EPRI

Innovative Manufactured Housing Urban Design Demonstration Project

Technical Report

Innovative Manufactured Housing Urban Design Demonstration Project

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REPORT SUMMARY

One quarter of the new houses sold in the United States in 1999 were manufactured homes, and manufactured housing represents an important and growing market for power producers. One niche market opportunity for manufactured homes is in urban areas. EPRI facilitated the completion of two limited demonstrations of energy efficient manufactured homes designed specifically for urban neighborhoods.

Background

Electricity use in manufactured homes has been monitored at 16,000 to 20,000 kilowatt-hours per year for all-electric homes (EPRI report TR-100429). Most manufactured homes are sited in suburban and rural locations, but there is a serious need for more affordable housing in urban areas. Furthermore, many lots remain vacant for lack of an acceptable housing product. EPRI facilitated the completion of two limited demonstrations of manufactured homes specified to be highly energy efficient and designed specifically for urban neighborhoods.

Objective

- To demonstrate all-electric, energy efficient manufactured housing for urban neighborhoods
- To analyze energy and demand for key end-uses and whole house electrical load
- To develop strategies to increase market share for all-electric manufactured housing.

Approach

In a tailored collaboration, the project team brought together interested electric utilities, an experienced designer of manufactured homes, local land developers, neighborhood leaders, city government officials, committed home manufacturers, state trade associations of manufactured housing, and ultimately residents of affordable housing to build and evaluate all-electric energy efficient affordable innovative manufactured housing for urban neighborhoods. The team built five homes in Nashville and two in Washington, DC. They monitored electricity performance in four of the homes including such parameters as electricity use for the whole house, the heat pump, the water heater, and the refrigerator and also monitored outdoor and indoor temperature. The team also interviewed eleven key participants to determine their satisfaction with the product and the development process.

Results

The demonstration homes feature designs to blend in with the surrounding neighborhood. Compatible features include one and a half or two stories, porches, garages, brick siding, and permanent foundations. The demonstration homes were developed in conjunction with the Manufactured Housing Institute, the major national trade association of the industry. At the local

level, a collaborative process brought together government and non-profit land owners, developers, city zoning and building officials, citizens associations in target neighborhoods, financial lending authorities, home manufacturers, and state associations of home manufacturers. Utilities played a central role in identifying and coordinating key individuals and organizations in the local housing and political community.

Electric energy use in monitored homes ranges from about 12,000 to 18,000 kilowatt-hours per year. The largest energy use is for space heating and cooling, followed by water heating and refrigerator usage. The small-scale demonstrations have been quite well received for the homes planned in each community. Residents appear satisfied, housing officials are pleased, and developers have expressed an interest in purchasing more homes for other neighborhoods.

EPRI Perspective

The project was well reported in both the popular and professional press, and publicized at seminars and on the Internet. One measure of success of the urban design project has been the strong interest generated in the housing community. Inquiries have been made about the project from numerous local housing authorities, community development organizations, state housing agencies, non-profit developers, planning agencies, and affordable housing organizations. These inquiries have come from all parts of the country and include proposals for larger projects.

Keywords

Manufactured housing
Field testing
Energy monitoring
Market research
All-electric homes
Appliances

ABSTRACT

Manufactured housing, more popularly known as mobile homes, represents a large portion of new homes in the U.S. Shipments in 1999 were approximately 350,000 manufactured homes or about one out of four new single family homes in the U.S. Since most manufactured homes are sited in suburban and rural locations, a niche market opportunity exists for affordable housing in urban areas. The objective of the EPRI tailored collaboration project was to demonstrate all-electric energy efficient affordable innovative manufactured housing for urban neighborhoods. Part of the objective was to cooperate and develop relationships with national stakeholder associations and local housing interests, such as housing authorities, city planners, zoning administrators, developers, builders and non-profit housing groups. Participating utilities included Nashville Electric Service with the Tennessee Valley Authority, Potomac Electric Power Company, and Alabama Power of the Southern Company. The demonstration homes were developed in conjunction with the Manufactured Housing Institute, the major national trade association of the industry. Demonstrations were completed in Nashville, TN and Washington, DC. Monitoring showed energy consumption ranged from about 12,000 to 18,000 kWh per year. Satisfaction by all participants, including residents, was high. The homes featured split system and Insider heat pumps, which were well received. The project exceeded goals in the sense that a total of seven homes were installed in two communities versus a target of six homes in three communities. The manufactured housing urban design demonstration supported by participating EPRI utilities has stimulated significant interest for larger projects.

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INTRODUCTION AND BACKGROUND

Manufactured housing, more popularly known as mobile homes, represents a large portion of new homes in the U.S. Shipments in 1999 were approximately 350,000 manufactured homes or about one out of four new single family homes in the U.S.

Manufactured homes are becoming more popular in all regions of the country. They are gaining in popularity due to:

- Improved quality and energy efficiency, reflecting standard construction practices in enclosed weatherproof factories,
- Larger space as indicated by higher penetration of double-section homes,
- More pleasing appearance and modern features, and
- Greater value compared to site-built housing.

One niche market opportunity for manufactured homes is in urban areas. Most manufactured homes are sited in suburban and rural locations, but there is a serious need for more affordable housing in urban areas. Furthermore, many buildable lots remain vacant for lack of an acceptable housing product.

Electricity use in manufactured homes has been monitored at 16,000 to 20,000 kilowatthours per year for all-electric homes. (EPRI, Manufactured Housing – Energy Use Assessment, TR-100429, July, 1992.) Usage can vary even more due to such factors as weather conditions, envelope efficiency, types of heating and cooling systems, single versus double section housing sizes, and living habits. Energy savings can be achieved through improvements in the thermal envelope and more efficient heating systems and appliances.

EPRI facilitated the completion of two limited demonstrations of manufactured homes specified to be highly energy efficient and designed specifically for urban neighborhoods. The demonstration homes feature designs to blend in with the surrounding neighborhood. Compatible features include one and a half or two stories, porches, garages, brick siding, and permanent foundations.

The demonstration homes were developed in conjunction with the Manufactured Housing Institute, the major national trade association of the industry. At the local level, a collaborative process brought together government and non-profit land owners, developers, city zoning and building officials, citizens associations in target neighborhoods, financial lending authorities, home manufacturers, and state associations of home manufacturers. Utilities played a central

role in identifying and coordinating key individuals and organizations in the local housing and political community.

Twelve months of monitoring was conducted for two homes each in two cities. The utilities were heavily involved in planning and conducting the monitoring activities.

The small scale demonstrations have been quite well received for the homes planned in each community. Residents appear satisfied, housing officials are pleased, and developers have expressed an interest in purchasing more homes for other neighborhoods.

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OBJECTIVES AND GOALS

The objective of the EPRI tailored collaboration project was to demonstrate all-electric energy efficient affordable innovative manufactured housing for urban neighborhoods in cooperation with national stakeholder associations and local housing interests, such as housing authorities, city planners, zoning administrators, developers, builders and non-profit housing groups.

The energy features that were sought in the innovative manufactured homes were expected to include:

- Extra insulation and thermal envelope improvements,
- High efficiency space conditioning, including heat pumps,
- Energy efficient kitchen appliances, including refrigerators,
- High efficiency laundry appliances, specifically front-load washers,
- High efficiency water heating,
- Energy efficient lighting, and
- Security systems and outdoor lighting.

The goals of the tailored collaboration were to:

- Demonstrate two all-electric energy efficient homes for each participating utility,
- Analyze energy and demand for key end-uses and whole house electrical load,
- Document resident satisfaction and build community support for more homes,
- Strengthen relationships between utilities and the manufactured housing industry,
- Increase local and national awareness of all-electric manufactured housing, and
- Develop strategies to increase market share for all-electric manufactured housing.

Utility Roles

Participating utilities were expected to devote a few internal in-kind resources to participate, including:

- Working with state and local housing interests in identifying land developers, home sites, and potential owners or tenants in the properties;
- Coordinating service connections, conventional metering, and billing arrangements;

- Cooperating with EPRI on establishing end-use monitoring protocols and designing satisfaction surveys;
- Obtaining and installing metering equipment of the utility on two manufactured homes;
- Providing a year of monitoring data for analysis of local conditions and national comparison;
- Arranging for local housing and other interested parties to meet with MHI and EPRI support contractors to build awareness, provide information, and obtain feedback;
- Cooperating in arranging and holding media and other promotional events; and
- Participating in, if necessary, the semi-annual meetings of the tailored collaboration members and, if appropriate, the steering committee of the Manufactured Housing Institute.

Utilities were not expected to purchase or underwrite the manufactured homes. Rather, the product was expected to compete in the market place for affordable housing.

Substantial Benefits

Many benefits were suggested by the utilities participating in the tailored collaboration to demonstrate innovative urban designs for manufactured housing. Tangible and intangible benefits should include:

- Increased utility sales and revenue from new market niches,
- Additional affordable housing in target communities,
- More energy efficient housing and less delinquent customers,
- Better quality construction and compatible urban designs,
- Verification of energy performance,
- Satisfaction from consumers and land developers,
- Stronger relationships with builders and retailers of manufactured housing,
- Greater appreciation of utilities from housing and governmental organizations, and
- Positive media attention and publicity.

Monitoring and Analysis

Particular attention was to be devoted to documenting energy performance of the innovative urban designs for manufactured housing. Up to eight parameters were suggested for possible measurement, including:

- Whole house electric use
- Heat pump electric use
- Water heat electric use

- Clothes washer electric use
- Refrigerator electric use
- Outdoor temperature
- Indoor temperature
- Time

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TAILORED COLLABORATION PROCESS

The tailored collaboration process followed several general steps. The process was structured to bring together interested electric utilities, an experienced designer of manufactured homes, local land developers, neighborhood leaders, city government officials, committed home manufacturers, state trade associations of manufactured housing, and ultimately residents of affordable housing.

Step 1 – Recruitment of Utilities. Utilities were identified through several criteria. The primary consideration was membership in EPRI. Other criteria included utilities with a significant number of urban customers and an interest in all-electric energy efficient manufactured housing as an affordable investment for homeowners. Three utilities were selected:

- Nashville Electric Service with the Tennessee Valley Authority,
- Potomac Electric Power Company, and
- Alabama Power of the Southern Company.

These utilities agreed to participate in the tailored collaboration program by contributing a project management fee which was matched by EPRI. Barrett Consulting Associates was the contractor selected by EPRI to manage the tailored collaboration process in conjunction with the utility participants.

Step 2 – Design consultant. An architect with experience in manufactured housing designs for urban environments was identified and selected by the Manufactured Housing Institute. Susan Maxman Architects was selected by the Manufactured Housing Institute to lead the design process.

Step 3 – Identify target neighborhoods. Neighborhoods considered good locations for the housing were selected in conjunction with the utility and local government officials. The neighborhoods were visited by the EPRI and MHI contractors to select the most promising ones.

Step 4 - Agree on urban design(s). Preliminary designs were developed and presented to one or more community and neighborhood associations to obtain their preferences for particular features. Several meetings were usually necessary to gain consensus agreements with neighborhood leadership, the land developer, and local zoning and code officials for compatible designs.

Step 5 – Specify the manufactured home. Detailed designs and specifications were developed for the homes to be built. This included features for neighborhood compatibility and for energy efficiency. The EPRI contractor worked closely with various parties to insure the homes were specified as all-electric with high envelope efficiency, heat pumps, and energy efficient appliances.

Step 6 – Select a manufactured home builder. Several manufactured home builders were identified for building the homes for each of the three cities. Interviews were conducted with the home manufacturers to narrow the choice to the preferred home manufacturer. In addition, visits to the plants where homes would be built were made by some of the developers and utility sponsors. The EPRI contractor helped identify, select and coordinate the process.

Step 7 – Build and site the home. The manufactured home builder contracted with the local developer to construct the home according to specifications. Furthermore, the home manufacturer arranged for delivery and placement of the home on a foundation provided by the land developer. The EPRI contractor assisted in clarifying responsibilities and communicating between the various parties involved.

Step 8 – Inspect and dedicate the homes. The homes were inspected and approved by appropriate code and zoning officials. Once approved, the homes were ready for dedication, including ribbon cuttings and other public events. The EPRI contractor assisted in drafting press releases, announcements, brochures and other publicity materials. EPRI was featured in the dedication ceremonies.

Step 9 – Occupy under sale. The land developers identified and selected home owners. The utility was not responsible for financing the home; one utility contributed a grant toward the purchase of the home including the horizontal axis clothes washer. The land developers also assisted the home owner in arranging mortgage financing.

Step 10 – Monitor energy usage. The utility obtained permission from developers and residents to install monitoring equipment to document key end-uses. The utility, with advice from EPRI contractors, arranged for equipment acquisition, installation, and recording.

At least one year's worth of data was collected from the homes monitored for end-uses. The data are tabulated to show annual and monthly usage for the home and each end-use. The utility was responsible for recording the data and providing the data to EPRI contractors for tabulation and analysis.

Step 11 – Conduct satisfaction surveys. Telephone interviews were conducted to determine satisfaction of key interests including home occupants, land developers, home builders, and government officials. The EPRI contractor conducted the survey in consultation with the utility.

Step 12 – Report results. The last step in the process is to report results. This step is accomplished in the following pages. These will be presented by each demonstration location starting first with Nashville, TN; then Washington, D.C.; and finally Birmingham, Alabama.

