## Purpose

Methodology for characterizing the energy use of a utility's commercial market in order to identify DSM options that will most cost-effectively reduce energy use intensity.
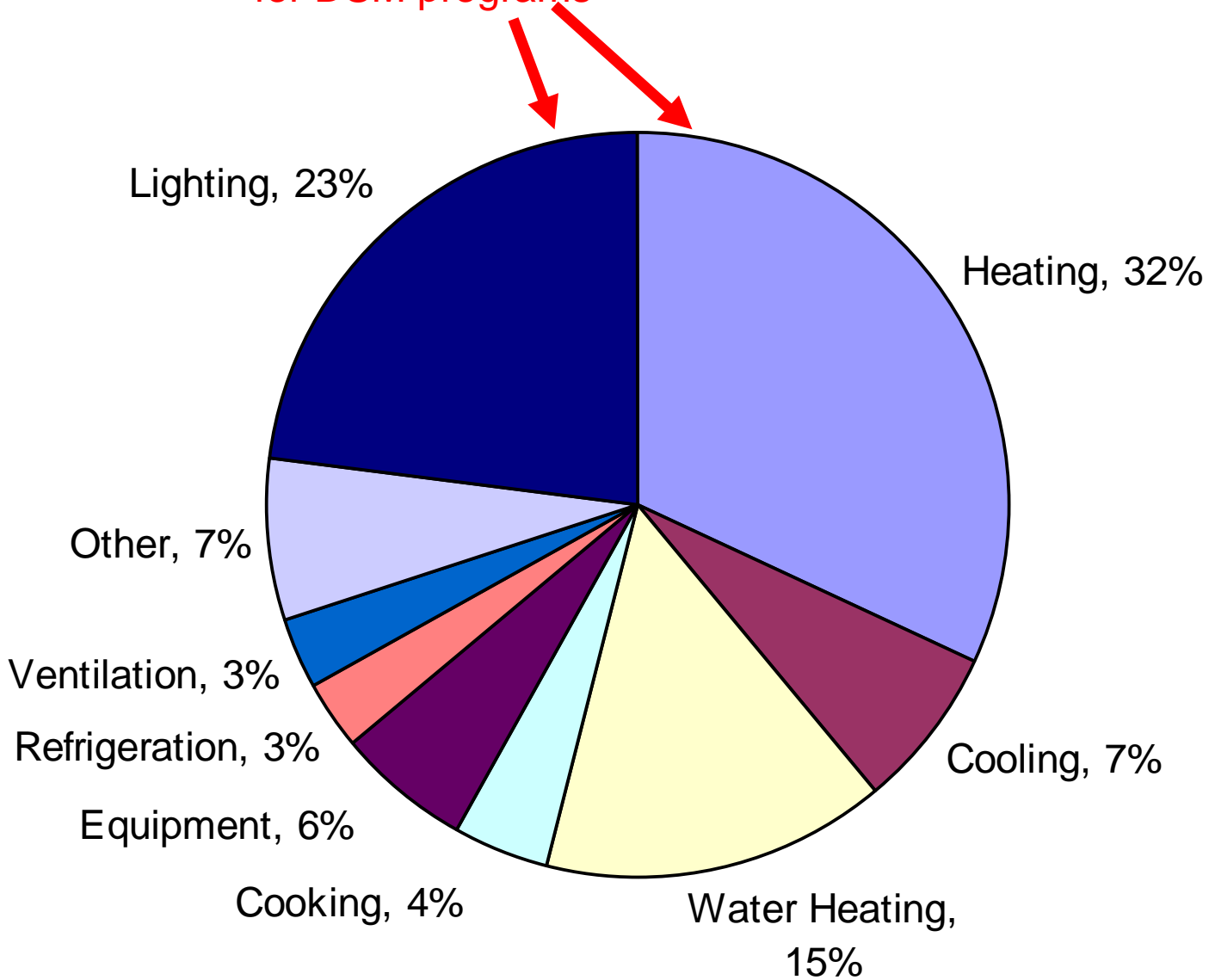
Objectives

1. Stratify the commercial accounts of Gainesville Regional Utilities (600 MW) into major North American Industry Classification System (NAICS) market segments

