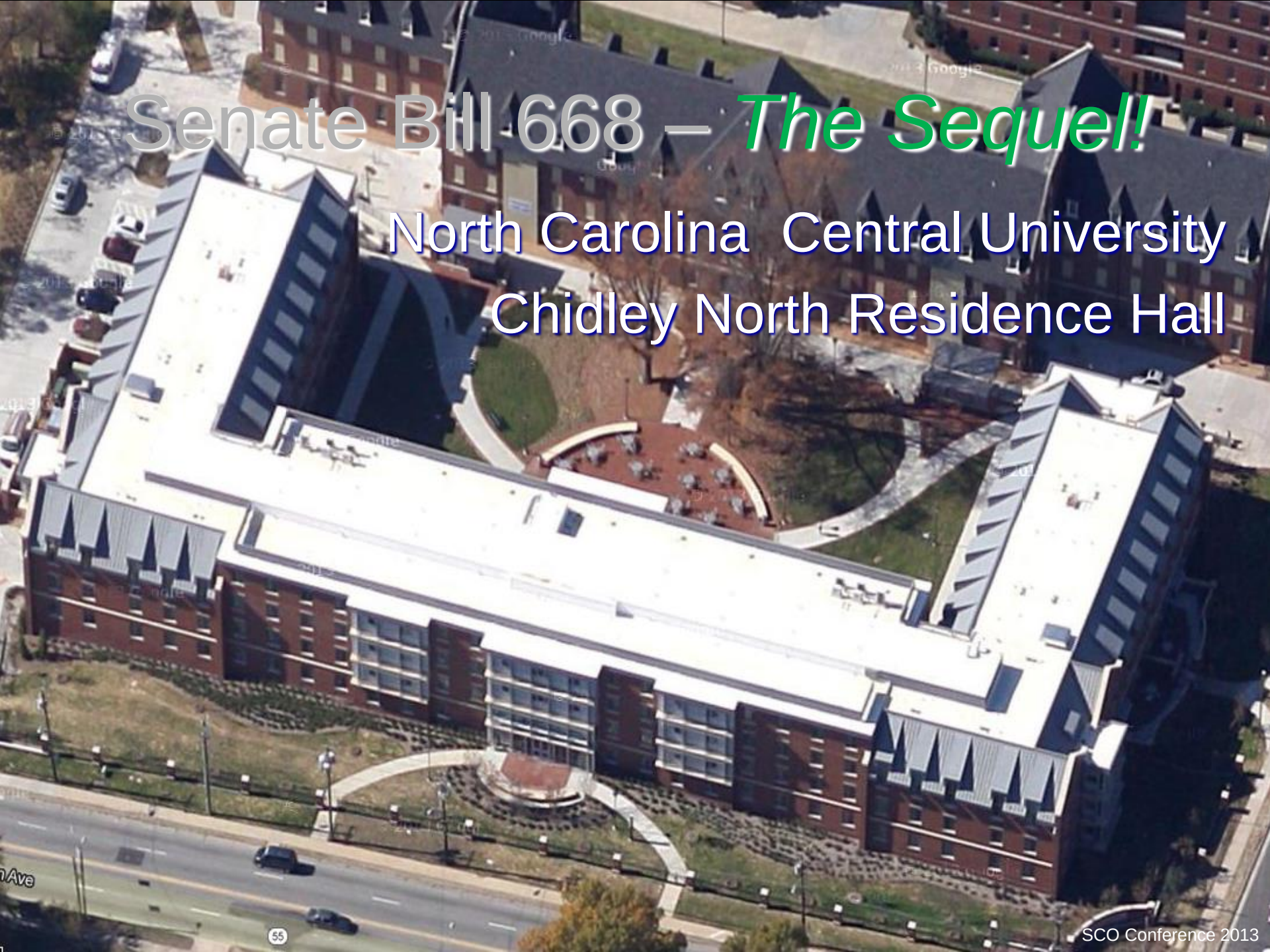
Dayton St
Lincoln St
NCCU
SCO Conference 2013