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NASHVILLE ELECTRIC SERVICE DEMONSTRATION

Recruiting. An approach was made by EPRI contractors in late 1996 to NES about participation in the project.

Proposal. NES submitted its proposal on April 23, 1997 for participation in the EPRI tailored collaboration project and the MHI Urban Design program. Co-sponsors for the proposal included:

- Tennessee Manufactured Housing Association
- Affordable Housing Resources of Nashville, Inc.

EPRI contractors assisted in developing the proposal in order to expedite the process and further assure approval. The proposal was endorsed by TVA.

Developer. The developer was Affordable Housing Resources of Nashville, Inc. It provided the home purchase, construction financing, construction management, site development, sales and marketing, and overall project direction. From 1989 to 1998, it had been among the pre-eminent community development groups based in Tennessee. It had assisted over 2,000 families in the process of buying affordable homes and constructed over 160 single family homes.

Planning meetings. The initial meeting took place July 2, 1997 in Nashville at the offices of the Tennessee Manufactured Housing Association. Attendees included:

- Tennessee Manufactured Housing Association: Bonita Hamm, James McGree, Linda Bloodworth
- Fleetwood Homes: Bill Graves
- Nashville Electric Service: Kate Tallmadge, George Ramsey
- Affordable Housing Resources: Ed Latimer, Brian Parent
- TVA: Ken Carter
- MHI: Bruce Savage
- Susan Maxman Architects: Muscoe Martin
- EPRI: Harry Gautsche

A subsequent planning meeting was held August 15, 1997 with the same organizations plus several others including Clayton Homes and Champion Homes. Invited to the meeting but absent was the zoning and permitting agency for the city.

On October 8, 1997 a meeting was held at the Clayton Homes factory in Norris, Tennessee to review designs and pricing for the homes and take a factory tour. Attending were Ed Latimer of Affordable Housing Resources, Loretta Owens of Nashville Housing Fund, Bonita Hamm and James McGee of the Tennessee Manufactured Housing Association, Kathleen Talmadge and George Ramsey of Nashville Electric Service, and Muscoe Martin of Susan Maxman Architects.

Location. Two sites were initially selected; one at 2001 Britt Place and another consisting of two lots on Moore Avenue. In addition, three other sites were developed.

Specification. The home for 2001 Britt Place is 1,300 square feet in size. It incorporates three bedrooms and two baths. The all-electric home includes the following energy efficient features:

- Extra insulation including R-30 in the ceiling, R-19 in the walls and R-19 in the floor,
- High efficiency low E-glass windows,
- Energy efficient heat pump,
- Energy efficient water heater,
- Electric clothes washer, and
- Energy efficient refrigerator.

The home was designed to meet the high energy efficiency standards of the *energy right* home program of the Tennessee Valley Authority.

Home manufacturer and installation. The home was built by the Norris Division of Clayton Homes of Knoxville, TN. Installation was accomplished by Action Homes of Columbia, TN.

Dedication. The dedication took place on February 27, 1998 for the first home. It was located at 2001 Britt Place, Nashville, TN. The dedication was attended by about 50 people including officials from TVA, NES, EPRI, and various community leaders. These included:

- Nashville Electric Service: Dr. Matt Cordaro, President; James Dalrymple, Vice President and Chief Operating Officer; Don Khanski, Senior Vice President and Chief Financial Officer; Kate Tallmadge, Vice President for Customer Service and Marketing; George Ramsey, Marketing Manager, and others.
- TVA: Johnny Hays, Director; Katie Rawls, TVA Senior Customer Service Manager; and others.
- EPRI: Joe Exum, Customer Services Representative
- Affordable Housing Resources, Inc.: Ed Latimer, President
- Clayton Homes, Inc.: Kevin Clayton, Vice President

Ms. Tallmadge noted: “Homes like the one being dedicated today not only will give families the opportunity to purchase affordable housing, but will serve as a springboard in helping revitalize an urban area of Nashville, which is a plus for our community.”

Occupancy. The Britt place home was maintained as an open house for about six months after dedication. This was to allow visitors and others to not only visit but enter the model home.

Price and Financing. The homes were sold for $70,000 to $75,000. Construction financing was arranged locally with Union Planters Bank with Fannie Mae providing a grant to underwrite the interest. Home buyers acquired mortgages with conventional lending institutions with down payments of less than 1% of the purchase price. They obtained terms of 6% for up to ten years. Cost was slightly less per square foot than a site built home according to the developer. The developer wants to pursue additional homes if the cost and time of installation can be reduced.

Public Information. Activities included the following:

- Bill insert to all NES customers describing the project sent in Oct., 1997,
- NES invitation to the dedication,
- NES press release of February 20, 1998
- EPRI press release of February 27, 1998,
- MHI press release of March 4, 1998.

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POTOMAC ELECTRIC POWER COMPANY DEMONSTRATION

Recruiting. Pepco was approached by EPRI contractors June 14, 1996. There was an immediate expression of interest from Gwen Hawkins, Manager, Community Conservation Programs. Mr. Gautsche met with Ms. Hawkins and a representative of the Marshall Heights Community Development Organization on June 25, 1996. A formal letter of interest was submitted to Pepco by Mrs. Iraline G. Barnes, Vice President – Corporate Relations. Terry Statt, Manager, Residential Systems responded on August 13, 1996 to Ms. Barnes to encourage participation in the tailored collaboration.

Proposal. Ms. Hawkins of Pepco submitted a proposal to participate in the tailored collaboration on August 13, 1996. Marshall Heights Community Development Organization was identified as the developer partner. The proposal also identified Community Lending Group of NationsBank as the lender and Citizens Housing Development Corporation as the builder and sales organization.

Developer. The Marshall Heights Community Development Organization, Inc. was the developer. MHCDO was active in a number of community development activities including job training, substance abuse counseling, family advocacy, and housing development.

Planning Meetings. An initial planning meeting was held October, 1996 at the MHCDO offices. Attending were MHCDO, Pepco, MHI, and Susan Maxman Architects. The purposes were to introduce the various team members, explore zoning and permitting issues, review design parameters, and lay out a general plan for development. MHCDO indicated a desire to start site development in March, 1997 and have the homes placed and construction completed by May, 1997.

A planning meeting was held December 18, 1996 at MHCDO. In addition to the first organizations attending, Harry Gautsche joined on behalf of EPRI. He presented recommended specifications for energy equipment and efficiency levels. He also recommended several home manufacturers and steps to select one. The meeting reviewed roles, responsibilities, tasks, and schedules. A follow-up meeting was held between Pepco and MHCDO on December 31 to confirm agreements and plan a visit to Crest Division of Schult Homes.

On February 25, 1997 a visit was made to the plant of Crest Homes in Milton, Pennsylvania. Joining the visit were Pepco, MHCDO, and Susan Maxman Architects.

On May 30, 1997 Art Linde, Development Manager for MHCDO submitted a construction schedule to William Reasor, Crest Homes. It proposed a schedule for permitting, construction, and completion by October 27, 1997.

Location. A single story home was located at 1014 44th Street, N.E., Washington, D.C, and two story home at 903 44th Street, N.E. The lots were acquired by MHCDO through the Homestead Program of the Government of the District of Columbia.

Specifications. The single story home featured:

- 1,400 square feet
- 3 bedrooms
- 2 bathrooms
- full kitchen
- dining area
- living room.

The two story home featured:

- 1,447 square feet
- 940 square foot unfinished basement
- 2 bedrooms
- 1 family room/bedroom
- 2 bathrooms
- full kitchen
- dining area
- living room.

The energy efficiency features included:

- Extra insulation including R-30 in the ceiling, R-19 in the walls and R-30 in the floor;
- 6 inch exterior walls;
- High efficiency low E-glass windows;
- Insider heat pump by Consolidated Technologies, Inc.;
- Energy efficient water heater;
- Horizontal front loading clothes washer by Maytag; and
- Energy efficient refrigerator by Whirlpool.

Dedication. The single story home was dedicated June 23, 1998 at 1014 44th Street, N.E., Washington, D.C. Attendees included:

- PEPCO: Gwen Hawkins, Manager of Community Development; Susan Cory, Project Manager
- EPRI: Hank Courtright, Vice President, Product Lines Management; Andy Saleh, Manufactured Housing Project Manager
- Home owner: Joyce Jackson

As Gwen Hawkins of PEPCO noted: "The manufactured housing industry is very important to the renewal of the District. Furthermore, these homes will demonstrate how the Insider heat pump can provide both heating and cooling in one economical unit."

The second home was occupied in January, 1999. It is located at 903 44th St., N.E.

Home Manufacturer. Crest Homes of Milton, PA was selected as the home manufacturer. It is a division of Schult Homes. The particular plant was selected in part due to experience in construction of modular homes as well as HUD Code homes.

Price and Financing. The single story home was sold for $115,000. The two story home was sold for $125,000. The cost was about the same as a site built home according to the developer. The developer hopes that with larger volume purchases of manufactured housing, the factory will be able to offer the homes at a lower cost.

The financing was arranged through the Homestead program of the D.C. Department of Housing and Community Development. The Homestead program takes vacant homes and lots in sewer tax or water arrears and sells them to owner-occupants or non-profits who sell them to an eligible buyer. The Community Development Fund is the Marshall Heights Community Development Organization, Inc. internal fund source for housing and economic development activities. It is primarily financed by low-interest loans and investments from the Franklin National Bank CDC, Fannie Mae Foundation, and First Union Bank. MHCDO uses the funds in the CDF to finance development activities, including land acquisition, and construction, at no interest expense to the project. This fund was used in the Urban Design Demonstration Project and has enabled MHCDO to undertake substantially more development activities than would otherwise be possible.

Public Information. Activities included the following:

- MHI media advisory for the June 23 dedication;
- EPRI press release of June 23, 1998;
- MHI press kit of June 23, 1998;
- Invitation to the dedication;
- Program agenda for the dedication

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SOUTHERN COMPANY, ALABAMA POWER DEMONSTRATION

Recruiting. The approach to Alabama Power was made by EPRI contractors in August, 1996. Alabama Power was approached after it was learned that the Alabama Manufactured Housing Institute had wanted to participate in the Manufactured Housing Institute urban demonstration project. The institute assembled a team including a developer, home manufacturer, and banker. Furthermore, the institute obtained letters of support from the Mayor of Birmingham and Smithfield Neighborhood Association, Inc. The neighborhood association was a non-profit corporation which had an inventory of at least 26 vacant urban lots available for development.

Proposal. A proposal was submitted from Southern Company to EPRI in the fall of 1996 to participate in the demonstration.

Developer. The developer identified was Gus Davis Development, a local business that was building other homes in the targeted neighborhood. The developer was identified through the Alabama Manufactured Housing Institute, the state trade association. The developer was also preferred by the Smithfield Neighborhood Association.

Planning meetings. The initial planning meeting took place on August 28, 1996 in Birmingham for the purpose of reviewing the project purposes and organizational responsibilities. Attending the meeting were:

- Alabama Manufactured Housing Institute: Robert Gofourth
- Alabama Power: Frank Denny and Gene McFall
- Smithfield Neighborhood: Guss Davis and T.R. Patton
- Cavalier Homes: James Caldwell and Phillip Privett
- Community Enterprise Community, Office of the Mayor, City of Birmingham: John Gemmill
- Susan Maxman Architects: Susan Maxman and Muscoe Martin
- Manufactured Housing Institute: Andy Scholz

A second meeting was held October 11, 1996 with city officials to explain the project and secure cooperation. Two issues were of importance. First, there was a need to rezone the land for development. While zoned residential, the density was outdated and needed to be reduced. That is, the old zoning rules allowed smaller lots than current practice and the land needed to be rezoned for larger sized lots.

A second issue was acceptance of the HUD Code for residential building inspection purposes. If the homes were simply set up on the lots, there would be no question. However, foundations, porches, and exterior lighting were also planned, hence the need for local building code approvals.

A subsequent meeting on December 3, 1996 resulted in the unanimous support for the project by the city zoning and building code officials.

A meeting was held with Smithfield Neighborhood Association Community Committee on December 3, 1996 to obtain their views on the designs of the homes. Attending were members of the committee, Guss Davis, John Gemmill and Bill Gilchrist of the City of Birmingham, Kevin Miller and Philip Privett of Cavalier Homes, Andy Sholz of MHI, and Susan Maxman and Muscoe Martin of Susan Maxman Architects. Comments were obtained on drafts of designs regarding size, rooms, configuration, materials, heating and cooling equipment, porches, garages, and affordability.

A second neighborhood meeting with the committee took place January 14, 1997. In addition to the organizations attending the first meeting, others represented were Frank Denney for Alabama Power, Harry Gautsche for EPRI, and Robert Gofourth for the Alabama Manufactured Housing Institute. More comments were received on drafts of architectural drawings with discussion on zoning and permitting considerations. Another meeting with the neighborhood committee took place March 9, 1997.

Another meeting with city officials took place March 10, 1997. One item holding up the project was to secure financing for the infrastructure of curbs and sidewalks. Smithfield Neighborhood Association sought funds from the City of Birmingham Community Development Department. The department administered funds for such purposes for affordable housing projects from resources received from the U.S. Community Development Block Grant Program. Given the small number of homes contemplated for the project, the infrastructure costs were higher on a per home basis than the department normally granted.

