

Applications with Natural Refrigerants

– country situation and experiences –

by

euramm^on
refrigerants delivered by mother nature



Reasons and barriers in switching to natural refrigerants in the developing countries, how to overcome them?

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1. INTRODUCTION

The Montreal Protocol (1987) caused a large quake in the field of refrigeration and air conditioning industry.

The Kyoto Protocol caused further turbulence in the refrigeration and air conditioning industry.

Because of the similarity of technologies and many other factors almost all equipment manufacturers and users of CFCs switched to HFC fluids.

Since 1995 a slow expansion of applications with natural working fluids takes place, mostly in Northern Europe.

There is no single criterion governing the choice of a refrigerant: type of application, size of the system, cooling temperature, environment, safety, ...

1. INTRODUCTION (continued)

There are many groups with varying interests on the market, different positions of many organizations, different national regulations and policies.

Differences between Northern and Southern European countries, between Europe and US, between developed and developing countries.

Polemics and confusion regarding refrigerants and technologies are present in the developed countries.

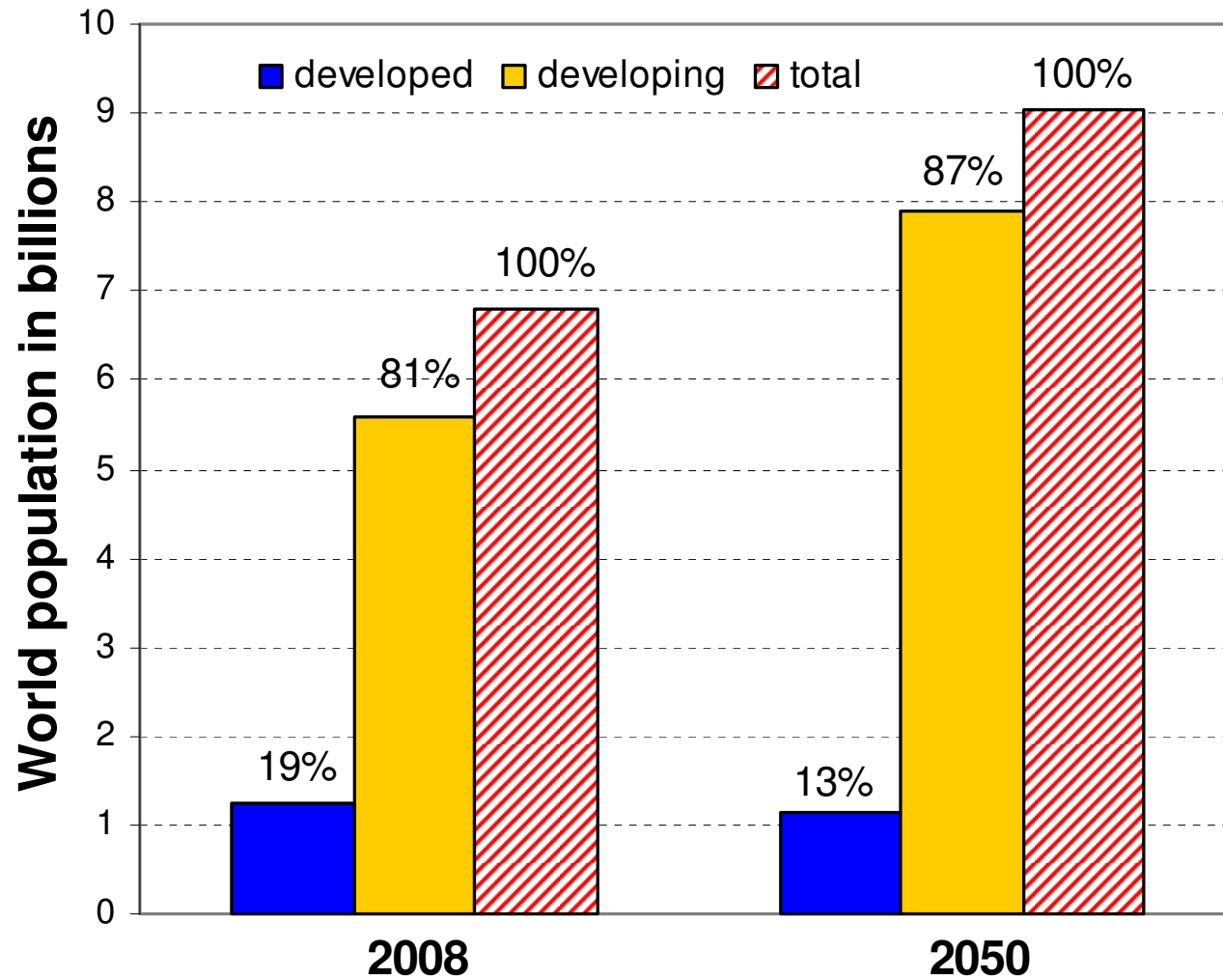
In the developing countries the confusion and uncertainty are present too much.

Alarming projection of HFCs consumption by Velders et al (2009).

Urgent measures and activities at global and national levels are necessary.