Senate Bill 668 – The Sequel!
North Carolina Central University
Chidley North Residence Hall
55

Senate Bill 668 – *The Sequel!*

Senate Bill 668 – *The Sequel!*

Agency/Institution	NCCU
Project Name and Description	Chidley North Residence Hall
	528 Beds
Total Project Cost	$ 25,575,984
Project Size (Square Feet)	110,489
Square Foot/Bed	209
Cost/Square Foot	$ 231

Senate Bill 668 – *The Sequel!*

Envelope Improvements

- 3” continuous polyisocyanurate roof insulation (polyiso)
- Insulated concrete form exterior walls
- PPG Solarban 70 XL Starphire glazing
- Aluminum clad wood windows, thermally broken

Senate Bill 668 – *The Sequel!*

HVAC Improvements

- Energy reclamation from exhaust air for ventilation
- Heating and cooling by 4 pipe fan coil units
- Water cooled chillers

Senate Bill 668 – *The Sequel!*

Lighting Improvements

- Reduced lighting density
- 28 watt T8 fixtures

Senate Bill 668 – *The Sequel!*

Chidley North Residence Hall

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	16,482	149		
Proposed	10,635	96	35%	5,847
Metered	5,347	48	68%	11,135

Senate Bill 668 – *The Sequel!*

Chidley North Residence Hall

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 292,778	$ 2.65		
Proposed	$ 198,708	$ 1.80	32%	$ 94,070
Metered	$ 107,655	$ 0.97	63%	$ 185,123

Senate Bill 668 – *The Sequel!*

Chidley North Residence Hall

Water Usage					
	Gallons/Year	% Improvement	Savings Gallons	Gal/Res/Yr	Gal/Sq Ft/Yr
Baseline	6,283,057			11,900	57
Proposed	4,373,148	30%	1,909,909	8,282	40
Metered	70,068	99%	6,209,989	138	1

Senate Bill 668 – *The Sequel!*

Chidley North Residence Hall

Energy Consumption				
	kBtu	EUI (kBtu/Sq Ft/Yr)	% Improvement	Savings kBtu
Baseline	16,482	149		
Proposed	10,635	96	35%	5,847
Metered	5,347	48	68%	11,135
Metered **+ Modeled** **Gas & Steam**	5,347 +118+2,757 **= 8,222**	**74**		

Senate Bill 668 – *The Sequel!*

Chidley North Residence Hall

Energy Dollars/Year				
	$	$/Sq Ft/Yr	% Improvement	$ Savings
Baseline	$ 292,778	$ 2.65		
Proposed	$ 198,708	$ 1.80	32%	$ 94,070
Metered	$ 107,655	$ 0.97	63%	$ 185,123
Metered **+ Modeled Gas & Steam**	**$ 147,161**	**$ 1.33**		

