



# Hawke's Bay Refrigeration

Refrigerants

Presented By Shayne Murphy



# Introduction

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- Design Engineer
- CEO of Hawke's Bay Refrigeration
- 30 years of practical experience in the Refrigeration industry



**Refrigerants and their use in New Zealand will be affected by global trends. How does this affect you the end user?**

### **The Past**

It is widely known the last time Refrigerants became a global talking point and the subject of legislation to reduce their use was in the late 1970's, when holes were found in the Ozone layer above the polar regions. Scientists discovered that refrigerants with halogen atoms break down  $O_3$  Ozone into  $O_2$  oxygen in the upper atmosphere.

A reduction of Ozone leads to greater Ultraviolet radiation exposure and is damaging to plants, animals and humans. In 1987 the Montreal Protocol was adopted by many countries to try to reverse the decline in atmospheric Ozone and many years later the results are clear, with the holes having largely repaired themselves.

This first stage of phasedown of the main Ozone depleting refrigerants, namely CFC's (Chlorofluorocarbons) and HCFC's (Hydrochlorofluorocarbons) resulted in new synthetic refrigerants being developed to take their place. This new range of refrigerants were called HFC's (Hydrofluorocarbons) and do not have the halogen atoms that cause Ozone depletion.

## The Present



As time passed, scientists also started to see patterns of global warming emerging and the evidence supporting this phenomenon is vast and varied. Most countries subscribe to the science of global warming and that it is a direct result of human activity.

In 1992, an international treaty called the 'United Nations Framework Convention on Climate Change' was put together. This treaty had the goal of limiting global temperature rise of the planet to less than 2°C in the period to the year 2050. In 1997, the Kyoto Protocol set legally binding obligations for developed countries to reduce green house gas emissions. Green house gases are those that absorb radiation in the atmosphere and cause a warming effect.

Typical examples of these gases are Methane  $\text{CH}_3$  and Carbon Dioxide  $\text{CO}_2$ . Since the Kyoto Protocol, there have been various updates and amendments, the most recent of which is the 2015 Paris Accord which came into force in November 2016. Due to more evidence and scientific research, it was agreed to limit global warming to less than 1.5°C and definitely well below 2°C compared to pre-industrial levels. Each country had to setup its own systems for greenhouse gas reduction to meet its national obligation under the agreement.

Unfortunately, HFC's (also referred to as synthetic greenhouse gases SGG in legal policy documents) that were developed to reduce damage to the Ozone layer, were found to have a significant global warming impact if they leak into the atmosphere. This effect is calculated in equivalent terms relative to 1 kg of Carbon Dioxide Gas  $\text{CO}_2$ . R404A has been a very popular HFC used extensively in New Zealand Cold Storage applications and unfortunately it has a GWP ( global warming potential is the unit of measure versus carbon dioxide ) of 3992, which means every kg released into the atmosphere is equivalent to 3992 kg or 3.992 tonnes of Carbon Dioxide, which produces a significant global warming effect. There are many other HFC's in use in New Zealand and they typically have global warming effects over a 1000 times that of Carbon Dioxide.

**The Paris agreement is not targeting refrigerants alone and many industries and processes contribute to global warming gases being released into the atmosphere, hence there are multiple policies and programmes actively focused on this issue.**

The phasedown for HFC's ( SGG's) in New Zealand starts in 2019 with a 10% reduction, a further reduction to 40% in 2024 and so on until we have an 85% phasedown of these by 2036.

There are 2 main factors which affect businesses utilizing HFC's as refrigerants in their systems. The first factor affecting us in New Zealand is the Carbon tax levy component applied by the government to help New Zealand meet its carbon reduction obligations. The second factor is the rising cost of HFC's due to their phasedown around the world and hence availability in the near future. The carbon tax, is linked with the GWP number for each Refrigerant, so for R404A with a high number of 3992 the tax is \$ 34.65 per kg.

As New Zealand does not manufacture these HFC's, we are exposed to these significant price rises which in the next few years could reach a magnitude of 5 to 10 times the current levels. As capital plant for large industrial applications are designed and generally built to last for over 20 years, it is very important for end users to be aware of life cycle costs when investing in capital plant, otherwise there is a significant risk of the plant becoming uneconomical to run early in its lifespan.