On September 17, 1997, a meeting was held with City of Birmingham zoning and housing code officials, New South Federal Savings Bank, Smithfield Neighborhood Association, Inc., Cavalier Homes, the Alabama Manufactured Housing Institute, the Manufactured Housing Institute, and Susan Maxman Architects. The purpose was to review zoning and code questions and responses. It was reported that the Smithfield Neighborhood Association would meet October 12, the City Zoning Board October 14, a building permit applied for by October 17, and delivery of homes expected by mid-November.

Government approvals. In September, 1998 and after several meetings where the project was discussed, the City Council tentatively approved financial support, assuming an expected installation by December, 1998.

Location. Two lots were identified during a city tour as part of the first planning meeting. They were considered suitable for a single section home and a double section home. The lots were held by the Community Development Department of the City of Birmingham. It was understood

that ownership of the lots would be transferred to the homebuyer upon purchase of the manufactured home. At the September 14, 1997 meeting, five lots were being targeted for the homes. By June, 1998, the Mayor's Office was targeting 17 lots for manufactured homes.

Specification. One home was specified at 1,330 square feet, which included three bedrooms, two baths, living room, dining room and kitchen. The outside dimensions were 28 feet wide with a length of 52 feet plus an 8 foot porch along the entire front. A second home was specified for 1,160 square feet, which included two bedrooms, one bath, living room, dining room, and kitchen. The outside dimensions were 28 feet wide with a length of 42 feet plus an 8 foot porch along two thirds of the front of the home.

The homes were specified to meet the Alabama Power Good Cents Home guidelines including an energy efficient split system heat pump. Insulation levels included R-28 in the ceiling, R-19 in the floor, and R-13 in the walls; all of which significantly exceed requirements of the U.S. HUD Code for manufactured housing.

Home manufacturer. Cavalier Homes, Inc. was recruited as the developer early in the process by the Alabama Manufactured Housing Institute. Cavalier is headquartered in Addison, Alabama, and at the time was the eighth largest manufacturer in the U.S.

Installation. The homes were never built due to the absence of a firm commitment for payment from the developer. In turn, the developer did not obtain necessary financing to allow the project to proceed. Financing was contingent in part on approvals from local officials and the approvals were contingent on satisfying particular zoning and building requirements. For reasons that remain unclear, the developer and the city officials were not able to reach sufficient agreement to allow the project to proceed. Thus, the homes were not built.

However, the designs and specifications remain available for use in other locations. Accordingly, the Alabama Manufactured Housing Institute was planning to pursue developments in other parts of the state.

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MEDIA ATTENTION AND TECHNOLOGY TRANSFER

The project was well reported in both the popular and professional press. Articles ranged from generic reports about urban designs in general to specific stories about the project and people involved in local communities. A list of approximately 40 media reports is presented below.

- "Prefab Homes Could Fill in City Lots," The Miami Herald, January 19, 1997.
- "Latest in Affordable Housing: 2-Story Mobile Home," Lexington Herald-Leader, January 19, 1997.
- "Two Story Homes Get A Tryout," Detroit Free Press, January 19, 1997.
- Kenneth R. Harney, "Ínexpensive Factory-Built Homes to Take Root on Urban Landscape," The Washington Post, January 18, 1997.
- "Two-Story, Factory-Built Homes Could Help Meet Big-City Needs," the Charlotte Observer, January 25, 1997.
- Susan Maxman and Muscoe Martin, "Manufactured Housing Urban Design Project," Urban Land, March, 1997.
- Jane Bryant Quinn, "Mobile homes gain in popularity because of low cost, flexibility," Colorado Springs Gazette, April 7, 1997.
- M.J. Place, "Prefab house to speed construction," Pittsburgh Post-Gazette, May 1, 1997.
- "Urban Design Project Showcased During Symposium," Manufactured Housing Institute In Focus Newsletter, May, 1997.
- Alan J. Heavens, "Manufactured housing firms seek elusive urban acceptance," The Philadelphia Inquirer, July 23, 1997.
- Michele Derus, "Manufactured homes may fill need in central city," Milwaukee Journal Sentinel, August 4, 1997.
- Vernon Mays, "Breaking out of the box: manufactured housing is residential architecture's latest proving ground," residential architect, January-February, 1998.
- "MHI Urban Design Project: Bringing HUD-Code Homes to the Neighborhood," Automated Builder, April, 1998.
- "Manufactured homes now carry Energy Star label due to heat pumps," Air Conditioning, Heating and Refrigeration News, April 6, 1998.
- "New home houses energy efficient equipment," Electric Light and Power, June, 1998.

- "Urban Design Project Moves to the Nation's Capital," MHI In Focus Newsletter, June, 1998.
- "Manufactured Housing Institute urban design demonstration project," American, June 18, 1998.
- "Manufactured Homes Now Carry Energy Star Guarantee," Southern PHC, June-July, 1998.
- "New Homeowner Gets Keys with Help from PEPCO," Washington Sun, July 16, 1998.
- "Pepco Makes Urban Home Design Project Energy Efficient," Pepco Focus Newsletter, July, 1998.
- Pamela Beck Danner, "Urban Design Project Unveils D.C. Home," Manufactured Home Merchandiser, August, 1998.
- Pamela Beck Danner, "Washer/Dryer Set: Maytag Neptune Appliance," Manufactured Home Merchandiser, August, 1998.
- Housing Operations Manager, August, 1998.
- "Partnering to Design Energy-Efficient Housing," Transmission and Distribution, September 1, 1998.
- "Blending In," Public Power, September-October, 1998.
- Susan Brady, "Factory-Built Housing Pushes the Envelope," Professional Builder, October, 1998.
- "HUD-Code Housing's New Image," Professional Builder, October, 1998.
- "MHI: Manufactured Housing: Affordable Alternative Housing Comes to Louisville," Automated Builder, October, 1998.
- "Meeting Urban Needs: The Urban Design Project Debuts DC Prototype," Automated Builder, October, 1998.
- "Design Project Brings Factory-Built Houses to Suburbs and Cities," Butane Propane News, January, 1999.
- Susan Fleishman, "Putting Together a Better Reputation," The Washington Post, September 4, 1999.
- "Power for the 21st Century," Electrical Apparatus, March, 1999.
- "Tapping New Markets: Urban America," Manufactured Housing Technologies, Fall, 1999.
- "At Home in the City," Modern Homes, January – February, 2000.
- "Advancements in Affordable Manufactured Housing from MHI" and Affordable Solutions to Inner City Housing Woes," Professional Builder, January 1, 2000
- "Two Story Manufactured Housing (HUD Code), Professional Builder, January 27, 2000.
- "HUD Code Homes Maturing, New Demonstration Project Shows," Professional Builder, March 3, 2000.

- "MHI Recognized for Urban Infill Project," Modern Homes Development, May, 2000.

In addition, success was achieved with presentations at professional meetings. One event was a paper delivered by Mr. Gautsche.

- Authors: Larry B. Barrett, Harry H. Gautsche, and Terry G. Statt
- Title: "Managing the Commercial Introduction of the Next Generation of Energy Efficient Manufactured Housing"
- Event: Technology Transfer Society Annual Meeting, Denver, Colorado, July 19-23, 1997.

Another event was the leadership of Messrs. Barrett and Gautsche in the Manufactured Housing Track of the 1997 Excellence in Building Conference and Exposition held by the Energy Efficient Building Association. Messrs. Barrett and Gautsche suggested the track, recruited the presenters, and managed the panels. During the course of the all day session each of the three demonstration communities was highlighted. The session was held November 7, 1997 in Denver, Colorado.

A third occasion of technology transfer was participation in the seminar on "Developing with Manufactured Homes" sponsored by the Manufactured Housing Institute, the Manufactured Housing Educational Institute, and Professional Builder magazine. Mr. Gautsche made a presentation on the urban design project. He also recruited the local developer for the Washington, D.C. project to make a presentation. About 70 developers, financial representatives and others attended the seminar held September 27-29, 1999 in Arlington, VA.

The urban design project was honored with special recognition at the International Builders Show in January, 2000. Professional Builder magazine awarded the Urban Design Project with the Professional Achievement Award for Advancements in Affordable Housing.

The urban design homes have been featured on various internet sites. One particularly useful site is www.housingzone.com. A recent item on the web-site was "Affordable Solutions to Inner-City Housing Woes."

8
ENERGY MONITORING

The overall goal of the project was to demonstrate all-electric energy efficient HUD Code homes for urban neighborhoods. Accordingly, it was important to measure energy use for several homes.

Energy use data were collected for two homes each in Nashville and Washington. Data were collected for whole house energy use by time-of-day for twelve months. This was to allow investigation of daily load profiles, including the peak days for each month. In addition, data were collected for certain key end-uses such as the heat pump usage for cooling and heating, the auxiliary heating usage of the heat pump for winter months, water heating usage, and refrigeration usage. In addition, energy usage was collected for the horizontal axis washer in the Washington homes. In the Nashville homes, additional data were collected for the dishwasher, conventional clothes washer, dryer and range.

The utility was responsible for installing monitoring equipment and collecting the data. Compilation of the data was performed by New Horizon Technologies Energy Services, LLC for EPRI. Analysis and results are summarized below with details in Appendix E.

Results for Washington, DC. Monitoring was conducted to measure electricity use for the whole house and for key end-uses. The single story home used 17,662 kilowatthours for the first year of use. The two story home, which was constructed and installed later, used 13,965 kilowatthours for the first year of use.

The largest uses are for space conditioning, followed by water heating and refrigeration. By reviewing the monthly data for the whole house, one observes higher energy use in the winter months and the summer months compared to the rest of the year. This is as expected.

Baseloads stay relatively even in kilowatthour usage per month, as may be observed with the high efficiency refrigerator, water heater, and front-load washing machine usage. The unmetered end use includes other appliances, lights and miscellaneous electrical equipment.

The front-load or horizontal axis washers developed by EPRI in conjunction with Maytag exhibit quite small energy use for both homes. This again is expected since the major energy savings from the front-load washer are in reduced demand for hot water.

The heat pump presents typical patterns and levels of energy usage for the two story home, with annual consumption of 7,204 kilowatthours (of which 81% was for the heat pump and 19% for auxiliary strip heaters). The single story home exhibits higher than expected heat pump energy use in the winter months, for a total annual consumption of 12,089 kilowatthours. The higher

energy consumption of the heat pump for the single story home is largely due to greater use of the auxiliary strip heaters, which accounted for 75% of the space heating usage.

Results for Nashville, TN. Two homes were also monitored in Nashville through the participation of Nashville Electric Service. The homes at 508 Moore Avenue and 2001 Britt Place are both about 1,300 square feet.

Again, the monthly electricity usage shows an expected annual pattern for the final twelve months with winter and summer usage being higher than fall and spring usage. One home consumed 18,487 kilowatthours for the year and a similar home used 12,895. This illustrates how differences in lifestyle can dramatically influence energy consumption. End-use data are not available for the homes.

9
EVALUATION INTERVIEWS

Interviews to determine the degree of satisfaction were conducted for a total of 11 key participants in the NES and Pepco projects. For NES, the interviews included:

- George Ramsey, Marketing and Customer Service Manager, NES
- Eddie Latimer, Executive Director, Affordable Housing Resources, Inc.
- Rick Boyd Vice President of Engineering, Clayton Homes
- Bonita Hamm, Executive Director, TMHA
- Resident and owner of 508 Moore Avenue
- Resident and owner of 2001 Britt Place

For Pepco, interviews included:

- Susan Cory, Engineer Energy Services
- Kevin Moody, Housing Development Manager, Marshall Heights Community Development Organization, Inc.
- Alan Froehle, General Manager, Crest Homes Division of Schult Homes

Owners were not interviewed for the Pepco homes at the request of the developer and the residents, since they had accommodated numerous media inquiries and visits by housing experts.

Also, interviews were conducted with key partners that were active in both projects, including:

Andy Scholz, Manufactured Housing Institute

Muscoe Martin, Susan Maxman & Partners

The interviews are summarized in this section. Since all respondents in the telephone interview agreed to publication of the results and they had a chance to review the write-ups, the detailed responses are included in Appendices B,C, and D. However, the names of the owner residents are not included to protect their privacy.

Satisfaction with the home. The telephone survey was divided into two parts. The first set of questions dealt with the home and the second set focused on the process. The results are presented in a similar order here.

The homes overall were rated by most respondents as very satisfactory. A few answered satisfactory or fair, due in part to some particular problem. The design and appearance of the home was rated as very satisfactory by all, except the developers gave a satisfactory rating.

Respondents liked the way the homes fit into the neighborhoods in terms of size and appearance. The homes blended in so well that one participant in the project took a government official through the neighborhoods and challenged the person to pick out the manufactured homes, which he could not do.

The only suggestions on the design were to use more false brick exteriors to better blend into certain neighborhoods and to improve the roof design and set-up to reduce persistent leakage that developed in at least one case.

Energy features. The energy features of the homes were all perceived as very satisfactory or satisfactory. They included the windows, appliances, water heating, lighting, heating and cooling system and the envelope insulation.

The heat pump was also considered very satisfactory or satisfactory by all respondents for the Nashville homes. The heat pumps were considered quiet and clean. The residents both noted the system was comfortable and that energy bills were lower than their previous homes or apartments.

The heat pumps for the homes in Washington were not as well received. While the unit was considered fine, the ductwork was found unsatisfactory. This was particularly the case with the two story home where the basement was to be conditioned. The home manufacturer and the developer each thought the other party was responsible with the result that the heat pump was undersized and ductwork was not installed initially for the basement area.