2. SOME FIGURES FOR DEVELOPING COUNTRIES

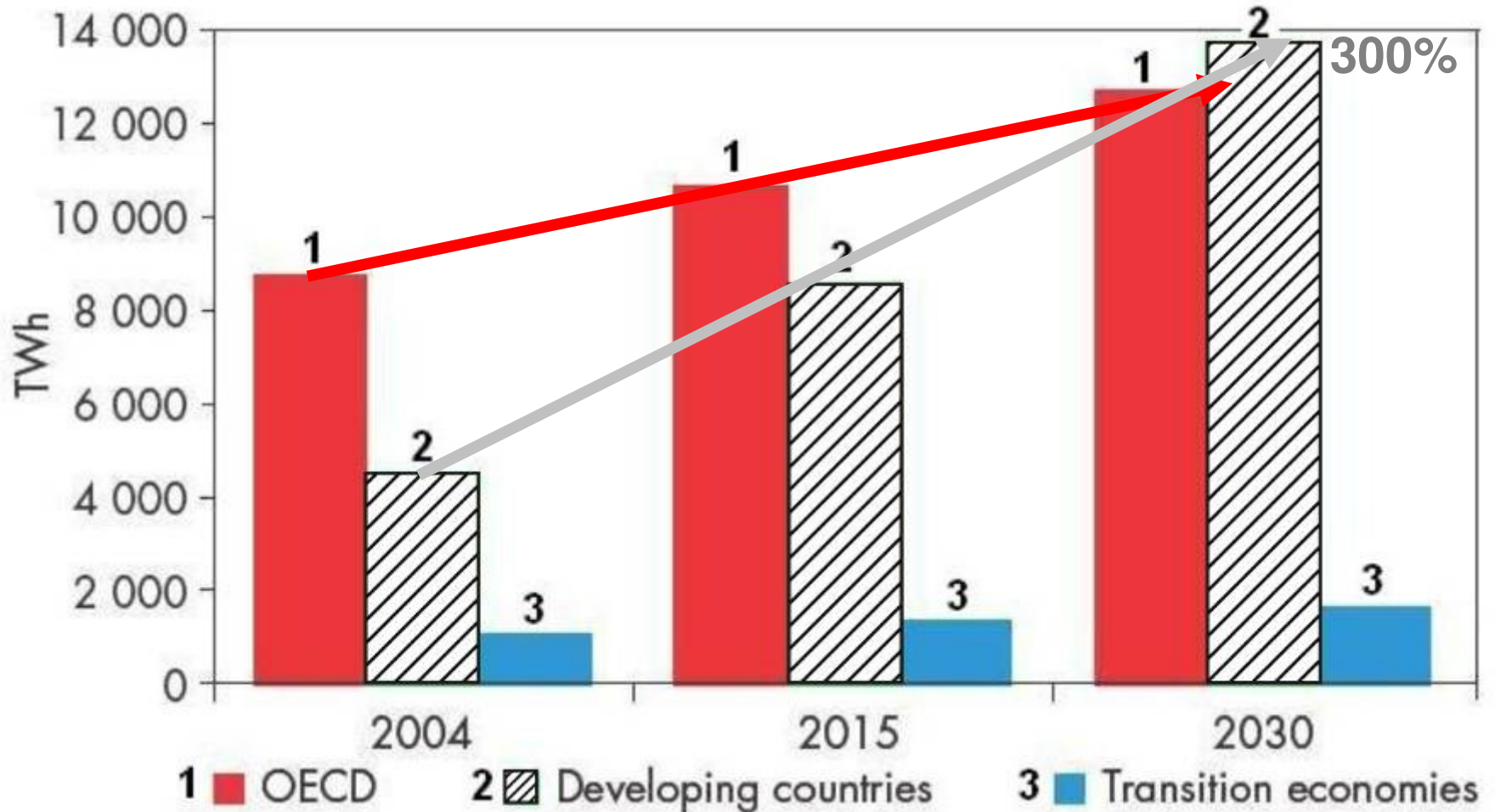
World population in 2008 and projected in 2050



Source: UN, 2009

2. SOME FIGURES FOR DEVELOPING COUNTRIES

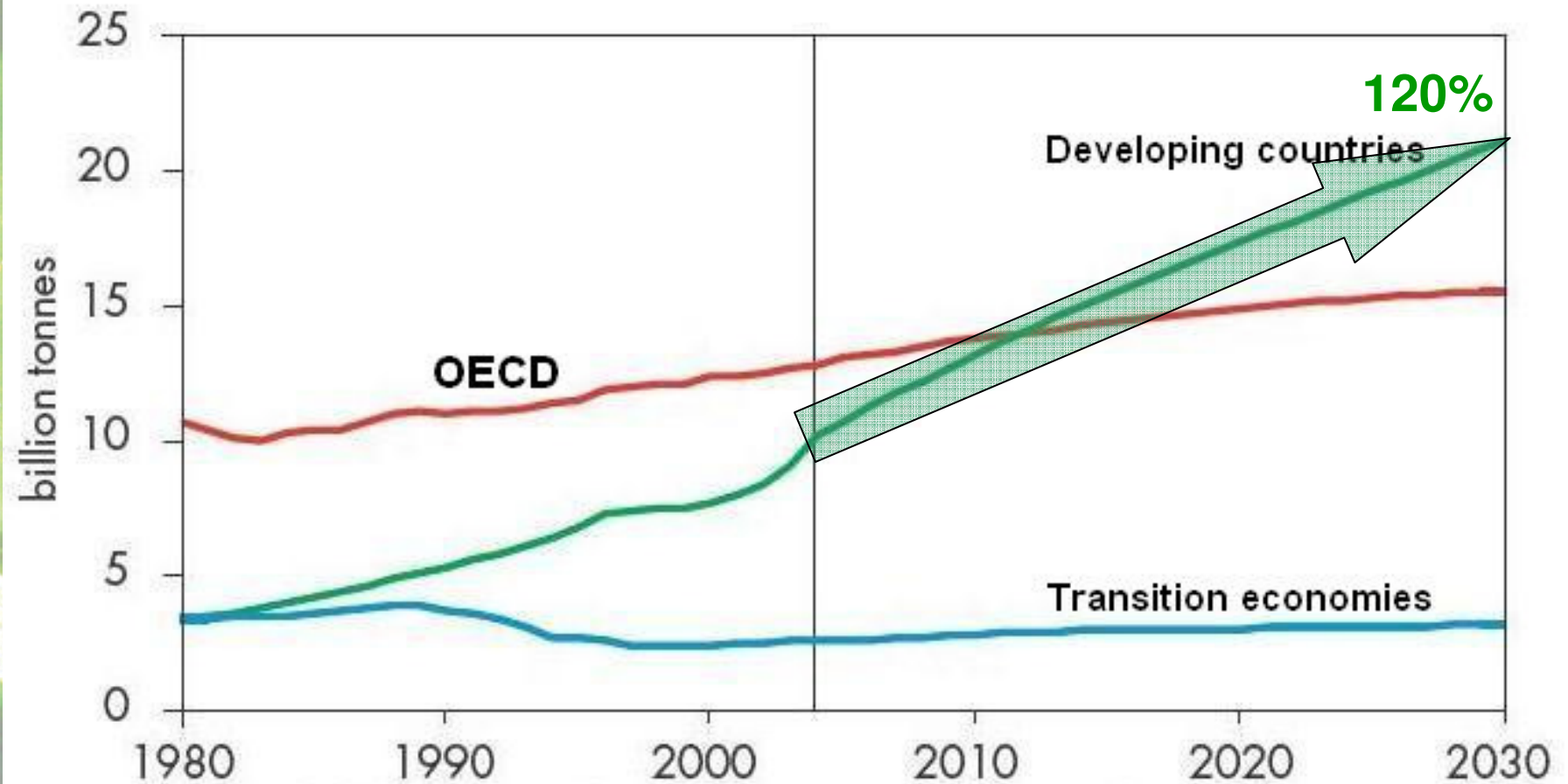
World electricity demand in the reference scenario



