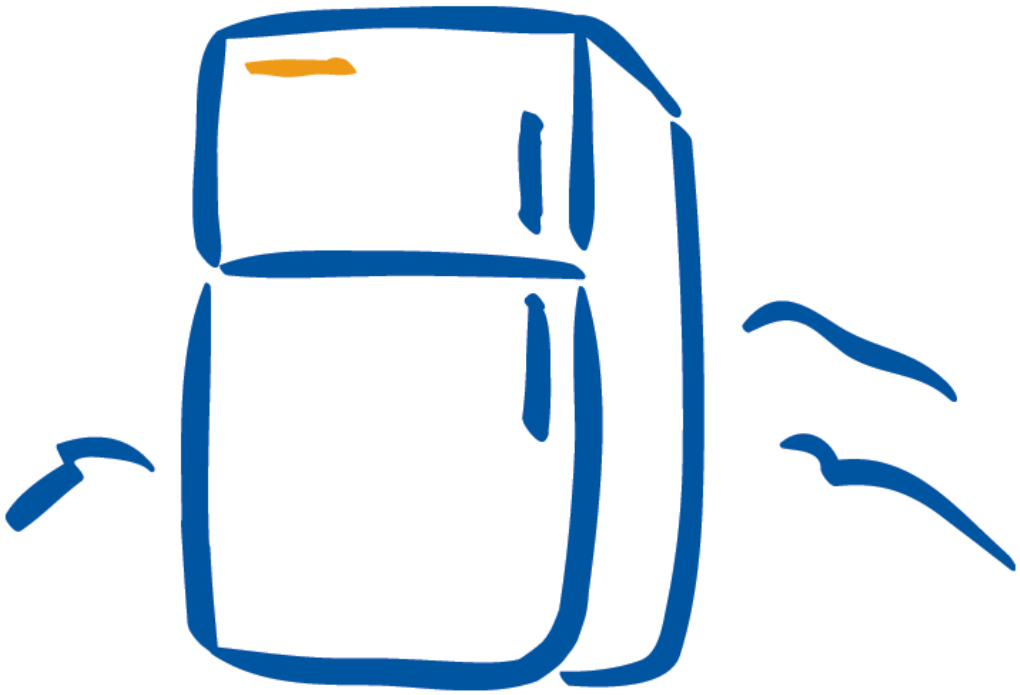

The Phoenix Fridge Project

Report of Stage 1 Trial Project, Nov 2003 – Jan 2004

Executive Summary

Moreland Energy Foundation

April 2004

Introduction

The Phoenix Fridge Project is a unique opportunity to increase social equity while responding to critical environmental issues. The scheme aims to increase the energy efficiency of second hand fridges distributed to low income households. The outcomes are threefold; greenhouse gas emissions are reduced while achieving more economical operating costs for low income households and the creation of employment and economic opportunities.

In October 2003 the Moreland Energy Foundation Limited (MEFL) made a submission to Minister Thwaites at the Moreland Community Cabinet for funding to conduct a small scale trial of the Phoenix Fridge project within Moreland with a view to planning a broader rollout across the municipality and eventually statewide. The Department of Sustainability and the Environment (DSE) provided $10,000 for the trial which was conducted during the period November 2003 to January 2004

The first stage of the project has successfully demonstrated that old fridges can be recovered from homes with multiple appliances, and can be made more energy efficient and economical to run through low cost retrofit measures. The energy performance of most old fridges can be improved through simple low-cost measures - some by as much as 25%. It is further possible to achieve savings of greater than 50% through slightly more expensive measures.

The project has been designed with the aim of expanding to a full scale scheme. The first stage validates the concept and demonstrates the suitability for implementation on a larger scale. The report documents the results of Stage 1 and discusses a series of factors involved with expanding the project.

Background

Refrigerators are one of the largest energy using appliances in most households, responsible for around 14% of household greenhouse gas emissions in Victoria.[1] Many households have two or more fridges, which add to the energy usage. A survey in 1991 found that there is an over saturation of some 32% of refrigerators with over 0.5 million second refrigerators and freezers in households in Victoria.[2] Many households have fridges running full time in a hot garage to keep a few beers cold.