Planning and design process. The design process was found to be very satisfactory or satisfactory. However, participants found the government approval process to range from satisfactory to unsatisfactory.

It was recognized that as a demonstration project of a new housing concept, the process would be somewhat unique. Neighborhood groups were not a concern since the developers were relatively well known and accepted. The government approval process was more involved, except for Nashville, where the developer and utility had excellent relationships with the local officials. In Washington, the approval process took too long.

Installing the home was found to be the biggest problem with the process. Home manufacturers found sites were not properly prepared by the developer when the units arrived for set-up. Developers expected more from home manufacturers in the set-up process and tried to complete installation with site-built housing crews rather than hire crews with expertise in manufactured housing.

10
CONCLUSIONS

The principal objectives of the tailored collaboration project that were achieved included:

- Demonstrating all-electric energy efficient manufactured homes within urban neighborhoods,
- Monitoring energy use for whole house and component loads,
- Documenting satisfaction with the homes and the process,
- Strengthening relationships between utilities and the manufactured housing industry,
- Increasing local and national awareness of all-electric energy efficient manufactured housing with heat pumps, and
- Participating in efforts to increase market share for all-electric manufactured housing.

The project exceeded goals in the sense that a total of seven homes were installed in two communities versus a target of six homes in three communities. Although three utilities were recruited and actively participated, homes were built ultimately in only two of the communities, with Nashville placing five homes and Washington, DC seeing two homes. For the third community, homes were not placed due to shortcomings of the developer and local government. This occurred despite the best efforts of all other parties involved.

Four homes were monitored through EPRI coordination and support. Electric energy use ranges from about 12,000 to 18,000 kilowatthours per year. The largest energy use is for space heating and cooling, followed by water heating and refrigerator usage.

An evaluation of the product found participants were generally satisfied or very satisfied with design, both exterior and interior, as well as with the energy efficient equipment. The heat pump was found to be clean, quiet, comfortable and economical.

Regarding the design process, there was general satisfaction as well. Less satisfaction arose over the coordination between the home construction and set-up as well as follow up with some of the post-installation corrections.

Extensive neighborhood consultations were not needed in Nashville and Washington since local developers and community leaders were involved. While a local developer was involved from the beginning in Birmingham, the neighborhood association consultations extended the project without significant difference in design considerations compared to other locations.

Coordination between the land developer and the home manufacturing plant is critical. Areas of particular importance are proper site preparation, coordination on home set-up, installation, and responsibilities for problems uncovered following home completion.

Another critical area is coordination between the developer and local government officials responsible for zoning and building permits. In particular, government officials are typically unfamiliar with manufactured homes and are reluctant to support a new housing product. However, once educated, such officials can be strong supporters of manufactured housing as a viable option for affordable housing.

Financing is another key to success. Experienced developers appear able to secure financing, even for new housing concepts. Less experienced developers appear to have more difficulty and without strong financial commitments, home manufacturers are not inclined to build units.

One measure of success of the urban design project has been the strong interest generated in the housing community. Inquiries have been made to the Manufactured Housing Institute about the project from numerous local housing authorities, community development organizations, state housing agencies, non-profit developers, planning agencies and affordable housing organizations. These inquiries have come from all parts of the country and for larger projects.

Thus, the manufactured housing urban design demonstration supported by participating EPRI utilities has stimulated significant interest for larger projects.

A
ENERGY EFFICIENCY SPECIFICATION GUIDELINES

Urban Manufactured Housing Demonstration Project

Nashville:

- Meets or exceeds TVA *energy right* standards
- Extra insulation or R-30 ceiling, R-19 wall with 6” framing, R-19 floor
- High efficiency windows with no more than 15% of floor and double glazed
- Energy efficient electric heat pump for heat/cool with 10 SEER energy rating
- Vents for kitchen and all baths
- Energy efficient water heater
- Low-flow shower heads
- SERP, super energy efficient refrigerator
- Electric clothes washer
- Energy efficient electric dryer
- Energy efficient range/oven
- Fluorescent lighting with compacts in kitchen and baths
- Energy efficient outdoor and security lighting

Washington DC:

- High efficiency E-glass windows
- Energy efficient electric heat pump providing heat/cool all from inside home (Insider model)
- Energy efficient electric horizontal axis front load washer which uses less water and saves energy required for drying by removing more moisture from clothes (Maytag Neptune model)
- SERP energy efficient refrigerator (Whirlpool model)
- Extra insulation values beyond the Federal HUD code of R-30 ceiling, R-19 walls(6”framing), R-30 in floor (Owens Corning brand).

B
INTERVIEWS FOR NASHVILLE DEMONSTRATION

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** Sept. 3, 1999

Mr. George Ramsey
Marketing and Customer Service Manager
Nashville Electric System
1214 Church Street
Nashville, TN 37203
615-747-3680
fax - 3774

1. **How would you rate the overall home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Good layout in the home. Sizable kitchen. Quality materials. Fit into the neighborhood well. Good curb appeal. Good landscaping and shrubbery.

4. **What could be improved about the design and appearance?**

A little more shrubbery and less bare ground would improve appearance. But this may come with time and ownership. He had not been by since the dedication, so it may be much more improved by now.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

6. What do you like best?

Above the Model Energy Code requirements.

7. What could be improved?

Not much. From a marketing perspective, the house tour could have used some more information and signs about the features and equipment. It might have helped if the owner moved in earlier to show a more natural appearance with furniture, etc.

8. How would you rate the heat pump in the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

9. Why?

Quiet. Clean.

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

11. Why

The homes helped improve and clean up a neighborhood that had been degraded in appearance and personality. There had been more crime and drug activity. Now that is gone.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

A church in the neighborhood had an active pastor that helped lead the process of improving the area.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

15. What worked best?

It worked relatively quickly once everyone understood and trusted each other. The process was

smooth. It had the right players. It took a lot of work, but was worth it. The state manufactured housing association was not as interested initially as expected. But once they understood the idea and got involved, they were very supportive. It went quickly once everyone bought in.

16. What could be improved?

Just the need to get buy-in from the key players.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

18. What worked best about the public approval process?

Mr. Ramsey visited the City Code Department and found they were agreeable once they understood the objective and process. Electrical, mechanical, plumbing, zoning and other requirements were not a problem.

Another aspect was the role of the church pastor. Because of his interest and support, there was no need for neighborhood meetings. He saw to it that the neighborhood supported the homes. It also helped that the pastor was an employee of NES and encouraged the COO of NES to support the concept.

The pastor also made sure that some local officials were recognized for their support. In particular, two minority representatives on the City Council supported the project, in part since the pastor knew them and also was a minority.

19. What could be improved?

Nothing.

20. How would you rate the process of installing and setting-up the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

21. What worked best?

22. What could be improved?

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

24. What worked best?

It did not hurt that the President of the Union Planters Bank sat on the Board of NES. Although it was a coincidence that Affordable Housing Resources had contacted that bank for the construction loan. And the bank wanted to do it.

25. What could be improved?

26. What other comments or suggestions do you have about the process? What would you do differently next time?

Mr. Ramsey was quite impressed with the professional and effective manner of Harry Gautsche in coordinating the planning, design, and installation process.

Mr. Ramsey was complimentary about the excellent job of Muscoe Martin of Susan Maxman Partners, the architect hired by Manufactured Housing Institute. He was excellent at anticipating questions and concerns in advance. When issues came up he handled them in a way that brought participants into the process and accepted his answers and recommendations without any problems.

Monitoring was an issue. NES had committed to provide equipment, install, and collect data. EPRI was expected to take the data and provide tabulations and analysis. By the time the homes were ready, EPRI had not settled on a monitoring support contractor. After many attempts to coordinate with EPRI, its potential contractor, and others, NES went ahead and made a unilateral decision about what equipment to install, how frequently to record the data and other key installation decisions. It would have been easier if EPRI had a monitoring contractor in place to assure the protocols and guidelines were in agreement.

27. **May I attribute your comments in a public report?** Yes

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline for Larry Barrett

Person interviewed: **Date:** Sept. 3, 1999 and Aug. 25, 1999

Mr. Eddie Latimer
Executive Director
Affordable Housing Resources, Inc.
1011 Cherry Avenue
Nashville, TN 37203
615-251-0025
fax 256-9836
elatimer@ahrhousing.org

1. **How would you rate the overall home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Externally, like the brick foundation in the front. When visitors are driven through the neighborhood to look at the homes, they regularly cannot pick out the manufactured homes, since they blend so well into the area.

The homes are sturdy with 2x6 studs, I-beams along each section, and drywall.

Three floor plans were used in five homes.

4. **What could be improved about the design and appearance?**

Would have been nice to have brick pillars instead of wood on the porch. Would like to have front door centered, but realizes this is not practical. Would like to avoid the marriage wall strip in the attic and other complications of the marriage wall.

Roof design was a real challenge. It took a week for the first home to have the roof completed. Part of the problem was rain, which because of the roof design allowed some of the ceiling to be damaged, which had to be replaced. The second home took three days. The next three homes were easier, because Clayton Homes improved the roof design.

5. **How would you rate the energy features of the home including insulation, windows,**

appliances, heat and cooling system, water heating, and lighting?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

6. What do you like best?

Thought the appliances were good quality, including refrigerator, dishwasher and stove. Owner supplied washer and dryer.

7. What could be improved?

Would like to have seen results of energy analysis.

8. How would you rate the heat pump in the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

9. Why?

Per Bryan Tenant, construction supervisor for AHR, there have been no complaints. All units have been split systems. He thinks by Intertherm. While package units by Insider were considered, the home retailer suggested split systems. This required installing the outdoor compressor and hooking up the system once the home was set up.

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

11. Why

Initially the neighbors perceived the home poorly, especially before it was in place. But once the home was in place, they were satisfied.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

One concern was the telephone wiring. The phone company replaced all the factory installed wiring claiming it would not work.

Plumbing connections were not tight and needed to be repaired. On three occasions carpets needed to be replaced and in one case some flooring, when toilet and other bathroom connections allowed leaks to develop and go unnoticed until damage was done.

A vent pipe for one of the bathrooms was not sealed sufficiently to prevent rain leaks through the roof. It took about five times to repair this one problem.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

15. What worked best?

Got the players to the table. Took four or five meetings. But all were necessary.

16. What could be improved?

Would have helped to bring the home retailer, Action Homes, into the process more.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

18. What worked best about the public approval process?

There were not issues, because multi-wide homes are allowed in Nashville.

19. What could be improved?

Single-wide homes are prohibited by Nashville building codes.

20. How would you rate the process of purchasing or acquiring the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

21. What worked best?

22. What could be improved?

23. How would you rate the process of installing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

24. What worked best?

Action Homes did the set-up on the first two homes. AHR did the set-up for the next three homes including marriage line sealing, roof sealing, and foundation work. This was because

they wanted to use local crews, as opposed to crews from several counties away that served Action Homes, which was located several counties away.

25. What could be improved?

It was hard for AHR to do set-up. They had little cooperation from the manufactured housing industry state association or Action Homes about finding set-up crews and advising on set-up. For example, the state manufactured housing association could not provide a list of set-up companies. The developer, AHR, eventually found necessary people through contacts in the construction industry. They speculate that the manufactured housing retailers are reluctant to provide much information about their contractors, since they keep them quite busy as it is.

26. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

27. What worked best?

Clear and concise. Union Planters Bank provided the construction loan. Fannie Mae provided a grant to underwrite the interest on the construction loan. Home buyers acquired mortgages through conventional lending institutions. Down payments were required at less than 1% of purchase price.

28. What could be improved?

29. What other comments or suggestions do you have about the process? What would you do differently next time?

Very positive about the homes. The manufactured homes were sold at between $70,000 and $75,000. This was about $5,000 under equivalent site built homes. Want to get the cost down another $3,000 - $6,000 under the price of site built homes. Thus want the manufactured homes to sell for about $65,000 - $70,000. There is hope this can be achieved by savings in set-up costs and avoiding other installation costs, such as plumbing and wiring. They plan to build more once the cost savings can be more readily assured.

30. May I attribute your comments in a public report?

Yes, as long as a copy is provided to AHR.

Note: The first two homes were at 2001 Britt Place and 508 Moore Avenue. These are being monitored by Nashville Electric Service. Three other homes have since been placed at 14th Avenue South, 1904 Britt Place and 1908 Britt Place.

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** Sept. 10, 1999

Ms. Bonita Hamm
Executive Director
Tennessee Manufactured Housing Association
240 Great Circle Drive
Nashville, TN
615-256-4733
fax 255-8869

1. **How would you rate the overall home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

That the home could not be distinguished from a site built home. Ms. Hamm took an official of the Tennessee Transportation Department for a tour of the neighborhood, since this agency has jurisdiction over transport of manufactured homes. He predicted he would be able to spot the manufactured home, but in fact picked out a site built home. Not until he went up to the manufactured home and saw the HUD Code marker did he believe it.

4. **What could be improved about the design and appearance?**

Nothing in particular.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

6. **What do you like best?**

Since she did not pay particular attention to the energy features, but left that to others, she considered them satisfactory because no issues or problems arose.

7. **What could be improved?**

Nothing

8. How would you rate the heat pump in the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. Why?

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

11. Why

At the ribbon cutting, some of the neighbors attended and expressed their pleasure.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

No.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

15. What worked best?

She only had to attend one meeting. She was impressed how quickly the process moved along.