Source: IEA, 2006

2. SOME FIGURES FOR DEVELOPING COUNTRIES

Energy-related CO2 emissions in the reference scenario



2. SOME FIGURES FOR DEVELOPING COUNTRIES

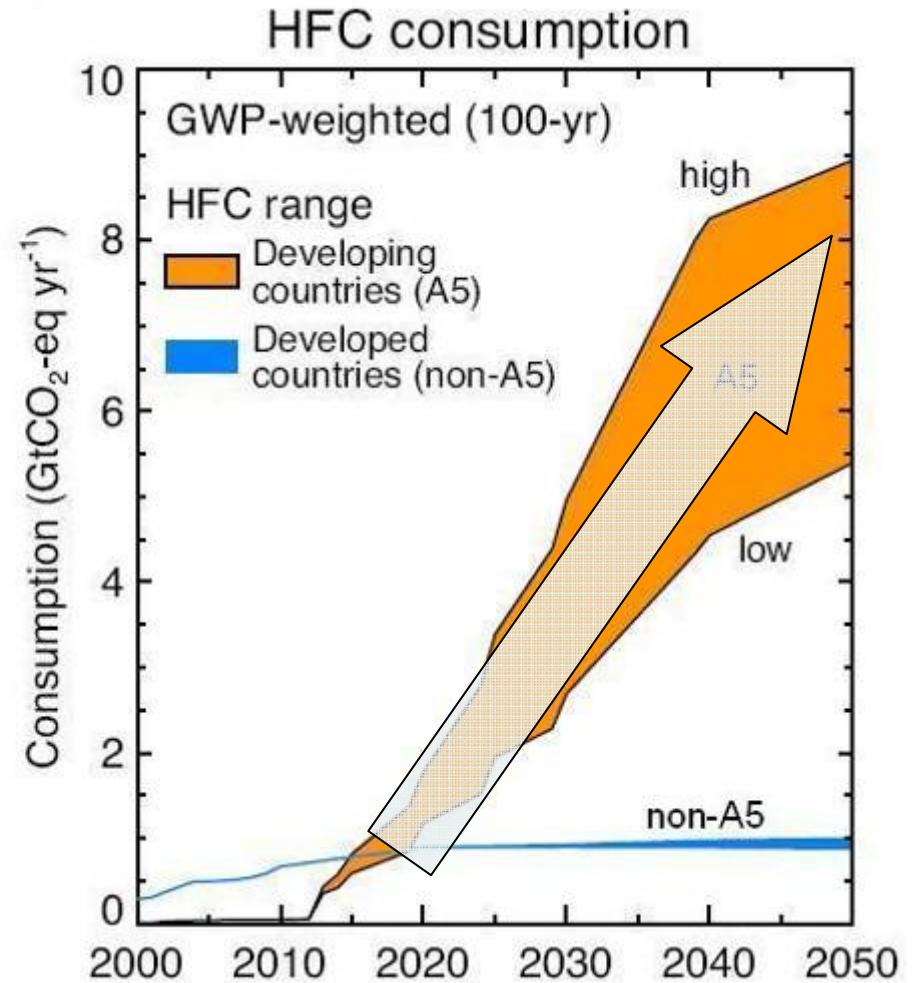
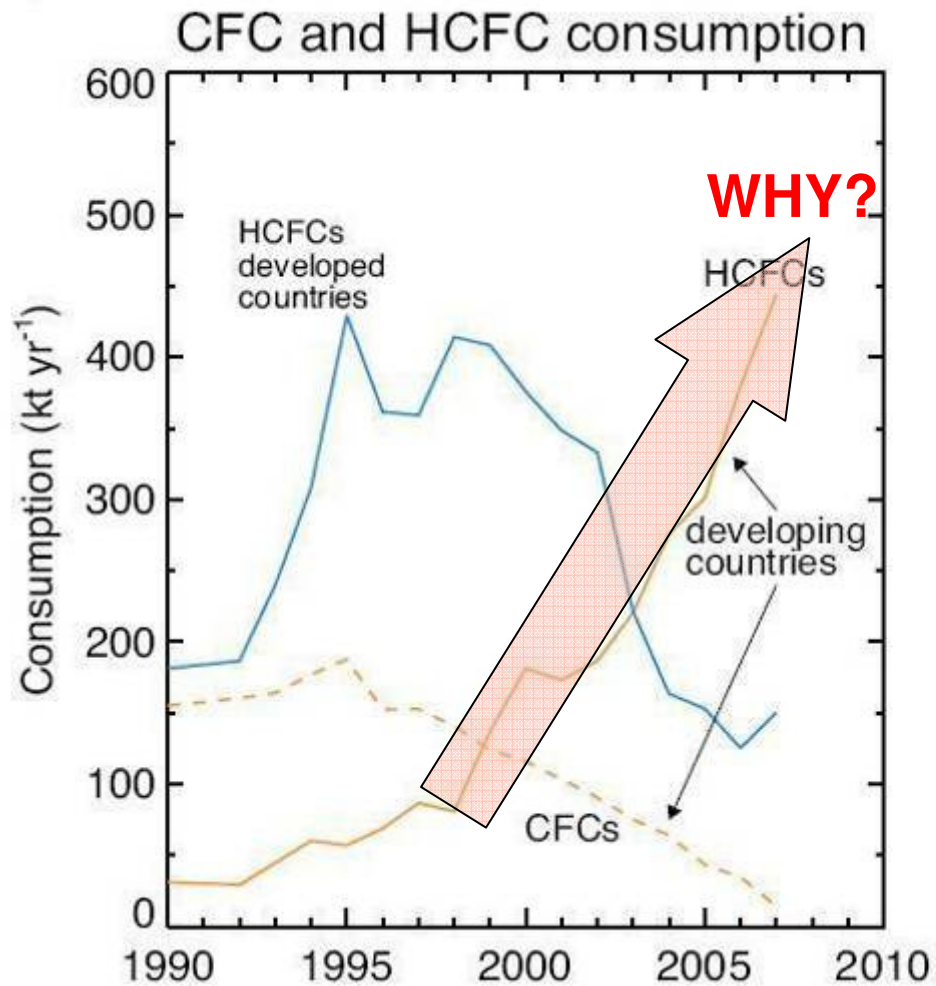
GHGs emissions

