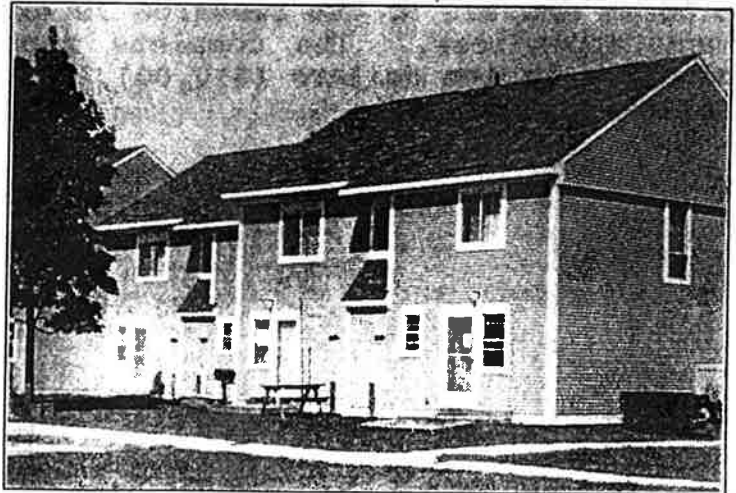




# The Northgate Miracle

Energy efficiency and  
affordable housing



**Prepared by:**

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**Submitted to:**

*U.S. Department of Energy*

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Prepared by Chip Patullo

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U.S. Department of Energy  
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Lawrence Berkeley Laboratory  
Berkeley, California

Videos: "The Northgate Story: Energy Conservation & Affordable Housing:  
Produced by Brian Doubleday and Chip Patullo  
Thermostat Training video  
Produced by Brian Doubleday, Chip Patullo & Jamie Dennis

The full report details all the steps of the energy education program and all of the research is explained and included in the many appendices. The complete report cost for shipping and handling is ten dollars (\$10.00), which may be obtained from the following address:

Northgate Housing, Inc.  
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275 Northgate Road  
Burlington, VT 05401  
(802) 860-7090

Photos on the cover:

Center right of cover: Northgate 1989. Before renovations.

Lower left of cover: Northgate 1991. After renovations!

Photos by Chip Patullo

## EXECUTIVE SUMMARY

### The Miracle at Northgate:

#### Energy Efficiency & Affordable Housing

The U.S. Department of Energy awarded a grant of \$54,800 to Burlington Electric Department, (B.E.D.), and Northgate Housing, Inc., in September 1990. The purpose of this grant was to fund a tenant energy specialist to help the residents of Northgate's 336 unit apartment complex understand their newly-converted heat systems, thermostats and the performance of their newly remodelled, more energy efficient apartments. In addition, this specialist would research actual energy cost savings for the site. This program would utilize existing demand-side management programs of the utility.

#### Grant Purpose:

The vision in the original grant and of those at Northgate was to document the success of Northgate in reducing the costs of living in subsidized housing to affordable levels, and to get this information out to the 360,000 H.U.D. Section 221.D3 at-risk apartments in the rest of the United States.

The grant included an evaluation of the cost effectiveness of the energy efficiency measures and the fuel switching. The Lawrence Berkeley Laboratory assisted with the technical analysis.

Data on building construction components of the existing site was compiled by the specialist and shared with Lawrence Berkeley Laboratory. Electric utility consumption records were gathered for the year previous to the heat conversion and both gas and electrical fuel consumption for the year after the heating systems were installed, September 1990 - August 1991. All of this data was then compiled and corrected for any weather variances from one year to another. All of this helped determine any changes in total energy use and show the cost savings from the retrofits, including the switch from electric to gas heat.

#### BACKGROUND

Northgate was at-risk of being lost as affordable housing, due to the option in the H.U.D. regulations which allowed the original developer to pre-pay the low interest H.U.D. Mortgage and to redevelop the property or sell. Northgate was the first tenant organized buy-out under the H.U.D. Housing Preservation Guidelines. Through creative financing and a strong effort by the residents and community, funds were raised from 9 sources to buy the project, and create Northgate Housing, Inc. Its board now consists of a majority of residents who control their own housing.

Northgate underwent a major building rehabilitation to deal with deferred maintenance.

**Northgate Rehab.**  
 As part of the buy-out, the Northgate Task Force raised an extra \$8.1 million to fix deferred maintenance:

- New Roofs + Siding
- New Windows + Doors
- New Backyard Fences
- New Kitchen + Bath Floors
- Some Bath Tile replacement
- Site Grading + Sill Repair
- Sewer reparations
- Appliance replacement

As part of the \$8.1 million building rehabilitation, there were measures aimed specifically at energy improvements:

- Typar building infiltration-barrier wrap
- Insulation and sealing of cellar walls
- Replacing electric baseboard heat with natural gas-fired, hydronic baseboard heat
- Insulating walls and attics as needed

The energy share of rehabilitation was approximately \$2.1 million or \$6,250/apartment. The improvements show a site wide average savings of \$617/year per apartment!

**SAVINGS**  
**\$617**  
**per**  
**YEAR**  
**per**  
**APT!**

This yields a simple payback of ten years, not counting

fuel inflation or economic net-present-value modelling methods. The rehabilitation process was designed to use components which required minimal maintenance. All of these items have a useable lifespan of a minimum fifteen years and in some cases twenty to twenty-five.