At the same time, low income households who cannot afford the cost of new high efficiency models often have second hand or old fridges that are costing them a lot to run. A four star refrigerator would cost a household around $50 per year to run compared to a one star fridge that would cost over $100. The cost to purchase a four star refrigerator is around $1000 which is prohibitive for a low income household.

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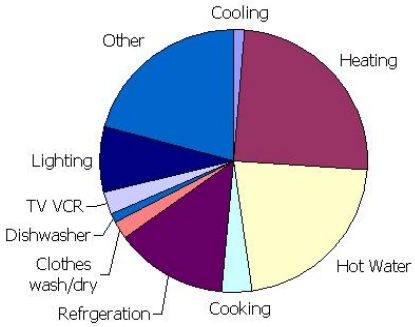
In addition, the lack of information on energy use for second hand fridges is a significant issue as the consumer is unable to compare models on running costs and will tend to purchase the cheapest (and probably least efficient model. A program that was able to provide information on the energy performance of second hand fridges would be valuable in itself, in terms of improving consumer information and influencing consumers purchase decisions.

[1] George Wilkenfeld and Associates, Household Energy Use in Australia March 1998
[2] McLennan Magazanik Feasibility Study conducted for the SECV Demand Management Unit August 1991

Household Greenhouse Gas Emissions



George Wilkenfeld and Associates, Household Energy Use in Australia March 1998

Total Emissions : 52017 KT CO_2

Refrigeration : 14-17%

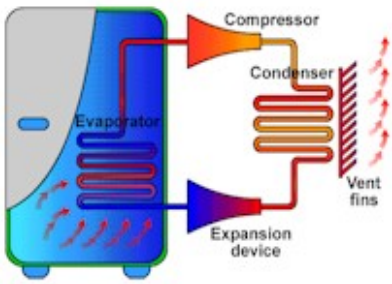
Refrigeration Emissions: 7282 – 9097 KT CO_2

Equivalent to 1.6 – 1.9 Million Cars

Cfc's

CFC's commonly used in pre 1994 fridges have a global warming potential 6000 times that of CO_2 per kg. Old fridges also contain CFCs in the refrigerant and in the foam insulation inside the fridge which can total up to a kilogram of CFC per fridge. Most of these CFCs remain in the fridge for the life of the appliance and are not released unless the appliance is damaged or vandalized e.g. in a landfill or on a nature strip. If these CFCs could be safely captured and destroyed, the reduction in greenhouse emissions would be enormous as well as the benefits for reducing ozone depletion.

The Fridge

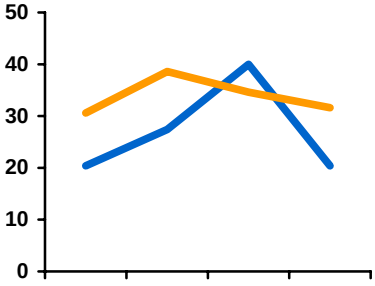


When a liquid evaporates it absorbs heat. Refrigeration utilizes this basic principle via a series of mechanisms

1. **Compressor**
2. **Heat-exchanging pipes –**
coiled set of pipes outside the unit
3. **Expansion valve**
4. **Heat-exchanging pipes –**
coiled set of pipes inside the unit
5. **Refrigerant –**
Evaporative liquid used inside the refrigerator

Factors of Efficiency

The efficiency of a fridge is primarily determined by how hard the compressor needs to work to maintain the required temperature inside the fridge.