	Population	GHGs emissions
Developed countries	19%	60%
Developing countries	81%	40%

Ratio of GHG emissions per capita:

$$\frac{\text{Developed countries}}{\text{Developing countries}} = 6.4$$

2. SOME FIGURES FOR DEVELOPING COUNTRIES

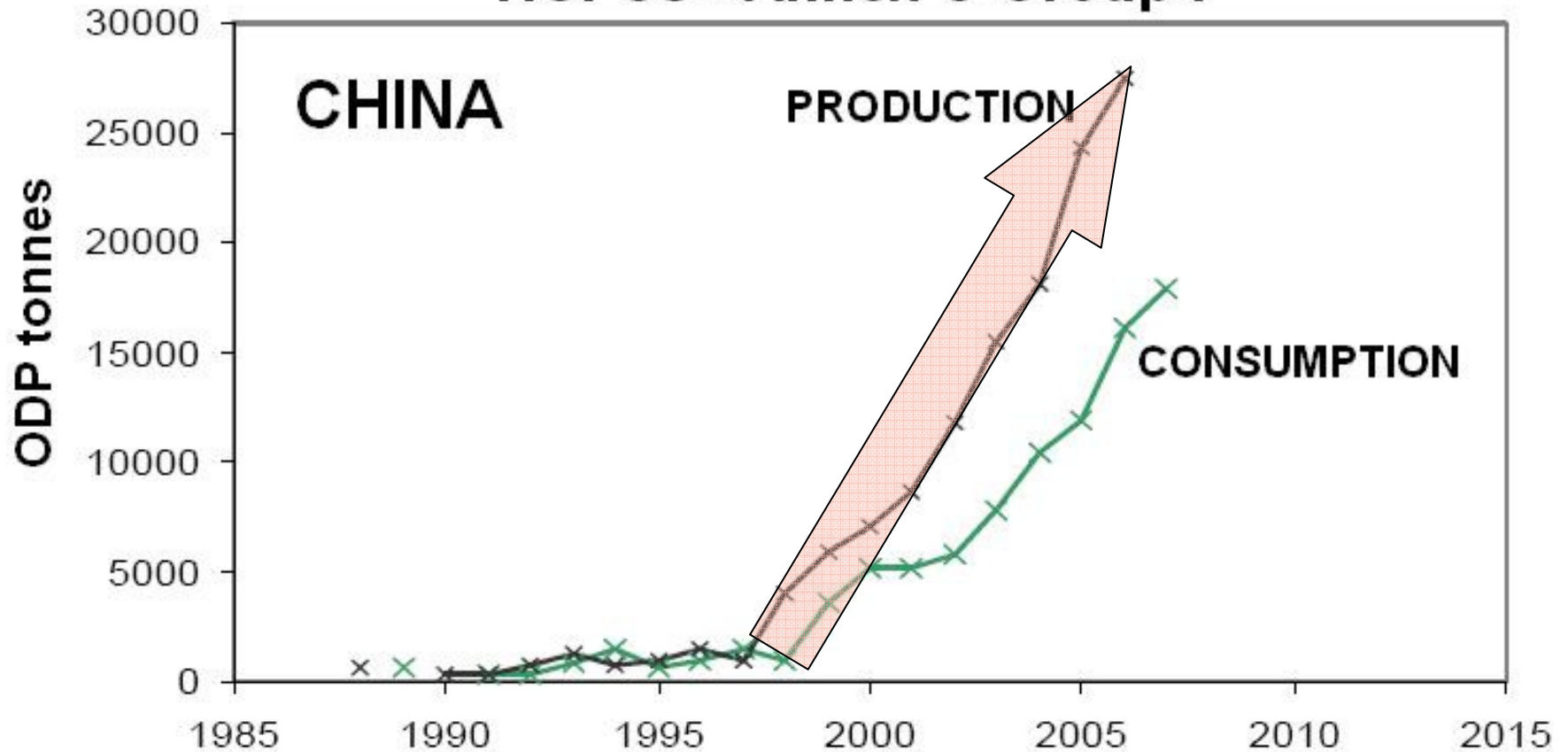


Source: Velders et al., PNAS, 2009

2. SOME FIGURES FOR DEVELOPING COUNTRIES

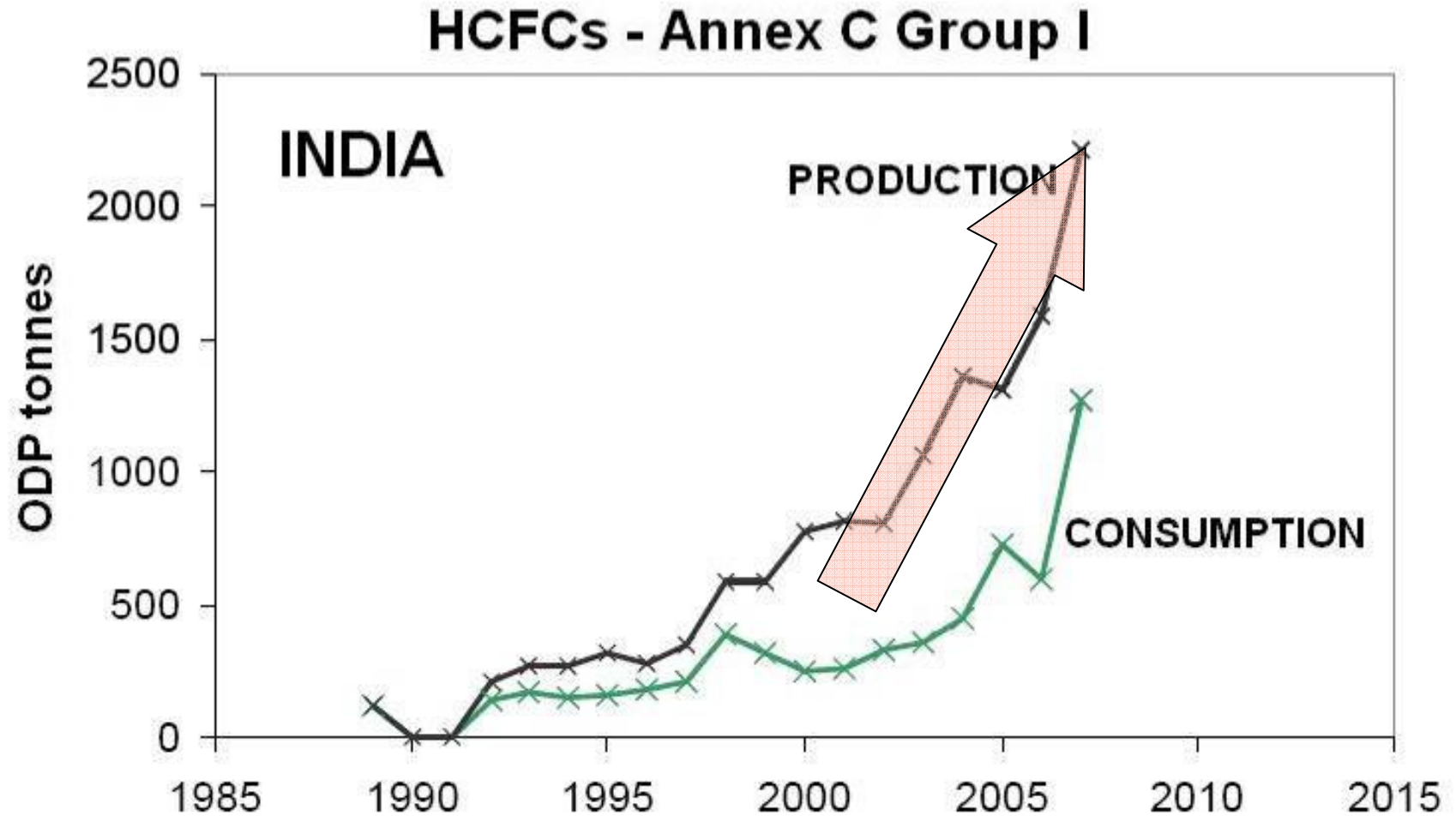
HCFCs production and consumption in China

