

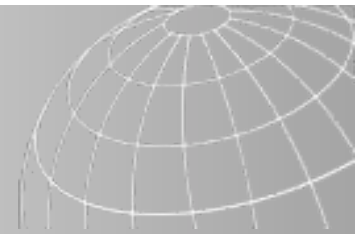
On behalf of



Federal Ministry for the  
Environment, Nature Conservation  
and Nuclear Safety

of the Federal Republic of Germany

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# **23<sup>rd</sup> Meeting of the Parties to the Montreal Protocol**

## **Applications for low-GWP replacement of HCFC22**

**20<sup>th</sup> – 25<sup>th</sup> November 2011, Bali, Indonesia**

**Daniel Colbourne**

[d.colbourne@re-phridge.co.uk](mailto:d.colbourne@re-phridge.co.uk)

# Introduction

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- Use of low-GWP (<150) refrigerants often raised within Montreal Protocol discussion
  - Which low-GWP refrigerants?
  - Suitable for what sectors?
  - Possible implications?
- Often disagreement/lack of understanding
- GIZ Publication – short guide intended to provide Parties with general guidance as to what can be used where and how easy/difficult it is
- Based on experience in Article 5 and non-Article 5 countries

# Key messages

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- Publication summarises
- High priorities for the introduction of low-GWP technologies are seen in particular for portable, split & window air conditioners, centralised retail refrigeration and cold storages.
- By targeting the high-priority sub-sectors, some 70% of the HCFC-22 consumption for new systems and installations can be avoided.
- Most suitable low-GWP options are natural refrigerants CO<sub>2</sub>, Ammonia and R290 (propane)

# Key messages

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- Publication summary...
- High priorities for the introduction of low-GWP technologies are seen in particular
  - for portable, split, window air conditioners
  - centralised retail refrigeration
  - Industrial and cold storage
- By targeting the high-priority sub-sectors, ~70% of the HCFC-22 consumption for new systems and installations can be avoided.
- Most suitable low-GWP options are currently natural refrigerants CO<sub>2</sub>, Ammonia and R290 (propane)

# Overview of RAC sector

Sub-sector	Equipment type	low-GWP priority	Consumption of R22		
			New (kt)	Service (kt)	Share (%)
Retail refrigeration	Stand-alone	High	neg	neg	<1%
	Cond units	Med	4,500	16,000	8%
	Centralised	High	3,000	9,000	14%
Cold storage/ind	all	High	15,000	12,000	7%
Transport refrigeration	Road, rail, marine	High	neg	neg	<1%
Stationary air conditioning	Split, window	High	58,000	54,000	45%
	Multi-split/VRF	Low	14,000	14,000	15%
	Rooftop/ducted	Med	2,500	3,000	4%
	Chillers	High	5,000	9,500	4%
Heat pumps	hot water, central	High	900	200	<1%

# Breakdown for each sub-sector

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- Refrigerant options

- Typically HCs (R290, R1270), R717 (ammonia), R744 (CO2)
- Also includes some in indirect/secondary systems

- Cost effectiveness

- IOC and ICC
- Values provided are in range; due to differences amongst equipment types, location, specific refrigerant option, etc
- NOTE: Try to address REAL costs, not negotiated HPMP-type costs

- Emissions reduction

- Approx. =  $M_{R22} \times GWP_{R22} \times (EF_{use} \times N + EF_{eol}) / (M_{R22} \times 1000)$

# Retail refrigeration

- Stand-alone cabinets
  - Available with R290, R1270, R744



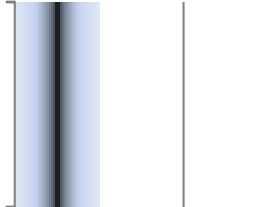
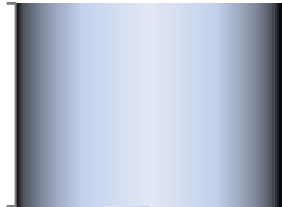
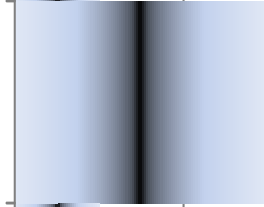
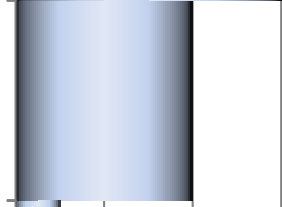