2. Merge utility energy use records from 1994 to 2006 with county property appraiser building data (tax records)

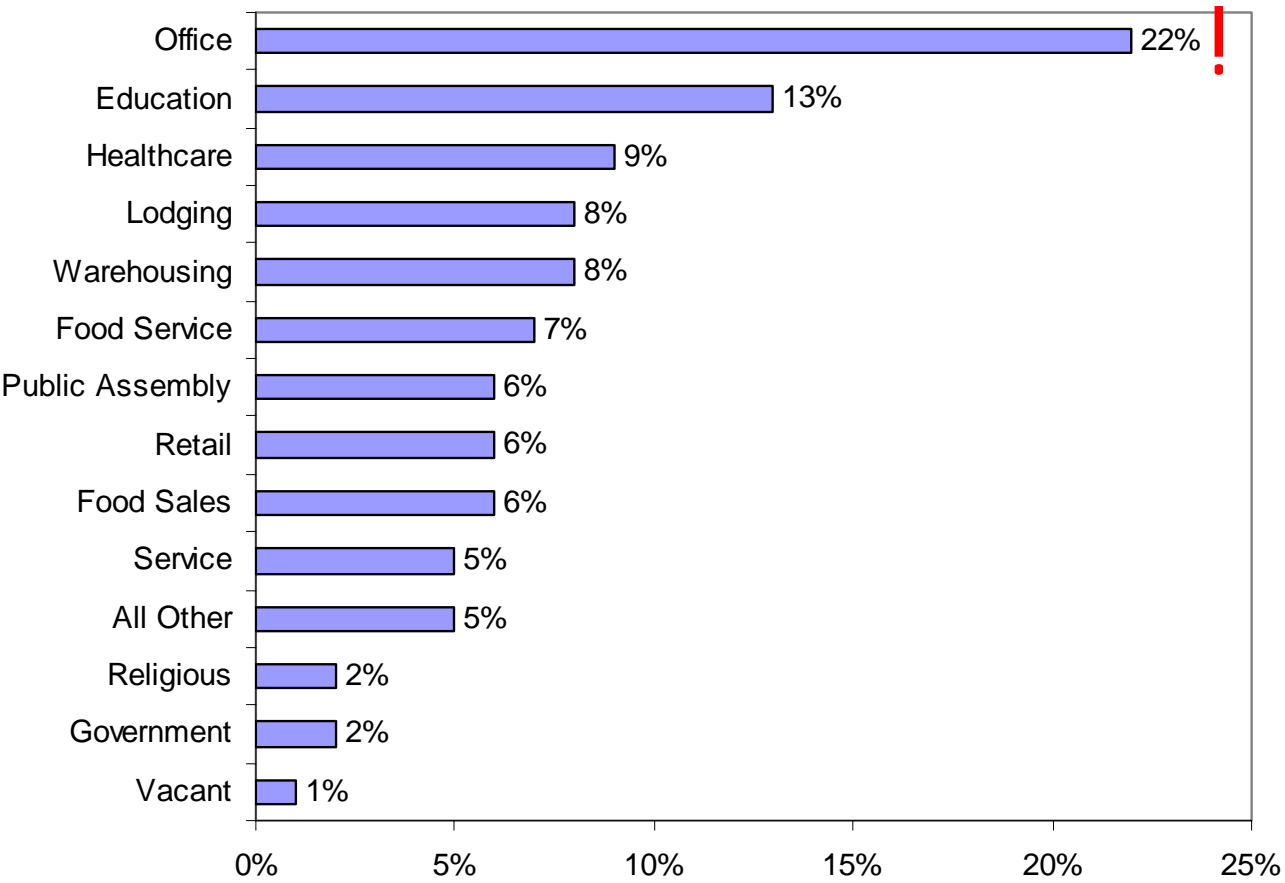3. Compare the energy use intensity (kWh/sf/yr) among NAICS market segments
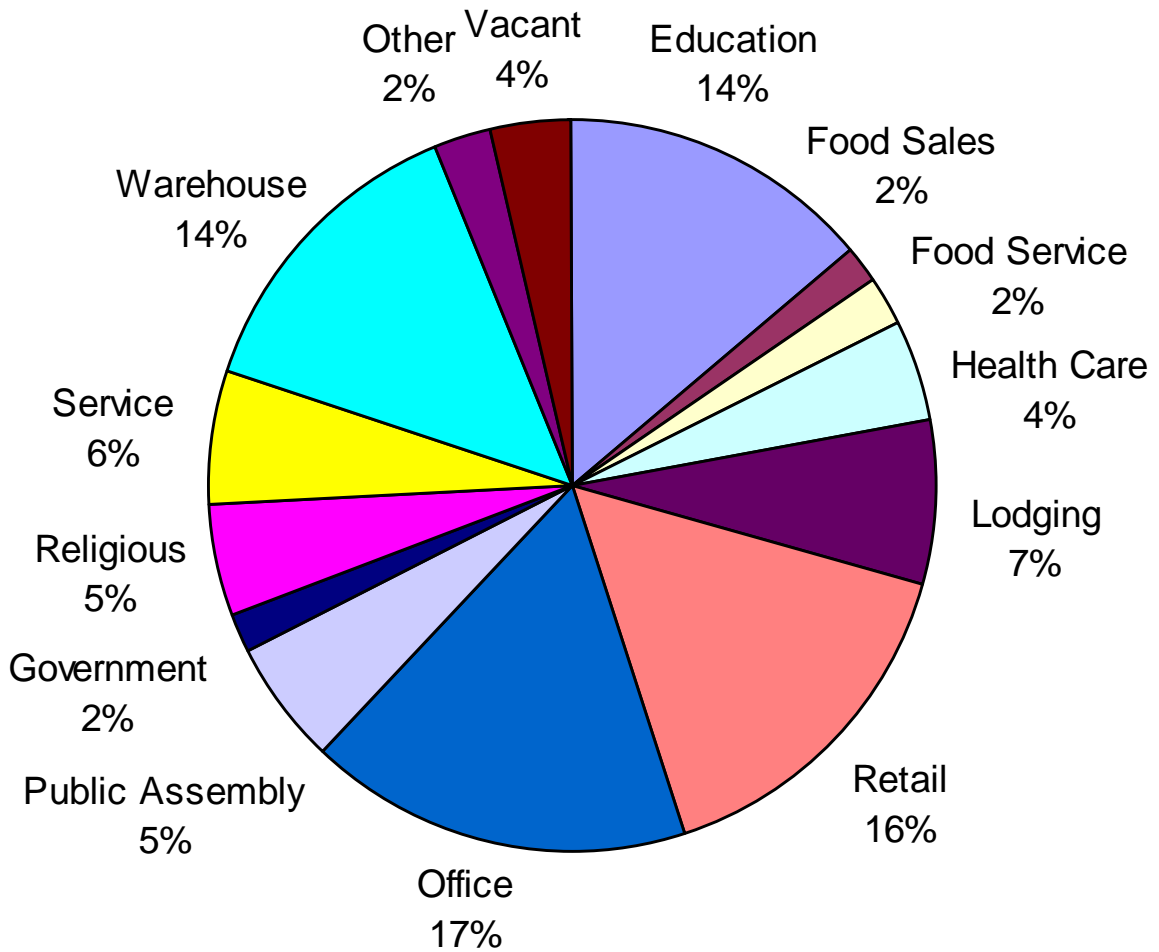
Distribution of U.S. commercial building by floor area (Energy Information Administration (EIA), 2006).

Over half the energy use is for lighting and heating. These areas are usually targeted first for DSM programs

Distribution of U.S. commercial building energy use (EIA, 2006).

Category	Percentage
Office	22%
Education	13%
Healthcare	9%
Lodging	8%
Warehousing	8%
Food Service	7%
Public Assembly	6%
Retail	6%
Food Sales	6%
Service	5%
All Other	5%
Religious	2%
Government	2%
Vacant	1%

Percentage of total U.S. non-residential building energy use

Source: EIA, 2006

US energy use intensity of non-residential buildings by market sector (EIA, 2006)

Market Sector	Energy use intensity (kWh/sf/yr)
Food Sales	156.9
Food Service	153.1
Healthcare	101.3
All Other	93.4
Government	64.8
Office	62.0
Lodging	56.6
Public Assembly	52.7
Retail	50.6
Education	46.6
Service	44.4
Warehousing	27.6
Religious	22.6
Vacant	9.7