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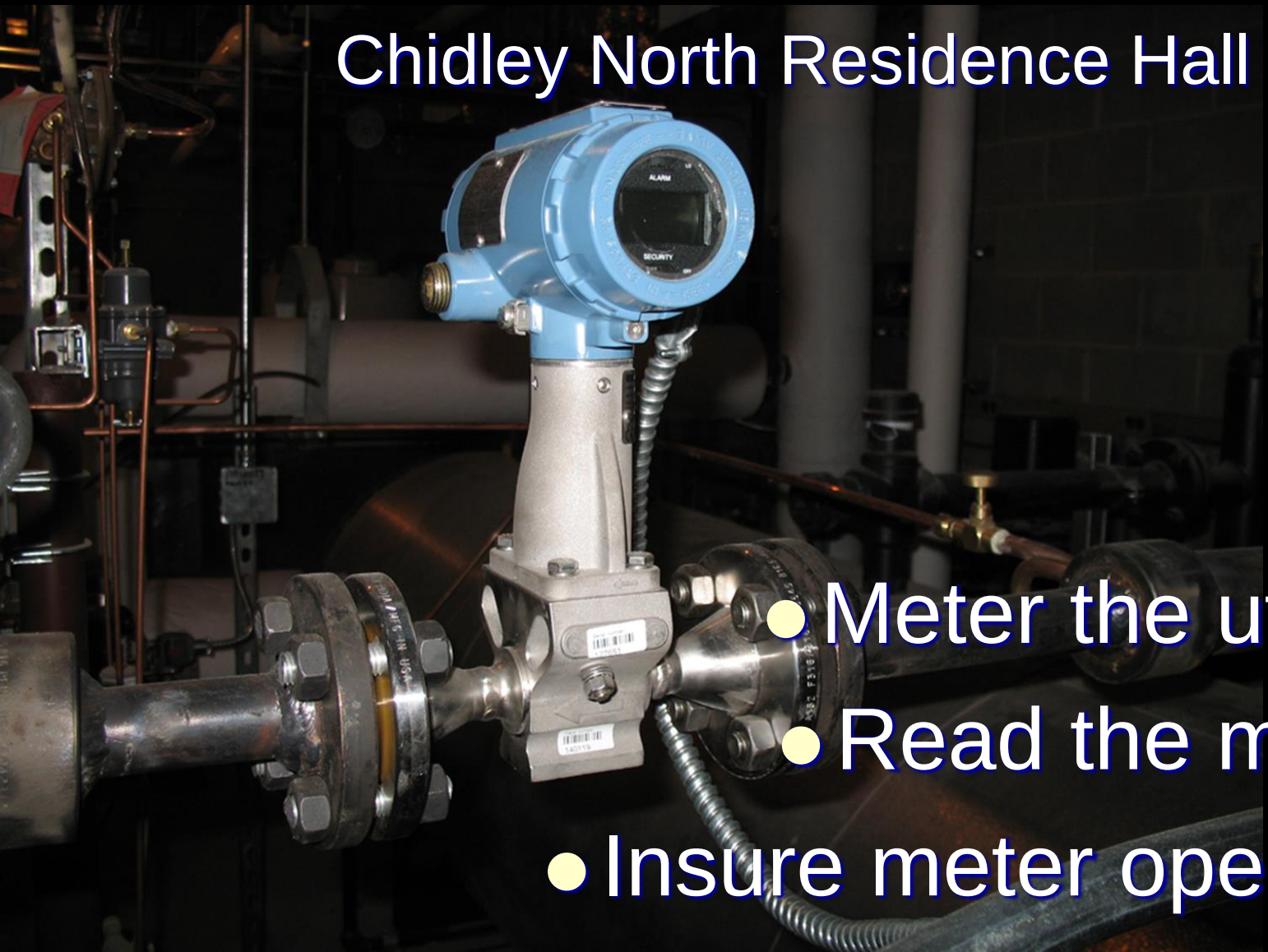

Chidley North Residence Hall

- Meter the utilities
- Read the meters
- Insure meter operation

Senate Bill 668 – *The Sequel!*

Chidley North Residence Hall Lessons Learned

- Verify operation and reporting of meters
- Verify correct units are used when reporting meter data:
  - Gallons?
  - Cubic Feet? (CF)
  - Hundred Cubic Feet? (CCF)
  - Dollars? ($)

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Comparison of data for the six buildings analyzed