16. What could be improved?

Nothing.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

18. What worked best about the public approval process?

She did not have to get involved, since it was handled well by Eddie Latimer, the developer and

others.

19. What could be improved?

Nothing.

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory

21. What worked best?

No major problems.

22. What could be improved?

Nothing she is aware of.

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/<u>No opinion</u>

24. What worked best?

25. What could be improved?

26. What other comments or suggestions do you have about the process? What would you do differently next time?

The bidders were limited to manufacturers in Tennessee. Initially two showed interest. Ultimately one submitted a proposal, Clayton Homes. The other prospective bidder figured the interruption to its assembly process to produce one home of an unusual design was not worth the effort. A typical plant produces 15-20 homes a day. A custom manufacturer produces about two homes per day. Developers might consider approaching custom manufactured home producers if only a few homes are being ordered. Large producers can be more readily approached if many homes are being ordered.

27. May I attribute your comments in a public report? Yes.

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** Sept. 14, 1999

Mr. Rick Boyd
Vice President of Engineering
Clayton Homes
423-380-3365
fax-3782

1. **How would you rate the overall home?**

   Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the home?**

   Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Good use of space. Appeal of exterior.

4. **What could be improved about the design and appearance?**

Second and third bedrooms might have been a little bigger, but this could be said about many homes. For the price point of the home, no improvements recommended.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   <u>Very satisfactory</u>/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

6. **What do you like best?**

Overall consciousness toward energy.

7. **What could be improved?**

Nothing.

8. **How would you rate the heat pump in the home?**

   Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. Why?

No particular problems.

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

Compared to other existing homes he saw in the neighborhood.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

No.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

15. What worked best?

Design architect and plant developed a design that was fair and equitable. This included officials from Clayton, Susan Maxman Partners, and EPRI.

16. What could be improved?

Some specified features were not standard. So some features had to be modified closer to standard materials. For other features, special materials were acquired to meet the specification.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

18. What worked best about the public approval process?

Not applicable

19. What could be improved?

Not applicable

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

21. What worked best?

Not applicable.

22. What could be improved?

Experienced set-up crews were needed. Some of the homes suffered water damage. This was because the homes were exposed to rain. In particular, the hinged trusses were not set-up properly which allowed water damage.

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

24. What worked best?

No problems.

25. What could be improved?

No comment.

26. What other comments or suggestions do you have about the process? What would you do differently next time?

Get the home manufacturer involved earlier in the design process. This could save time and expense by educating the architect and others about standard and special materials or features. If there is a bid process to select the home manufacturer allow the bidder to suggest design and materials alternatives or provide design and materials alternatives for the bidder.

27. May I attribute your comments in a public report? Yes.

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** September 13, 1999

Name Confidential
Britt Place
Nashville, TN 37208

1. **How would you rate the overall home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Way it is made. Lots of space. Layout. Big kitchen.

4. **What could be improved about the design and appearance?**

While we like the front porch, a deck in the back would be nice.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

6. **What do you like best?**

Heating and cooling system. Control system. Programming has been performed to schedule lights and manage peak demands for space conditioning and water heating.

7. **What could be improved?**

A couple of the windows were drafty and had to be resealed.

8. **How would you rate the heat pump in the home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. **Why?**

Works fine. Utility bills have been reasonable. Bills are lower. Comfort is double previous residence.

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

Everyone loves the home. Lots of compliments. Of the twelve new homes, this is the only manufactured home.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

The jacuzzi is really nice. Financing was not a problem. The down payment was about $1,000 and GMAC holds the mortgage.

13. **May I attribute your comments in a public report?** Yes.

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date: 9/7/99**

Name Confidential
Moore Avenue
Nashville, TN 37203

1. **How would you rate the overall home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory
   except for roof.

2. **How would you rate the overall design and appearance of the home?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory
   except for roof

3. **What do you like best about the design and appearance?**

Likes it all, except for the roof. It leaks. When it rains, water drips around the bathroom fan. It has damaged the floor and the ceiling around the fan. Since moving in about January, 1999, there have been 6 or 7 calls to the developer. The developer has indicated their concern and promised to send someone to repair the leak. But no-one has appeared and it has not been done.

4. **What could be improved about the design and appearance?**

Nothing, except for the roof leak.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

6. **What do you like best?**

Likes it all.

7. **What could be improved?**

Nothing.

8. **How would you rate the heat pump in the home?**

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

9. Why?

It is very quiet. Comfortable. Energy bills are about average. In fact, a little less for the three bedroom home compared to the two bedroom apartment, he previously lived in.

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

11. Why

Like appearance.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

The owner believes the roof repair should be covered by the one year warranty and is worried the repair will not be accomplished within the warranty period and he will have to pay for it.

13. May I attribute your comments in a public report?

Yes

C
INTERVIEWS FOR PEPCO DEMONSTRATION

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** 9/21/99

Ms. Susan Cory
Engineer, Energy Services
Potomac Electric Power Company
1900 Pennsylvania Avenue, N.W.
Washington, D.C. 200668
202-872-2185
fax – 7987

1. **How would you rate the homes overall?**

   Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the homes?**

   <u>Very satisfactory</u>/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Fit into the neighborhood. Blended in nicely.

4. **What could be improved about the design and appearance?**

Not much to improve. Not enough space was left for the refrigerator, washer and dryer. Even though the manufacturer was given the specifications, the units purchased by PEPCO and Marshall Heights did not have adequate space.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

6. **What do you like best?**

Systems operated fine, except for the heat pump.

7. What could be improved?

Installation of the heating and cooling system left something to be desired. Doors were not plumb.

8. How would you rate the heat pump in the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. Why?

The Insider heat pump lacked proper supply registers and return registers. For the two story home, no ducts or registers were supplied for the basement, initially. The thermostat was improperly located. Flex ducts were used, when metal ducts were expected. Also problems developed with the fresh air intake. The homes appear to be using too much heat. It is possible they were not installed correctly and therefore are not operating correctly. The single story home owner received some counseling on proper operation of the Insider heat pump.

Monitoring seems to indicate the home is using too much energy, especially in the winter months. Part of this could be due to lifestyle of the residents. But part would also appear to be due to the heating and cooling system. It seemed best to let things alone, since this was a demonstration and there was a desire for gaining monitoring data unaffected by too much counseling.

10. How do you think the neighborhood perceives the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

Many neighbors watched as the foundations and site preparation took place. They voiced concerns about common images of manufactured homes. Once the homes arrived and were finished, there was general approval. Many came to the dedications and toured at open house.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

Many of the problems should not have occurred and would not have occurred with better coordination.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/<u>Unsatisfactory</u>/Very unsatisfactory/No opinion

14. How would you rate the design process?

Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory/No opinion

15. What worked best?

Working with the local developer, since it knew the neighborhood and the residents.

16. What could be improved?

The process took too long – 22 months from the beginning with the proposal to participate until the first home was dedicated in June, 1998. The second home, a two story model, was opened in January, 1999. Some of the delay may have been due to competing projects involving MHI and Susan Maxman Partners, the architects. Another problem with the design process was that some of the specified items were not appropriate for affordable housing. Standard items should have been specified more rather than premium or specialty items, particularly for small features such as door handles.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

18. What worked best about the public approval process?

Neighborhood approved.

19. What could be improved?

While happy with the design, the approval process took too long. Permitting took six to eight months. The code officials had not dealt with a manufactured home before in the District of Columbia. Many questions about materials and construction methods were raised and the manufacturer had to supply extra information to answer them.

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/<u>Very unsatisfactory</u>/No opinion

21. What worked best?

Nothing. Even just shipping the home presented problems, when the proper permits were not obtained. The homes might still be standing at the border between Maryland and DC had not extra efforts been made by PEPCO personnel for expeditious resolution.

22. What could be improved?

For the two story home, the dimensions of the foundation did not meet the dimensions of the home. As a result extra effort was required to seal the gaps to prevent infiltration. The location of the water and sewer drains in the basement of the two story home were on the wrong half of the home. The drains were constructed by the developer according to the plans from the home manufacturer. When the home arrived, the plans had not been followed. This necessitated extra effort to facilitate proper connections and drainage.

There seemed to be too much on-site work including drywall, painting, carpeting, replacing siding, and repairing trimwork.

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

24. What worked best?

25. What could be improved?

26. What other comments or suggestions do you have about the process? What would you do differently next time?

Responsibilities should be more clearly defined and understood. Too many problems arose, even though Marshall Heights Development Corporation made two trips to the manufacturing plant. Also the plant manager came to visit after the first home was installed. Expectations for a smoother installation of the second home were not met. Certainly some problems are unique to each area and project. But greater commitment from the home manufacturer would have helped

27. May I attribute your comments in a public report? Yes.

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date: 9/21/99**

Mr. Kevin Moody
Housing Development Manager
Marshall Heights Community Development Organization, Inc.
3939 Benning Road, N.E.
Washington, D.C. 20019
202-396-1200
fax - 4106

1. **How would you rate the homes overall?**

   Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the homes?**

   Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Lends itself to designs in the neighborhood.

4. **What could be improved about the design and appearance?**

Second floor on the two story home was only 2/3 as wide as the first story.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

6. **What do you like best?**

High end energy efficient appliances.

7. **What could be improved?**

Nothing.

8. **How would you rate the heat pump in the homes?**

Very satisfactory/Satisfactory/Fair/<u>Unsatisfactory</u>/Very unsatisfactory/No opinion

9. Why?

Problems developed with ducts and registers, particularly for the two story home, and particularly for the basement. Expected more involvement from the utility in following up on heating problems and heating bills.

10. How do you think the neighborhood perceives the homes?

Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

Neighbors were skeptical at first, but once they saw it, they were pleasantly surprised.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

Recommend the use of copper piping rather than plastic. It is easier to repair copper piping. While the home manufacturer came to fix leaks, this is not a long term solution.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

14. How would you rate the design process?

Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

15. What worked best?

Mr. Moody was not involved in the whole process, since he arrived about 21 months ago. Actually three managers were involved during the course of the project, due to turnover.

16. What could be improved?

Better coordination between the architect, the home manufacturer and the developer. For example, the porch nearly got built on the wrong side, until the developer got it corrected.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

18. What worked best about the public approval process?

Nothing worked well. Permit process took too long. The manufacturer had to get heavily involved in gaining approval.

19. What could be improved?

D.C. permitting office needs to be improved.

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/Satisfactory/<u>Fair</u>/Unsatisfactory/Very unsatisfactory/No opinion

21. What worked best?

22. What could be improved?

Since it was a demonstration project and things were being done for the first time, problems could be expected. One problem was that the developer/builder put on sole plates on top of the foundation. The home manufacturer during set-up modified the sole plates.

23. How would you rate the process of selling and financing the home?

Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory/No opinion

24. What worked best?

The single story sold for $115,000. The two story for $125,000. Residents could qualify for up to $20,000 from a special fund to assist with the downpayment.

25. What could be improved?

26. What other comments or suggestions do you have about the process? What would you do differently next time?

No other comments.

27. May I attribute your comments in a public report? Yes.

Addendum

9/24/99 Today I talked with Norman Porter, Construction Manager, Marshall Heights Community Development Organization at 202-276-7212.

Regarding the heat pump, he said it was a nice concept. He liked the Insider concept of having

heating and cooling combined in one unit and installed at the factory. He said it worked fine. The unit provided good comfort. The problem was that for the second home, the two story, the ductwork distribution system was not planned properly. He thought the home manufacturer should have been more attentive. He indicated the residents seemed satisfied with the heating and cooling system as evidenced by no call backs or complaints.

Regarding the home set-up, he explained how the sole or sill plate situation was handled. The first home was single story built over a crawl space on a foundation. He had attached sill plates to the top of the foundation. During set-up the home was placed by a crane. In order to place the home, the sill plate had to be cut in about 8 places to accommodate the cables from the crane. Once the cables were removed, the gaps had to be reboarded and sealed. For the second home, the sill plates were not affected since the crane used brackets to hold the sections while being lowered into place.

Regarding anchors, neither home has anchors. This is because the home is attached to the sill plates. He visited a manufactured home development in Howard County, Maryland, along Route 1 where foundations and two story models were being placed. This helped him in the construction of the foundation for the second home. The second home also had an I beam running the length for additional support.

The wheels were removed from the homes once in place. The second story home did not have a wheel chassis at all, but was a module shipped on a flat bed truck and then craned onto the lower section.

EPRI Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** 9/24/99

Mr. Alan Froehle, General Manager
Crest Homes Division of Schultz Homes
30 N. Industrial Park Road
Milton, PA 17847
800-927-4567
fax 570-742-3842

1. **How would you rate the homes overall?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the homes?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

The architectural details were good, such as wide trim.

4. **What could be improved about the design and appearance?**

Could do more to upgrade trim, cabinets, and hardware. Instead of surface mounted hinges on the doors, use mortise hinges.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

6. **What do you like best?**

Considered the energy features fairly normal, since many of the modular units have similar characteristics.

7. **What could be improved?**

Nothing.

8. **How would you rate the heat pump in the homes?**

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. Why?

Putting in the Insider or All-in-One heat pump was not a major problem. Ductwork was a problem in the second, two story home. The heating and cooling unit may be undersized. The heat pump for the second home was designed to serve the first and second floors. So when it was learned that the unit was also supposed to serve the basement, there was a problem in remedying the situation. While he had not heard of any problems with comfort or energy use, it would not be surprising if energy use was higher than expected.