Energy use intensity (kWh/sf/yr)
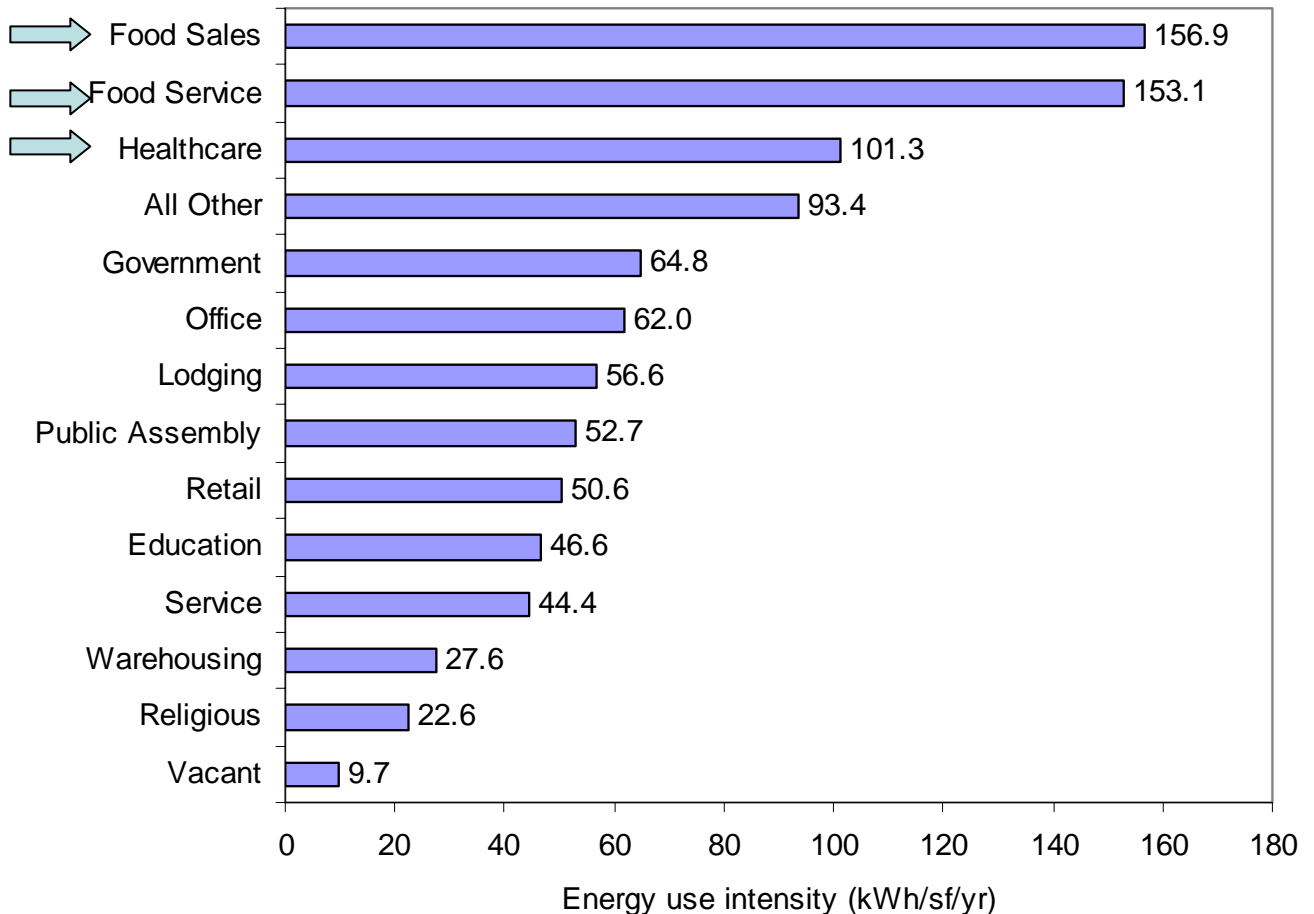
Weighted by total useable floor area in each market, the average U.S. commercial building used 53.7 kWh/sf/yr

Energy use intensity in the southeast was approximately that of the U.S. average for all markets
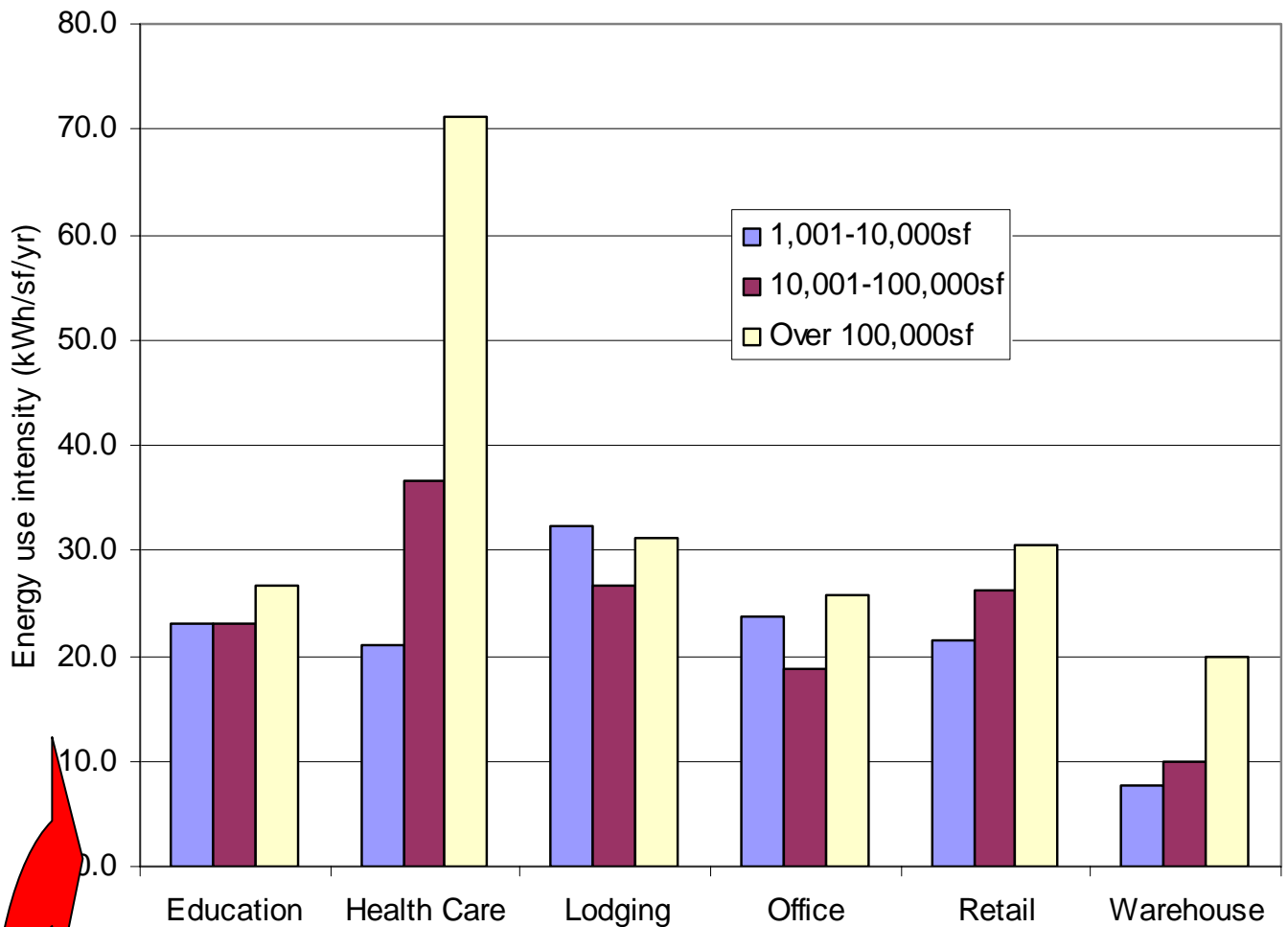
Influence of building size on energy use intensity by select U.S. markets (EIA, 2006).