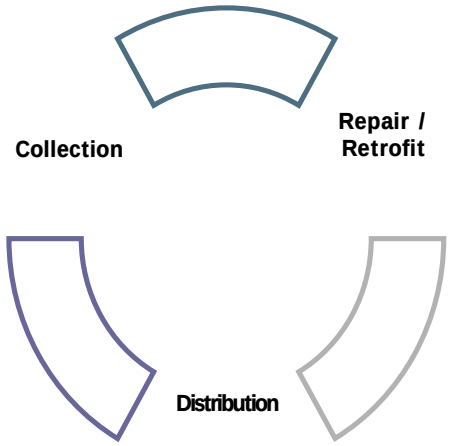


Insulation & Seals:
The capacity to trap cold air inside the fridge is critical to how hard the fridge needs to work. If there's good insulation and seals on the door then the fridge will stay cooler, reducing the amount of work the compressor needs to do.
Heat Dissipation:
A fridge uses the heat exchange coils on the outside to cool the refrigerant gas. The easier it is to take heat away from the gas the more efficient the fridge will operate. Common problems occur when air is unable to circulate behind a fridge.
Operating Period:
A fridge uses a thermostat to switch on and off between a range of temperatures. Faulty thermostats can increase the period of time a fridge is operating unnecessarily.
Operating Effort:
Older compressors tend to be less efficient than modern versions, i.e. using more electricity to achieve the same result.

Approach

Concept

The Moreland Energy Foundation developed a trial program to assess the feasibility and effectiveness of measures to increase energy efficiency in second hand fridges.



Key Aims

- To remove underutilised 2nd & 3rd fridges from households
- To refurbish old fridges to make them more energy efficient
- To assess the feasibility of a larger pilot scheme.
- To understand the demand for refurbished fridges
- To develop partnerships with relevant charity organisations, TAFE and Universities and government agencies
- To explore a “labeling scheme” for second hand fridges.

Method

The trial was conducted at the Brunswick Business Incubator with fridges collected from community members. A modern three-star energy rated fridge was used as a reference fridge.

1. An initial investigation of each fridge by a refrigeration mechanic was conducted to assess their condition and potential for improvement through retrofit.
2. Changes were then implemented and monitoring conducted to assess the effectiveness of different retrofit items.
3. Each fridge’s performance before, during and after the trial was assessed against the reference fridge.
4. Those fridges that were deemed to be too faulty to warrant repairs were disposed of In an environmentally responsible manner.

Results

Key Findings

- The energy efficiency of most old fridges can be improved by up to 25% through simple low-cost measures
- Efficiency increases of > 50% can be achieved through slightly more expensive measures such as compressor replacement.
- Assessing and removing unrepairable fridges from the market entirely is an important aspect of the program in terms of reducing greenhouse emissions and saving low income households from the high running costs of poor quality fridges..
- There is a very large unfulfilled demand for refurbished fridges in low income households.
- The community is willing to donate their 2nd or 3rd fridges to a program such as this
- There are significant numbers of fridges disposed of inappropriately resulting in the release of cfc gases

Collection Issues

A local transport company was used to transport the fridges to the test site. The cost of transporting was underestimated in the initial budget as the time required to collect them was more than expected. In an extension of the project it would be simpler and more cost-effective to pick fridges up from and drop them off to a central site if at all possible. Using an established distribution system such as a charitable organisation’s collection service would be an advantage.

Assessing retrofit suitability

A combination of volunteer and paid refrigeration service mechanics were used to do the initial assessment of fridges for retrofit suitability. The sample of fridges collected for the trial represented a reasonable cross-section of the second hand fridge population. One of the lessons from the test project was that every fridge is completely different - in terms of how it operates, how it performs under different conditions, its pluses and minuses - and therefore savings from retrofit items will not necessarily be the same for every fridge in the future – they may be more or they may be less.

Retrofit Results

Example 1.
Fridge #2 'Vinnie'

Measures:
Insulation fitted to the back of the cabinet and around compressor to reflect heat away keeping the cabinet as cool as possible.

Initial Energy Use: 354 kWh pa **Materials Cost:** $8
Final Energy Use : 295 kWh pa **Savings pa.:** 80kg CO_2 - e, $7.14
Efficiency: 14% **Payback Period:** 1 year

Example 2.
Fridge #7 'Crosley'

Measures:
A faulty thermostat was replaced and new compressor using propane refrigerant installed.

