Technical Note 05-01

Energy Related Characteristics of New-Home Construction in Florida 1999-2005

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Background

In January 2001, the Shimberg Center for Affordable Housing entered into an agreement with the Florida Department of Community Affairs to serve as the receiving point for Florida Energy Efficiency Code for Building Construction (FEECBC) Compliance forms submitted by local building officials across the state.

Upon receipt of the FEECBC Forms, the Shimberg Center draws a random sample of 1 out of 20 (5%) of the forms for entry into a database. If a jurisdiction submits less than 20 forms, one form is selected at random and entered in to the database. This procedure insures representation in the database of housing markets with low levels of construction activity.

The following summaries are focused on the data that had been manually entered into the database through February 2005. As shown in Table 1, a total of 5,441 forms had been entered representing the energy-related characteristics of single-family detached homes built in Florida between late 1999 and early 2005.

The objective of this report is to provide the Department of Community Affairs and other interested organizations and individuals with insight into trends in the energy-related features of single-family homes being constructed in Florida. The summaries stratify the state into three climatic zones (i.e., south, central, and north) for the purpose of exposing any trends that may be present.

Table 1: Sample Distribution by Year and Climatic Zone

	Climatic zone			
Year	South	Central	North	Totals
1999	45	69	20	134
2000	115	103	100	318
2001	314	795	350	1,459
2002	161	391	120	672
2003	205	528	219	952
2004	273	819	101	1,193
2005	170	353	190	713
Totals	1,283	3,058	1,100	5,441

Conditioned Floor Areas

Presented in Table 2 are the average conditioned floor areas for the homes built in the three climatic zones in the seven years covered by this report. These data are also summarized graphically in Figure 1. As may be seen in Figure 1, the homes built in the south and north zones display increased floor areas on the order of 20 to 30 percent. The homes built in the central zone also display an increase but on the order of 10 percent.

Table 2: Average Conditioned Floor Areas (Square feet)

	Climatic zone		
Year	South	Central	North
1999	2211.6	1925.0	1605.6
2000	2481.4	2297.1	2025.1
2001	2327.8	2064.1	2012.8
2002	2544.4	2057.0	2147.3
2003	2476.7	2230.6	2321.4
2004	2394.6	1971.3	2063.4
2005	2683.0	2126.2	2144.2
Sample	1283	3054	1097

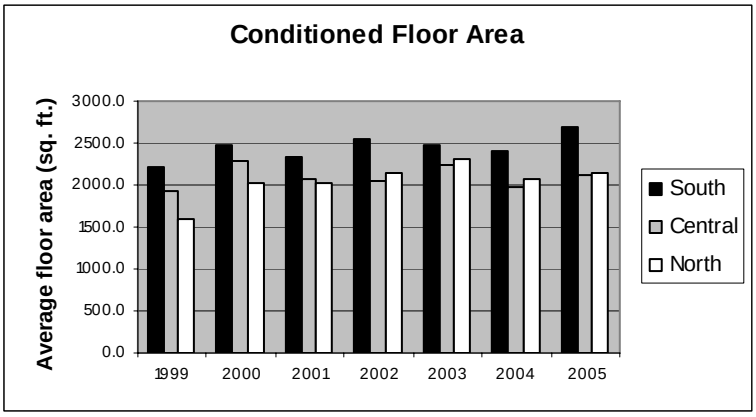

Figure 1: Average Conditioned Floor Areas (Square feet)

In addition to these point estimates of the conditioned floor areas of the homes included in the sample, it is useful to consider the frequency distribution of the individual homes included in the sample as shown in Figure 2 and listed in Table 3.

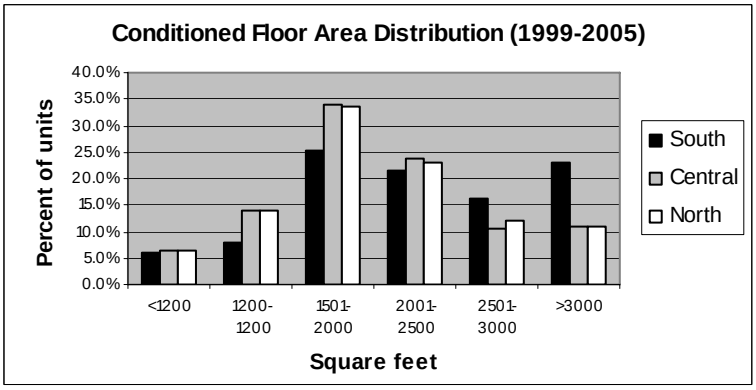

Figure 2: Frequency Distribution of Conditioned Floor Areas (1999-2005)

Table 3: Frequency Distribution of Conditioned Floor Area (1999-2005)

Floor areas	Climatic zone		
	South	Central	North
<1200	6.2%	6.5%	6.6%
1200-1500	7.8%	14.0%	14.0%
1501-2000	25.3%	34.1%	33.5%
2001-2500	21.5%	23.8%	23.0%
2501-3000	16.1%	10.6%	12.1%
>3000	23.1%	11.0%	10.8%
Sample	1,283	3,054	1,097

Figure 2 indicates that all three climatic zones have a similar distribution of homes based on conditioned floor area. The most frequently built home in all regions is between 1,501 and 2,000 square feet; about 6 percent of the homes built are less than 1,200 square feet; and over 10 percent of the homes are built with over 3,000 square feet. In the south zone these homes with over 3,000 square feet of floor area represent 23.1 percent of the homes built from 1999 through 2005 as shown in Table 3.

Exterior Wall Systems

The Florida Energy Code Compliance Form allows the builder to specify the exterior wall system from a list of eight options: concrete, wood-frame, steel-frame, light-weight concrete, face brick, concrete bead-poly bead frame, log, and other. Of the 5,441 homes included in the sample, only the first four exterior wall system types were reported in sufficient numbers to summarize. Data for the incidence of concrete, wood frame, steel frame and light-weight concrete exterior walls is shown in Table 4. These data are converted to percentages and presented graphically in Figure 3.

