2016 AUSTRALIAN SUMMER STUDY ON ENERGY PRODUCTIVITY

empower a brighter tomorrow

Sydney 24-26 February, 2016

Energy Efficiency in HVACR Energy Productivity for Everyone



Forging the Future for Refrigeration and Air Conditioning

Four Things to Take Away

- HVACR will ADD at least 40% to global warming by 2050 if we don't dramatically reduce the use of HFC refrigerants. That is additional to carbon at 450 ppm.
- Therefore major regulatory change by international agreement: "HFC Phase Down"
- National cost savings of about \$10B pa are available. The solutions are commercially warranted.
- You can future proof your HVACR by using natural refrigerant based technology NOW and make it highly energy efficient.

Refrigeration & Air Conditioning In Australia

The HVACR Industry serves everyone:

commercial, residential, industrial, transport, food, hospitality, public facilities, health care....

everyone, every where!

- 53* million individual HVACR installations (\$100B),
- 2% of GDP (\$26B spend, \$6B capital investment PA)
- **22% of electricity**, (\$14B PA, 10% of national emissions)
- 12 /14 %+ of national GHG emissions (2/4% direct emissions, synthetic refrigerants, HCFC / HFC)*
- 20,000 firms, 200,000 direct employees, 70,000 licensees tradesmen

Source: Cold Hard Facts 2, Dept. of the Environment 2013,* adjusted by ARA

HVACR Sectors In Australia

HVAC	Installations
Domestic & Low Rise Commercial – Split Systems	12,000,000
Commercial Chillers	30,000
Industrial chillers and splits	100,000
Cars and Trucks	12,000,000
Refrigeration	
Domestic fridges and freezers	17,000,000
Commercial display cabinets, vending	1,000,000
Industrial, Manufacturing refrigeration	80,000
Grocery Stores	10,000
Cold Stores	100,000
Transport	29,000
Hot Water & Heat Pump	11,000,000



(Source: CHF2 stock model)



(Source: DCCEE 2012b, CBBS Volume 1, page 5)

The Role of Refrigerants

When you choose an HVACR plant you choose the refrigerant: Direct & Indirect Emissions

Indirect emissions



Refrigerant selection is a key determinant of HVACR efficiency.

70% of HVACR emissions 10% of Australian Emissions



Two sides of the same coin

Direct Emissions

Refrigerant leakage is inevitable /understated, growing source of direct emissions (HFC).

30% of HVACR emissions 4% of Australian Emissions

The Role of Refrigerants



Two sides of the same coin

Direct Emissions: Pervasive

All HVACR systems leak refrigerants: mechanically intense, they shake, they break, they leak.

Lack of enforcement. It is illegal to knowingly emit but effectively no prosecutions. It is a profit source for the irresponsible, ill informed.

Low maintenance is a key contributor.

Likely to be high in high HVACR growth countries.

The Role of Refrigerants



Two sides of the same coin

Indirect Emissions / Energy use

Natural Refrigerants are more energy efficient: **an incontrovertible fact** of molecular thermal dynamics, superior heat transfer properties.

5 – 40% more energy efficient than synthetic refrigerants subject to optimal design by sector. Available for use in all HVACR sectors.

Add integrated energy efficiency engineering and 60% energy savings are available.

Why: The History / Future of Refrigerants

Danfoss: "three main parameters which must be aligned to accomplish a real sustainable balance: affordability, safety and environment".



