Stakeholder Meeting for the implementation of

UNEP' GLOBAL TECHNICAL ASSISTANCE PROGRAMME IN THE CHILLER SUB-SECTOR

CONCEPT NOTE

29 October 2006

BACKGROUND

The 48th meeting of the Executive Committee of the Multilateral Fund approved a Global Technical Assistance Programme in the Chiller Sub-Sector to be implemented by UNEP. The project complies with decision XVI/13 and in particular with regard to the countries which didn't receive a chillers demonstration project or any support in the chillers sector from the Multilateral Fund. Through UNEP's Compliance Assistance Programme, this project aims at providing global technical assistance to Article 5 countries in the chillers sub-sector to enable the countries to gain better understanding of the available financial and technological options in the chillers sub-sector to phase-out ODS through a close coordination with other Implementing and Bilateral Agencies working on investment projects in the chillers sector, other relevant stakeholders at the global and regional level as well as the regional teams of the Compliance Assistance Programme.

The 47th & 48th meetings of the Executive Committee approved several chillers demonstration projects within the funding window opened as per decision 45/4 covering countries in Latin America, Africa, East Europe, West Asia and South Asia & Pacific regions. Historically there were also previous approvals –under the Multilateral Fund- for chillers demonstration projects and activities (replacement & retrofitting); additionally many developed countries and some developing countries adopted national programs for phasing out the CFC-based chillers. On the other hand, most of international manufacturers developed and promoted non-CFC technologies during the last two decades. The TEAP special report on Chillers –that issued in 2004- provide a comprehensive snapshot on the technology trend as well as available information on remaining CFC-based chillers around the world. International/regional/national associations and societies are also contributing to the phase out actions through research activities, functions and thematic initiatives.

UNEP recognizes the importance of compiling all past, ongoing and future efforts in this movement and present relevant information in a useful way to the targeted stakeholders i.e. owners, policy makers, consultants and others influential parties to the chillers sector. UNEP also understands the values of coordination and appropriate planning for the sake of best results and saving of resources. Therefore, UNEP will organize a stakeholder meeting to discuss the implementation of the Global Technical Assistance Programme in the Chiller Sub-Sector.

TARGETED PARTICIPANTS

Participants to the stakeholder meeting will be representing the key partners and source of information for the implementation of the Global Technical Assistance Programme in the Chiller Sub-Sector, the proposed list includes:

- Bilateral & Implementing Agencies (Canada, Germany, France, Japan, USA, UNDP, UNIDO & World Bank);
- TEAP Chiller Task Force;
- Industry Representatives (Carrier, Trane, York, Daikin and others);
- Relevant International Associations/Organizations (ARI, ASHRAE, ICARMA, IIR) &
- Financial institutions

This meeting is being coordinated by UNEP's Compliance Assistance Programme Team (CAP) in cooperation with United States Environmental Protection Agency (US EPA).

OBJECTIVES

The stakeholder meeting will have the following objectives:

1. Discuss the project implementation approach and activities and compile feedback/proposals of participants and views on cooperation during the implementation timeframe.
2. Review the implementation time schedule of UNEP project with other Bilateral and Implementing agencies schedules in executing the demonstration projects to ensure that outputs of these projects are well reflected in the products developed by UNEP project.
3. Identify sources of information that could be used during the compilation phase of the project and means of verifying collected data.
4. Discuss the potential role of manufacturers and associations in compilation and dissemination of information during the various stages of the project.

DISCUSSION TOPICS

The topics proposed for discussions in the stakeholder meeting are:

- Detailed explanation of the project content and UNEP' view of implementation
- Plans and schedules for the chiller demonstration projects implemented by Bilateral and Implementing agencies
- Manufacturers views and experiences (focus on replacement/retrofit experience)
- Associations activities in the chiller sector
- Adequacy of the proposed activities and products in addressing countries' needs
- Role of Industry and international associations in information compilation and dissemination
- Proposed coordination plan inline with to the implementation time schedule
- Other topics (to be suggested by participants of the meeting)

DATE & VENUE

29 October 2006 from 9.00 a.m. to 5 p.m. at India Habitat Centre, New Delhi.

Chiller Replacement Projects

Presentation by World Bank
Global Chiller Workshop
29 October 2006
New Delhi, India

Objectives

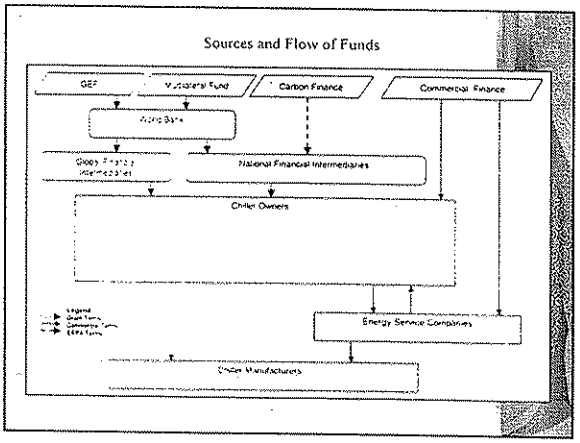
- Provide an overall strategy for all participating countries for phasing out CFCs in the chiller sector; and
- Promote utilization of more energy efficient chillers.