Table 4: Exterior Wall Construction Systems

Year	Concrete			Wood			Steel			Lt. Wt Concrete		
	South	Central	North	South	Central	North	South	Central	North	South	Central	North
1999	38	65	2	19	40	18	0	0	0	5	2	0
2000	97	93	12	39	62	89	0	0	0	7	2	0
2001	271	705	89	119	346	262	1	1	1	12	12	3
2002	104	193	10	48	185	102	0	2	0	5	4	2
2003	183	430	35	79	241	197	0	4	0	12	14	1
2004	241	602	12	77	405	91	1	7	0	15	7	0
2005	153	320	56	49	162	133	2	0	0	6	1	1
Sample sizes	1,087	2,408	216	430	1,441	892	4	14	1	62	42	7

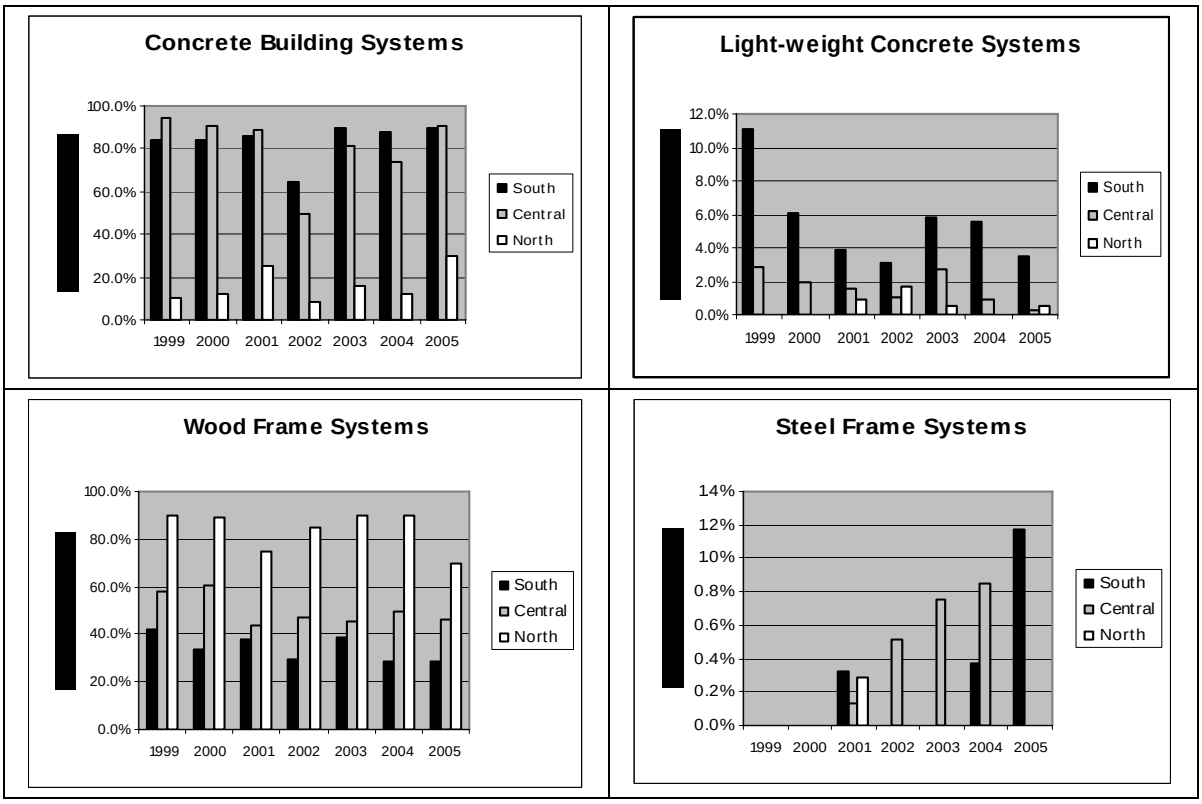

Figure 3: Exterior Wall Construction Systems

When studying the four charts in Figure 3, the reader is cautioned that the percentages may add to more than 100 percent. This situation is caused by the homes that are built with multiple exterior wall building materials and, therefore, appear more than once in the database. The concrete systems dominate the market in the south and central zones while wood-frame construction dominates in the north. The light-weight concrete systems are losing market share in the south while steel-framed construction, although at a low percentage, is increasing market share in both the south and central zones.

Insulation Levels

Average R-values of the insulation installed in attic spaces are listed in Table 5 and displayed graphically in Figure 4. The trend in this chart is an increasing level of attic insulation in all three zones over the seven years presented.

Table 5: Average R-value for Attic Insulation

	Climatic zone		
Year	**South**	**Central**	**North**
1999	22.1	21.4	27.7
2000	23.8	23.8	25.5
2001	23.9	24.0	29.7
2002	22.7	24.7	30.5
2003	23.7	26.4	29.9
2004	24.3	23.8	32.5
2005	25.7	32.6	29.5

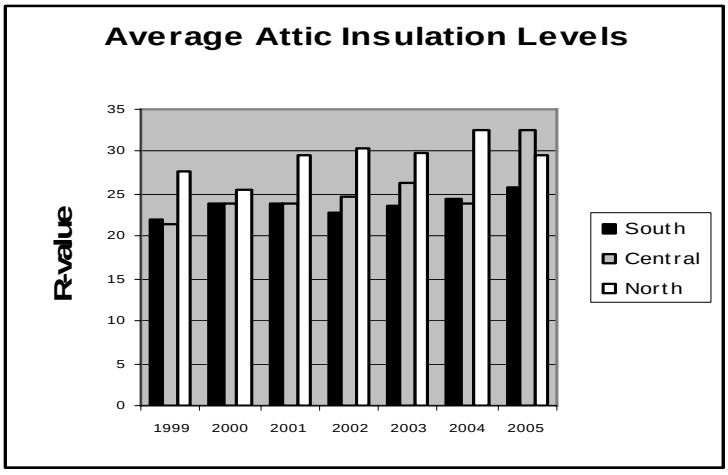

Figure 4: Average Attic Insulation Levels

The frequency distribution of level of attic insulation in homes built between 1999 and 2005 is presented in Figure 5. As may be seen, homes in the south are more likely to have a lower attic R-value than homes built in the north. The percentages used to produced the histogram are shown in Table 6.

Table 6: Frequency Distribution of Attic Insulation (1999-2005)

R-value	Climatic zone		
	South	Central	North
<19	0.4%	0.1%	0.2%
19-23	53.6%	53.5%	37.5%
>23 - 30	44.4%	46.2%	55.2%
>30	1.5%	0.2%	7.1%
Sample size	1,375	3,519	1,708

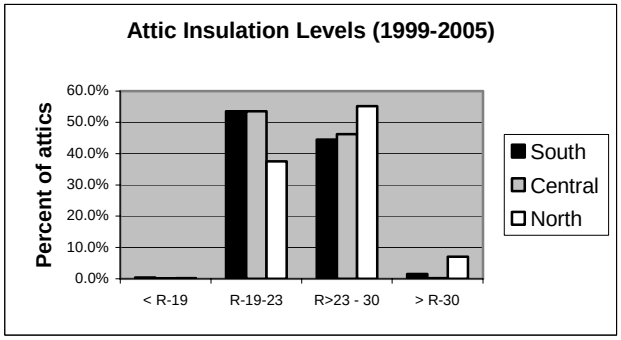

Figure 5: Frequency Distribution of Attic Insulation (1999-2005)

Glazing Materials

Seventy to 80 percent of the housing units used single-pane, clear glazing in the south and central zones while nearly 80 percent of the units in the north zone used double-pane, clear gazing. It should be noted that prior to 2001, the term "tinted" included glazed areas that were either tinted, covered with a film, or covered with a sun screen. The types of glazing are summarized in Table 7 and Figure 6.

