

bsc

CONCLUSIONS

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bsc Recall: Environmental Impact

- Largest single global industry
- Hence, buildings consume resources
 - Lots of materials
 - Lots of energy
 - Lots of money
 - Pollute, displace, and destroy habitats
- Last a long time: A “durable good”
 - Running shoe (1 yr), car (10 yr), bldg (100yr?)
- Hence - more careful long-term design
 - i.e. societal involvement is justified

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bsc Building America Research Goals

Energy Use Intensity versus Residential Integration Goals

Energy use intensity (BA benchmark = 1)

Residential energy goal

Onsite energy goal

40% energy savings

50% energy savings

70% energy savings

30% onsite power by 2020

25,000 houses in 34 states

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bsc Energy Use in the Home

Lighting 8.8

Water Heating 9.1

Space Heating 10.1

Air Conditioning 16

Refrigerator 13.7

Other 42.2

All Others 26.7

Color TVs 2.9

Furnace Fans 3.2

Freezers 3.5

Clothes Dryers 5.8

Source: Energy Information Administration, Form EIA-457A, B, C, E, and H of the 2001 Residential Energy Consumption Survey.

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bsc Remember “Site” vs “Source”

- Heating your house with light bulbs is 100% efficient (site energy) but ~30% efficient (source energy)
- “Zero” needs to be measured properly

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bsc So how do we measure it?

- Energy per unit floor area per year
- kWh/meter²•year (**Europe & the rest of the world**)
- Btu/square foot•year (**or kBtu/sf•year; 1000 Btu = 1 kBtu**)
- Conversion:
kWh/m²•year_0.317 = kBtu/sf•year

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bsc Calculating kBtu/sf•year (site)

<p>Electricity</p> <ol style="list-style-type: none"> 1. Take total kWh for year 2. $_3.412 = \text{kBtu/yr}$ 	<p>Natural gas</p> <ol style="list-style-type: none"> 1. Take total therms for year 2. $_99.98 = \text{kBtu/yr}$
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3. Add electricity & gas kBtu/yr

4. \div square footage = kBtu/sf•year

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bsc Calculating kBtu/sf•year (source)

<p>Electricity</p> <ol style="list-style-type: none"> 1. Take total kWh for year 2. $_3.412 = \text{kBtu/yr}$ 3. $_3.013 = \text{kBtu/yr of source energy}$ 	<p>Natural gas</p> <ol style="list-style-type: none"> 1. Take total therms for year 2. $_99.98 = \text{kBtu/yr}$ 3. $_1.02^* = \text{kBtu/yr of source energy}$
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4. Add electricity & gas kBtu/yr

5. \div square footage = kBtu/sf•year

* Source to site losses exist for gas as well — 2-9%?

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bsc Architecture 2030 Goals

- Current goal: 50% of energy consumption – for regional or national average for building type
- 60% in 2010
- 70% in 2015
- 80% in 2020
- 90% in 2025
- Carbon-neutral by 2030

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bsc Comparison figures

- 2030 Challenge: Current average use

Building Type	Site Energy (kBtu/sf•yr)	Source Energy (kBtu/sf•yr)
Distribution/shipping center	~50	~50
Retail store	~80	~150
Restaurant/cafeteria	~300	~550
Single Family Detached	~50	~50
Single Family Attached	~50	~50
Multi-Family 2 to 4 units	~50	~50
Multi-Family 5 or more units	~50	~50

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bsc How to Get There . . .

Our Approach:

- Step 1: Reduce Enclosure Energy Use
- Step 2: Reduce Mechanical System Energy Use
- Step 3: Add Site Generated Energy

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bsc Top Ten Elements

1. Design for comfort with as little added energy as possible
2. Build tight
3. Ventilate
4. Use more insulation
5. Provide for durability by controlling moisture
6. Design a roof that is sloped to the south
7. Use the most efficient equipment the project can afford
8. Use efficient lighting, appliances; match to occupant needs
9. Reduce energy use 40-70% before adding onsite energy generation

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bsc Again: What we are finding . . .

- 40% easy (even for production builders)
- 50% is getting expensive
- MEL are becoming larger
- PV is making more sense in \$/Btu

Outlook:


- Single-family – 50% enclosure, 50% on-site
- Multi-family – 30% enclosure, 70% on-site

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bsc Resources

Building Science Corporation
Designs that Work – Cold Climate Case Study

find this at:
www.buildingscience.com/dtw

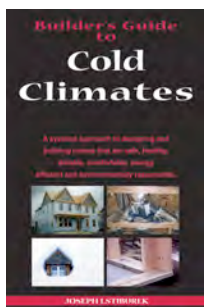


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Building Science Corporation
Builder's Guide to Cold Climates

find this at:
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Building America
Cold Climate Best Practices Guide

find this at:
www.buildingamerica.gov
(look for "publications")



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