Since larger buildings typically have greater usable floor area in relation to envelope area, it is postulated that they are more energy efficient.

However, data shows that large buildings are more energy intensive than smaller buildings in the same use designation.

Little correlation between age and energy use intensity in non-residential markets
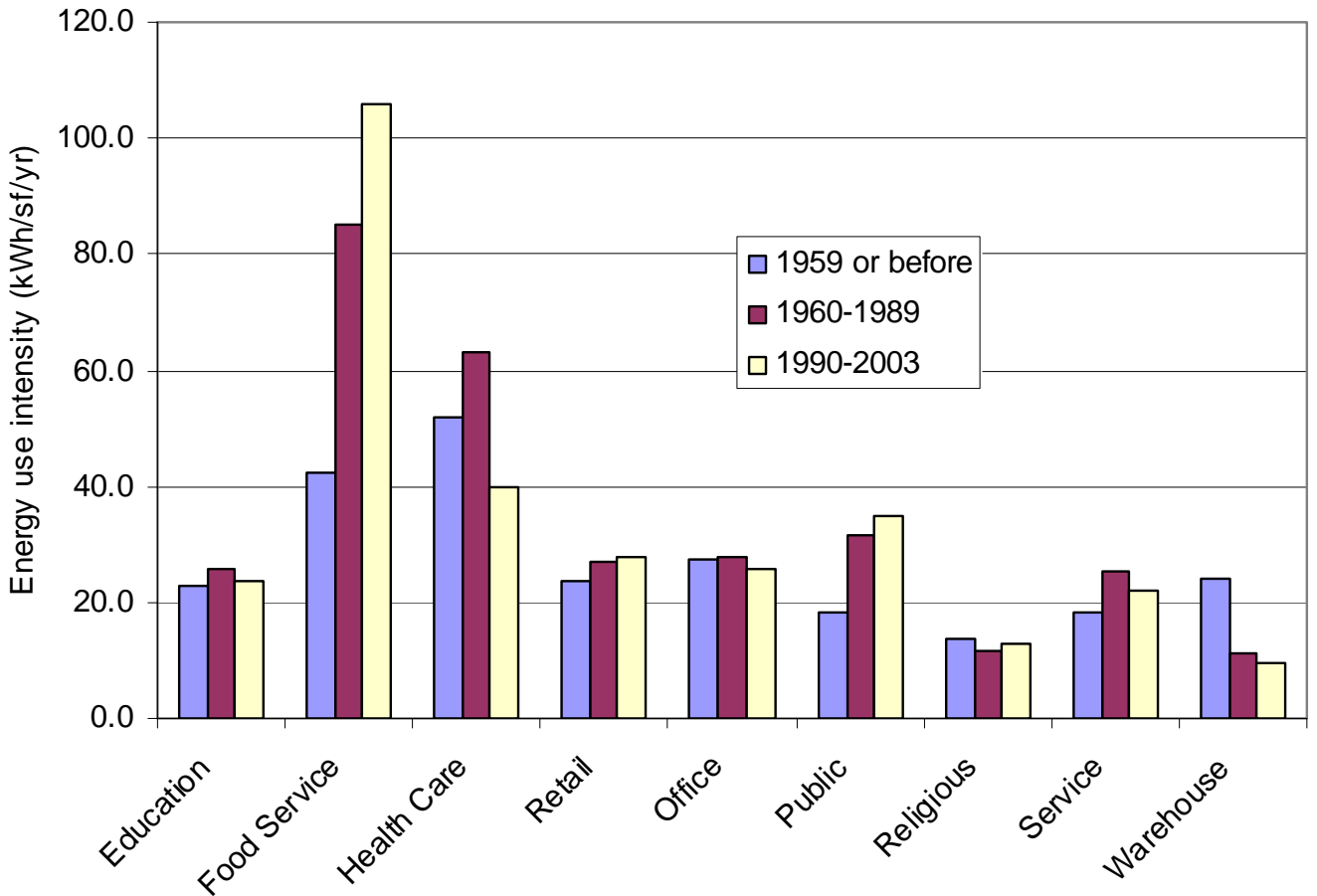
Influence of building age on energy use intensity by select U.S. markets (EIA, 2006).

Utilities	Electric, gas, water, wastewater and telecommunications
Total net revenue	USD 77.3M
Electric customers	88,663 (9,538 commercial)
Electric sales	2,110.8GWh (955.9GWh commercial)
Electric generation capacity	611MW
Electric service area	124sq mi, 1,399 circuit miles
Gas customers	32,520
Gas sales	22.0 million therms
Gas service area	117sq mi, 705 main distribution miles

Gainesville Regional Utilities (GRU) 2006 demographics

Stratify the commercial accounts of Gainesville Regional Utilities (600 MW) into major North American Industry Classification System (NAICS) market segments