HCFCs - Annex C Group I



Source: UNEP, 2009

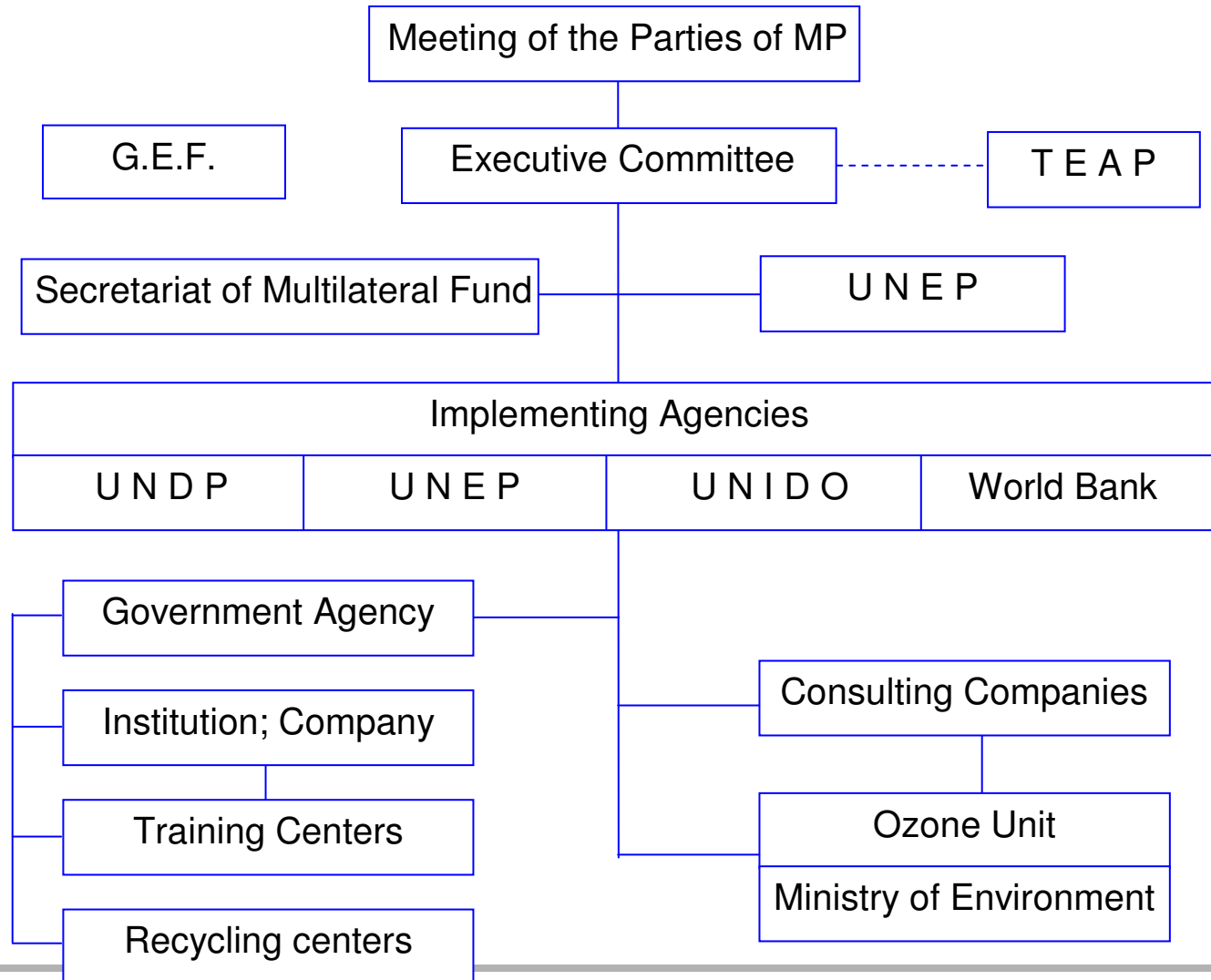
2. SOME FIGURES FOR DEVELOPING COUNTRIES



Source: UNEP, 2009

3. DEVELOPING COUNTRIES AND MONTREAL PROTOCOL

Structure of the Montreal Protocol



3. DEVELOPING COUNTRIES AND MONTREAL PROTOCOL

146 parties referred as “Article 5” countries.

The ExCom approved over **US\$2.5 billion** for over **6,200 projects**.

The ExCom has approved **143 country programmes**, and has funded the establishment and operating costs of **143 NOUs**.

The GEF allocated over **US\$370 million**: projects to phase-out ODS

It is announced that the MP is the most successful agreement in the world achieving complete phase-out of CFCs in 2010.

We should see the other side.

4. PASTE AND CURRENT CFC REPLACEMENT TECHNOLOGIES

Uncompleted unofficial survey on MLF funded projects

Sector	CFC replacement technology		
	HCFC; HFC	HCs	Ammonia
Domestic refrigerators	200	26	-
Commercial refrigeration	335	0	1
Chillers	11 (?)	0	0
MAC	27	0	-

Source: MLF, personal communication, 2009

4. PASTE AND CURRENT CFC REPLACEMENT TECHNOLOGIES

In almost all projects the CFCs are replaced with HCFC and HFC technologies.

**Minor exceptions at domestic refrigerators and freezers:
63 % of current world production employs HFC-134a,
even HC technology is proved and economically viable since 1994.**

Project: replacement of centrifugal chillers (mostly with CFC-11)

**In all cases they were replaced with new chillers with HFC-134a.
In the industrial sites ammonia screw chillers were not applied. ->
WHY?**

**The main reason: the lower first cost (named as cost effectiveness)
which is not correct approach.**

New approach: Life Cycle Cost; TEWI value; MCII; ...

**2010 MP Decision: Funding up to maximum 25% above the cost
effectiveness threshold for low GWP alternatives. HFO-1234yf ?!
Special Funding Facility – under consideration.**

5. ACCELERATING PHASE-OUT OF HCFCs – MP DECISION IN 2007

- Freeze in 2013,
- 10% reduction by 2015,
- 35% reduction by 2020,
- 67.5% reduction by 2025,
- 97.5% reduction by 2030,
- 100% reduction by 2040.

Upheaval in the Montreal Protocol position to the climate change

In the Decision XIX/6 of MoP (2007) on the HCFC phase-out for developing countries, for first time it is mentioned:

“To encourage Parties to promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate, ...”.

There are still discussions on the replacement strategies in HCFC phase-out management plans.

This might impact significantly on the selection of technologies.

5. ACCELERATING PHASE-OUT OF HCFCs – MP DECISION IN 2007

In a first instance with the strategy until 2015 it can be expected that the management plans will use conversions to HFCs. ->**WHY?**

More information for options about replacement technologies are published in the **TEAP** report in 2010.

On the XXI MoP (November 2009) a proposal for phase-down of HFCs was submitted, it means the production and consumption of HFCs to be governed under the MP. (plateau of 15% in **2043**).

Consensus could not been reached. It is under discussion (2010).

The UN climate conference (2009, Copenhagen) resulted only with a political document (“accord”) without legal commitments. The negotiations were mostly unsuccessful.

The uncertainty is continuing.

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES



The biggest barrier to use natural refrigerants in developing countries: **lack of information** and **proper information**.

“The ammonia technology is old, dangerous and expensive ???”
They don't know for improvements and new possibilities to use.

There is paradoxical situation: some ammonia cold stores in developing countries are renovated switching to HFC-404A.



6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

The first cost of equipment with ammonia and CO₂ is higher, this is a barrier at a global level.