Figure 1: The historical cycle of refrigerants

Refrigerants glossary- the alphabet soup of HVACR

Synthetic Refrigerants

CFCs / HCFCs: fluorocarbon refrigerants, ozone depleting High GWP – 1500 / 23,000 times CO_2

- HFCs: hydrofluorocarbon, High GWP, not ozone depleting
- **HFOs**: hydrofluoroolefin, Low GWP, not ozone depleting

Natural Refrigerants:

Ammonia, CO₂, Hydrocarbons, air, water: very low / no GWP, not ozone depleting **far more energy efficient.**

Current International Agreements:

- Montreal Protocol: discontinuing the use of ozone depleting refrigerants: CFC, HCFC
- Kyoto Protocol: GHG accounting includes only High GWP HFC refrigerants based on 100 yr. GWP,
- > **Note the Gap**: MP GHG emissions excluded from KP, not counted !
 - Average HFC atmospheric life is 21 yrs !!!!
 - Average HFC 20 yr GWP is 2X100 yr GWP
 - KP understates HFC and CFC / HCFC emissions dramatically
 - Plus a good deal more understatement like end of life emissions

Refrigerant Regulations Are Changing Rapidly

Montreal Protocol

Article Five (industrialized)

Non Article Five (developing countries)

CFC,HCFC banned 2020 banned 2030

(Australia effectively phased out importation last year)

HFC ? Dramatically reduced by 2030 / 35 ?

Refrigerant Regulations Are Changing Rapidly

Montreal Protocol

Article Five Non Article Five

CFC,HCFC banned 2020 banned 2030

HFC ? Dramatically reduced by 2030 / 35 ?

- The Phase Down of HFC refrigerants is now, imminent.
- The Economist: "the MP has achieved more in Climate Change mitigation than all other policies combined"

PROPOSED HFC AMENDMENTS TO THE MONTREAL PROTOCOL





- To Reduce Short Lived Climate Pollutants:
 - Carbon Black
 - HFC
 - Methane
- A partnership of governments, NGOs & Industry
 - 49 countries
 - 53 industry and NGO partners (including the ARA)
- The Coalition is government-led but is highly cooperative and voluntary.



Both sides of the HVACR industry are fully represented:

Natural Refrigerants vs. HFOs

"The HFC Initiative"

Both sides are calling for the industry to transition to Low GWP refrigerants using the Montreal Protocol

The Consumer Goods Forum

Over 400 multinational food retailers and suppliers:

- Sainsbury, Tesco, Carrefour, Woolworths, Metcash etc.
- Unilever, Nestles, Kraft, Coca Cola, Red Bull, etc.

Member revenue over \$5 Trillion pa.

Comprehensive Sustainability Strategy:

- Transition to natural refrigerant based technology by 2015
- All sectors of refrigeration the mission critical Food Cold Chain
- No Equivocation, ongoing R&D for performance improvement in collaboration with Refrigeration Suppliers .



Other Sources on Natural Refrigerants

- Refrigerants Naturally
- The Green Cooling Initiative
- Real Alternatives
- Environmental Investigation Agency
- Institute For Governance & Sustainable Development:
- The Natural Voice
- Shecco: R744.com, Hydrocarbons 21.com, Ammonia 21.com

- The International Institute of Refrigeration
- The International Institute of Ammonia Refrigeration,
 - Climate and Clean Air Coalition
- Eurammon
- GIZ Proklima
- UNEP Ozone Secretariat

See the ARA website for the links

Refrigerant Regulations Are Changing Fundamentally

- The EU legislation: reduce High GWP HFC use by 85% by 2030.
- G20, Climate and Clean Air Coalition: same by 2035
- Montreal Protocol highly likely to adopt HFC phase down.
- Australia is committed to High GWP HFC phase down 85% by 2036????.
- OEMs are shifting to Natural and HFO refrigerants **now**.

Refrigerant Regulations Are Changing Rapidly & Fundamentally

Refrigerant regulations and international agreements matter because:

High GWP refrigerants will become at least 28% of global emissions by 2050 unless
The Foundation Australian Legislation – The OPSGG MA is under Review.

Will it create the regulatory framework for the industry in Australia? Industry is calling for nationally consistent regulation of all refrigerants.

Outcomes pending: April 2016 ?? licensing, training, innovation, validation, commercialisation by sector. ?? Requires collaboration – industry and all levels of government

*Source: Dr. Gus Velders et al, 24 FEBRUARY 922 2012 VOL 335 SCIENCE

Refrigerant Regulations Are Fundamental

• Low GWP refrigerant alternatives are available / proven.