Table 7: Glazing Type Distribution (1999-2005)

Climatic zone	Numbers of housing units by glazing type				
	Sing/Clear	Sing/Tinted	Doub/Clear	Doub/Tinted	Totals
South	848	150	150	43	1,191
Central	2,466	230	385	133	3,214
North	185	12	898	64	1,159

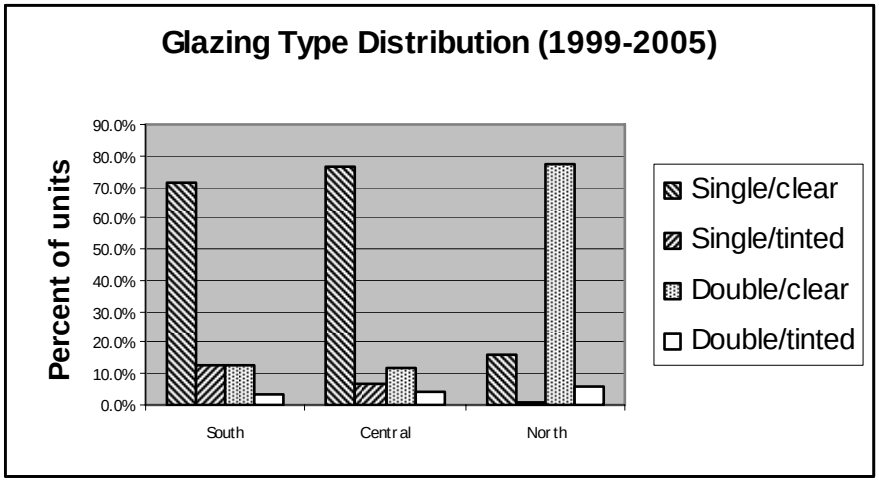

Figure 6: Frequency Distribution of Glazing Types (1999-2005)

The glass/floor area ratio ranged between 0.13 and 0.17 in all regions between 1999 and 2005. Homes in the south zone were reported to have larger glass-to-floor area ratios in all years (See Figure 7). The average ratio over the seven-year period for the south was 0.161. The average ratios for the central and north zones were 0.143 and 0.140, respectively. (See Table 8)

Table 8: Average Glass/Floor Area Ratio

Year	Climate zone		
	South	Central	North
1999	0.158	0.144	0.155
2000	0.155	0.138	0.137
2001	0.168	0.146	0.147
2002	0.166	0.151	0.152
2003	0.152	0.143	0.138
2004	0.164	0.140	0.130
2005	0.160	0.140	0.134

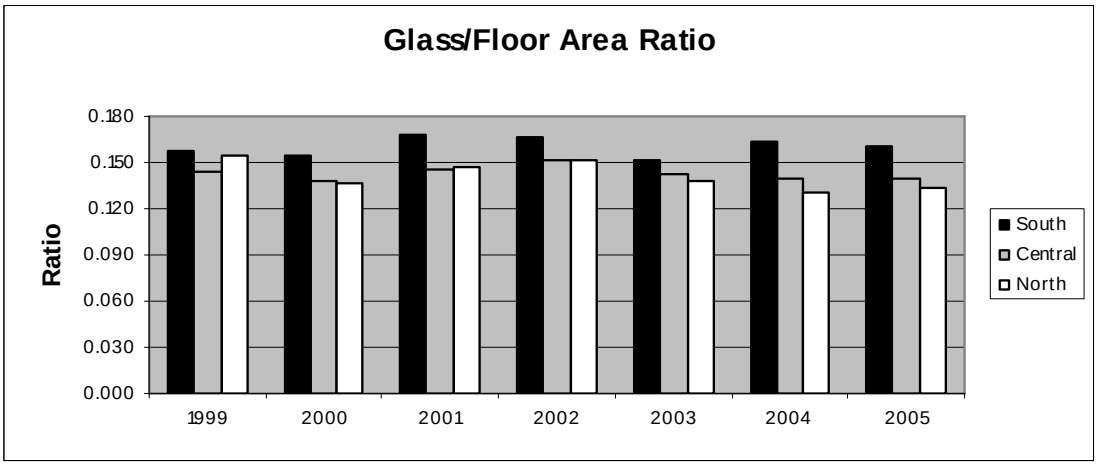

Figure 7: Glass-to-Floor Area Ratios

Cooling System

An essential piece of equipment in homes built in Florida is the cooling system. The two main characteristics used to describe the systems are the system's capacity and efficiency. The cooling systems installed in homes in the south zone had higher rated capacities than in the other two zones. (See Table 9 and Figure 8) The average cooling system capacities for the south zone ranged from 40.6 Btuh to 47.5 Btuh between 1999 and 2005. The range for the central zone was from 36.2 Btuh to 38.9 Btuh and the range for the north zone was 29.5 Btuh to 38.7 Btuh.

Table 9: Average Cooling System Capacity

	Btuh Capacity		
Year	South	Central	North
1999	44.3	36.2	29.5
2000	42.4	37.9	32.6
2001	42.7	37.8	36.6
2002	47.5	38.3	37.3
2003	40.6	38.3	38.1
2004	42.2	37.3	35.3
2005	43.7	38.9	38.7

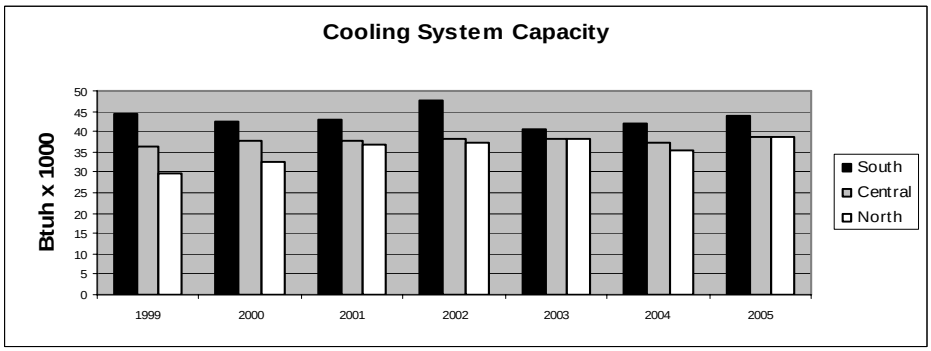

Figure 8: Cooling System Capacity

Presented in Table 10 is a list of the average efficiency ratings for the cooling systems reported each year in the three climatic zones.