10. How do you think the neighborhood perceives the homes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

Blends in well. In fact, the overall appearance upgraded the neighborhood.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

His plant is primarily a modular plant. It builds HUD Code homes on an exception basis. His plant was selected by headquarters partly because they were experienced in building two story modular homes for the New Colony development in Columbia, MD. He was most familiar with the ranch home, the first home, and less familiar with the two story home, the second home. He saw the finished product for the ranch home, but did not visit the site for the two story home.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

15. What worked best?

Pre-production meetings worked well.

16. What could be improved?

Since there were three managers for the land developer during the process, one continuous manager would have solved many issues. Subsequent managers for the developer were not conversant with the details arranged with the first manager. This led to problems such as not

having ducts for the basement in the second home. The first manager understood that ducts for the basement would be the responsibility of the developer, but the subsequent managers thought they would be the responsibility of the home manufacturer.

Get the plant involved sooner. Corporate headquarters participated in most of the early discussions, so that many decisions were made without input from the plant. Once he got involved some changes were necessary in the design. But they were minor. It is not abnormal for a specification to be changed somewhat once the production plant gets involved. For these homes, the number and types of changes to build the home based on the design and specification were about normal, compared to modular unit construction.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/<u>Unsatisfactory</u>/Very unsatisfactory/No opinion

18. What worked best about the public approval process?

19. What could be improved?

Accelerate the regulatory approval process. Six months is too long to get a building permit.

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/<u>Satisfactory</u>/Fair/Unsatisfactory/Very unsatisfactory/No opinion

21. What worked best?

Crest was responsible for setting-up the home.

22. What could be improved?

The ranch home had a foundation error that had to be corrected. The top two rows of block had to be removed from the front of the foundation to accommodate the chassis and hitch. Even though drawings were provided to the developer by the manufacturer to help them in construction of the foundation, when the home arrived, this detail had been missed.

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/<u>No opinion</u>

24. What worked best?

25. What could be improved?

26. What other comments or suggestions do you have about the process? What would you

do differently next time?

It would have helped for the new project managers to visit the manufacturing plant like the first project manager did for the developer. Instead, the plant manager visited the developer and actually brought a set of plans and designs, since the developer could not locate a copy.

It is not normal for the home manufacturer to do work below the sill plate. Hence the miscommunication over the ductwork in the basement and the registers.

The chassis remained with the homes for both the ranch and two story model. Also the second story chassis remained, which makes for a strong, although heavy home. The wheels and axles on which the homes are shipped are removed.

Even though the homes may be heavy they must be anchored. Since the homes are on foundations, the homes are anchored by brackets to the sill plate. The sill plate in turn must be anchored to the foundation blocks. The developer is responsible for the sill plate attachment to the foundation. The home manufacturer takes responsibility for attaching the home to the sill plate.

27. May I attribute your comments in a public report? Yes

D
INTERVIEWS OF INDIVIDUALS ACTIVE IN ALL DEMONSTRATIONS

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** 11/12/99

Andrew R. Scholz
Director, Developer Sales
Champion Enterprises, Inc.
P.O. Box 230278
Centreville, VA 20120
800-808-6459 x 03
703-815-1538
Ascholz@champent.com

Note: Mr. Scholz was Vice President of the Manufactured Housing Institute and responsible for the urban design project during most of its history.

1. **How would you rate the homes overall?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the homes?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Looked like they belonged in the neighborhood. Blended in. Designs were specific to each neighborhood.

4. **What could be improved about the design and appearance?**

Nothing for the exterior. Two story homes had a stairway in one model that wasted space. In later design, the space was used better. However, in both cases the light at the top of the stairwell was inconvenient if not impossible for changing.

5. How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

6. What do you like best?

Expectation of saving consumers money.

7. What could be improved?

To produce more homes with high energy features in order to gain economies of scale and reduce production costs.

8. How would you rate the heat pump in the homes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. Why?

Homeowners were pleased.

10. How do you think the neighborhood perceives the homes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

They helped in design and approved of designs. They had no negative comments.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

None

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

15. What worked best?

Included good people, the right people. Got government cooperation for the most part.

16. What could be improved?

Would like more leverage to get approvals and accelerate process. Perhaps include performance milestones to impose on key participants.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

18. What worked best about the public approval process?
Neighborhood process was fine. Public approval by zoning and codes was acceptable. Could be accelerated in some jurisdictions which were way too slow, but only because that is standard operating procedure, even for site built homes. However, in some jurisdictions, approvals went better than was expected.

19. What could be improved?

Construction funding from government agencies was the major hold up in some cities. In one community, grants were requested from the city's Community Development Department out of the U.S. Community Development Block Grant. The funds were to be deployed for infrastructure like curbs, sidewalks, and utilities. The grant was delayed due to concerns about the higher cost on a per lot basis compared to other projects. But this was because other projects were larger in scale and this was a demonstration.

City official interest was important in some cases. A zoning department official became a supporter of the urban design project, but colleagues in building and inspections were not. When promoted over both departments, the resistance disappeared.

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

21. What worked best?

Site-preparation and construction was not a problem. Set-up was o.k.

22. What could be improved?

Finishing construction was a problem. In every case, the non-profit developer chose to use local construction crews to finish the home once it was in place. Such as drywall, carpeting, and siding. Since the tasks were often small and the home unfamiliar, contractors took too long to get to the job and complete the tasks. What took weeks could have been done in days, had the retailer and manufactured home builder stayed involved. Developers should have used experienced crews of the home retailer and manufacturer.

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

24. What worked best?

No problems. Mortgage financing was never an issue. Just construction financing. In one jurisdiction not part of the EPRI project there was an issue over the appraised value. The home was to be sold for $65,000 but was appraised for $75,000. A buyer could afford $65,000 and applied, but not the higher amount. The city refused to allow state grant funds in its possession to underwrite part of the cost for six months. The developer was forced to seek another buyer. After six months the city relented under pressure from the state housing agency and the original applicant bought the home.

25. What could be improved?

See more for-profit developers. Find more reliable sources of construction financing.

26. What other comments or suggestions do you have about the process? What would you do differently next time?

Working with non-profits is more difficult that with for-profit developers. Non-profits typically have insufficient cash and few assets. Consequently they must depend on government programs for construction funds, whether for grants or loans. This takes time, often unreasonable lengths of time. For-profit developers can obtain construction funds from conventional sources since they have better credit. For-profit developers sometimes have difficulty obtaining approval for affordable housing from zoning and other governmental authorities. Also non-profits can get grants of land for free or at low cost compared to for-profit developers. An option in the future is to combine for-profit developers to obtain construction funds and non-profit developers in partnership to obtain public approvals for land, zoning, etc.

Manufactured home builders were great to work with. Considering it was a different product for a new market, the manufactured home builders were most cooperative.

If more homes could be built, costs could come down and homes would be more affordable. Orders of five homes would allow such economies.

If manufactured home industry construction crews were allowed to finish the homes, there would also be financial advantages. One would be reduce costs for carrying a construction loan. Second would be reduced damage and pilferage at the site, while the home is being finished.

If non-profit developers were more aggressive in undertaking larger projects, economies of scale could be achieved. Too often they have such limited resources as only to do a few homes a year, when there is a potential and need for many times that.

An advantage to manufactured housing is that payment is not expected by the manufactured home builder from the developer in general until delivery. Thus the developer has a great savings in the level of construction financing needed and the term for the financing. Even if payment must be assured by the manufactured home builder through a letter of credit, the costs to the developer are still significantly less than site built homes for construction financing.

27. May I attribute your comments in a public report? Yes

Manufactured Housing Urban Design Tailored Collaboration Project Evaluation

Questionnaire Outline used by Larry Barrett

Person interviewed: **Date:** Oct. 8, 1999

Mr. Muscoe Martin, Principal
Susan Maxman & Partners
123 South 22nd Street
Philadelphia, PA 19103
215-985-4410
fax –4430
mbm@maxmanpartners.com

1. **How would you rate the homes overall?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

2. **How would you rate the overall design and appearance of the homes?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory

3. **What do you like best about the design and appearance?**

Integrated porches and brickwork fit well with neighborhood and helped neighborhood.

4. **What could be improved about the design and appearance?**

Exterior materials, such as vinyl siding and trim, particularly around doors and windows. Appearance would improve if the materials were better and more substantial.

5. **How would you rate the energy features of the home including insulation, windows, appliances, heat and cooling system, water heating, and lighting?**

   Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

6. **What do you like best?**

In theory, should be very satisfactory. In practice, the marriage line and other on-site work were not always satisfactory.

7. **What could be improved?**

The marriage line between the sections and connections between the sections were not done well. This included proper installation and connection of crossover ducts, insulation along the marriage line, and siding around the marriage line.

8. How would you rate the heat pump in the homes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

9. Why?

Liked concept. Does not know about performance, since had not heard or read anything yet.

10. How do you think the neighborhood perceives the homes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

11. Why

Neighbors were thrilled by the home as evidenced by comments at some of the dedication events. Also neighbors were pleased to be consulted in the process.

12. Do you have any other comments or recommended improvements about the home appearance, appliances, or other features?

If vinyl siding is used, allow more generous trim. Wood windows and doors would be an improvement, as well as wider casings and trim.

Steeper roof pitches would help in the appearance of the homes in Nashville. The ones in Pennsylvania had steeper roof pitches.

On the inside, drywall would improve appearance in place of vinyl walls.

13. How would you rate the overall process of planning, designing, purchasing and installing?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

14. How would you rate the design process?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

15. What worked best?

Got good feedback from the developers. Good input from the community, where consulted.

16. What could be improved?

Bring home manufacturer into the process as soon as possible. In Nashville, the manufacturer was brought in relatively early in the design process. For Washington, D.C., the manufacturer

was brought in after the design was relatively complete. This made it harder in Washington to handle some changes to accommodate the manufacturer.

17. How would you rate the neighborhood, regulatory and other public approval processes?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

18. What worked best about the public approval process?

It was very satisfactory in Nashville since the approval process was quick.

19. What could be improved?

It was unsatisfactory in Washington, since it took too long – six months. However, it is believed that most building permit approvals take too long in Washington. It was crazy how long things took in D.C.

20. How would you rate the process of installing or setting-up the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

21. What worked best?

Based on hearsay, there were no sigificant problems.

22. What could be improved?

No comment.

23. How would you rate the process of selling and financing the home?

Very satisfactory/Satisfactory/Fair/Unsatisfactory/Very unsatisfactory/No opinion

24. What worked best?

25. What could be improved?

26. What other comments or suggestions do you have about the process? What would you do differently next time?

Involve manufacturer earlier.

Where community input is being sought, obtain earlier. This caused delays in Birmingham. It also helps where the developer is well known in the community. Where community input is not sought directly, rely on local developers that know the neighborhoods and the housing needs.

Manufactured homes can have an advantage over stick homes even if the costs are about the same. From a developer perspective he heard that cash requirements are easier with manufactured housing, since payment is not expected normally until the home is placed.

May I attribute your comments in a public report? **Yes**

E
MONITORING RESULTS

Compiled by New Horizon Technologies Energy Services, LLC.

Monitoring System Specifications—Potomac Electric Power Company (Pepco) Service Area Homes

Monitoring Period:

1014 44th St. N.E. Washington, D.C.: 6/19/98 to 6/19/99
903 44th St N.E. Washington, D.C.: 5/1/99 to 5/1/2000[1]

Monitoring Services:

Potomac Electric Power Company and GEOMET Technologies, Inc. Germantown, MD.

Monitored Circuits:

Refrigerator (Energy Efficient)

- 110V, Single Phase—FW-Bell 120V Watt Transducer

Front Loading Clothes Washer

- 110V, Single Phase—FW-Bell 120V Watt Transducer

Water Heater

- 110V, Single Phase—100 A Ohio Semitronics Current Transformer/Watt Transducer System

Heat Pump (Auxiliary Heat)

- 110V, Single Phase—50A Ohio Semitronics Watt-hour Transducer (2-Wire)

Heat Pump (Compressor)

- 110V, Single Phase—100A Ohio Semitronics Watt-hour Transducer (2-Wire)

Electric Panel Service Entrance

- 240V, 200A Ohio Semitronics Watt-hour Transducer (3-Wire)

[1] Monitoring was interrupted in April & May 1999 due to system shutdown. Twelve months of continuous data were collected from 5/1/1999 through 5/1/2000.

Unmetered End Use Loads:

Calculated by subtracting metered loads from whole building load.

Monitoring Protocol:

Data Recorder:	Campbell Scientific 21X Micrologger
Integration Interval:	15-minutes
Data Collection:	Nightly via telephone/modem
Data Storage:	15-minute interval data in Access database.