But

- New refrigerants require new plant, significant retrofit.
- All Low GWP refrigerants are flammable > new requirements.
- New regulatory systems standards, licensing, training, innovation, validation, commercialisation by sector.
- Major Commercialisation requirement.

Implications for the HVACR Industry

Implication: From a procurement POV 2030 is **NOW**:

The Australian HVACR industry has the opportunity to:

Reduce the energy cost of HVCAR by 60%+ (\$8B PA)

Reduce GHG emissions by 50%

Reduce national emissions by 7% from HVACR alone

These opportunities are commercially warranted!

HVACR in Australia

It is not clear to us that the energy management industry is sufficiently engaged with HVACR energy efficiency!

- Specifiers
- Contractors
- Owners & Users

We believe the industry can reduce energy consumption by 60/70% - \$8/10 B PA

Innovation In HVACR Energy Efficiency

• We need to !

• You can !

It is commercially required and warranted - NOW

Innovation Because

Obama:

- "We are the first generation to feel the impact of climate change and we are the last generation that can do something about it".
- "We only get one planet. There's no plan B."

August 2015

We Need To !

HVACR Transition in Australia is:

Energy Efficiency

Direct Emissions elimination

Australia should be a leader:

- high growth for those that embrace transition
- national competitiveness
- export development, import reduction
- demonstration to / with the third world

The solutions are in our hands NOW

THEREFORE

We are going to **Tell It Like It Is**

HFOs are Low GWP, but:

- Not more energy efficient that HFCs
- Very expensive
- Not safer. Why risk thermal decomposition lethal
- Not lower cost on a life cycle basis
- High Life Cycle Assessment impact

Do we really need another synthetic refrigerant ?

THEREFORE

- Natural Refrigerant Based Technologies Are:
- More energy efficient
- Lower cost
- Proven cost and performance superior
- Can be used safely
- Require particular expertise to design and service

Commercialisation Is Required

You Can !

Let's be absolutely clear about the considerations:

- Natural Refrigerant based solutions are available & proven in all HVACR sectors.
- They deliver major energy efficiency savings.
- They are commercially justified.
- There are no excuses for delay.

Public awareness is almost nonexistent !

There is a Major Commercial Confrontation

The Future is Natural Refrigerants vs HFOs:

- If you are telling your client anything else you are not telling the truth.
- If you are telling your clients that natural refrigerants are more dangerous you are not telling the truth.
- Why would you be representing anything but a natural refrigerant based technology?

It's hard to drain the swamp when you are up to your neck in alligators



Implications for the HVACR Industry

From a procurement POV 2030 is **NOW:**

Despite the major benefits of transition to low emissions technology the HVACR industry will be highly controversial for the foreseeable future.

You can expect a good deal of obfuscation as the various commercial interests press their POV.

Transition to High Efficiency, Low Emissions

Opportunities for Energy Efficiency:

Technology:

- New more energy efficient solutions
- Integration for optimal cost savings, emissions reduction

Management

- Life Cycle Costing
- Life Cycle Management

Collaboration

- Government & Industry
- Training & Education

Technology

Vapour Compression by sector

- High Rise HVAC, Industrial HVAC
- Commercial and Residential Split System HVAC
- Cold Stores & Cool Rooms
- Commercial Refrigeration & Display Cabinets
- Industrial Refrigeration
- Transport Refrigeration
- District Energy

Integrated Energy Efficiency

Energy

- Measurement
- Control Systems
- Voltage Optimisation
- Power Factor Correction

Refrigerant Selection Maintenance Leakage Control Engineering for Performance

Heat Load Management

Windows, Fans, Appliances Ambient temperature air ingress, egress Ducting / Insulation Low Heat Lighting Reflective Paint, Roof Heat Management

Technology

Vapour Compression by sector

- High Rise HVAC, Industrial HVAC
- Commercial and Residential Split System HVAC
- Cold Stores & Cool Rooms
- Commercial Refrigeration & Display Cabinets
- Industrial Refrigeration

Refrigerant Selection

Maintenance

Leakage Control

Engineering for Performance

Transport F District Enf New Technology available in every sector and dimension !