Table 10: Average Energy Efficiency Ratings of Cooling Systems

	Climatic zone		
Year	**South**	**Central**	**North**
1999	11.0	10.4	11.1
2000	10.9	10.7	10.4
2001	11.1	10.4	10.7
2002	11.7	10.7	10.8
2003	11.6	11.7	10.9
2004	11.4	10.6	10.7
2005	11.7	11.8	10.9

The average energy efficiency ratings of cooling systems are displayed graphically in Figure 9. The energy efficiency ratings in the south and central zones display an increase through the period shown while the average efficiency in the north zone remained relatively unchanged.

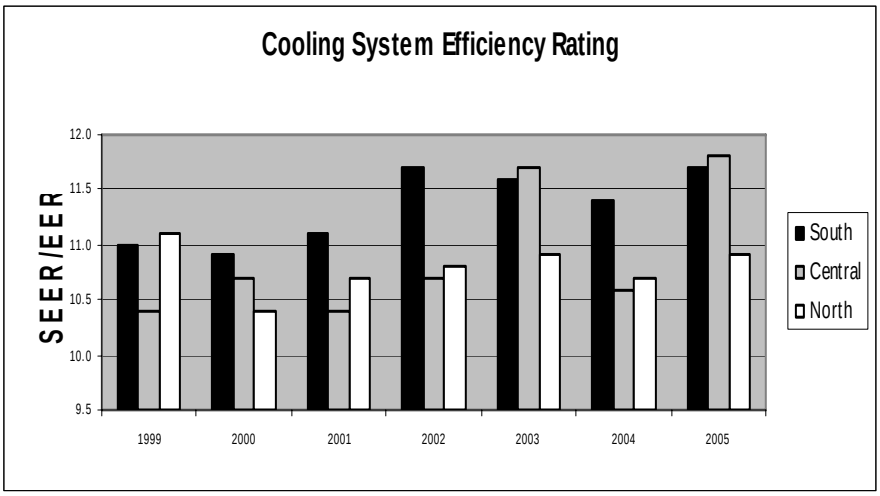

Figure 9: Average Energy Efficiency Ratings – Cooling Systems

Heating System

Heating systems are listed in Table 11 by fuel type, climatic zone, and year. As may be expected, the south zone is dominated by electric strip heating systems and electric heat pump systems due to the lack of availability of natural gas in south Florida. In the central zone the installation of electric strip heating declined to less than 10 percent; electric heat pumps comprise 73 to 85 percent of the units installed, and natural gas systems captured between 12 and 26 percent of the market.

Table 11: Heating Systems by Fuel Type

Year	South			Central			North		
	Elec strip	Heat Pump	Nat. Gas	Elec strip	Heat Pump	Nat. Gas	Elec strip	Heat Pump	Nat. Gas
1999	100.0%	0.0%	0.0%	0.0%	73.9%	26.1%	5.3%	26.3%	68.4%
2000	95.6%	4.4%	0.0%	4.9%	83.3%	11.8%	1.0%	47.9%	51.0%
2001	92.3%	7.4%	0.3%	3.9%	84.2%	12.0%	0.3%	72.5%	27.2%
2002	95.0%	5.0%	0.0%	8.0%	77.5%	14.5%	4.3%	77.8%	17.9%
2003	87.7%	9.8%	2.5%	5.2%	79.2%	15.6%	2.3%	86.6%	11.1%
2004	97.8%	2.2%	0.0%	1.6%	73.0%	25.4%	0.0%	91.9%	8.1%
2005	90.0%	10.0%	0.0%	1.1%	83.5%	15.4%	0.0%	94.1%	5.9%
Sample size	1,188	79	6	110	2,380	518	13	848	220

The most striking trend during the seven year period occurred in the north zone where the electric heat pump market share increased from 26 percent to 94 percent while the natural gas system market share declined from 68 percent to 6 percent. This change in market share is shown graphically in Figure 10.

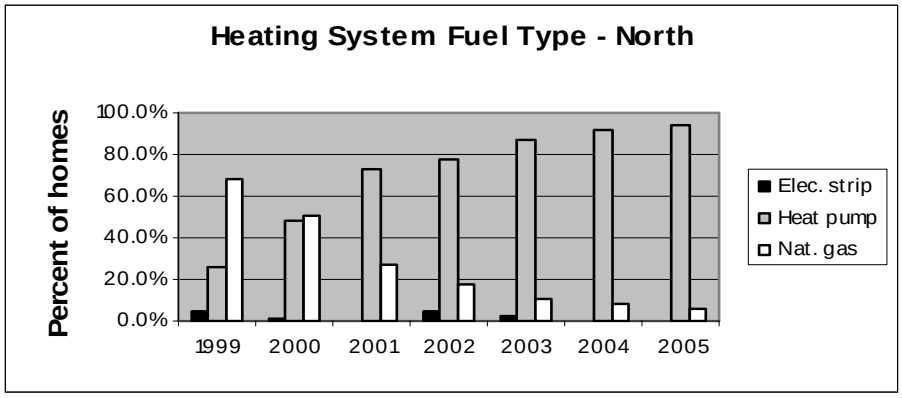

Figure 10: Heating System Fuel – North Zone

Air Handler Location

The air handler component of the cooling/heating system can be placed in a variety of locations. The energy code compliance forms allow this location to be specified as: attic, garage, interior, outdoors, or other. The counts of units installed in the three most common locations are shown in Table 12.

Table 12: Air Handler Location

Year	South			Central			North		
	Attic	Garage	Interior	Attic	Garage	Interior	Attic	Garage	Interior
1999	1	17	34	2	56	15	0	12	7
2000	7	52	73	8	70	40	5	59	29
2001	50	123	188	34	574	199	16	241	100
2002	18	92	86	31	263	79	12	81	38
2003	19	93	136	22	349	168	22	138	96
2004	82	78	163	26	517	172	1	52	58
2005	40	72	96	14	237	121	16	131	57
Totals	217	527	776	137	2,066	794	72	714	385

Presented in Figure 11 are the percentages of air handlers placed in attics, garages, or interior. Less than 1.0 percent of the units were reported to be placed in either the "outdoors" or "other" locations. It appears that there is a tendency in all three climatic zones for the air handler to be placed in an "interior" conditioned space. This choice should improve the performance of the system. Yet, a substantial percentage of air handlers are installed in attics and garages.