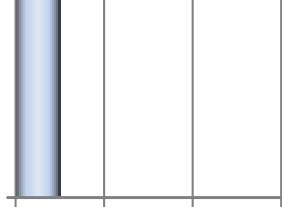
- Condensing units
  - Available with R290, R1270, R744



- Centralised supermarket systems
  - Many installed with R744, R717, R290, R1270
  - Several alternative concepts



# Retail refrigeration

Equipment type	Low-GWP refts	% easily applied	Cost implications		Emission red tCO2e/kg R22
			ICC (\$/kgR22)	IOC (\$/kgR22)	
Refrigerated/freezer cabinets (integral)	R290, R744	High			2.7
Refrigerated/freezer cabinets (condensing units)	R290, R744	Low			4.5
Refrigerated/freezer cabinets (centralised)	R744, [R290, R1270, R717]*	Med			8.1



# Cold storage / food processing and industrial

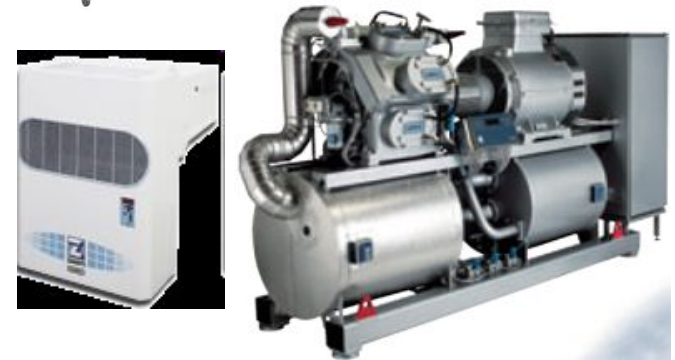
- Storage cabinets/coldrooms (integral)

- Available with R290 and R744



- Cold storage, process (cond. units)

- Available with R717, R744



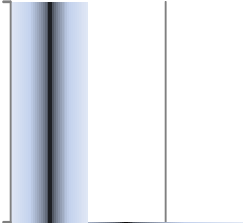
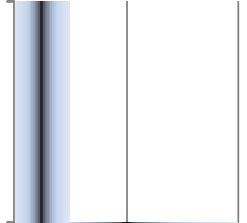
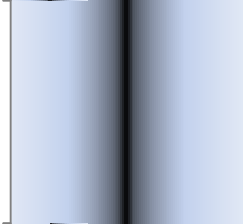
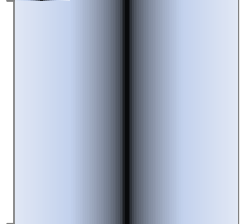

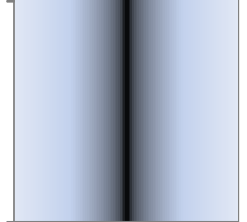
- Cold storage, process (centralised)

- Often used with R717, R744

- Available with R290, R1270



# Cold storage / food processing and industrial

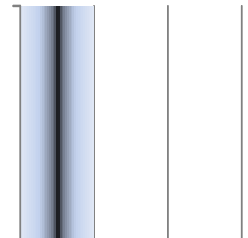
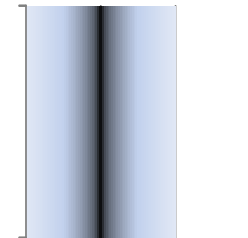
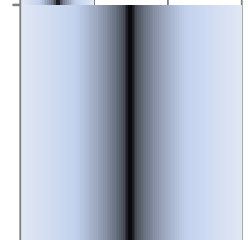
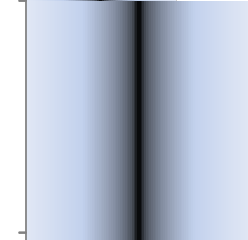
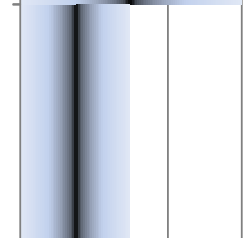
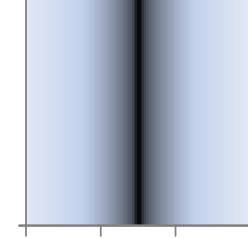
Equipment type	Low-GWP refts	% easily applied	Cost implications		Emission red tCO2e/kg R22
			ICC (\$/kg)	IOC (\$/kg)	
Storage cabinets and coldrooms (integral)	R290, R1270, R744	High			3.2
Cold storage, process (cond units)	R290, R1270, R744, R717, [R290, R1270, R717]*	Low			5.4
Cold storage, process (centralised)	R744, R290, R1270, R717 [R290, R1270, R717]*	High			8.1