Integrated Energy Efficiency

Energy

- Measurement
- Control Systems
- Voltage Optimisation
- Power Factor Correction

Heat Load Management

Windows, Fans, Appliances

Ambient temperature air ingress, egress

Ducting / Insulation

Low Heat Lighting

Reflective Paint, Roof Heat Management

Management

Too often we are told that capital cost is the key determinant of buying decisions in association with:

- A lack of financing initiative
- Split incentives
- Lack of Life Cycle Costing, and Life Cycle Management

We see enormous opportunity for HVACR cost reduction and performance improvement through better management of the full range of considerations.

The starting point is awareness of the sources of energy efficiency The next step is understanding and integration!

Collaboration

- Government & Industry, End Users
- Training & Education
- R&D, Validation, Commercialisation

The transition to low GWP refrigerants calls for new HVACR industry management systems:

- Standards
- Regulation
- Licensing
- Innovation
- Training & Education
- Communications

Specifiers and End Users should engage with: **ARA, DoE, OEH, VEET**

You need a voice, we need your voice in these policy developments.

Collaboration

The transition to low GWP refrigerants calls for new HVACR industry management systems:

Licensing

Low GWP refrigerant based technology is clearly the future but not addressed by the current HVACR licensing system.

Training, Education and Communications

There is an enormous educational need to make all stakeholders aware of the benefits and requirements of low GWP refrigerant based technology (perhaps 100,000 individuals).

Innovation

The technology is available, validation & consideration is critical, government and academia have important roles.

Who is Responsible For Innovation

- Commercialisation, Standards, Regulations, Enforcement, Training, Finance, Public Procurement, Leadership
- Whoever takes the initiative ?
- What is the role of "the industry"?
- What is the role of Government all three levels?
 - Federal?
 - State: OEH, VEET, ACT.....
 - Local?

Here's what ARA members are doing:

Innovation !

- Mayekawa
- GEA
- Scantec
- Minus 40
- Tri Tech Refrigeration
- CA Group Services
- Pioneer
- Hychill
- Engas
- Power Star

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There is a great deal more that you will find on the ARA Website

Integrated Energy Efficiency Engineering

HVACR Energy Efficiency Seminar 2016

5-6 April | Sydney **Australian Technology Park**

Presented by



Forging the Future for Refrigeration and Air Conditioning





Tell Me What You Need !

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The Voice of Natural Refrigerants in Australia



Natural Refrigerants (CO_2 , ammonia, hydrocarbons, water, air) are far more energy-efficient than HCFC / HFCs.

AND

Negligible Global Warming Potential.

End-Users and Specifiers need to know about their properties and advantages because.



Natural Refrigerant Based Technologies are a mainstream solution all HVACR sectors,

And

Can replace HCFC/HFC now:

- commercially warranted
- new plant or retrofit

Trained professionals required.

Montreal Protocol

Open Ended Working Group April 2015

Presentations and Discussion

- European Union
- North America
- India
- China
- Africa
- Micronesia

You can access extensive reporting

The bottom line is agreement in principle to the phase down of HFC

The future of refrigerants is clear: HFOs vs. Natural Refrigerants

A Global Industry

Presidents Obama & Xi Jinping, PM Modi

"the United States and China agreed to using the expertise and institutions of the Montreal Protocol to phase down the production and consumption of HFCs".

The G-20 agreement on HFCs:

"We support using the expertise and the institutions of the Montreal Protocol to phase down the production and consumption of HFCs, based on the examination of economically viable and technically feasible alternatives".