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                        ┌─────────────────────────┐
                        │      All Accounts       │
                        │        104,498          │
                        └─────────────────────────┘
                                   │
                                   ▼
                        ┌─────────────────────────┐
                        │   Active C&I Accounts    │
                        │     13,827 (100%)        │
                        └─────────────────────────┘
                                   │
                                   ▼
                        ┌─────────────────────────┐
                        │       NAICS Match        │
                        │      12,188 (88%)        │
                        └─────────────────────────┘
                                   │
                                   ▼
                        ┌─────────────────────────┐
                        │  NAICS Confidence (>6)   │
                        │      9,650 (70%)         │
                        └─────────────────────────┘
                                   │
                                   ▼
                        ┌─────────────────────────┐
                        │     Active Electric      │
                        │      7,048 (51%)         │
                        └─────────────────────────┘
                                   │
                                   ▼
                        ┌─────────────────────────┐
                        │   Parcel (Tax) ID Match  │
                        │      4,917 (36%)         │
                        └─────────────────────────┘
                                   │
                                   ▼
                        ┌─────────────────────────┐
                        │     Valid Floor Area     │
                        │      4,162 (30%)         │
                        └─────────────────────────┘
                                   │
                    ┌──────────────┴──────────────┐
                    ▼                              ▼
      ┌─────────────────────────┐   ┌───────────────────────────────────┐
      │ Single Premise-Single   │   │ Multiple Premise-Single Parcel    │
      │ Parcel                  │   │ 2,966 (21%) – "Mixed Use"         │
      │ 1,196 (9%)              │   │                                   │
      └─────────────────────────┘   └───────────────────────────────────┘
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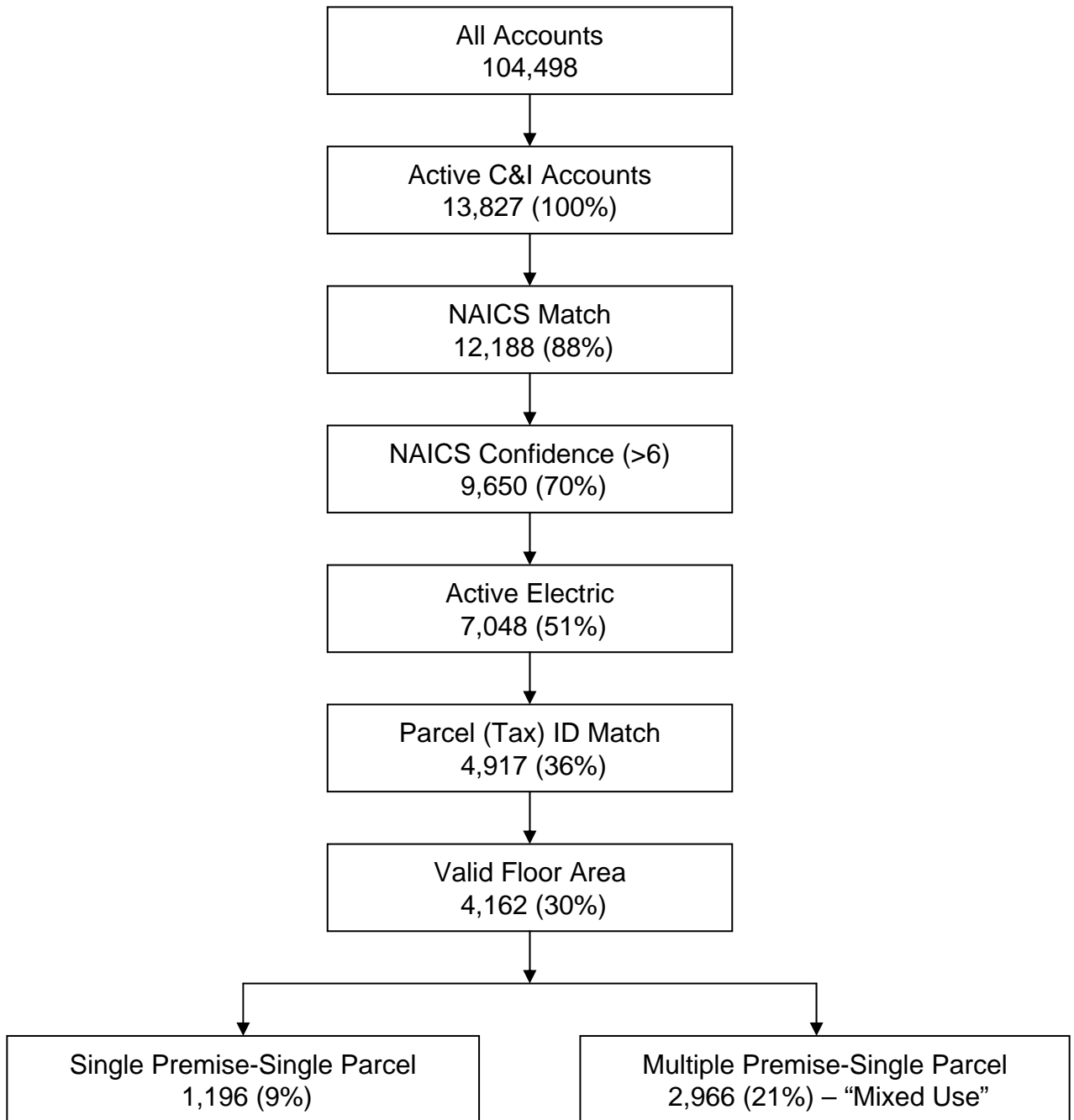
Annual electric consumption was added to average annual gas consumption (if present, therms converted to watts). Sum is divided by total parcel floor area to determine the average annual energy use intensity (kWh/sf/yr) for each account in each NAICS market segment.

The average and maximum annual energy use intensity for each NAICS market segment was identified.

Priority markets for demand-side management (DSM)

NAICS markets having:
1. high energy use intensity,
2. significant "spread" between users in a market segment.

Energy use characteristics (kW, kWh, load factor, etc.) and size (sf) of businesses for each NAICS market segment.