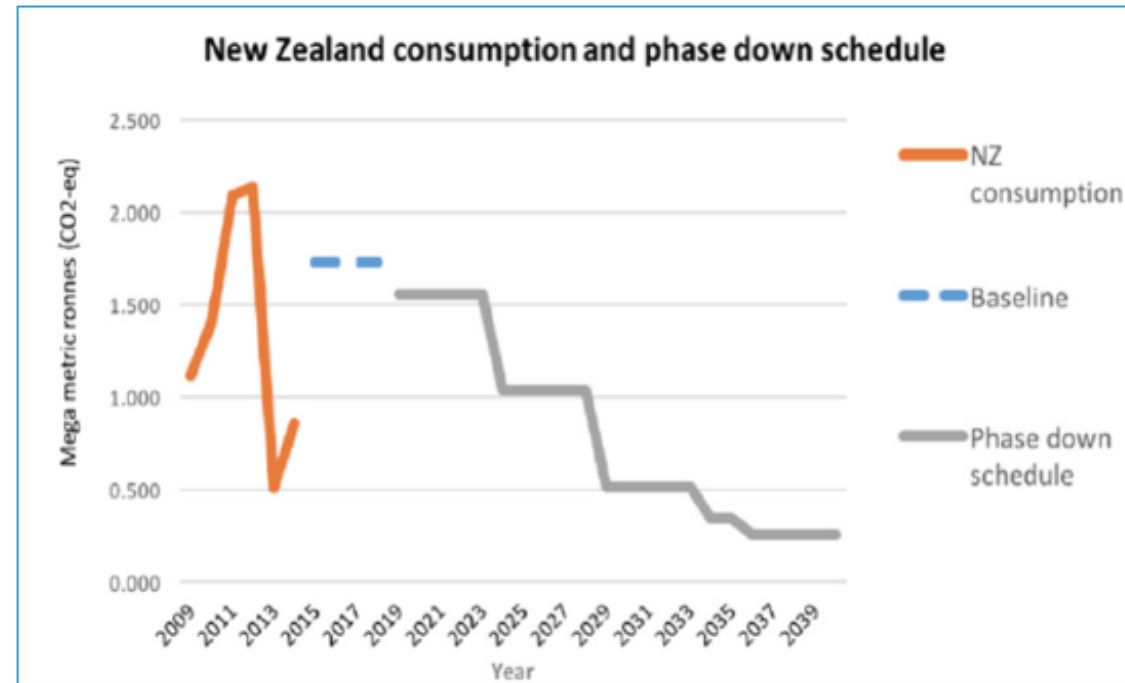


**United Nations**  
Climate Change



The carbon tax that is levied on SGG's is based on an agreed value for carbon units (NZU). The value of these units can be treated like shares or currency and they fluctuate with demand and availability on the global markets. For the 2018 tax year, the government of New Zealand set the carbon unit value at \$17.67. The forecast is for the price of carbon units to rise steadily for the foreseeable future, as all countries start to implement their greenhouse gas reduction programmes and need to purchase carbon units. This will increase the carbon tax levy on all HFC's with R404A being one of the highest increases due to the high GWP number of 3992.

The second factor mentioned that will have a significant effect on cost of HFC's is the global demand and availability of HFC's. As countries start to ban sales of HFC's, manufacture of these refrigerants will slow and will switch to production of next generation refrigerants. As countries are on separate phasedown schedules, the matching of supply and demand is going to be difficult and is likely to cause an increase in cost, just like what we saw happen when CFC's and HCFC's were phased down to prevent damage to the ozone layer.