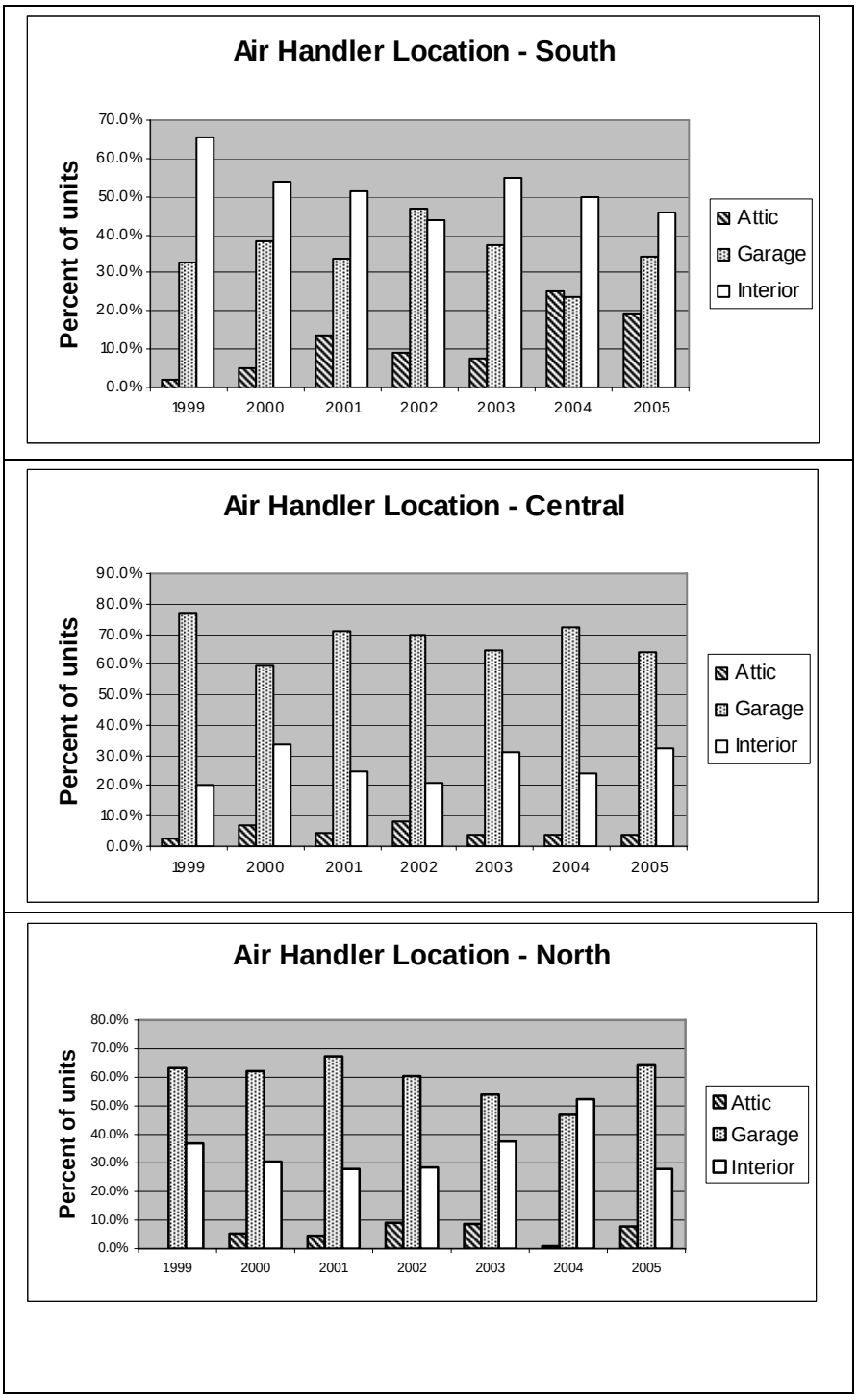

Figure 11: Location of Air Handler

Domestic Water Heaters (DWH)

Domestic water heaters in Florida utilize primarily electricity, natural gas, or LP gas as their fuel sources. In the south, electricity is the dominant energy used (see Table 13) although generally less than 5 percent in any one year are designed for either natural gas or LP gas. In the central zone between 75 and 85 percent of the DWH systems use electricity with the remainder using natural gas. During the seven years for which data are presented, the north zone water heating systems have shifted from a fuel choice dominated by natural gas (70.0% in 1999) to a fuel choice dominated by electricity (91.1% in 2005). This shift from natural gas to electricity for water heating is illustrated graphically in Figure 12.

Table 13: Domestic Water Heating Systems

Year	South				Central				North			
	Elec.	LP Gas	Nat. Gas	Other	Elec.	LP Gas	Nat. Gas	Other	Elec.	LP Gas	Nat. Gas	Other
1999	97.8%	0.0%	2.2%	0.0%	75.4%	0.0%	24.6%	0.0%	30.0%	0.0%	70.0%	0.0%
2000	94.6%	0.9%	4.5%	0.0%	87.3%	0.0%	12.7%	0.0%	39.2%	0.0%	60.8%	0.0%
2001	98.4%	0.3%	0.9%	0.3%	85.6%	0.4%	14.0%	0.0%	69.1%	0.6%	30.3%	0.0%
2002	97.0%	0.0%	3.0%	0.0%	84.1%	0.3%	15.7%	0.0%	70.7%	0.9%	28.4%	0.0%
2003	92.9%	1.9%	5.2%	0.0%	81.8%	0.8%	17.5%	0.0%	80.0%	1.3%	18.7%	0.0%
2004	97.5%	0.0%	2.5%	0.0%	74.3%	0.0%	25.7%	0.0%	92.2%	0.0%	7.8%	0.0%
2005	95.1%	0.5%	4.3%	0.0%	81.6%	0.0%	17.8%	0.6%	91.1%	0.5%	8.3%	0.0%
Sample size	1271	7	40	1	2335	8	526	2	823	7	283	0

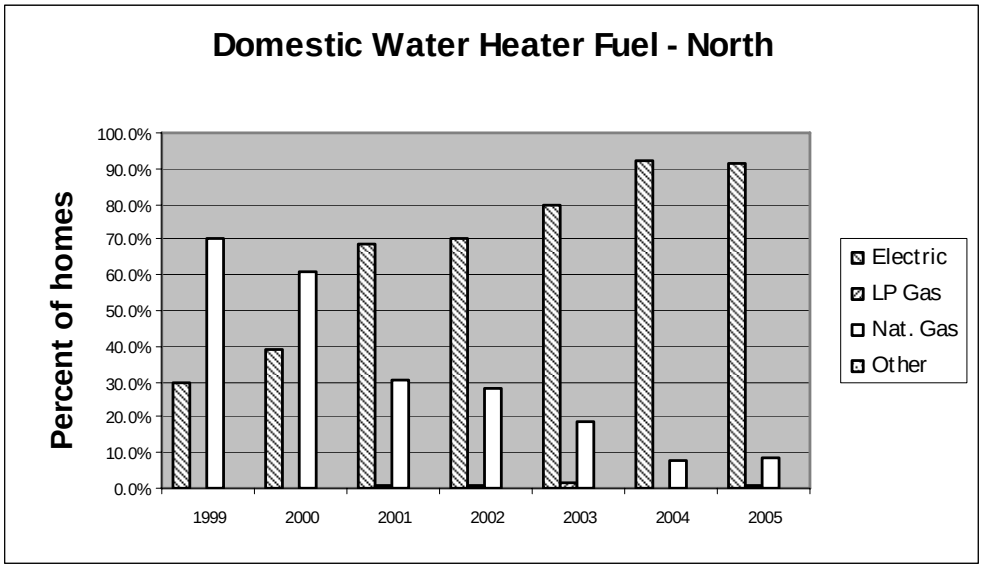

Figure 12: Domestic Water Heating Fuel – North

The efficiencies of the domestic water heating systems in the three zones are summarized in Table 14 for electric and natural gas fuel types. There were insufficient observations of the "LP Gas" and the "Other" fuel types to justify the calculation of average efficiencies. The average efficiencies for the electric systems range between 0.86 and 0.90 in all three climate zones. The average efficiencies for the natural gas systems range from 0.55 to 0.65.