Average GRU commercial building used 28.0 kWh/sf/yr

Average Southern commercial building used 33.5 kWh/sf/yr

Average U.S. commercial building used 53.7 kWh/sf/yr
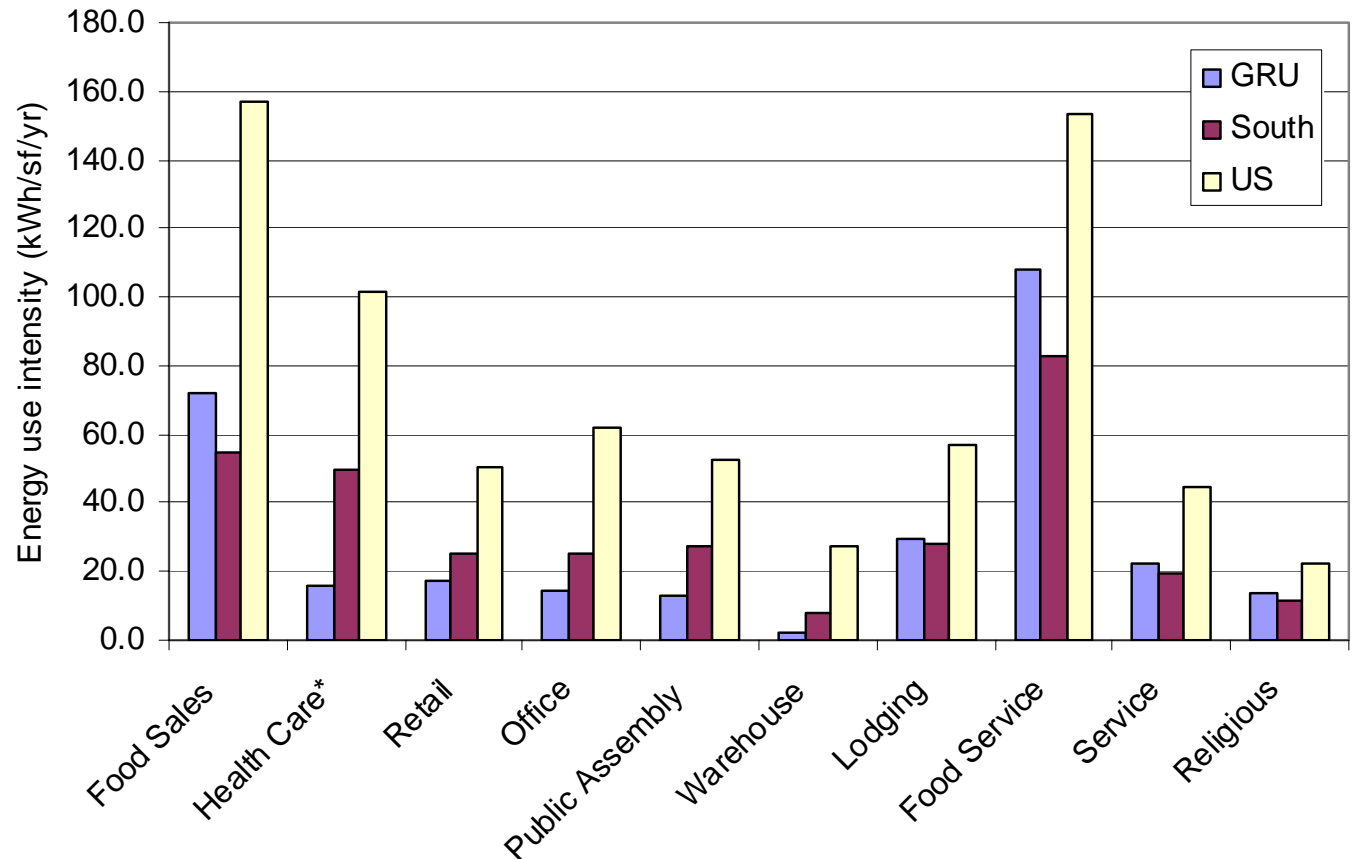
*non inpatient (e.g. hospitals)

Comparison of energy use intensity between US, South and GRU case study region.

Energy *demand* intensity is generally of greater importance to energy suppliers than energy *use* intensity.

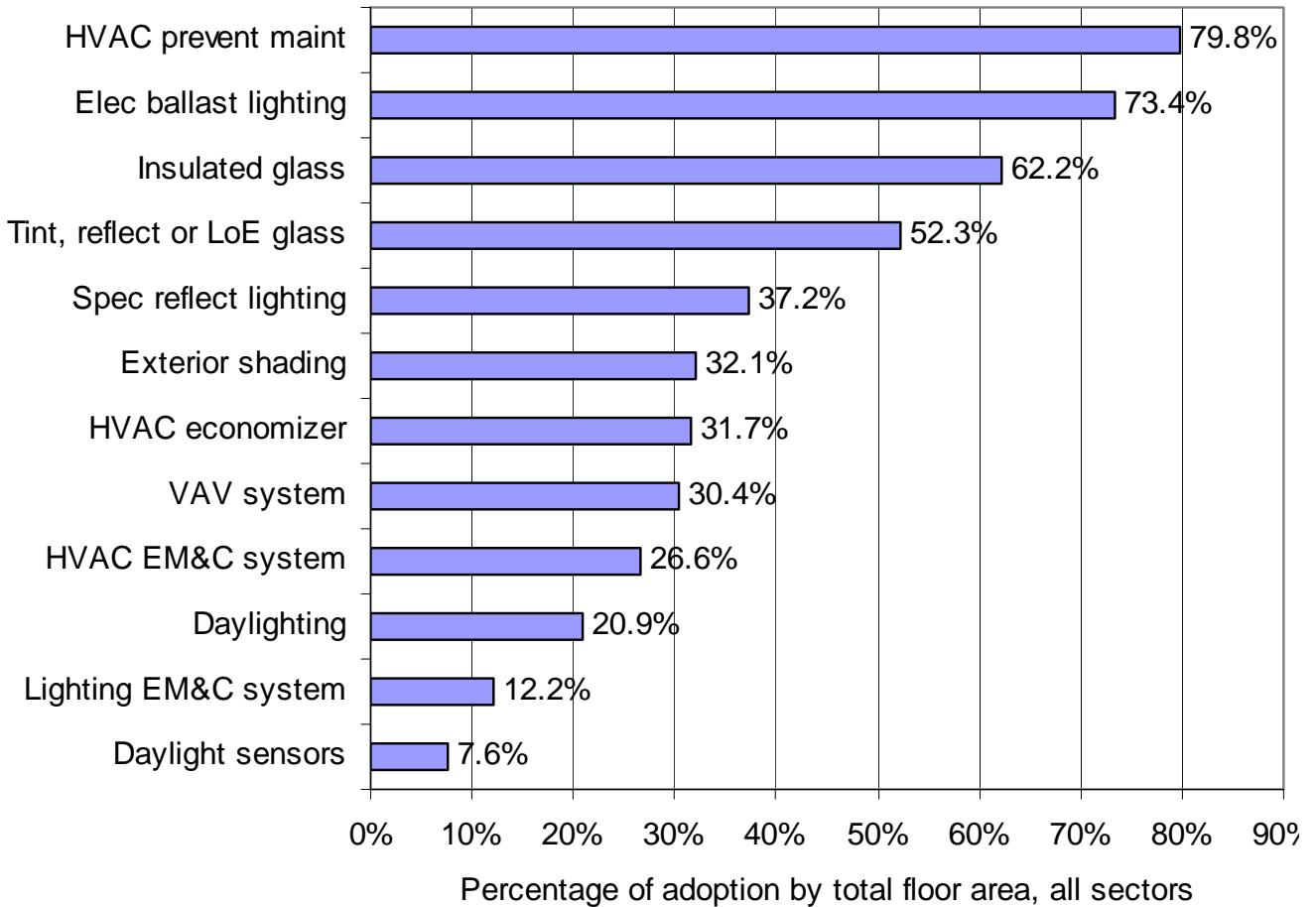Load factor, which represents the average load or energy demand in relation to the peak demand.