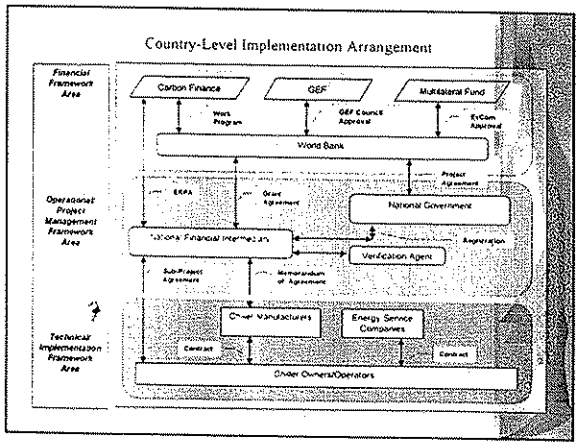
Expected Outputs

- Fulfillment of Protocol-mandated phase-out of CFC consumption;
- Accelerated transformation of the chiller sector market to one more technology-driven and responsive to energy saving opportunities;
- Free up power capacity of up to 416 MW;
- Reduce carbon dioxide emissions by up to 5.3 million MT per year for the next 17 years.

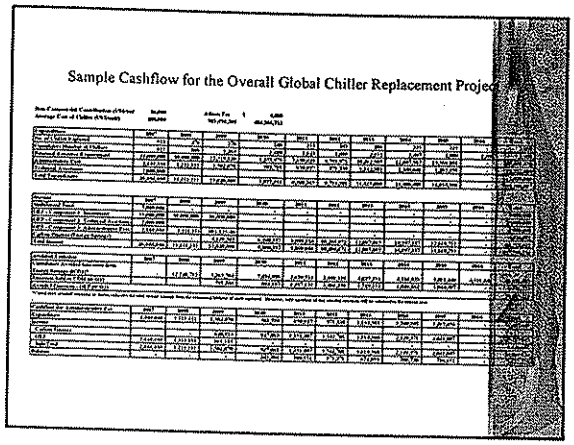
Project Description

- Deliver incentives to CFC chiller owners sufficient to overcome the well-documented techno-economic barriers;
- Stimulate the adoption by participating countries of policy and regulatory measures aimed at:
  - Fulfillment of CFC phase-out obligations;
  - Bringing private behavior in respect of energy conservation more in line with desirable social behavior; and
  - Reducing or eliminating avoidable greenhouse gas emissions.



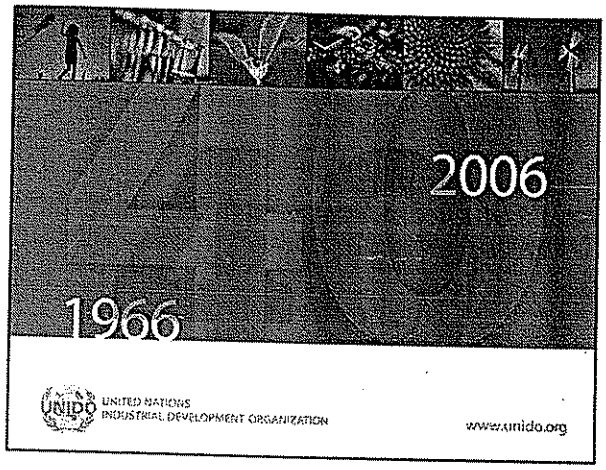


Sample Cashflow for the Overall Global Chiller Replacement Projec



Project Components

- Investment Component
  - Financial incentives to chiller owners to accelerate their chiller replacement schedules;
  - Level of incentives determined in accordance with para. (b) (ii) Decision 46/33;
- Technical Assistance Component
  - Local project implementation units (LPIU) will work with NOUs to assist chiller owners preparing decentralized refrigerant management plans;
  - Capacity building for LPIU on energy conservation and proper handling of refrigerants.
- Awareness
  - Chiller suppliers with their existing sales network will conduct, in close cooperation with LPIU and NOU, awareness activities for the targeted audience (chiller owners).