Table 14: Average Domestic Water Heating System Efficiencies

Electric DWH Systems			
Year	Climatic zone		
	South	Central	North
1999	0.88	0.89	0.89
2000	0.89	0.89	0.90
2001	0.88	0.90	0.90
2002	0.89	0.89	0.89
2003	0.89	0.89	0.88
2004	0.87	0.89	0.89
2005	0.86	0.89	0.89

Natural Gas DWH Systems			
Year	Climatic zone		
	South	Central	North
1999	0.60	0.65	0.61
2000	0.59	0.55	0.58
2001	0.56	0.62	0.59
2002	0.59	0.61	0.59
2003	0.57	0.61	0.59
2004	0.58	0.62	0.55
2005	0.57	0.61	0.59

The average capacity of the water heating systems in the three climate zones during each of the seven years reported range from 50 to 55 gallons in the south. The capacities in the central and north zone are slightly lower ranging primarily from 40 to 50 gallons. (See Table 15) These relationships are shown graphically in Figure 13.

Table 15: Average Water Heater Capacities (in gallons)

Year	Climatic zone		
	South	Central	North
1999	54.1	43.3	41.1
2000	54.8	45.8	46.7
2001	52.1	49.7	48.6
2002	51.5	45.8	49.5
2003	50.6	46.2	52.5
2004	51.7	45.9	49.9
2005	54.4	45.0	46.6

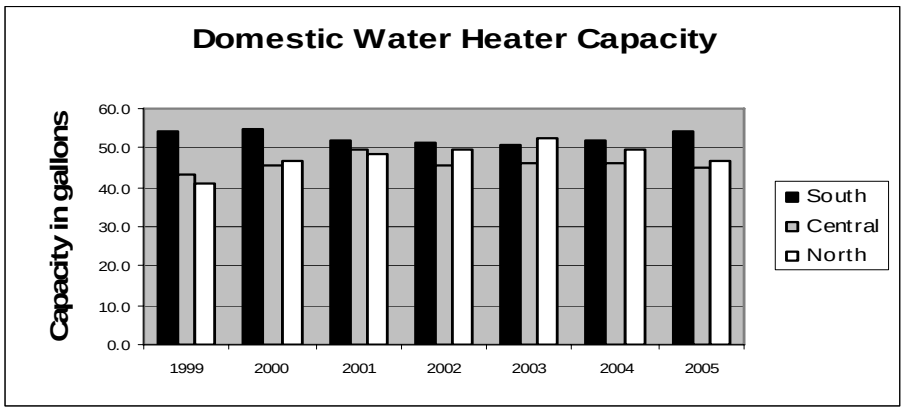

Figure 13: Average Water Heater Capacity (in gallons)

Water Heating Conservation Credits

Domestic water heating systems are second only to the HVAC system in the total energy consumption of a home. The Florida energy code provides energy conservation credits toward code compliance for: Dedicated heat pump, HP-Heat recovery, and AC-Heat recovery. As may be seen in Table 16, application for the conservation credits has begun to appear in the south zone, particularly for the AC-Heat recovery systems. The incidence of domestic water heating energy conservation credits is between zero and 0.5% in the central and north climate zones. These patterns of incidence are illustrated graphically in Figure 14.

Table 16: DWH Energy Conservation Credit Incidence

Year	South			Central			North		
	Dedicated Heat Pump	HP- Heat Recovery	AC - Heat Recovery	Dedicated Heat Pump	HP- Heat Recovery	AC - Heat Recovery	Dedicated Heat Pump	HP - Heat Recovery	AC - Heat Recovery
1999	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2000	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2001	0.0%	0.0%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
2002	0.0%	0.1%	0.5%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
2003	0.2%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
2004	1.3%	1.6%	0.2%	0.4%	0.4%	0.0%	0.0%	0.0%	0.0%
2005	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%