A commercial facility having an average load of 200kW and a peak load of 500kW for example, has a load factor of 40%. As a result, the utility must designate 500kW of "wires" and generation capacity to meet the facility's peak load, even though on average, only 40% of this infrastructure would be utilized at any one time.

Considering safety reserves and line losses, as much as 65%-70% of the utility's invested infrastructure dedicated to this facility may sit idle at any given time. As a result, utilities and energy suppliers are generally more inclined to promote DSM options that improve load factor among low performing markets.
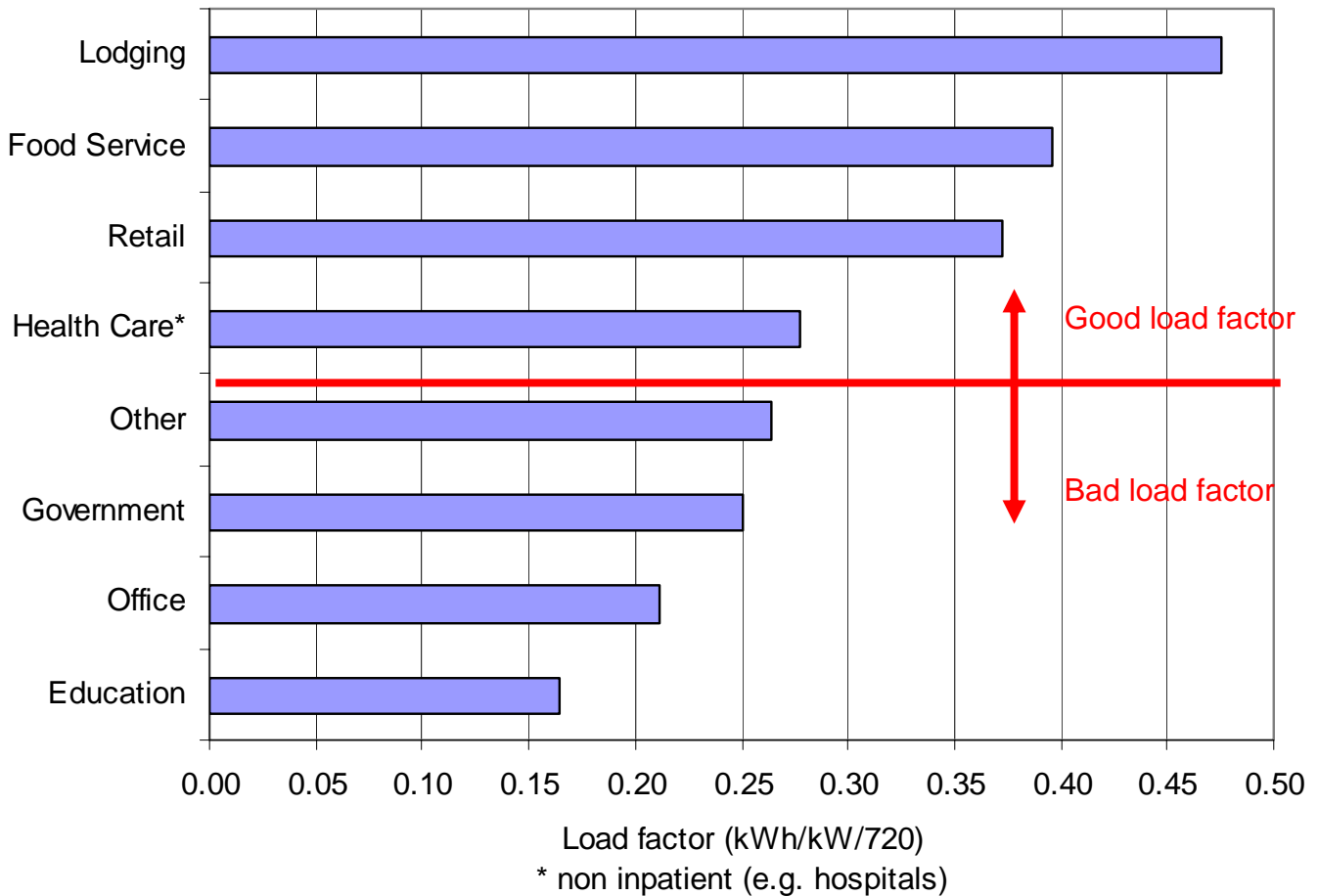
Comparison of average market load factors,
GRU case study region

Disparity in load factor could be largely attributed to greater
hours of operation among lodging, food service and retail
sectors as opposed to "9 to 5" government, office and
educational facilities. Retail such as 24-hour health and
personal care stores were found to have exceptionally good
load factors, many exceeding 70%.

HVAC prevent maint	79.8%
Elec ballast lighting	73.4%
Insulated glass	62.2%
Tint, reflect or LoE glass	52.3%
Spec reflect lighting	37.2%
Exterior shading	32.1%
HVAC economizer	31.7%
VAV system	30.4%
HVAC EM&C system	26.6%
Daylighting	20.9%
Lighting EM&C system	12.2%
Daylight sensors	7.6%

Percentage of adoption by total floor area, all sectors

Adoption rate of commercial DSM alternatives in the U.S. (EIA, 2006)

Most DSM options implemented in the U.S. are related to HVAC systems, lighting systems and the Building Envelope

Food sales market
56.9 kWh/sf/yr nationally
55.0 kWh/sf/yr in the south
72.2 kWh/sf/yr within the GRU case study region.

Food sales represent 1.8% of the C&I building stock by
floor area and about 6.0% of the C&I market energy
use.   Of the total C&I building stock, a *weighted
average* energy use intensity of 1.3kWh/sf/yr is
dedicated to the food sales market (72.2 *0.18).