Considering the current relative costs of fuel, the residents and taxpayers made a wise investment in preserving housing and cutting costs to more reasonable levels to make housing truly affordable.

The energy specialist surveyed the residents about their opinions of the energy changes and their energy behaviors. Through the survey, it was documented just how cold and drafty people felt they were then, and how much more comfortable they are now. All of these changes raise the pride of the residents and is evidenced by people who now take better care of their yards and help each other out more. With this report is a comprehensive video showing people telling positive accounts of their new homes.

Survey Highlights		
	Before	N O W
Temperature Rating:		
Cool -	84%	5%
Just Right -	16%	90%
Warm -		5%
Draft rating:		
Drafty -	97%	20%
Just Right -	3%	75%
Stuffy -		5%
Uniform temperatures in apartments:		
Yes -	17%	83%
No -	80%	14%
Other -	3%	3%
Hot Water satisfaction:		
Satisfied -	46%	72%
Neutral -	13%	7%
Dissatisfied -	41%	21%
Costs less Now:		98%

Affordability is the key note for now. Despite building envelope improvements of 21% greater energy efficiency, the at-the-meter energy consumption actually increases slightly. The energy use<sup>1</sup> increased due to the change from 100% efficient electrical heating to 84% annualized fuel efficient gas boilers and due to people raising their home temperatures. Now that they could afford to be comfortable, Northgate residents boosted their thermostats from their previous 60 degree average, up to a more normal 68 to 69°Fahrenheit. These two factors lead to a (roughly) 15% energy use increase at the meter.

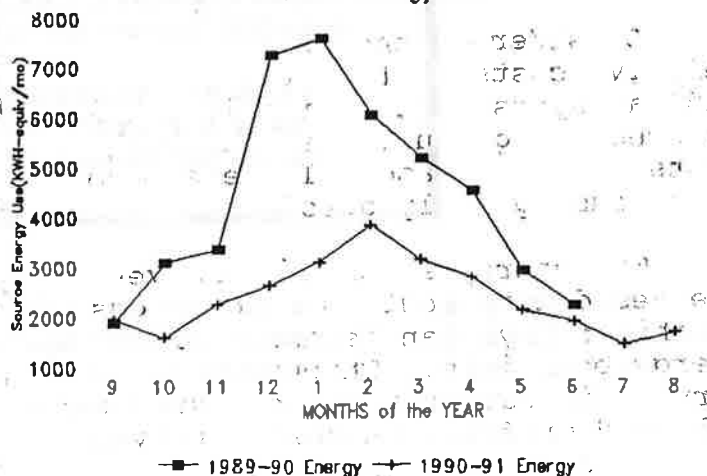
**48%  
annual  
cost  
savings!**

**Take Back  
Effect:  
15% increased use  
at-the meter.**

The societal effects of the fuel switch are greater. This report also investigates 'source energy' reductions at Northgate, that is, the reduction in the energy used to generate electricity which was used to heat the apartments. In New England, there is a roughly 33% efficiency in translating the source energy used to create electricity to the end user. This low efficiency is due to losses associated with generating and transmitting electricity.

Rather than use the "high-grade" energy source of electricity to heat homes, a relatively "low-grade" use, the source fuel was brought to each apartment. At Northgate, there was a 40% drop in source-energy use due to all the apartment improvements and due to switching the heat source from electricity to gas. (see graph at right).

Northgate Apartments 1989-90 vs 1990-91  
Source-Energy Use



<sup>1</sup> To compare the energy use between the two heating systems, we converted the natural gas units into comparable kilowatt-hour-equivalents, (kwh-e). The heat value of 1 cubic foot of gas in Burlington is 99,600 Btus. 10,242 Btus of heat is required to generate 1 kilo-watt hour. Therefore, 1 ccf natural gas = 9.7247 kwh-equivalents.

In addition to the reduction in energy, the project also had an impact on environmental quality. Fossil fuel combustion is a major contributor to the build up of greenhouse-effect creating gases. Extra peak electrical generation is often created by burning such fuels. By reducing the peak requirements, the benefits reach us all with cleaner air.<sup>2</sup> The broader social benefits of the fuel switch will continue for the life of the project.

<b>YEARLY Societal Benefits</b>	
Electricity Saved: <b>3,759 megawatt-hours</b>	
Source Energy Saved: <b>2,402 Megawatt-hours</b>	
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<b>Avoided Environmental Impact</b>	
<b>867 tons less carbon dioxide</b> (a major cause of global warming)	
<b>14+ tons less sulfur oxides</b> (a major cause of acid rain)	

Not only are there source energy reductions and environmental benefits from the "Miracle at Northgate", but substantial monetary savings as well. This makes housing affordable - reasonable rents and reasonable utility costs. The biggest benefits of energy efficiency are comfortable, happier residents.

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<sup>2</sup> Burlington's electricity comes from six different sources of energy: a wood-fired plant in the city, nuclear, hydro, natural gas, coal and oil-fired generating facilities. These last three are the most significant for carbon dioxide production. Coal and oil are the biggest sources of air pollution from electrical generation.