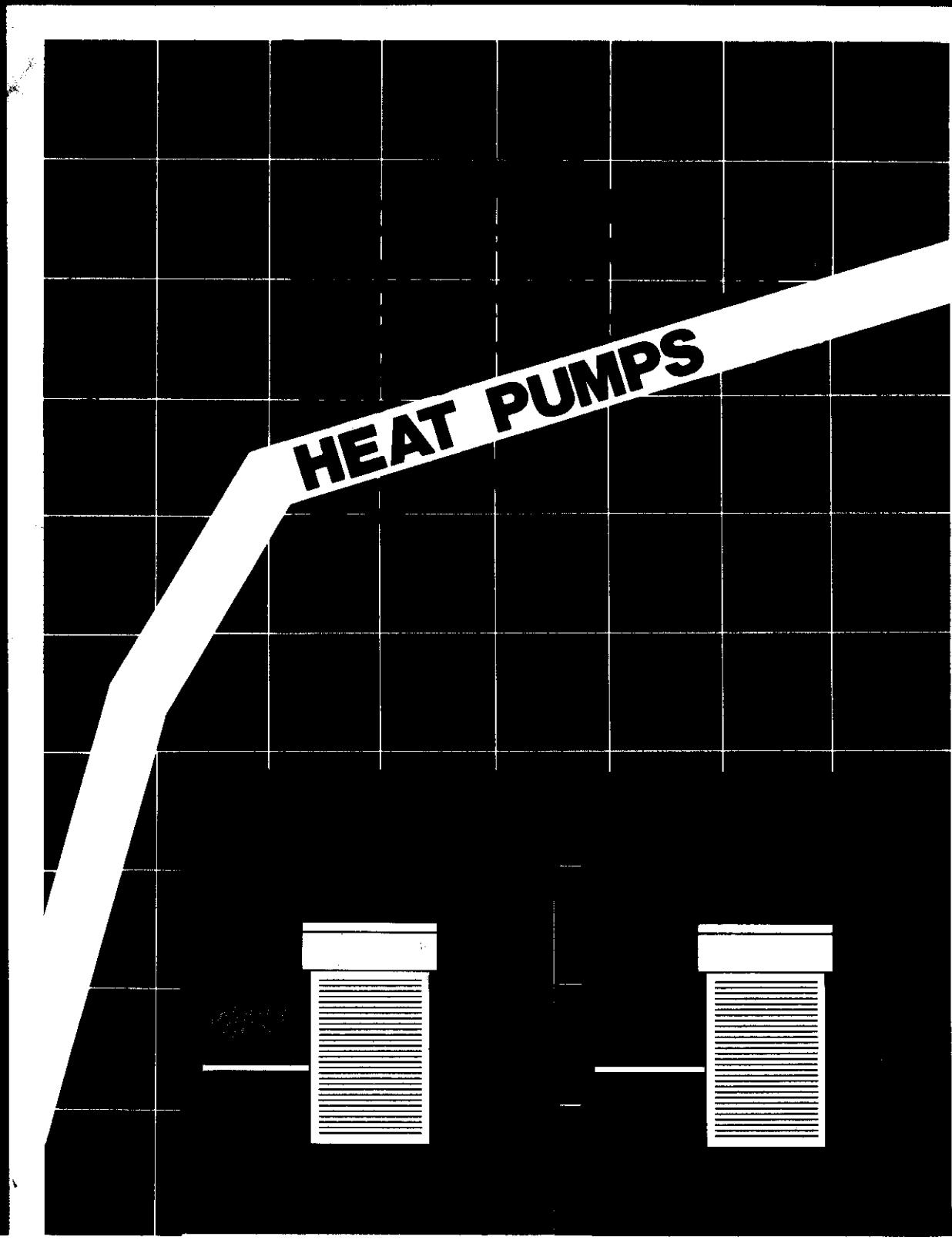
HEAT PUMPS



Ministry of Energy
Ontario

Energy Ontario

THE PROJECTED PENETRATION OF RESIDENTIAL AND COMMERCIAL HEAT PUMPS TO THE YEAR 2001

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ABSTRACT

This study estimates the market penetration of heat pumps in commercial and residential applications in Ontario from 1981-2001 and the resulting effects on energy consumption (gas, oil and electricity) in those sectors by 2001. Included is an investigation of possible technical developments in heat pump design; the relative economics of heat pumps and conventional heating/cooling systems; and the future market share of heat pumps for the types of buildings analyzed.