Nationally, the food sales market ranks third behind
government and healthcare among major markets in
the average number of DSM alternatives implemented
beyond minimum building energy code requirements
with 5.8 (48.5%) options implemented of 12 options
surveyed

The relative energy intensity, building stock and
subsequent energy consumption of the food sales
market (1.3kWh/sf/yr) by the potential for further DSM
adoption (1- 48.5%), a dimensionless DSM
prioritization "score" of 0.7 is calculated for the food
sales market.
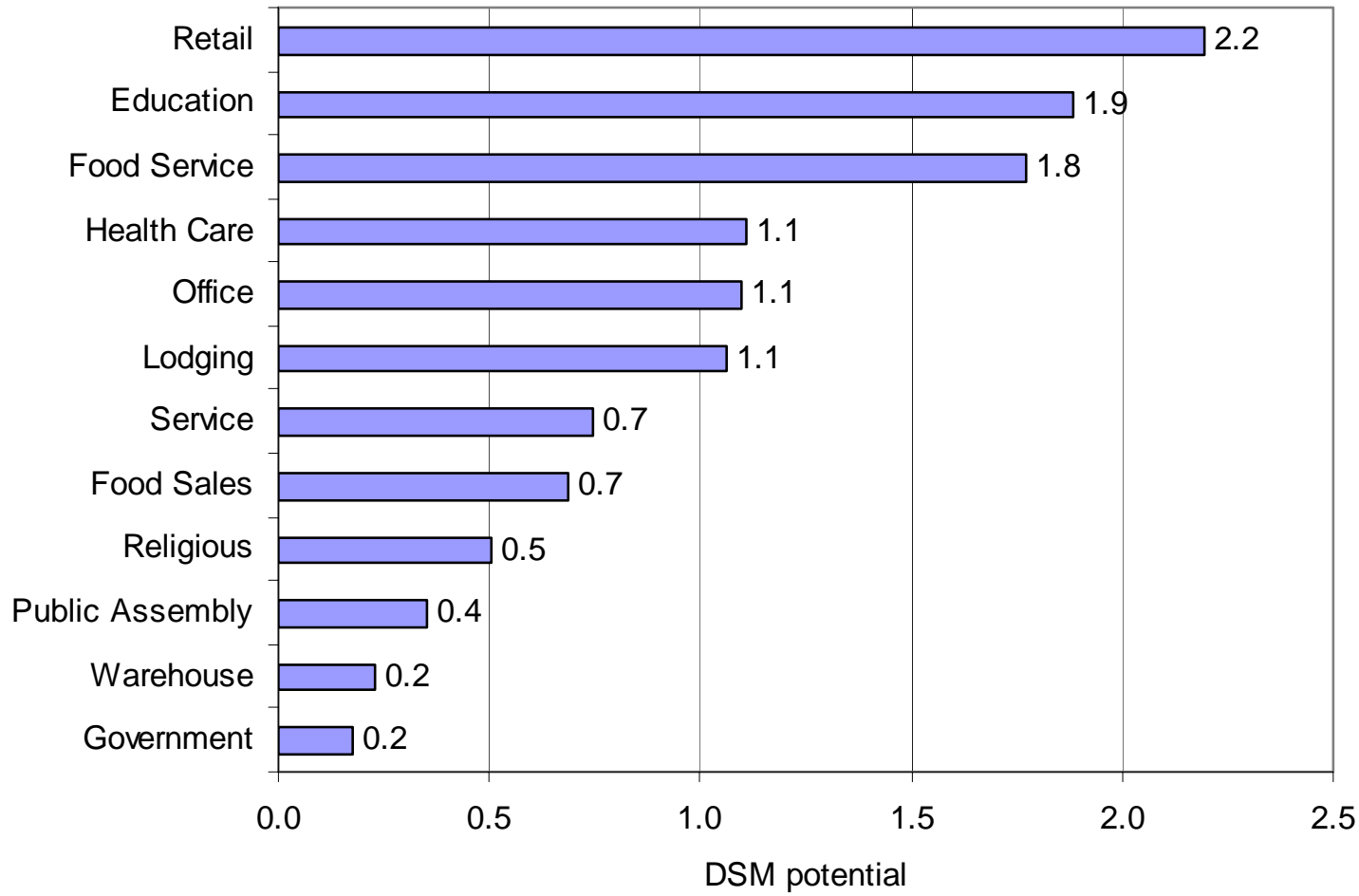 (1.3 kWh/sf/yr x (1-48.5%) = 0.7).

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Retail market
50.6kWh/sf/yr nationally
25.5kWh/sf/yr in the south
17.2kWh/sf/yr within the GRU case study region.

Retail represents 20.1% of the C&I building stock by floor area and 15.8% market energy use. *A weighted average* energy use intensity of 3.4kWh/sf/yr is dedicated to the retail market. (17.2 * .201)

Nationally, the retail market ranks next to last among major markets in the average number of DSM alternatives implemented beyond minimum building energy code requirements with 4.4 (36.7%) options implemented of 12 options surveyed. By factoring the relative energy intensity, building stock and subsequent energy consumption of the retail market (3.4kWh/sf/yr) by the potential for further DSM adoption (1 - 36.7%), a dimensionless DSM prioritization "score" of 2.2 is calculated for the retail market
(17.2kWh/sf/yr* (1-36.7) = 2.2)

Category	DSM potential
Retail	2.2
Education	1.9
Food Service	1.8
Health Care	1.1
Office	1.1
Lodging	1.1
Service	0.7
Food Sales	0.7
Religious	0.5
Public Assembly	0.4
Warehouse	0.2
Government	0.2

DSM potential

DSM market prioritization, GRU case study

Although the food sales market is considerably more energy intensive, retail comprises a much greater share of the total C&I energy market.

DSM market penetration within the retail market is comparatively less than that of the food sales market nationally.

Considering only these energy use characteristics, the potential for DSM adoption within the retail market is likely greater than that in the food sales market

Limitations

Utility information systems and property tax assessor records are not generally designed to be merged. Minor discrepancies or deviations in data fields from one database to another resulted in the data being mismatched or eliminated.

Data from records compiled over many years introduces error.

Markets with extended hours of operation or those with disproportionately high exterior energy loads and relatively little floor area (e.g. gas stations, car sales lots, etc.) will invariably show high energy use intensity. Thus, comparing energy use intensities between markets.

Energy use intensities within a market can vary. Although within the same market, healthcare administration and non-emergency walk-in clinics for example, have dramatically different energy use characteristics and hours of operation than inpatient healthcare and hospitals.

Changes in building use over time, especially within commercial lease space can also contribute error.