Table E-1
Summary Data—Pepco House #1, 1014 44th St. NE, Washington, DC

Measurement	Whole House kWh	Energy Efficient Refrigerator kWh	Front Load Clothes Washer kWh	Aux Heater kWh	Heat Pump kWh	Water Heater kWh	Unmetered End Use kWh
12 Month Total	**17,662**	**834**	**27**	**9,007**	**3,082**	**1,793**	**2,919**
June-1998	812	73	2	-	350	119	268
July	865	75	3	-	432	116	240
August	913	84	4	-	451	129	245
September	680	74	1	-	263	110	231
October	705	62	2	98	169	130	244
November	1,453	62	1	458	531	146	254
December	2,419	69	2	1,644	210	171	324
Jan—1999	3,099	68	2	2,544	58	189	239
February	2,642	61	1	2,193	50	160	178
March	2,239	70	1	1,334	423	193	218
April	1,268	66	4	662	119	183	235
May	568	71	2	74	26	149	245

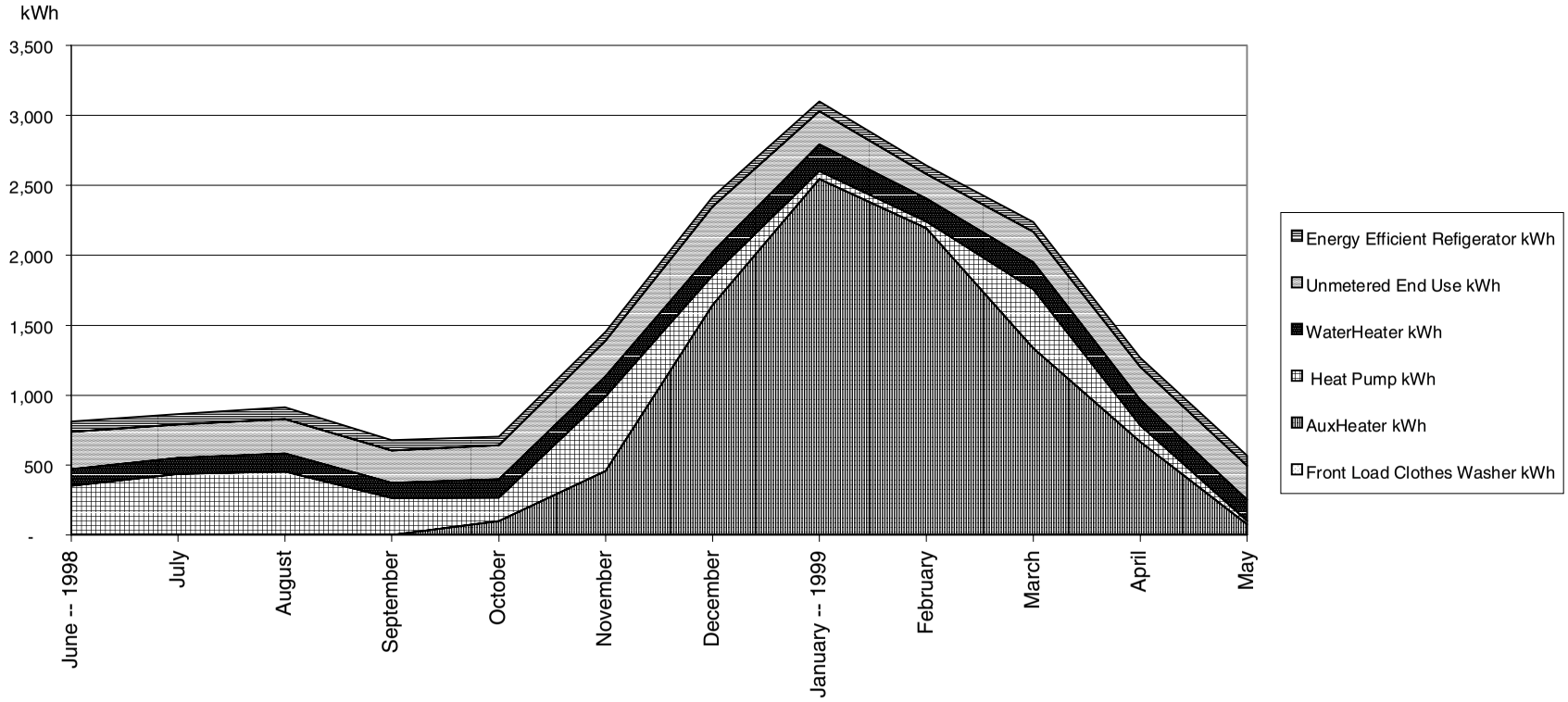

Figure E-1
Pepco #1 1014 44th St., Washington, DC
End Use Consumption

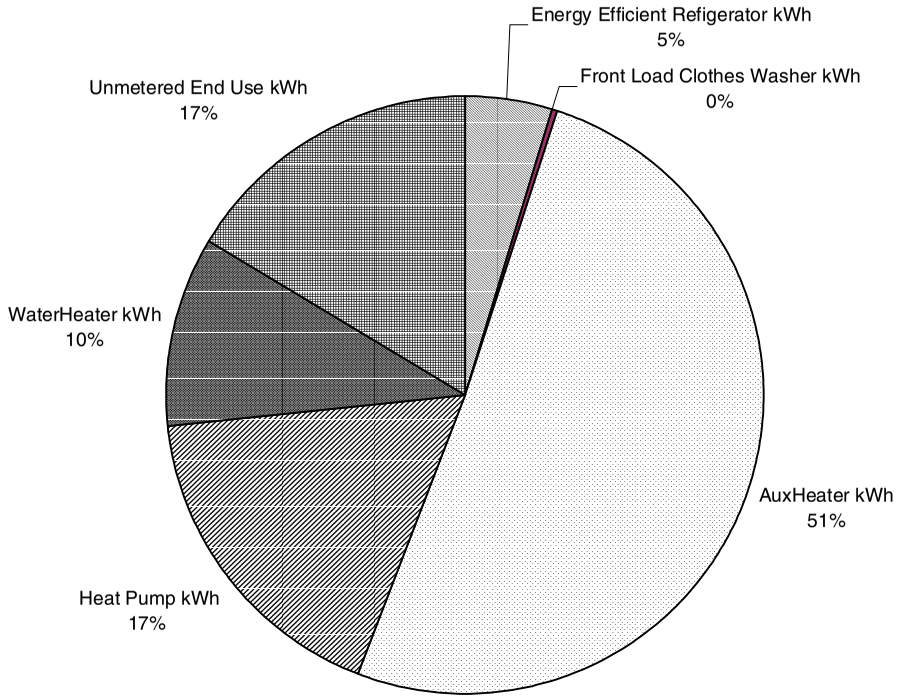

Figure E-2
Pepco #1 1014 44th St., Washington, DC
Comparative End Use Consumption

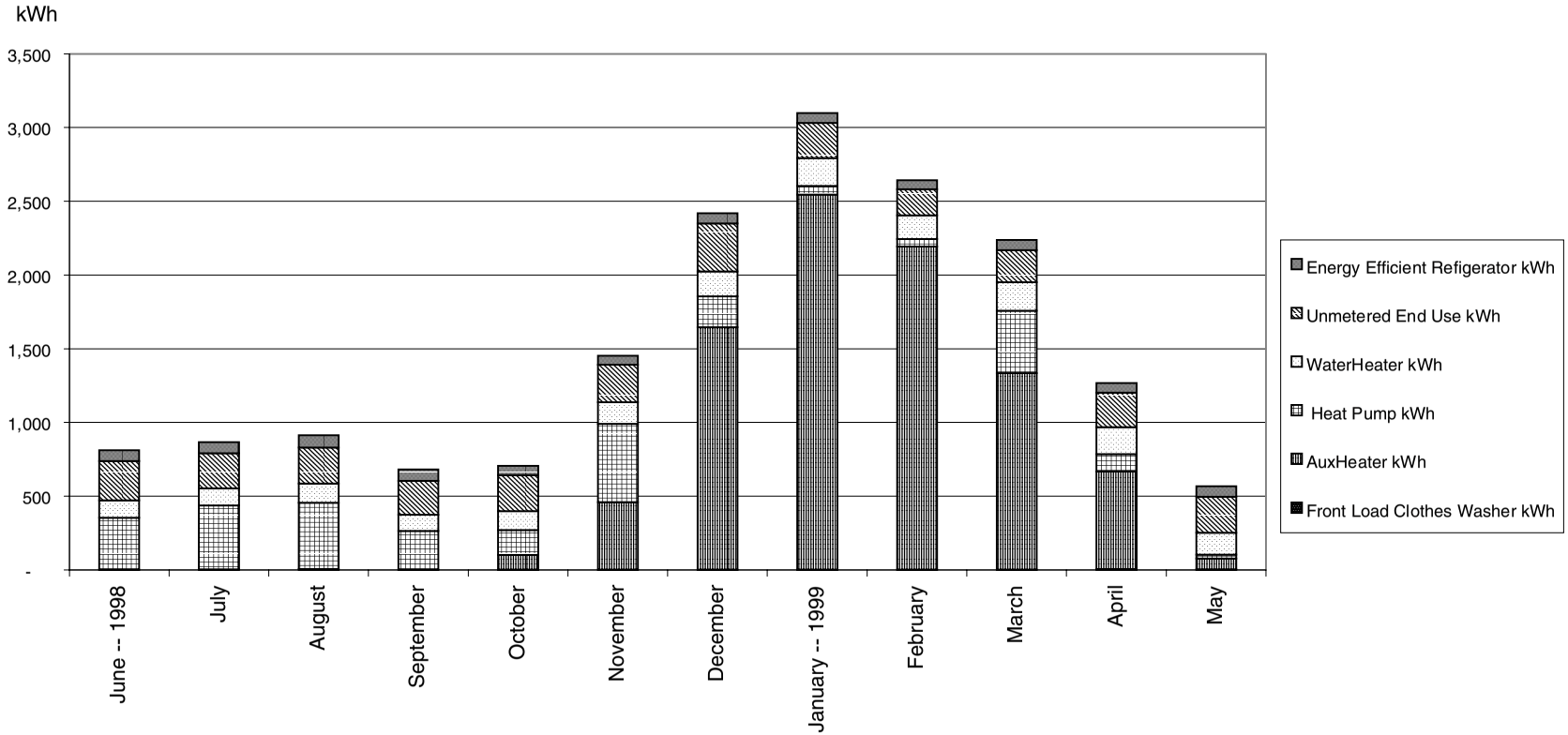

Figure E-3
Pepco #1 1014 44th St., Washington, DC
End Use Consumption

Table E-2
Summary Data—Pepco House #2, 903 4th St., NE, Washington, DC

Measurement	Whole House kWh	Energy Efficient Refrigerator kWh	Front Load Clothes Washer kWh	Aux Heater kWh	Heat Pump kWh	Water Heater kWh	Unmetered End Use kWh
12 Month Total	**13,965**	**411**	**22**	**1,373**	**5,831**	**2,097**	**4,232**
May—1999	615	58	3	29	57	182	286
June	930	59	3	25	198	131	515
July	996	62	2	26	456	104	347
August	750	46	2	27	246	99	330
September	542	37	1	33	53	109	309
October	814	28	2	59	250	157	318
November	1,116	24	2	85	453	197	356
December	1,872	20	2	205	1,010	238	396
Jan—2000	2,561	19	2	519	1,379	245	396
February	1,756	17	2	196	1,002	230	309
March	1,146	20	1	97	468	214	346
April	868	21	1	72	259	191	324