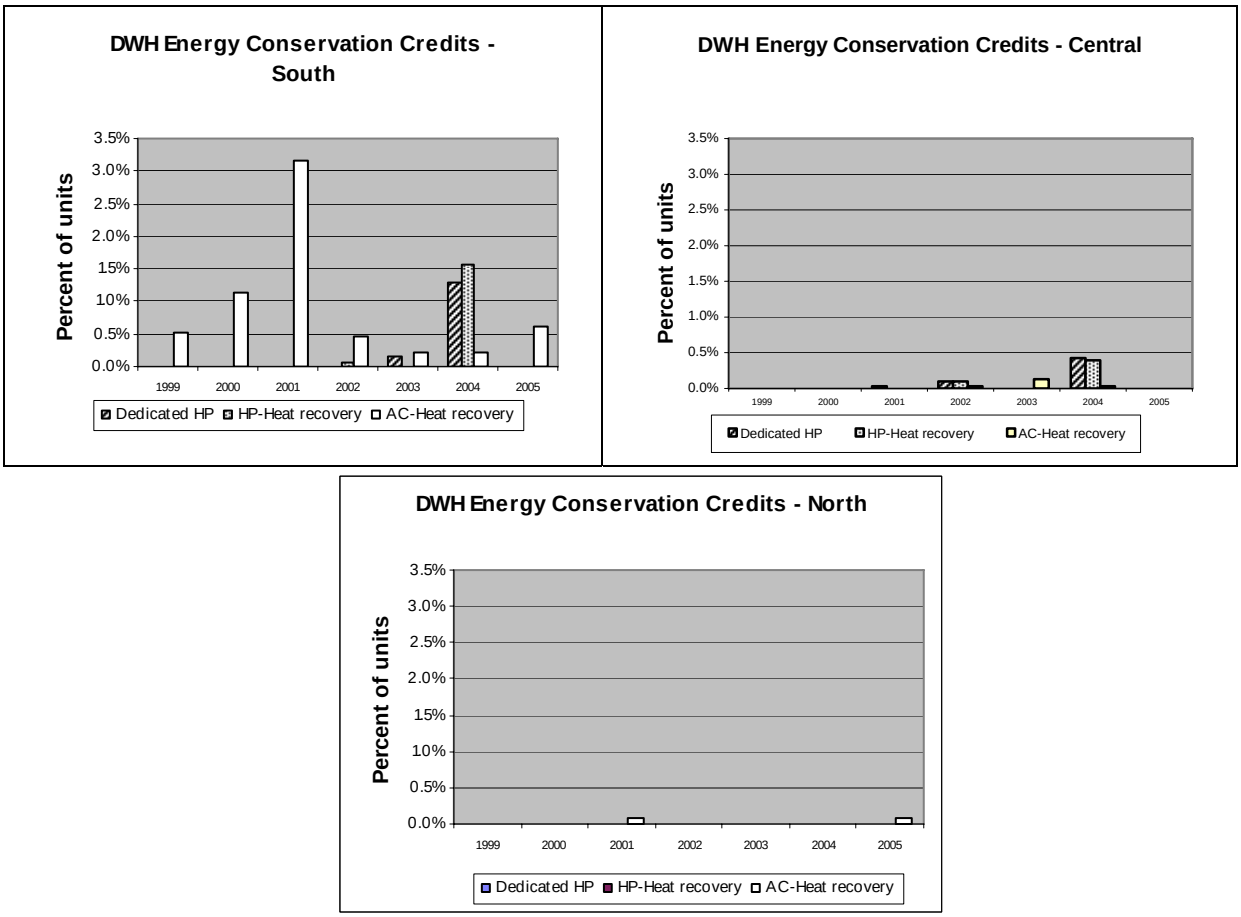

Figure 14: DWH Energy Conservation Credit Incidence

HVAC Conservation Credits

Energy credits are issued for buildings that are designed with certain energy conserving features that influence the energy consumed for heating, ventilating and air conditioning (HVAC). Presented in this section is a summary if the features claimed for energy credit. Note that these data may not indicate the level of market penetration of a given feature. This situation arises when the feature is present but no HVAC Credit is claimed.

Ceiling Fans: The incidence of ceiling fans in homes is erratic from year to year but is greatest in the south as shown in Table 17 and Figure 15.

Table 17: Incidence of Ceiling Fans

Year	Climatic zone		
	South	Central	North
1999	6.7%	0.1%	0.3%
2000	13.0%	0.2%	1.2%
2001	19.4%	2.5%	10.0%
2002	6.2%	1.2%	2.5%
2003	8.8%	2.3%	2.2%
2004	21.6%	2.1%	3.2%
2005	14.1%	1.5%	2.7%

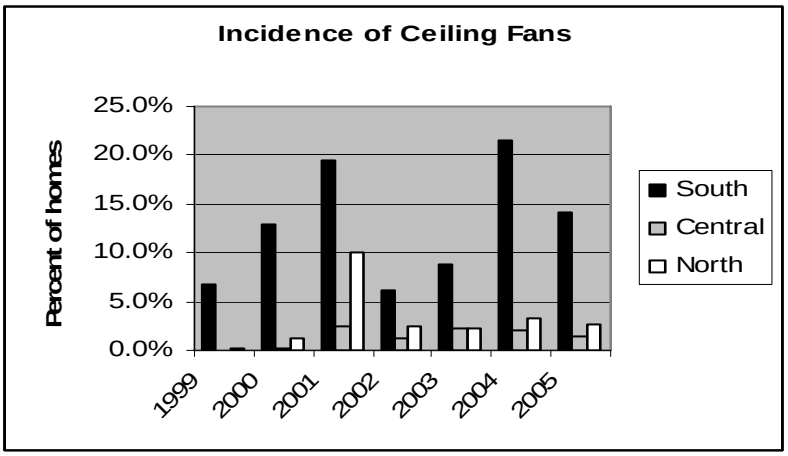

Figure 15: Incidence of Ceiling Fans

Cross Ventilation: As shown in Table 18 and Figure 16, cross ventilation has been employed as an energy credit in Florida homes since 2000. Generally speaking, the incidence has remained below 1.0 percent of the homes built. The exception to this statement is the south zone. In 2003

and 2005, the data indicate that 1.5% and 1.8%, respectively, of the homes built in the south claimed cross ventilation. In 2004 the percentage climbed to 8.4%.

Table 18: Cross Ventilation Incidence

Year	Climatic zone		
	South	Central	North
1999	0.0%	0.0%	0.0%
2000	0.0%	0.0%	0.1%
2001	0.0%	0.1%	0.3%
2002	0.0%	0.1%	0.1%
2003	1.5%	0.1%	0.1%
2004	8.4%	0.6%	0.1%
2005	1.8%	0.1%	0.2%

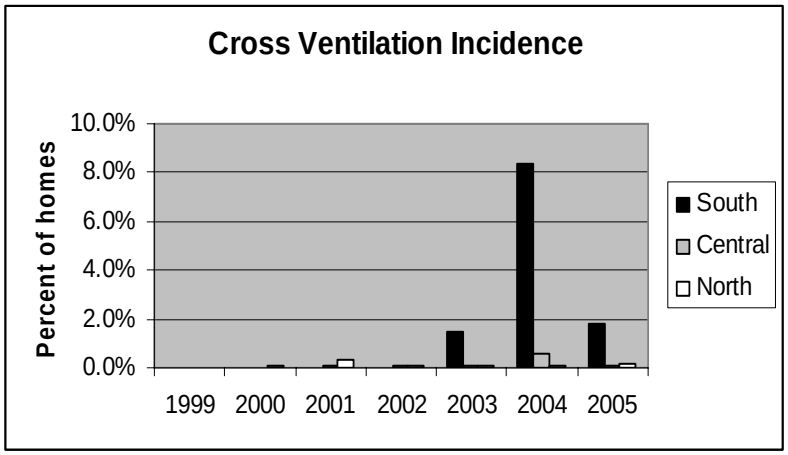

Figure 16: Incidence of Cross Ventilation

Programmable Thermostat AC: Programmable thermostats controlling the AC have been installed in about 5% of the homes in the south between 1999 and 2002 but displayed a marked increase beginning in 2003. The incidence in the central and north zones also increased in 2003 from less than 1% to about 5% or less in 2005. (See Table 19 and Figure 17)

Table 19: Programmable Thermostat AC Incidence

Year	Climatic zone		
	South	Central	North
1999	4.4%	0.0%	0.0%
2000	5.2%	0.1%	0.3%
2001	4.1%	0.3%	0.4%
2002	6.2%	0.9%	0.5%
2003	30.7%	5.5%	2.5%
2004	28.9%	3.2%	1.0%
2005	42.4%	5.0%	3.4%

