Why Buildings Matter
and the
Business Case for Energy Efficiency

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MC2 - Mathis Consulting Company
SSEB Mission:
To enhance economic development and the quality of life in the South through innovations in energy and environmental policies, programs and technologies.
Who Am I?

- **Building Scientist (35+ years)**
  - Energy performance of buildings and products
  - Utility and business implications

- **Author, Educator**
  - Books, technical papers, training classes on building performance, insulation, understanding source energy, window performance, peak power, etc.

- **Energy Codes and Standards Developer**
  - National and state energy codes

- **WNC Beekeeper**
The End in Mind

- **Buildings Matter!**
  - More than we know...

- **Trends Impacting Our Region**
  - Energy, Power, Water, People, etc.

- **The Business Case for Energy Efficient Buildings**
  - Focusing greater utility and ally engagement in shaping building energy policy in our region
Buildings Matter: US Energy Use

- Buildings: 22%
- Industry: 28%
- Transportation: 31%
- Commercial: 18%

Source: USEIA - 2012
U.S. Energy Consumption

Source: USEIA - 2012
Growth of Residential AC 1973-2013

Source: US Census 2013
Heat Pumps are Everywhere
Utility Concerns: Meeting the Demand

- Peak Loads
  - Cooling Driven
  - Simultaneous
- Heating
  - Especially now
- Lighting
- Plug Loads
Regional Peak Power News...

Power City

Duke Energy Progress sets all-time record in cold snap

Jan 8, 2014, 11:04am EST | UPDATED: Jan 8, 2014, 12:43pm EST
Winter Peak Periods Could Cost Utility Companies and Customers Money, Danville Utilities Gives Energy Saving Tips
Today's power peak this morning was just above 26,000 megawatts... when temperatures in the 7-state region averaged a low of 20 degrees Fahrenheit...

Colder weather predicted Wednesday night and early Thursday could easily push power demand above 30,000 megawatts.
Coincident Demand: Summer & Winter

- **Heating**
  - Like this past week

- **Cooling**
  - Driven by building demand
The Energy Megatrend

- Growing demand
  - More…

- Simultaneous demand
  - Peak power issues…

- Energy security
  - Enough for us?
  - Reliability?

- Economic security
  - Our economy?
  - World economy?
Homes Have Changed...
Average US Home Size - 1973 to 2013

1973 = 1,660 Square Feet
2013 = 2,679 Square Feet
Source: US Census Bureau

Average home size

<table>
<thead>
<tr>
<th>Year</th>
<th>Square Feet</th>
</tr>
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<tbody>
<tr>
<td>1983</td>
<td>1,725</td>
</tr>
<tr>
<td>1993</td>
<td>2,095</td>
</tr>
<tr>
<td>2003</td>
<td>2,330</td>
</tr>
<tr>
<td>2013</td>
<td>2,598</td>
</tr>
</tbody>
</table>
Homes Have Changed...

New Single Family Homes with Air Conditioning

1973: 49%
2013: 93%

Source: US Census 2014
Growth of Residential AC 1973-2013

Source: US Census 2013
U.S. Energy Production - 2012

- Coal: 46%
- Natural Gas: 20%
- Nuclear: 21%
- Renewables: 12%
- Oil: 1%

Source: USEIA - 2013
Projections on the Future?

Figure ES-5. Electricity generation by fuel in the Reference case, 1990-2040

trillion kilowatthours

<table>
<thead>
<tr>
<th>History</th>
<th>2012</th>
<th>Projections</th>
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<tbody>
<tr>
<td>1990</td>
<td></td>
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<td>2000</td>
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<td>2010</td>
<td></td>
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<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td></td>
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</tbody>
</table>

- Natural gas
- Renewables
- Nuclear
- Coal
- Petroleum liquids and other
World Energy Consumption by Fuel

1990 – 2035

Source: USEIA – 2012
The Energy Megatrend

- Increasing demand
- Supply challenges
- Peak power
- Energy security
- Economic security
Utility Concerns

- The “Timing” of our Demand
  - Base Load
  - Peak Demand
  - Cooling Driven
  - Lighting Driven
Worst US drought in decades deepens to cover 60 percent of lower 48 states
Water Implications...
US thermoelectric facilities use over 200 billion gallons of water a day.

Over half of the withdrawn water in the US...

Sources: Union of Concerned Scientists 2011, USGS 2012
Annual Net Migration 2000 - 2004

- **Florida**: 190,894
- **Arizona**: 66,344
- **Nevada**: 50,803
- **Georgia**: 41,298
- **North Carolina**: 39,137
- **Texas**: 36,566
- **Virginia**: 20,535
- **South Carolina**: 18,576
- **Tennessee**: 16,634
- **Washington**: 13,354
US Commercial Buildings

74% was built before 1989!

93% of our commercial building stock was built before 2003!

Source: USEIA, 2003 CBECS
Commercial Buildings 1950 - 1989

- **Common Issues:**
  - Insulation in walls?
  - Insulation on roof?
  - Windows?
  - Air sealing?
  - Heating systems?
  - Cooling systems?
  - Lighting systems?

