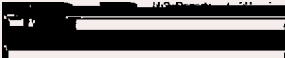
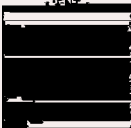




**TECHNOLOGY ROADMAP:**

**ENERGY  
EFFICIENCY  
IN EXISTING  
HOMES**

**Volume One:**













<b>PATH Program Goals</b> .....	<b>1</b>
<b>Roadmapping Process</b> .....	<b>2</b>
<b>Vision</b> .....	<b>2</b>
<b>Situation Today</b> .....	<b>3</b>
<b>Barriers/Challenges</b> .....	<b>10</b>
<b>Roadmap Overview</b> .....	<b>13</b>
<b>1. Building Envelope Technologies</b> .....	<b>14</b>
1.1 Envelope Air Sealing	







By 2010, consumers will be able to substantially improve the energy efficiency of their



Owner-occupied homes: 83%

Homes with a...

...clothes washer: 92%

...clothes dryer: 86%

...personal computer: 40%

Eligible for the Low-Income Home

Energy Assistance Program: 27%

Total energy consumed:

115 million BTU per household

...perfuel oil: 1Tj-10.6947115 TD (T)5 Tw (Eliggy consumed:)Tr thespaProheating: 60llion BTU per household

## T

The summary for single-family homes shows that average site energy consumption in 1997 for the 74 million existing homes was 115 million BTUs. Space heating was more than half of the total. On an expenditure basis, average expenditures were \$1,492, about one-third of which went for space heating and 10

percent for cooling in the 73 percent of homes with air conditioning. The balance of site energy use, and the majority of energy expenditures, went to operate water heaters, refrigerators, washers, dryers, other large and small appliances and lights.







Table 2 (page 5) disaggregates electricity consumption by end use and shows the market penetration of different types of electric appliances. Total electricity usage per household for all purposes averaged 10,215 kWh in 1997. This was 35 percent of total site energy usage in BTUs and 65 percent of total expenditures on energy. Note that more than 50 percent of electricity is used for lighting and appliances other than refrigerators, water heaters, and air conditioners.

A graphical breakdown of average electricity consumption by appliance type is in Figure 2 below





In order to identify strategies for improving energy efficiency in the existing housing





## OVERVIEW

For purposes of presentation, the needs and opportunities covered in this section are loosely organized into five categories that are intended to encompass the whole range of approaches available for use in addressing residential energy consumption.

- **Reduce the heating and cooling loads that must be met.**
- **Improve the efficiency of equipment and systems in meeting the envelope loads.**
- **Use energy for purposes other than space heating**



minimal expansion foams avoid this problem but must be applied more carefully in order to seal the openings. Both types also cure slowly. Two-part foams that



## 1.2 Building Insulation

1.2.1 Introduction

1.2.2 Thermal Insulation

1.2.3 Acoustic Insulation

1.2.4 Vapor Barriers

1.2.5 Air Sealing

1.2.6 Radiant Barriers

1.2.7 Insulation Installation

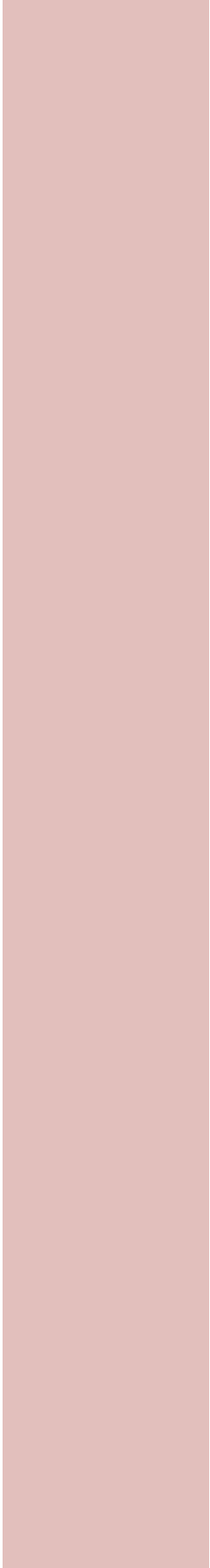
1.2.8 Energy Efficiency

1.2.9 Environmental Impact

1.2.10 Conclusion



Re-siding of existing homes is a relatively common major replacement project in which older, often deteriorated products are typically replaced with low maintenance alternatives. Consumer