If a Life Cycle Cost (LCC) is carried out then this barrier can be mitigated or overcome.

Furthermore, we have to take the additional cost of generated GHG emission of HFCs (CERs), and to take in account that the leakage rate in developing countries is double and more compared to developed countries.

In most developing countries:
there is a weak economy with a low purchase potential.

The refrigeration systems become older exposed to oftener leakage of refrigerants.

Due to the much higher leakage rate the consumption of H(C)FC refrigerants is big.

More and better maintenance and servicing are required.

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

Many companies from developed countries sell old HCFC equipment to developing countries.

Xxxxxxxx and Yxxxxxxx join forces on pioneering replace-and-export initiative for R22 chillers

Friday, 19 September 2008



Two leading UK air conditioning companies have joined forces to launch a ground-breaking initiative aimed at end users still dependent on R22-based cooling plant. Under the scheme, XXXXXXXX and XXXX: XXXX: will replace R22 chillers with modern state-of-the-art equipment, and then recondition and export the removed plant to developing countries, such as India. The financial benefit of selling on

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~~Two leading UK air conditioning companies will replace R22 chillers with modern state-of-the-art equipment, and then recondition and export removed plants to developing countries.~~

~~UK end users get modern, high efficiency replacement systems; and overseas end users get low cost reconditioned cooling systems ...~~

~~...a major business opportunity with benefits for all sides. The approach results in a win-win situation.~~

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

Many companies from developed countries sell old HCFC equipment to developing countries.

XXXXXXXXX and YXXXXXXXXX join forces on pioneering replace-and-export initiative for R22 chillers

Friday, 19 September 2008



In fact the problem with HCFCs is relocated to the developing countries.

on R22-based cooling plant. Under the scheme, XXXXXXXXX and XXXX:

Similar situation happened 10 years ago with domestic refrigerators and other equipment containing CFCs.

significant saving in capital outlay and delivering ongoing benefits associated with modern, high efficiency plant.

Probably a ban on import of HCFC equipment will be introduced after several years, but this will be too late.

to target what they see as a major business opportunity with benefits for all sides, reveals the companies' joint press release. XXXXX of XXXXXXXXX said: "A recent research suggests that up to 65 per cent of all installations still depend on R22. With a European-wide ban on the use of new R22 for topping up systems coming into force in 15 months time, and the cost of R22 rising steeply, end users could find themselves in serious difficulties if they do not grasp the nettle now." XXXXXXXXX of XXXXXXXXX said: "The approach results in a win-win situation. UK end users get modern, high efficiency replacement systems that cost less to run and maintain, and for a reduced capital outlay; and overseas end users get low cost reconditioned cooling systems that help meet the urgent need for industrial development to drive their own economies."

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

Almost all service companies in RAC sector are very small with one to five employed.

No budget for improvement neither time for further education; no new information and better practice.

The priority of the companies in developing countries is how to survive, the type of refrigerant is not so important.

There are many service technicians who work without registration that reflects to the quality of servicing.

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

The individual air conditioning units are distributed like other domestic appliances without interesting in what refrigerant inside is, usually say it is "freon".

There are units with a label where it is declared that R-22 is an ecological gas.

Generally all RAC equipment with HFCs is declared as ecological.-> **WHY?**

A photo made in 2009.

cooling capacity:
3510W

ecological gas:
R22

?

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

Kyoto Protocol – Clean Development Mechanism (CDM):
Destruction of HFC-23 which is a by-product at R-22 production.

CDM projects with CERs issued

CDM projects in the pipeline	All CDM projects in Pipeline			CDM projects with CERs issued	
	Projects	2012 kCERs	2020 kCERs	Projects	Issued kCERs
HFCs projects	22	476,516	1,100,200	18	218,637
All other rojects	5,421	2,392,229	7,461,486	741	211,661
Total	5,443	2,868,745	8,561,686	759	430,298

Source: UNEP RISO Center, 2010 September

6. PROBLEMS AND BARRIERS IN DEVELOPING COUNTRIES

2010: 218,637,000 CERs issued => 2.84 billion US\$

MLF + GEF = 2.87 billion \approx 2.84 billion US\$ -> WHY?
(1992 - 2010) (HFC-23 destruction)

The budget of MLF must be bigger!

By 2020: expected 1,100,200,000 CERs => 14.302 billion US\$

This is fantastic amount of money for perverse funding for destruction of HFC-23.

7. TRANSFER OF TECHNOLOGIES IN DEVELOPING COUNTRIES

The role of UN agencies in transfer of technologies is important: implementation of projects, regional networks, publications ...

Training manuals: published by UNEP in 1994.

There is nothing with natural refrigerants.

These manuals adapted on national levels are still in use.

However, there is not anything for Ammonia, HCs and CO₂. ->**WHY?**

There are guidelines for HCs, for domestic refrigerators, published by GTZ .

Technologies with NH₃ and CO₂ are a privilege of rich countries.

Facts:

- manufacturers and users of CO₂ equipment are in developed countries.
- new ammonia and NH₃/CO₂ cascade systems, supermarkets,
- IIR GL conferences, too expensive,
≈ 5% participants from developing world.

7. TRANSFER OF TECHNOLOGIES IN DEVELOPING COUNTRIES

Positive role of GTZ (German agency for technical cooperation)

Introduction of HC technology in domestic refrigerators at manufacturers in China, India, Brazil, since 1995.

About 75% of China's domestic refrigeration industry uses hydrocarbon (R600a) technology.

In 2009 GTZ have started a project with one Chinese manufacturer to introduce HC in room air conditioners.

The CoP 14 under UNFCCC, administered by the GEF approved: Strategic Programme on Technology Transfer.

Identified technology transfer as a long-term priority objective of the GEF in the climate change focal area.

This can be used for introduction of technologies with natural refrigerants.