Graph courtesy of the Ministry for the Environment

## The Future is here now

**So, in simple terms, what can end users do to ensure capital investments are done within budget and with future proofing in mind?** Luckily the global players in the refrigeration industry have known about global warming for many years and have been developing a range of low carbon or low GWP solutions. The first category of refrigerants you could consider are the natural refrigerants. These are called natural because they occur in their standard form without processing or synthesis in a factory or laboratory. The most common examples of these are carbon dioxide CO<sub>2</sub>, Ammonia NH<sub>3</sub> and Hydrocarbons. Hydrocarbons unfortunately are highly flammable and our industry in New Zealand is largely unable to support industrial projects using this category of refrigerant, mainly due to safety concerns. Ammonia is widely used for

large processing plants such as meat works and can be used as a primary refrigerant with a secondary heat transfer fluid, such as glycol, for cold storage. These ammonia systems require new plant and can't be retrofitted to existing HFC systems. Last, but not by any means least is CO<sub>2</sub> in this category for natural refrigerants. You would think that CO<sub>2</sub>, being a global warming gas itself should not be used, but as mentioned it is many times lower in its global warming effect than HFC's (SGG's) hence very useful as a refrigerant. New Zealand has quite a few systems installed that are running high pressure CO<sub>2</sub> as a refrigerant. CO<sub>2</sub> refrigeration systems require new capital plant and can't be retrofitted to HFC systems.

The chemical companies that are facing a reduction in sales of HFC's have had to

develop a next generation of synthetic refrigerants called HFO's (Hydrofluoroolefins). These can be used on their own or as one of the rapidly growing blends of HFC & HFO together. HFO's can be used in traditional HFC style plant, but retrofits would require significant upgrades to components, so best suited to new capital plant. The capital costs for new systems are similar to HFC systems currently in use.

The main point regarding HFC's (SGG's) is that their availability will continue to reduce and costs will continue to rise. HFC refrigeration systems economic life span is limited and will expire well before the plant itself has come to then end of its designed service life, so careful consideration is required to implement sustainable solutions in line with global trends to low GWP systems.



# Refrigerants in the Winery Sector

Main Factors:

- Reduce
- Low GWP
- Control
- Increase COP

The winery industry is generally well placed as have been using secondary refrigerants for years.

Glycol pumped and recirculated from the primary cooling plant is not new to the industry.

The primary cooling plant needs regular maintenance, and good house keeping.

- Regular maintenance
- Daily plus weekly checks
- Leak detection systems



# Energy Efficiency

It's all well and good striving for low GWP Refrigerants, but this is pointless if we use more energy/electricity.

Continue efforts for Energy Efficiency increased COP.

- Electronic Expansion Valves
- Clean Heat Exchangers/Condensers
- Clean Glycol
- Variable Speed Compressors/Pumps

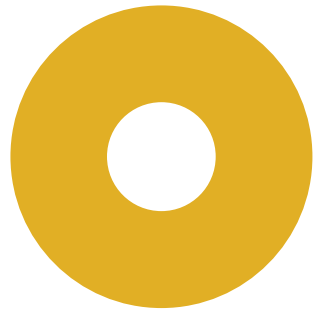


# Refrigerants of Today

	ODP	GWP	Notes	Safety Group
R717 Ammonia	0	0	Natural Refrigerant Toxic	B2
R744 CO <sub>2</sub>	0	1	Natural Refrigerant High Pressure	A1
R22	0.055	1810		A1
R404a	0	3922	Replacement for R502	A1
R449a	0	1397	Replacement for R404a	A1
R410a	0	2088	Replacement for R22	A1
R407f	0	1825	Replacement for R22	A1
R407c	0	1744	Replacement for R22	A1
R134a	0	1430	Medium temperature refrigerant	A1
R513a	0	631	Replacement for R134a	A1
R1234yf	0	4	Replacement for R134a	A2L
R32	0	675	Low flamability	A3
R290	0	3	Propane	A2