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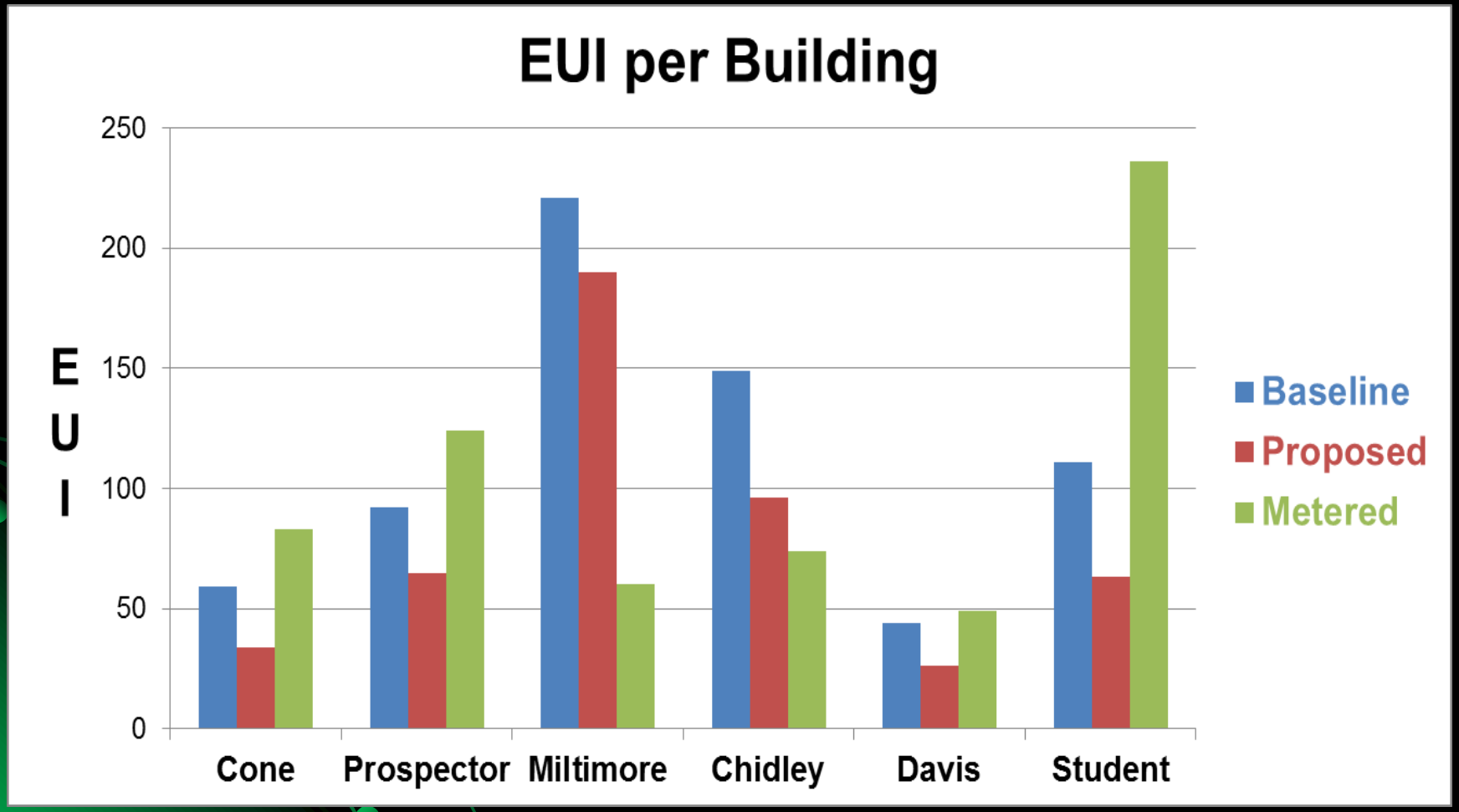