EXECUTIVE SUMMARY

This study assesses the potential market for heat pumps in Ontario to the year 2001 primarily to assist the Ministry of Energy in determining the relative contribution of oil, gas and electricity in meeting future energy demands for space conditioning in commercial and residential buildings.

The analysis includes an assessment of both external air-to-air heat pumps and internal water-source heat pumps, but excludes ground or ground water source heat pumps and fossil fuel-fired units. The results are based on the use of heat pumps in a limited number of representative buildings. It should be stressed, however, that the economic viability and net effect on energy consumption of a heat pump for a particular application can only be determined by analyzing the use of a heat pump in that application.

Basically, the analysis consists of three steps: first, an investigation of the possible technical developments in heat pump design over the study period (1981-2001); secondly, an estimate of the relative economics of heat pumps versus conventional heating/cooling systems for the representative buildings using life cycle costs; and thirdly, an estimate of the future market penetration of heat pumps and the resulting effect on future energy

The review of potential technical improvements in heat pump design indicates that the heating energy efficiency of air source heat pumps is likely to increase by 44 to 72 per cent and internal source heat pumps by 38 to 47 per cent by the year 2001. However, these increases will be matched to some extent by projected increases in the energy efficiency of conventional heating systems. For example, residential gas-fired furnaces are expected to become 50 per cent more efficient over the same time period.

Heat pumps are found to be life cycle cost effective with conventional heating/cooling systems in a number of commercial and residential applications by 2001. The effect of higher future energy prices is studied and will likely result in significant improvements in the cost effectiveness of heat pumps in some, but not all, applications. Higher technical developments, on the other hand are not expected to have much impact on their economics.

In applications where heat pumps are compared to residential heating systems without air conditioning, heat pumps are found to be only slightly more economical, even by 2001, based on future energy price assumptions. It should be noted, however, that, in these comparisons, that heat pumps provide the added benefit of space cooling.

Estimates of the future market share of heat pumps (measured as the portion of annual sales of heating/cooling systems to buildings that can use heat pumps) for the major types of buildings analyzed are summarized below:

- For central systems in new buildings, market share is expected to increase from approximately 20 to 25 per cent to 40 to 45 per cent by 2001. Penetration is highest in hospitals. Their use in retrofit applications is not expected to be significant due to unacceptably high conversion costs.

- For packaged roof-top commercial heat pumps in new applications, the market share is expected to increase from 23 per cent in 1981 to 35 to 50 per cent by 2001.

- For packaged terminal heat pumps in new buildings, market share is expected to increase from 15 per cent in 1981 to 50 to 60 per cent in 2001.

- For new, single detached homes with central air-conditioning, the portion that uses heat pumps is expected to increase from an estimated 7 per cent in 1981 to 50 to 60 per cent in 2001. The market share of heat pumps in semi-detached and row applications is less throughout the 20-year period.

- Market share for retrofit applications of air-source heat pumps is generally greater than for new applications due to the assumed higher energy requirements of retrofit buildings, resulting in larger potential savings. The exception is all-electric residential split heat pumps where the market share for retrofit applications is less than for new applications. (This is because it is necessary to remove the existing electric furnace when an all-electric heat pump is installed, whereas a conventional air conditioner can be added to an existing electric furnace.)

The future use of heat pumps is estimated to result in the following changes in commercial and residential energy consumption by the year 2001:

- 2.5 per cent reduction in natural gas consumption
- 3.6 per cent reduction in oil consumption
- 0.7 per cent increase in electricity consumption

The effect of heat pumps on utility load characteristics is briefly discussed. Both electric and gas utilities require approximately the same capacity to meet their maximum demand whether heat pumps are used or not. (Although heat pumps require less energy over an entire heating season, their peak demand on the coldest day is similar to that of a conventional system.) At the same time, the total annual requirement for energy is less, thereby lowering a utility's load factor. Such changes, however, are not large enough to cause undue difficulty for Ontario utilities.