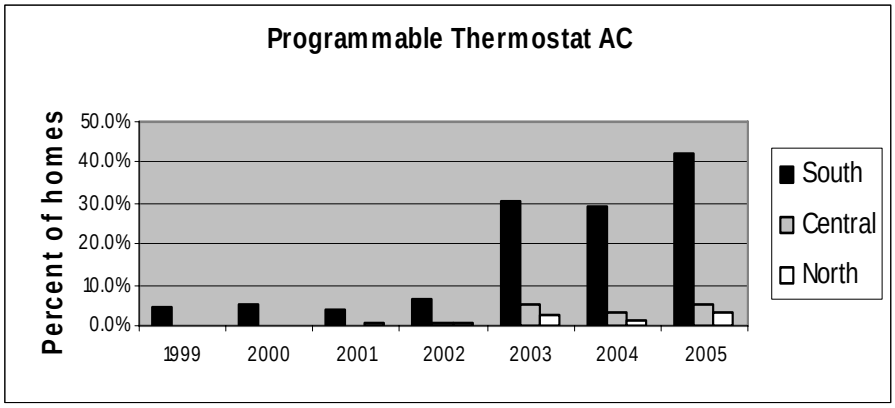

Figure 17: Programmable Thermostat AC Incidence

Programmable Thermostat HP: Prior to 2003, from 6% to almost 10% of the homes in the south had programmable thermostats installed for both heating and cooling that was provided by their heat pump. The incidence dropped to zero in 2003, rebounded to 3.7% in 2004, and dropped to 0.6% in 2005. The central and north zones have not embraced these thermostats as indicated in Table 20 and Figure 18.

Table 20: Programmable Thermostat HP Incidence

Year	Climatic zone		
	South	Central	North
1999	8.9%	0.0%	0.7%
2000	9.6%	0.1%	0.6%
2001	8.3%	0.9%	1.8%
2002	6.2%	0.2%	0.0%
2003	0.0%	0.0%	0.1%
2004	3.7%	0.4%	0.2%
2005	0.6%	0.0%	0.2%

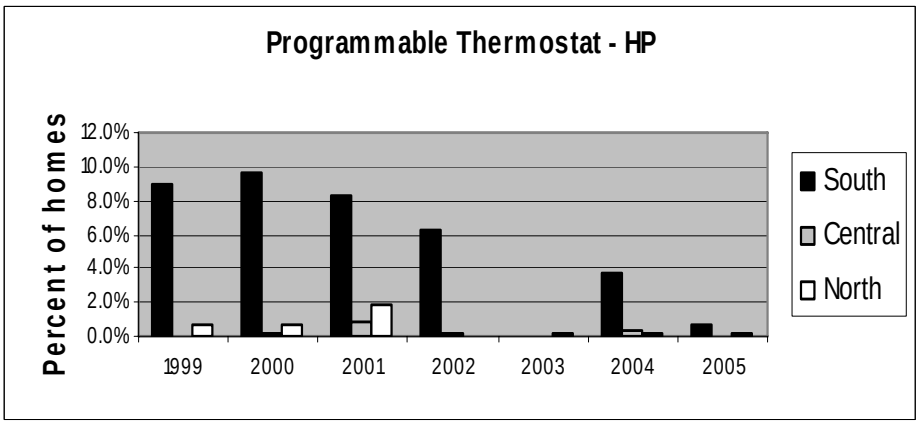

Figure 18: Programmable Thermostat HP Incidence

Multi-zone Cooling: HVAC systems designed for multi-zone cooling have been installed in homes built in the south throughout the seven-year period as shown in Table 21 and Figure 19.

In 2004 there was a substantial increase (nearly three-fold) in the incidence of the multi-zoned systems. In 2005 the incidence was approximately half of the high mark set in 2004. Multi-zone cooling in the central and northern market in 2000 has remained at or below 1.0 percent of the homes.

Table 21: Multi-zone Cooling Incidence

Year	Climatic zone		
	South	Central	North
1999	2.2%	0.0%	0.1%
2000	8.7%	0.2%	0.2%
2001	8.3%	0.9%	0.9%
2002	6.8%	0.1%	0.7%
2003	4.4%	0.8%	1.3%
2004	21.6%	1.0%	0.3%
2005	11.2%	0.5%	0.7%

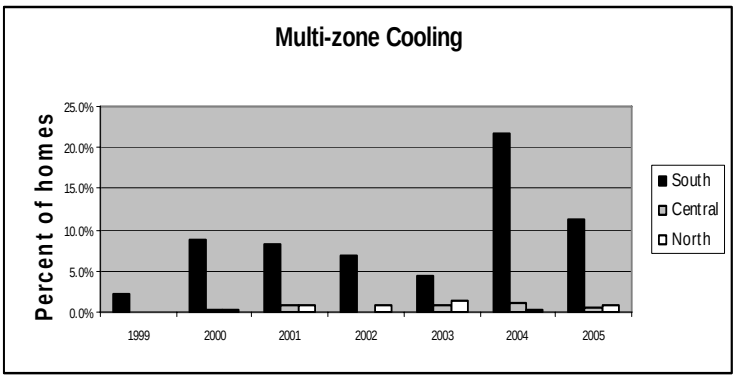

Figure 19: Multi-zone Cooling Incidence

Multi-zone Heating: The distribution of the incidence of multi-zone heating systems appears similar to that for the multi-zone cooling systems. The homes built in the south are being equipped with the multi-zone systems to a greater extent than are the homes in either the central or north zones. (See Table 22 and Figure 19)

Table 22: Multi-zone Heating Incidence

Year	Climatic zone		
	South	Central	North
1999	2.2%	0.0%	0.1%
2000	7.8%	0.2%	0.2%
2001	8.3%	0.7%	0.6%
2002	5.6%	0.1%	0.7%
2003	3.9%	0.7%	1.1%
2004	21.2%	1.0%	0.0%
2005	11.2%	0.5%	0.5%

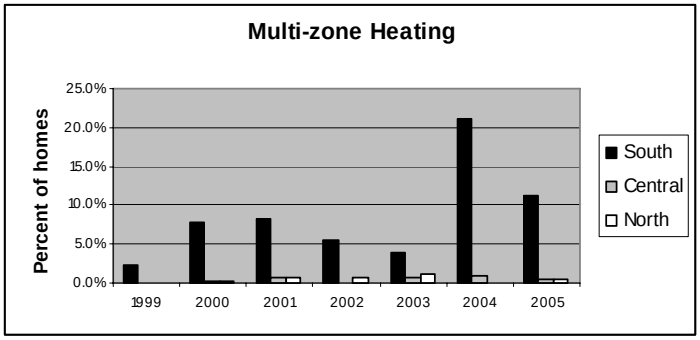

Figure 19: Multi-zone Heating Incidence