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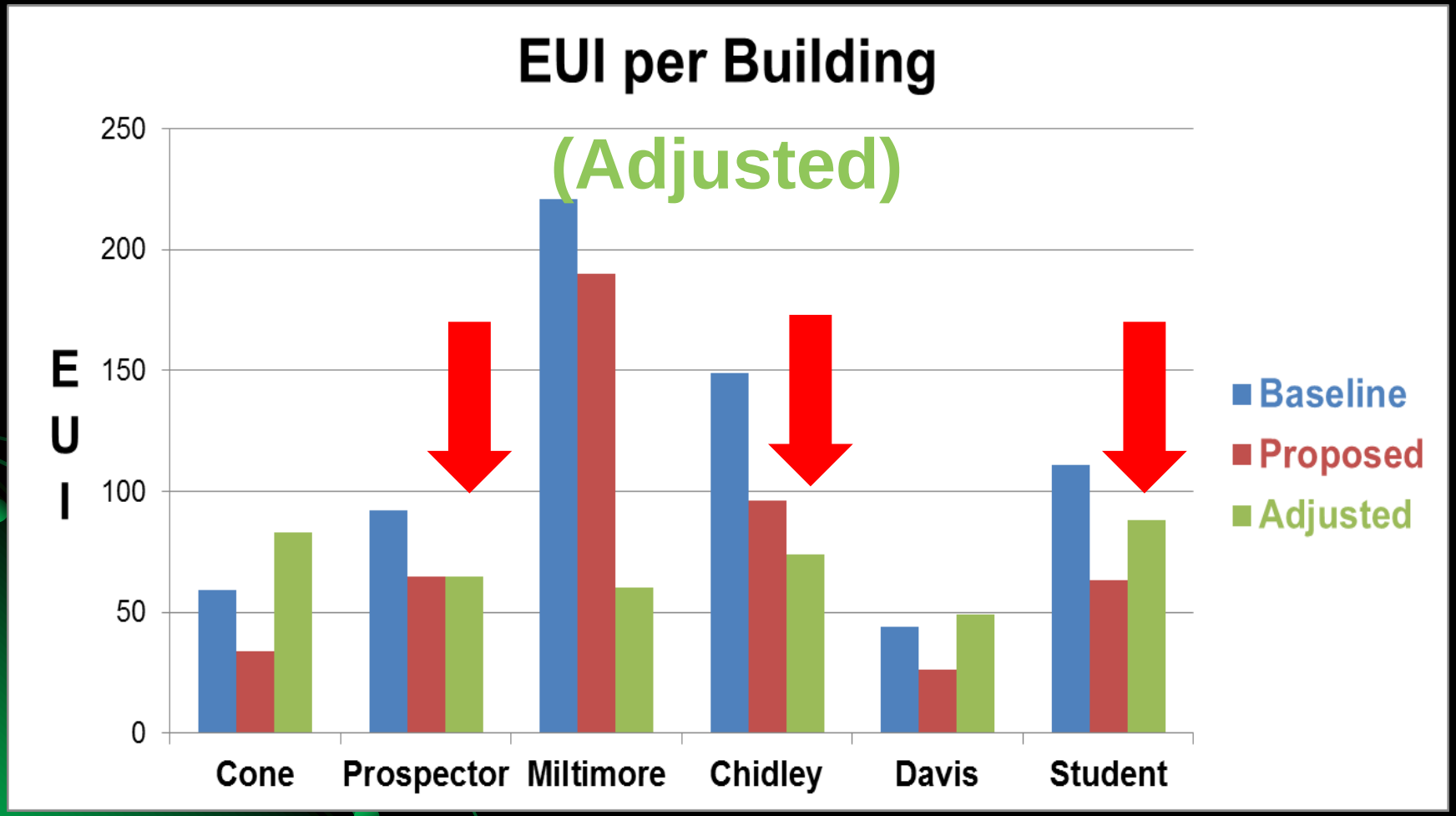