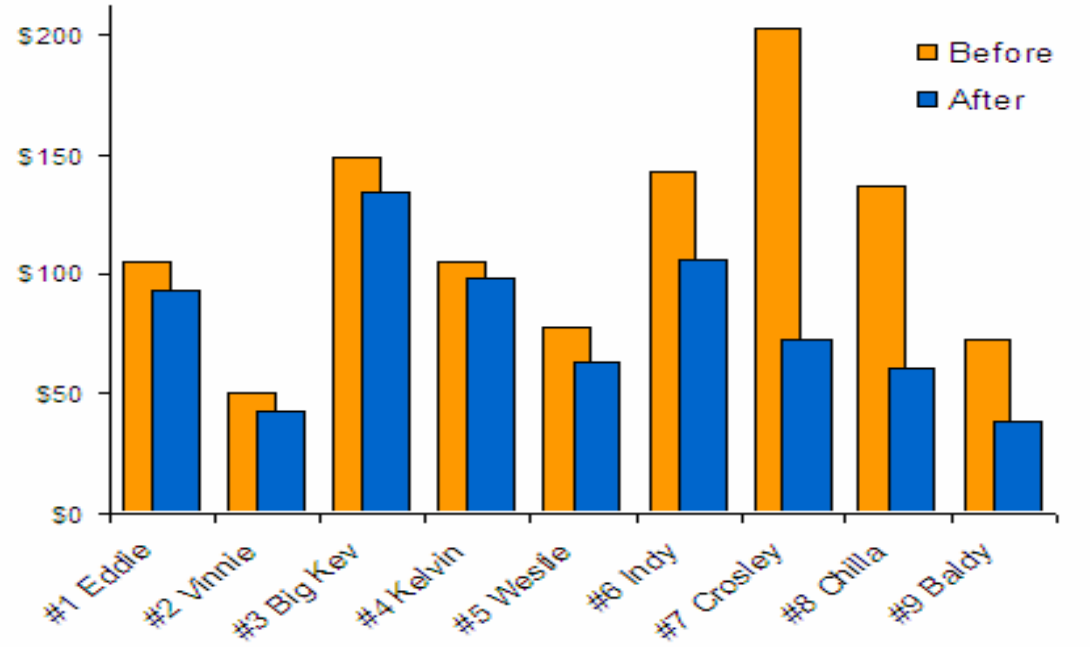
Initial Energy Use: 1690 kWh pa **Materials Cost:** $250
Final Energy Use: 562kWh pa **Savings pa.:**1.4 T CO_2 - e, $130
Efficiency: 64% **Payback Period:** 2 years

Comparative Measures

Fridge #	Change Made	Efficiency
1. Eddie	New door seals fitted only	9%
2. Vinnie	Air-Cell on back of cabinet and around compressor	14%
	As above + new seals	16%
3. Big Kev	Insulation-filled guard removed from around compressor	5%
	As Above + Air-Cell insulation and new seals fitted	8%
4. Kelvin	Replacement of faulty relay switch	Fridge not working prior
	Air-Cell fitted to back of cabinet	6%
5. Westie	Polystyrene fitted to exterior apart from back of cabinet	24% savings*
	As Above + Air-Cell around compressor. New seals fitted.	12% savings
	As above + Air-Cell removed from around compressor	14% savings
	All the above + Air-Cell fitted to back of cabinet	23% savings
	All the above + stainless steel cap and capacitor installed	18% savings*
6. Indy	Regassed with Hydrocarbon and thermostat replaced	26% savings*
7. Crosley[#]	Faulty thermostat replaced and new compressor fitted	64%
8. Chilla[#]	Freezer unit, faulty thermostat replaced.	56%
9. Baldy[#]	New compressor unit fitted, modified condenser location	47%

* Uncertainties discussed in main report
[#] Supplementary trial undertaken without reference fridge

Graph: Relative Operating Cost p.a. (Based on 13c/kWh Tariff)



Demand for refurbished fridges in low income households

Experience in sourcing second hand fridges from charitable organisations for the test project showed that a) only a small number of charitable organisations supply them due to legal obligations to have appliances tested; b) demand for fridges that did exist in the charity market was very high and c) those fridges that were obtained from the charitable organisation were among the *least efficient* in the trial.

Labelling scheme for second hand fridges

There is potential in a larger project to label the fridges before redistribution with a comparative energy rating that shows estimated energy use per year and approx. $$ cost per year to run. We see this part of a program as extremely valuable in terms of helping low income consumers choose fridges that are most economical in the long term.