# Discussion Questions





NEXUS  
FOAMS

# INSULATION

Karl Crawford  
Sales and Marketing Manager

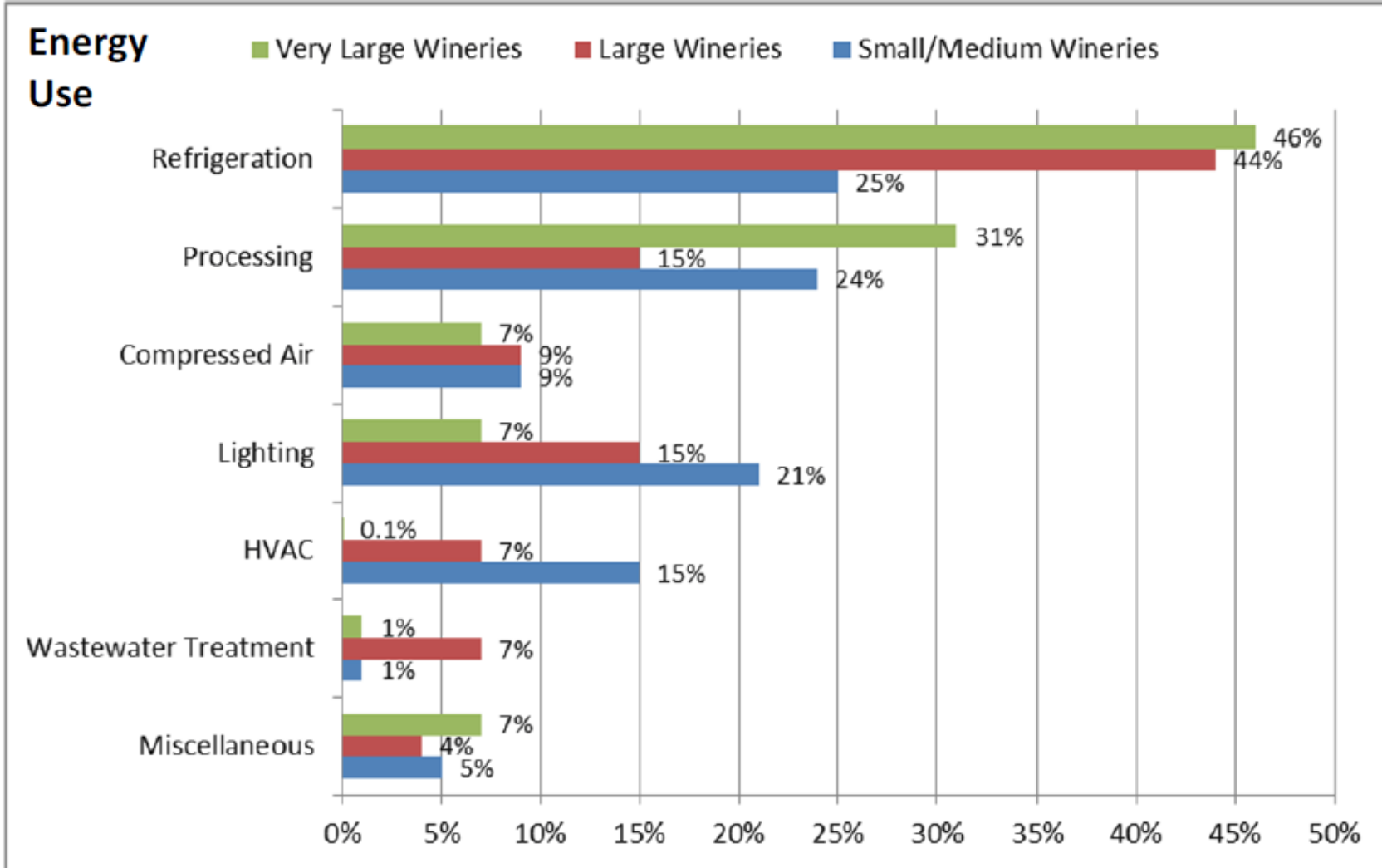
Winery Engineering Conference

Napier

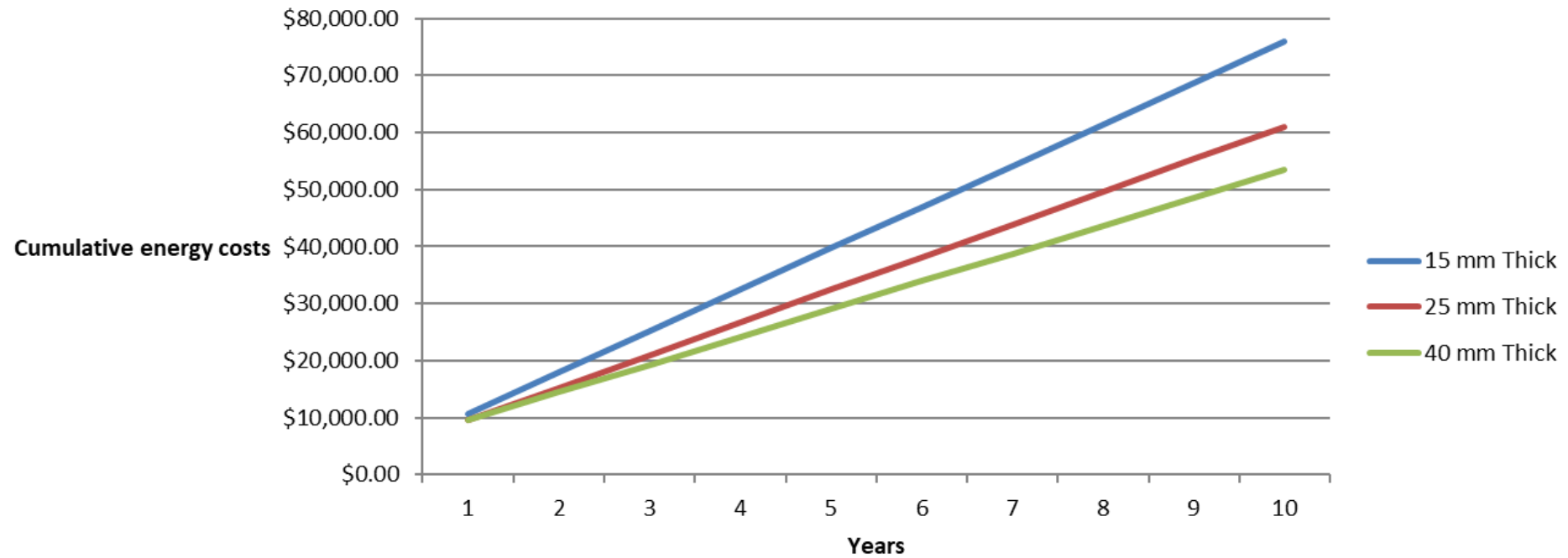
October 2018



WHY INSULATE?



## Savings in Cost on Basic Hot water system over 10 years relative to insulation Thickness



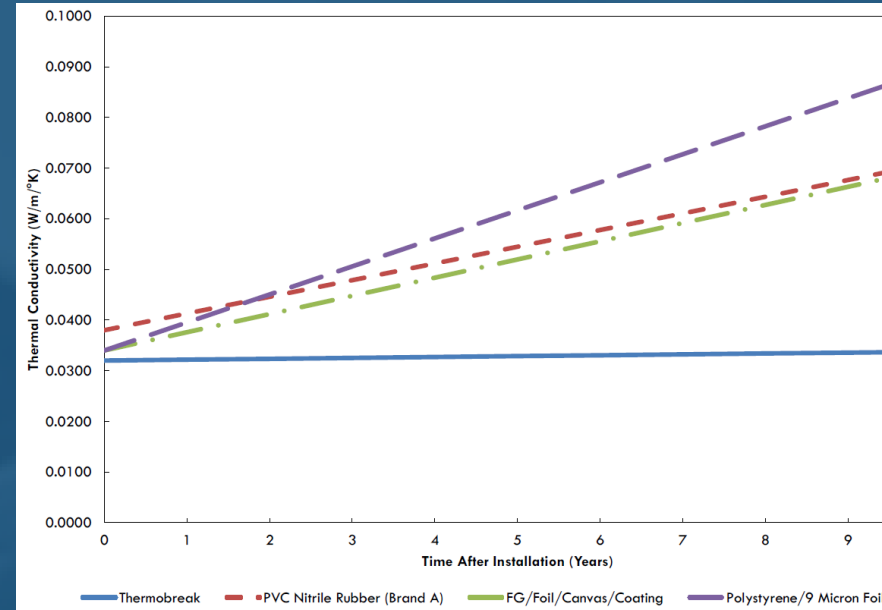
# DON'T UNDER SPECIFY

## k Values

The ability of a material to conduct heat – the lower the k value, the better the insulation

Typical k values (W/mK) at 25°C

- Air – 0.0262
- Foil faced, elastomeric insulation – 0.032
- Polyethylene – 0.330
- Apple – 0.390
- Water – 0.606
- Stainless steel – 16
- Platinum - 70



MOISTURE  
IS NOT  
YOUR  
FRIEND



# INSULATING IN THE BIG WIDE WORLD

**Q&A**