8. SUGGESTIONS

There are already proved technologies with natural refrigerants such as NH₃, CO₂ and HCs mostly applied in developed countries.

New strategy and measures must be undertaken to switch directly to technologies with natural refrigerants.

Dissemination of information on technologies and practices with natural refrigerants from developed to developing countries;

Introducing new products on the market in developing countries: new components and new systems. Incentives should be given.

Approaching to new concepts of refrigeration and air conditioning systems with a low refrigerant charge.

Presentations of possibilities using natural refrigerants in various applications: commercial and industrial refrigerating systems, air conditioning and heat pumps, and car air conditioning.

8. SUGGESTIONS

The importance of energy efficiency in the RAC systems with natural refrigerants should be emphasized.

To inform national stakeholders involved in preparation / implementation of management plans for phase-out of HCFCs for replacement technologies with natural refrigerants.

Technical assistance, education and training for safe operation with natural refrigerants.

New manuals for maintenance and servicing with natural refrigerants to be prepared and training courses to be organized.

To introduce standards and regulations for design and safe operation of these systems, using the positive experiences of the EU standard EN378. Explanations how and where the risk can be decreased and/or eliminated should be given.

8. SUGGESTIONS

To install demonstration units and systems with new technologies with ammonia and CO2 in every developing country, supported by MLF and/or GEF.

Spreading the above information to the RAC associations in every country. If there is not, giving support to establish a RAC association.

To support experts from developing countries to participate on the events that have programme for technologies with natural refrigerants, and to visit technical exhibitions for RAC equipment.

Outcomes:

sustainable development, ozone free and climate friendly technologies; achieving goals of the MP and Kyoto Protocol; elimination of uncertainty to many regulations; improving competitiveness and inclusion on the global market; new technologies will create new jobs.

9. DISCUSSION

The technologies with natural refrigerants (NH₃, CO₂ and HCs) were known since 19th century.

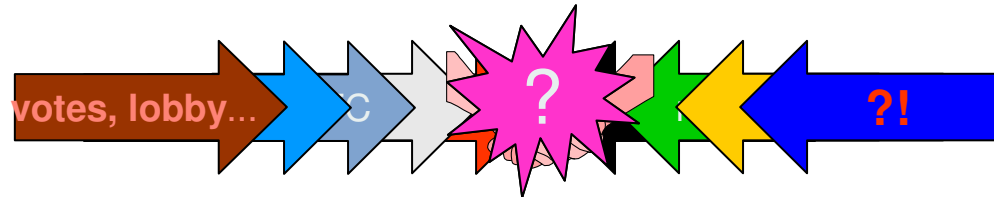
Since 1990 many technologies with natural refrigerants are more improved, implemented and proved.

However, the world community is late. -> **WHY?**

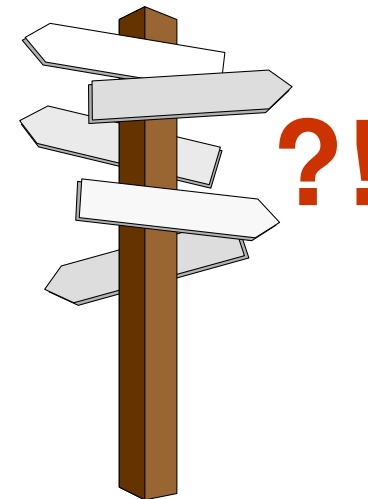
Behind a lack of proper information it hides conflict of interests from many interested sides.

9. DISCUSSION

CROSSING OF DIFFERENT INTERESTED SIDES:



- **Manufacturers of CFCs, HCFCs, HFCs**
- **Manufacturers of equipment with CFCs, HCFCs, HFCs**
- Distributors of equipment and refrigerants
- **Montreal Protocol**
- **Environment organizations**
- **Kyoto Protocol**
- **Research institutions**
- **Users**
- **Politics**



9. DISCUSSION

"Neutral position" is a pretext of many international organizations regarding the natural and synthetic refrigerants.

Between the high potent GHGs and climate friendly refrigerants a neutral position cannot exist.

Some UNEP officials asserted that "... these alternatives (HFCs) were used because there was no other economically feasible, commercially viable and safe option".

Other institutions state: "Almost everywhere, products based on non-halogenated substances have reached a technical level that makes their use ecologically and economically viable ".

**The current model in supporting projects under MLF if applied to HCFCs would actually promote HFC climate technologies. -> WHY?
A new model is necessary, using Life Cycle Cost, TEWI, and introducing incentives.**

9. DISCUSSION

In the past UNEP promoted "Responsible use principles for HFCs"! This is not a sustainable approach.

U. Lahl from Federal Ministry for Environment of Germany stated: Regulations (EN 842) are not the appropriate method to reduce F-gas emissions in the long term. **If we are not able to guarantee containment or recovery of refrigerants in Germany, how should this work in developing countries?**

The first cost of equipment with CO₂ and NH₃ will decrease if production and sales volumes increase.

➡ Expansion on market in developing countries (81% population).

So, the capital cost should not be seen as a barrier, but as a motivation to act.

9. DISCUSSION

New measures and regulations have to be introduced at a global and country level.

It is a fact that the chemical companies, producers of HFCs, have excellent marketing activities and strong lobby.

We see what happens with world financial and economic crisis when the profit is a priority without control.

Money makes the world go round!

The answer to **WHY:**
the money have a priority than the environment.

Many experts say: the technologies with natural refrigerants are not a technical question, it is political. This was evident on the UN climate conference in Copenhagen in 2009.



9. DISCUSSION

The switch to technologies with natural refrigerants will be a long process and more painful for developing countries because of their weak economies and lower technology level.

Without technical and financial support it cannot be expected a success in switching to technologies with natural refrigerants.



Necessity: to establish funding for starting activities in the developing countries.



4th International Conference



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14-16 April 2011, Ohrid, Macedonia

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