Projected Benefits

Direct Benefits

Greenhouse Reductions

We estimate conservatively that the greenhouse savings from a larger Phoenix Fridge pilot program aimed at collecting 125 fridges are as follows:

Estimated per year savings = 151 tonnes CO_2/yr **= 33 x** 

Estimated lifetime savings = 1510 tonnes CO_2

To Donor Households:
Households that donate their second fridges will each reduce their annual electricity bills by an average of $120 each year and reduce their emissions by 1.2 tonnes per year for the 5-10 years that they would have otherwise run those fridges. This equates to savings of $600 to $1200 for each household as a result of their donation.

To Low Income Households:
For low income households who may have purchased a 3kWh/day fridge that would have cost them around $150 per year to run, by being given a more efficient fridge that uses 1.5 – 2 kWh/day they will save $50 - 75 per year.

To Charitable Organisations:
The ability to provide a cost effective fridge to households seeking help will ensure that charitable organizations are better meeting their poverty prevention aims. They may also need to provide less support to those households in future.

To the Government:
These energy bill savings for low income households will also result in a direct reduction in the level of energy concession provided by the government to that household. The Phoenix Fridge Program provides Government with an opportunity to invest resources in real poverty alleviation with strong environmental benefits.

Social and Educational Benefits

This project focuses on empowering the community to fix an environmental problem with a solution that also assists those worse off in society. The educational aspect of the project is extremely important in terms of raising awareness of the energy consumption of refrigeration in households and its contribution to greenhouse emissions.

Other Environmental Benefits

By removing fridges from households and safely disposing of those that are no longer fit for redistribution, the project will be ensuring that these fridges have not contributed to landfill waste. As far as possible, the metal from these fridges will be recycled as scrap metal, while refrigerant gas including ozone depleting cfc's will be securely captured and stored.

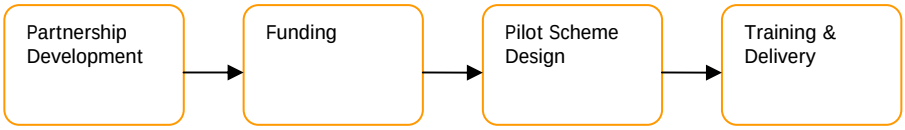
The Next Step

Society will benefit enormously from an expanded Phoenix Fridge program. Ultimately, Moreland Energy Foundation believes that the Phoenix Fridge program should operate Australia wide. Before we get to that point, we need to understand the best approach to generate support from the public for donating their second fridges. We also need to understand how best to distribute fridges to low income households.

For Stage 2 we plan to pilot the full Phoenix Fridge program, in partnership with charitable organizations. St Vincent de Paul has already agreed to participate in the pilot program and the Brotherhood of St Laurence are very enthusiastic to participate also. Working in partnership with two highly reputable charitable organisations will provide real benefit to the program and enable us to maximize the social benefits.

Moreland Energy Foundation and St Vincent de Paul have already applied for funding under the Victorian Greenhouse Strategy Community Action Fund to run a pilot based on 125 fridges. We will continue seeking other resources to ensure that we are able to put our best efforts into making the pilot of the full program a success.

Stage 2



Conclusion

Stage 1 of the Phoenix Fridge Program has clearly demonstrated the viability of the concept. Direct results from the initial trail show that significant increases in operating efficiency can be achieved through practical and inexpensive measures. In addition broader research undertaken during the trial confirms the potential for implementing the scheme with support from other community groups.

The project incorporates concepts of social equity and product stewardship while delivering direct reductions in greenhouse gas emissions. The distribution of more efficient fridges to low income households provides direct economic benefits to the recipient households. The collection of underutilised fridges for the program increases the product life where viable and in turn reduces waste to landfill.

Greenhouse gas emission reductions are achieved through the following paths:

- Reduced use of second and third fridges in households
- Increased the operating efficiency of fridges
- Safe collection of refrigerant gases eg. Cfcs

The Phoenix Fridge Program provides a holistic approach to reducing the environmental impacts of household refrigerators. Stage 2 will provide an opportunity to implement the full scheme at a local level. If successful the project will provide a model for responsible product stewardship which can be transferred to other priority environmental and social issues.

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