After 24 months
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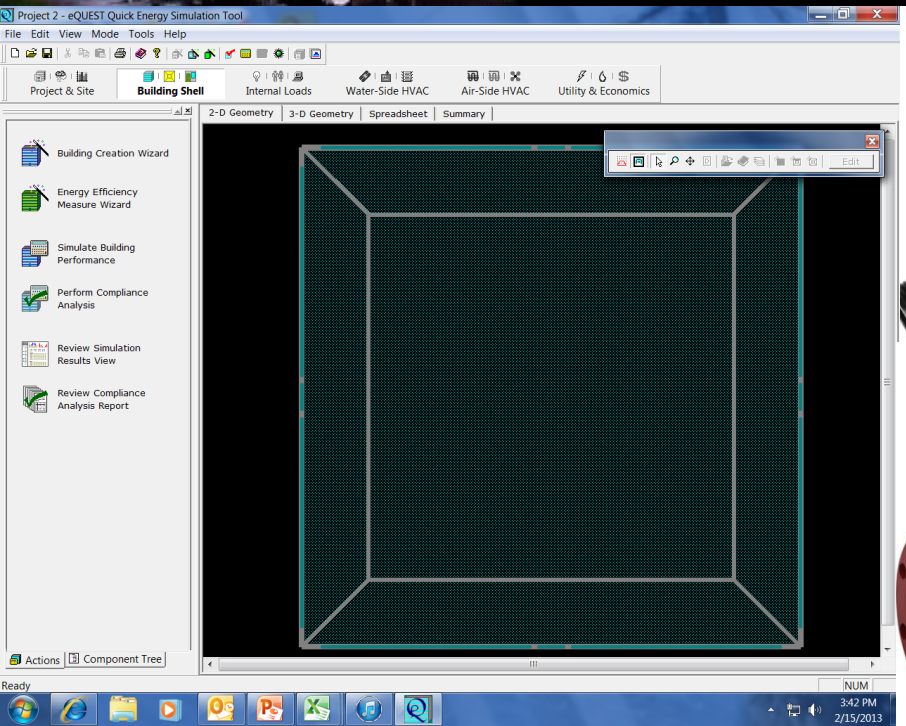
What have we learned?

- Fully analyze your model
- Account for process loads
- Model what you meter
- Meter what you model



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- ECSU — School of Education and Psychology
- DoAg&CS — SENC Agriculture Center
- DoA-VA — Veteran's Nursing Home Swannanoa
- Pitt CC — General Classroom Building
- UNCG — Quad Residence Hall Renovation
- WCU — Harrill Residence Hall Renovation
- UNCP — Nursing & Health Promotions Building
- FSU — Renaissance Residence Hall
- UNCW — Teaching Laboratory Building

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Thank You!

Questions?

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919-807-4093

http://www.nc-sco.com/

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90.1-2007 is 4.6% better than 90.1-2004

(site energy, not source energy)

Reference:

http://www.gpo.gov/fdsys/pkg/FR-2011-07-20/pdf/2011-18251.pdf

and

http://www.energycodes.gov/regulations/determinations/previous

and

http://www.energycodes.gov/sites/default/files/documents/BECP_FinalQuantitativeAnalysisReport901-2007Determination_May2011_v00.pdf

and

http://www.energycodes.gov/sites/default/files/documents/BECP_FinalQuantitativeAnalysisReport901-2007Determination_May2011_v00.pdf

Senate Bill 668 – *The Sequel!*

Here's the mathematical analysis:

SB668 – 30% better than ASHRAE 90.1-2004 →
SB668 = (0.70 * ASHRAE2004)

2012 NCECC = 20% better than ASHRAE2007 → 2012NCECC = (0.80 * ASHRAE2007)
2007 is 5% more efficient than 2004 → ASHRAE2007 = (0.95 * ASHRAE2004)

Then we start doing the math:
SB668 = (0.70 * ASHRAE2004)
2012NCECC = (0.80 * ASHRAE2007) = (.95 * 0.80 * ASHRAE2004) = **(0.76 * ASHRAE2004)**

In terms of ASHRAE 2004, SB668 is 70% better, 2012 NCECC section 501.1 is 76% better. In summary, if one meets SB668, one meets both 2012 NCECC section 501.1 and LEED.

Senate Bill 668 – *The Sequel!*

90.1-2010 is 30% better than 90.1-2004

(site energy, not source energy)

Reference:

http://www.energycodes.gov/sites/default/files/documents/BECP_Energy_Cost_Savings_STD2010_May2011_v00.pdf

and

http://en.wikipedia.org/wiki/ASHRAE_90.1

Energy savings compared to 90.1-2004 were approximately ***25 percent*** including plug loads and approximately ***31 percent*** excluding plug loads.