# Transport refrigeration

- Refrigerated trucks and trailers
  - Available with R290 and R744
  - Reefer containers available with R744



# Transport refrigeration

Equipment type	Low-GWP refts	% easily applied	Cost implications		Emission red tCO2e/ kg R22
			ICC (\$/kg)	IOC (\$/kg)	
Refrig trailers, trucks	R290, R1270, R744	High			6.3
Refrig railcars	R744	High			6.3
Marine refrig	R744, R717	High			10.8

# Stationary air conditioning

- Split, window
  - Available with R290, R1290



- Multi-split
  - Available with R744
  - Alternatively use R290, R744, R717 chillers, etc




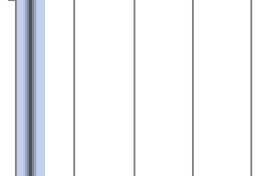
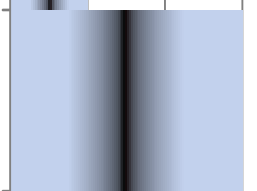
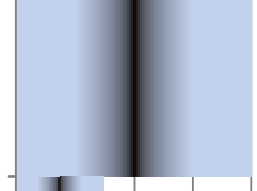
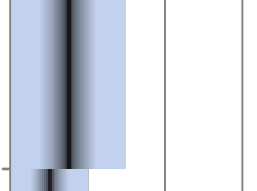
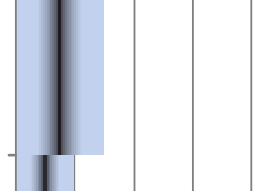
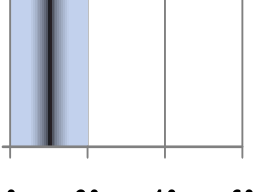
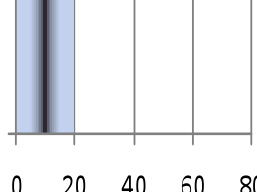
- Rooftop/ ducted
  - Available with R290, R744



- Chillers
  - Available with R290, R1270, R7



# Stationary air conditioning

Equipment type	Low-GWP refts	% easily applied	Cost implications		Emission red tCO2e/kg R22
			ICC (\$/kg)	IOC (\$/kg)	
Split, window	R290, R1270, R744	High			3.2
Multi-split	R744, [R290, R1270, R717]*	Low			2.7
Rooftop/ ducted	R744, R290, R1270	Med/low			2.7
chillers	R290, R1270, R717	High			1.8

# Special interventions to help overcome barriers

- Awareness-raising
  - Highlight the importance of the (climate) problem and the possibilities of (low-GWP) options available
- Training
  - Critical to adopt dedicated training – specific to each individual low-GWPs and specific to application/end use
- Guidance
  - High quality guidance of what low-GWP alternative, when, where and how; also targeted to specific stakeholder groups



# Special interventions to help overcome barriers

- Technical development
  - Improving efficiency of R744 AC systems for warm climates, reducing refrigerant charge sizes for systems using flammables, safety controls for systems using flammables
- Market development
  - Stimulate industry involvement with low-GWP alternatives; encourage local manufacturing, product directories, etc
- Financial incentives
  - Subsidies for using low-GWP, tax incentives for low-GWP/tax disincentives for high-GWP





# Special interventions to help overcome barriers

- Regulatory infrastructure
  - Impose better control of industry to work safely, modify regulations that inhibit low-GWP alternatives, ensure safety standards are constructive
- Montreal Protocol substantive issues
  - Decision-making bodies to introduce more incentives, HPMP consultants should be better assisted to embrace low-GWP alternatives
- ENGOs to more actively lobby on the high/low-GWP issue



## Final remarks

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- Short publication aimed to provide NOUs and industry with an overview of targets for low-GWPs
- Analysis of different sub-sectors and equipment types indicate suitable areas for early adoption of low-GWP refrigerants
- Large study in progress

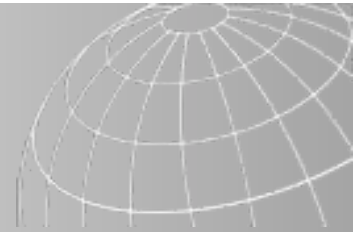
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**Thank you for your attention!**

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