- **Common Assets:**
  - Good Bones
  - Existing Infrastructure
  - Location
## Building Component Life Expectancy

<table>
<thead>
<tr>
<th>Building Measure</th>
<th>USDOE</th>
<th>NAHB</th>
<th>NIBS</th>
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<tbody>
<tr>
<td>Insulation</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Windows</td>
<td>40</td>
<td>50</td>
<td>50</td>
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<tr>
<td>Furnace, Forced Air</td>
<td>14</td>
<td>17.5</td>
<td>18</td>
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<tr>
<td>Unit Heaters, Gas or Electric</td>
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<td>17.5</td>
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<tr>
<td>Heat Pump</td>
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<tr>
<td>Air Conditioner</td>
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<tr>
<td>Central Air</td>
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<td>15</td>
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<tr>
<td>Window Unit</td>
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<td>10</td>
<td>10</td>
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<tr>
<td>Electric Water Heater</td>
<td>13</td>
<td>11</td>
<td>14</td>
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<tr>
<td>Gas Water Heater</td>
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<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Gas Range</td>
<td>17</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Electric Range</td>
<td>16</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Gas Oven</td>
<td>-</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Washer</td>
<td>11</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Dryer, Electric or Gas</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Refrigerator-Standard</td>
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<td>17</td>
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<tr>
<td>Freezer-Standard</td>
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<td>11</td>
<td>16</td>
</tr>
</tbody>
</table>
Audience Survey: For How Long?

- Your House?
- One of Your Parent’s Home’s?
- Grandparents?

- ~ 100 years!
U.S. Residential Buildings

99%

1%

New

Existing

Source: USEIA – 2009 RECS
Age of U.S. Homes...

- 70% Built Before 1989
- 30% Built 1989 - 2009

Source: USEIA – 2009 RECS
Air Leakage...
Diagnostic Tools...
FIRST: "Plug the Holes in the Ship!"
U.S. Commercial Construction

Over 50% new since 2010

Source: USEIA, 2013
Built Environment Trends

- More severe climate events
  - “Superstorms”
  - Extreme cold - “Polar Vortex”
  - Extreme heat

- Increased expectations for building performance
  - Energy, Durability, Health, IEQ, Resilience, etc.
  - What is “sustainable”?
  - For how long?
But we’ve got the building codes to handle that... right?
What is the Code?

- Least safe...
- Least strong...
- Least energy efficient...

- ...building allowed by law.

We’re not allowed to build it any crappier...
Energy Codes Have Changed...

Code minimum is still a long way from “Net Zero”
Where is Your State’s Minimum Code?
120 million homes in US
Half with crappy windows...

60 million homes
Over 1.4 billion windows
What If We Replaced Windows?
Use the “Worst” Code-Compliant Window
What Would We Save?

- 1 to 3 Tons of Air Conditioning per house
  - Depending on size, location, leakiness, etc.
- 1 ton = 12,000 Btu/hr
- 13 SEER = 13,000 Btu/kWh
- ~1 kW of peak power savings per house
- ~120 million existing homes
  - About half have lousy windows

\[ \text{What is } 60 \text{ million kW?} \]

- ~60 million * 1 ton * 1 kW/ton = 60 million kW
The equivalent PEAK capacity of \(~300 \ 200\text{mW}\) power plants...
What if...

Lessons from the 70’s...
Where do we get these building materials?
“The Rest of the Story”

➤ Where do we sell them?

- Builders FirstSource
- The Home Depot
- Lowe's
- 84 Lumber
- Stock Building Supply
- Menards
“The Rest of the Story”

Who Does the WORK?

- Home Builders
- Remodelers
- Air Sealing Contractors
- Plumbers
- Window Installers
- Carpenters
- HVAC Contractors
- Insulation Contractors
- Electricians
- Roofers
“The Rest of the Story”

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Our NEIGHBORS!
Job Creation!
Sustainable Business!
Durable Energy Savings!
Real Energy Security!
THIS also helps the most people...
Our nation’s existing homes and commercial buildings are essentially millions of little “power plants” we’ve already built but we haven’t turned on! We turn them “on” with improved energy efficiency.
Opportunities Aligned with SSEB Goals

Provide direct scientific and technical assistance to state governments

- Provide education and technical support concerning the role of buildings in state and regional energy needs/policy

Develop, promote and recommend policies and programs on energy, environment and economic development that encourage sustainable development

- Develop and implement market transformation strategies such as tax incentives, utility incentives, etc.
- Adopt updated energy efficient building codes
- Recognize and incentivize regional and local manufacturing, delivery and installation of durable EE building products
- Connect building energy conservation to regional water objectives
More SSEB Aligned Opportunities (2)

Provide technical assistance to policy-makers and the private sector on energy, environment and economic issues that ensure energy security and supply

- Connect various policy-makers who are responsible for different aspects of the regulation of energy in buildings
- Provide education and compliance support for energy codes and market transformation programs as a regional energy supply security investment

Facilitate energy and environmental policies between federal, state and local governments and the private sector

- Harmonize efforts by federal, state, and local policymakers to encourage energy efficient buildings
More SSEB Aligned Opportunities (3)

Sustain business development throughout the region by eliminating barriers to the use of efficient energy and environmental technologies

• Enhance existing programs targeting improved building energy performance – especially long-lived building envelope improvements that are regionally or locally produced and installed
• Consider utility programs that more powerfully leverage the impacts from combined building efficiency measures

Support improved energy efficient technologies that pollute less and contribute to a clean global environment while protecting indigenous natural resources for future generations.

• Support technologies that deliver long-lived building energy efficiency improvement
The End in Mind

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   ➤ More than we know...

➤ Trends Impacting Our Region
   ➤ Energy, Power, Water, People, etc.

➤ The Business Case for Energy Efficient Buildings
   ➤ Focusing greater utility and ally engagement in shaping building energy policy in our region
The Future is in Our Hands

Thank you!

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