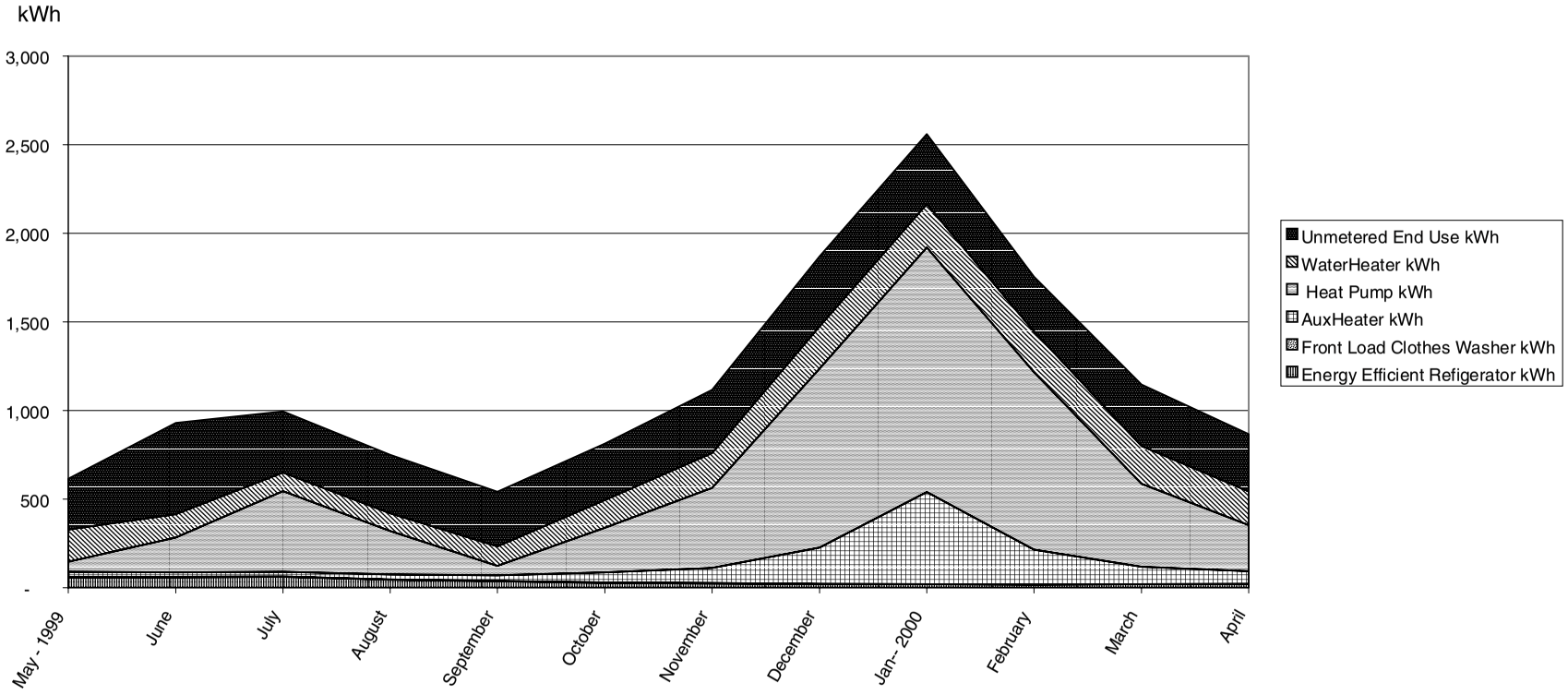

Figure E-4
Pepco #2 903 4th St. NE, Washington, DC
End Use Consumption

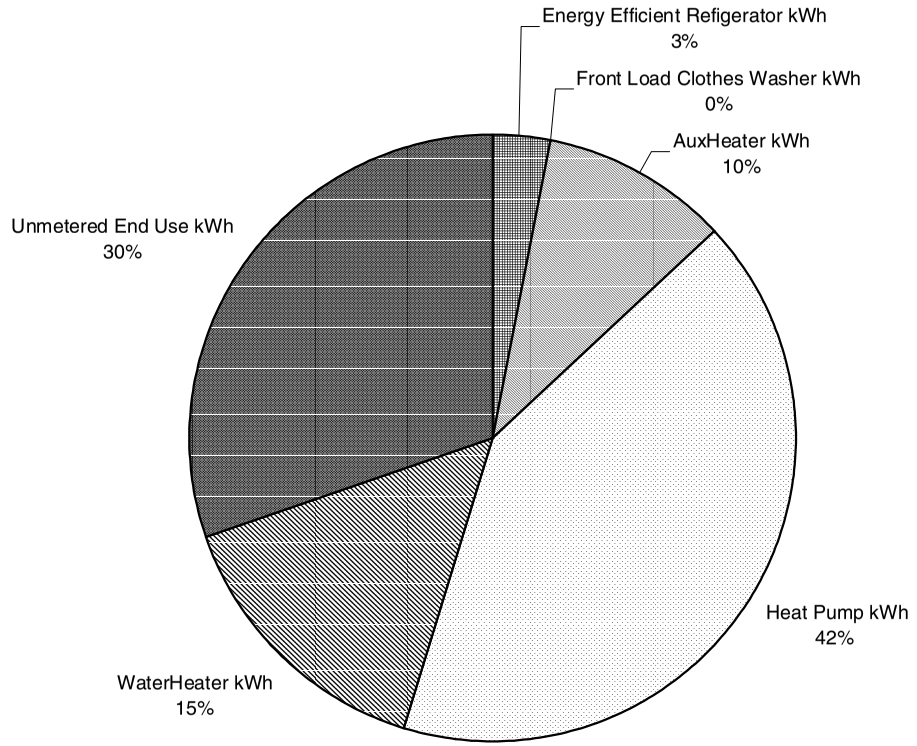

Figure E-5
Pepco #2 903 4th St. NE, Washington, DC
Comparative End Use Consumption

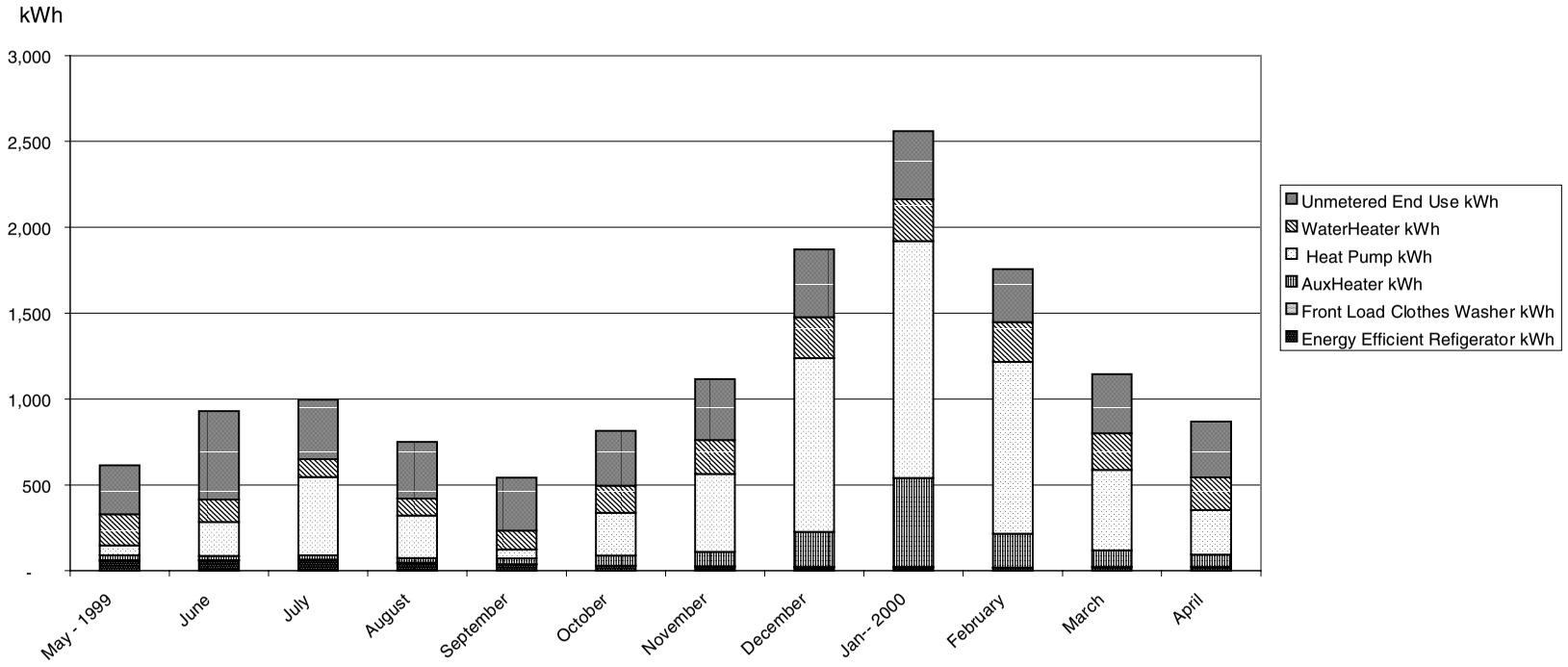

Figure E-6
Pepco #2 903 4th St. NE, Washington, DC
End Use Consumption

Monitoring System Specifications—Nashville Electric Service Area Homes

Monitoring Period:

2001 Britt Place, Nashville, TN:	7/13/98 to 1/11/2000
508 Moore Ave., Nashville, TN.:	1/5/99 to 1/5/2000

Monitoring Service: Provided by Nashville Electric Service

Monitored Circuits [1:]

- Whole House
- Heat Pump Compressor
- Fan/ Auxiliary Heat
- Dryer
- Range
- Water Heater
- Dishwasher
- Washer

Unmetered End Use Loads:

Not Applicable

Monitoring Protocol:

Data Recorder:	Residential Style Energy Recorder
Integration Interval:	15 Minutes
Data Collection:	See Note (1)
Data Storage:	Not Available

Table E-3
Nashville Electric Service Billing History Usage

2001 Britt Place			508 Moore Ave.		
Reading Date	**Days**	**kWh Used**	**Reading Date**	**Days**	**kWh Used**
1998					
08/11/98	29	1,467			
09/10/98	30	1,450			
10/13/98	33	1,241			
11/10/98	28	867			
12/10/98	30	1,033			
01/11/99	32	2,143			
1999					
02/10/99	30	1,243	02/04/99	31	1,198
03/11/99	29	1,487	03/05/99	29	1,192
04/12/99	32	1,296	04/06/99	32	1,215
05/11/99	29	1,068	05/05/99	29	693
06/11/99	31	1,723	06/04/99	30	797
07/13/99	32	1,919	07/07/99	33	1,169
08/12/99	30	2,135	08/05/99	29	1,221
09/14/99	33	1,928	09/08/99	34	1,157
10/12/99	28	1,107	10/07/99	29	679
11/10/99	29	1,164	11/04/99	28	864
12/09/99	29	1,411	12/03/99	29	1,070
01/11/00	33	2,015	01/05/00	33	1,640
Annual 1999		18,487			12,895

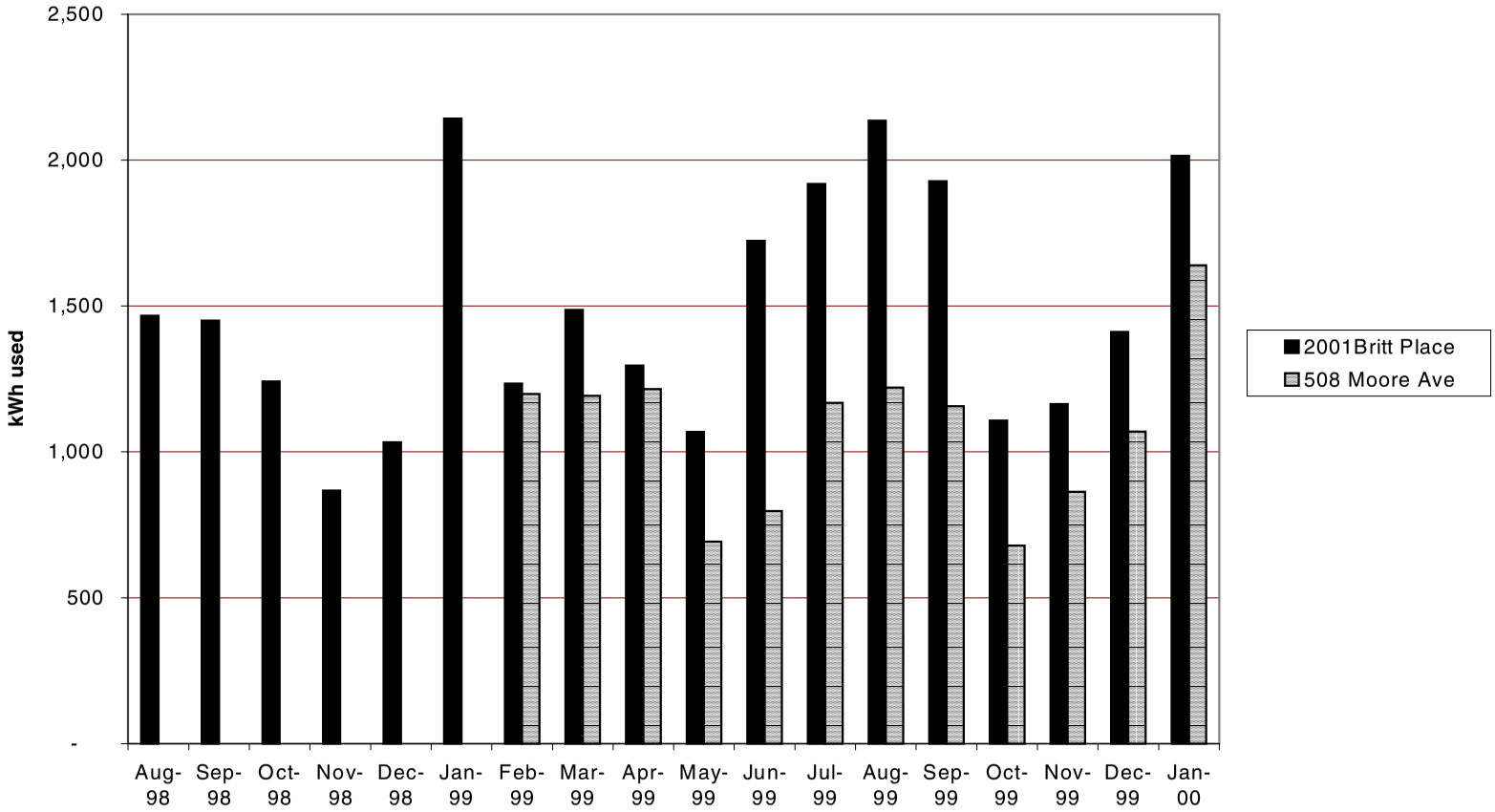

Figure E-7
Nashville Comparison

Monitoring Summary—Provided by Nashville Electric Service (NES)

Electricity consumption for the two Nashville sites was monitored by a residential home energy management system. The core component of the system is an interactive control unit (ICU) which is mounted on the wall of the home adjacent to the watt-hour meter. The ICU is a microprocessor-based device that communicates with the other components in the system over a CEBus Power Line carrier (PLC) Local Area Network (LAN). The CEBus PLC LAN is used to communicate with a retrofit Meter Module located within the watt-hour meter, a home PC user interface, a load controller and sub-metering devices. NES utilized this system in 100 homes as a pilot project for testing value-added services, but due to equipment and service problems, a decision was made not to deploy the system.

Current transformers (CTs) are installed on branch circuits in the load center and are designed to provide measurements of end use loads. The CTs did not prove as accurate as anticipated, leading to inaccurate sub-metered end use load data. As a result, end use load data are not included for these homes.

Target:

Residential and Commercial Business Development

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