Depending on the extent to which the sash must be modified during

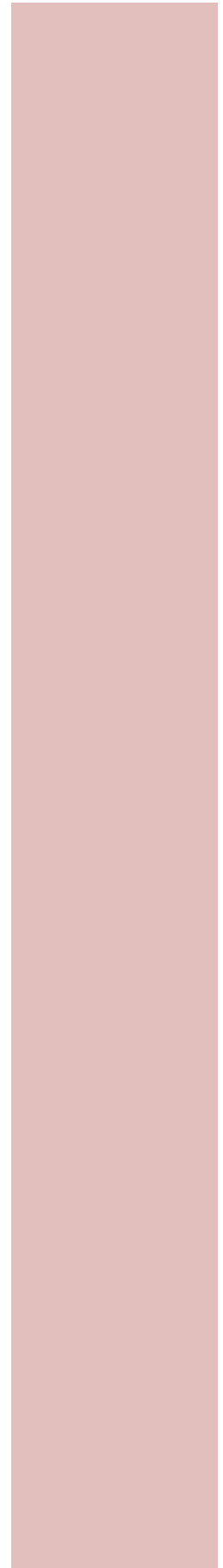


### **2.3 Duct Sealing in Place**

Duct leakage adversely impacts overall HVAC system efficiency, especially

### **3.1 Programmable Load Monitoring and Management**


Some type of system providing occupants with programmable control over multiple energy-using devices seems certain to emerge in the coming years. This could allow improved management of the energy used by water heaters, refrigerators, fixed lighting, and possibly other devices by enabling, disabling, or even “scaling back” activity according to time-of-day, power availability, real-time energy cost, or any other parameters that can be monitored. It probably should be integrated with HVAC thermostatic control and general home





watt of stand-by energy consumption, which should be beneficial for some devices but irrelevant for others. A similar standard has found its way into





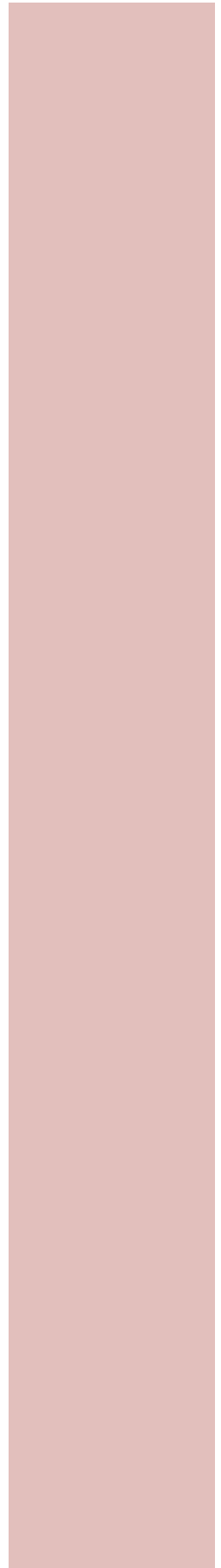
frequency noise and interference that have limited their application. Electronic noise and static may be even more problematic in a future environment that relies more heavily on communications and electronic controls.

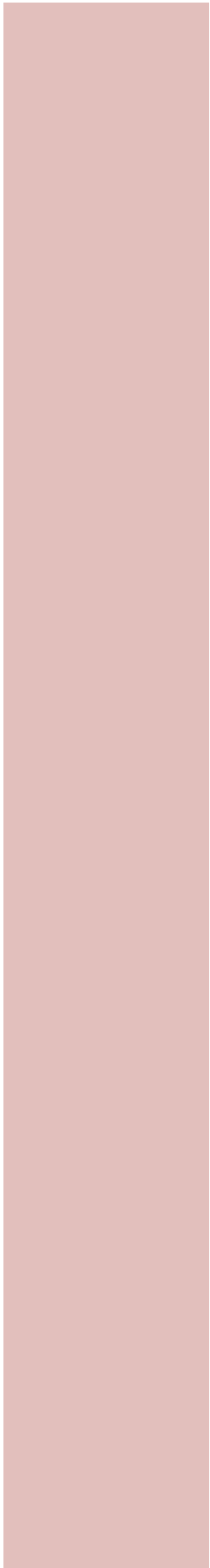
Another new lighting technology with significant implications for all homes is



## **4.1 Fuel Cells**


Various technologies are now or soon will be available for small-scale generation of electricity on-site. One of the most interesting involves new





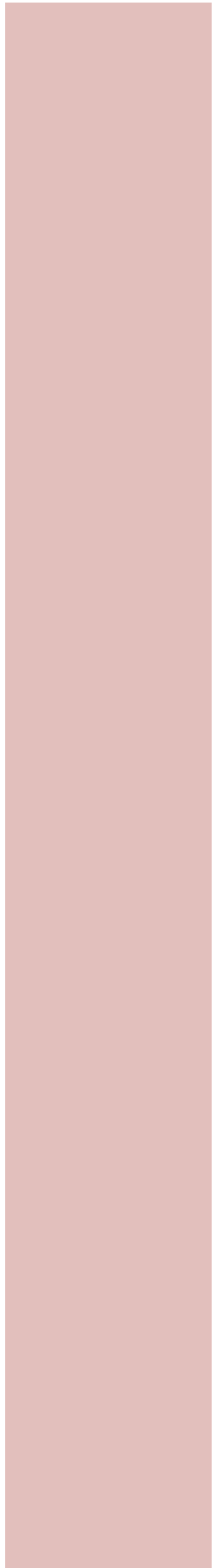
also represent opportunities for improvements such as new appliances, coupled with the possibility of low-cost, long-term financing. This approach is very powerful because every existing home is destined to pass through points where






Much thought and effort have gone into creating this Roadmap, but much, much more remains to be done. Many parties are interested and involved from the private sector, and several government agencies also have a stake in moving forward. Yet the program missions and visions of the future are not necessarily identical, or even parallel. In this loosely-organized environment, plans can succeed only to the extent they have inherent merit and are able to serve multiple, possibly disparate interests.

What follows is a framework for organizing future work, growing out of five





remodeling work. The curriculum might stand alone, or could be incorporated













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