UNIDO's Chiller Programme

UNEP - USEPA Chiller meeting side event

S. M. Si Ahmed

29 October 2006, New Delhi, India

Three Regional Projects Approved

- West Asia (US$ 585,961) – Syria.
- Eastern Europe (US$ 1,069,074) - Croatia, Macedonia, Romania, and Serbia and Montenegro (Former)
- Africa (US$ 2,000,000) – Cameroon, Egypt, Namibia, Nigeria and Sudan (with possibility to include more countries in Africa)

Under implementation by UNIDO, France, Germany and Japan

Project Activities

- Awareness Raising
- Policy advice
- Capacity Building
- Technology transfer
- Demonstration of funding approaches for replication aspects: Country based approach taking into account existing local conditions and chiller populations
- Dissemination of lessons learned

Croatia – Working through ESCOs

Role of the ESCO (Hrvatska Elektroprivreda)

- Information, advice and training on energy management issues
- Support for the implementation of energy plans
- Energy audits
- Raising awareness on energy efficiency
- Search for energy-management incentive funds at national and international level
- Financing through credit

Romania, Macedonia and Syria

Building the end users capacity in;

- evaluating the various available technology options,
- better understanding of the return on investment issue,
- preparing specifications,
- evaluating proposals,
- accessing chiller suppliers worldwide,
- available funding options

Serbia

- Provision of subsidies for the replacement of a number of chillers instead of the partial cost pertaining to the replacement of one chiller.

Common Limitations

- Substantial external financial resources are often required for the modification of the entire cooling plant, which creates an additional obstacle

Africa

- Innovative approach to clearly evaluate and demonstrate the incentives and remove barriers for operators to replace CFC based chillers through coordinating inputs from engineering facilities and energy contracting providers, investors, financial institutions, government and private sector stakeholders in the region.

Organizational and Institutional Framework

Government interventions in creating an overall framework that encourages chiller replacement

Differentiated roles ⇕ *Complementary roles*

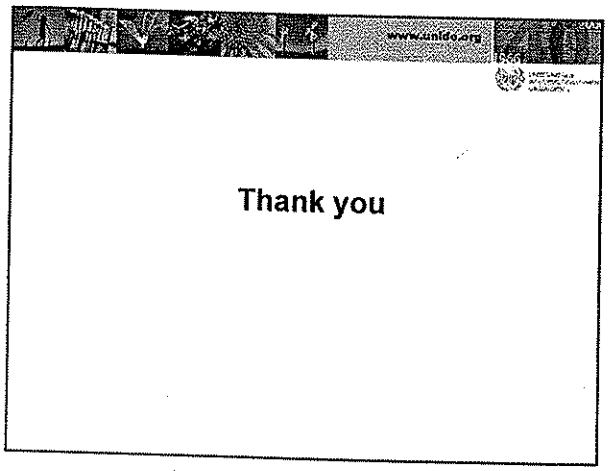
Stakeholder involvement and willingness to respond with creativity and business generating attitude

Potential External Funding Sources

- FGEF
- UNIDO's Investment and Technology Promotion Office (ITPO), Tokyo
- Japan Bank for International Cooperation
- African Development Bank
- Import / Export Banks (Afreximbank)
- Commercial Banks

Main Conclusions of the Regional Workshop in Cairo

- Need to maintain momentum under the project funding conditions
- Implementing agencies were requested to take up the use of approved funds with the Multilateral Fund so that release of the funds is not conditional to any other steps at the national level
- Need to explore the CDM potential (UNIDO is currently studying the possibility of starting with a pilot country)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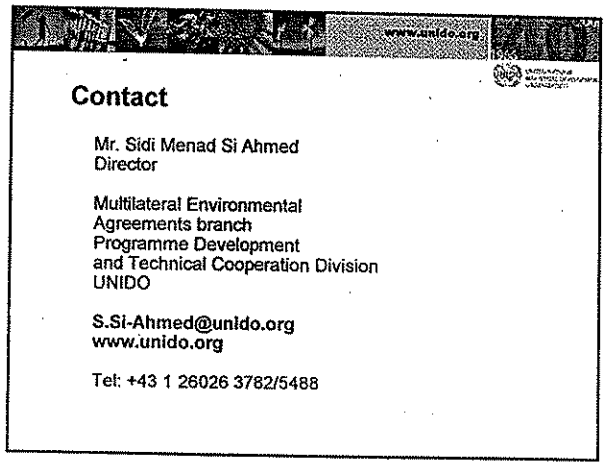
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"Utilizing the Clean Development Mechanism of the Kyoto Protocol to modernize Refrigeration Systems"

AFROC – AN EXAMPLE FOR CHILLER CDM FINANCING IN AFRICA

Juergen USINGER
GTZ Proklima

October - New Delhi

gtz

Content

1) **Introduction of AFROC Project**
2) **Network of AFROC**
3) **Possibilities on Financing and Funding**
4) **Possibilities on CDM Financing**

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1) Introduction of the AFROC Project

Background

- Approved by the MLF: funding of a demonstration project and financing of 19 chillers in 6 African countries
- Market: ca. 600 to 1,000 chillers in the African countries
- Estimated average investment: ca. 140,000 US $ per chiller
- Incentive for significant exports of energy efficient technology system (unit and system)
- Proposed initial volume of funding: 20,000,000 US $

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1) Introduction of the AFROC Project

Phase I
- Demonstration of financial incentives and necessary infrastructure
- Technology acquisition for 19 chillers in 6 African countries
- Set up of a network and replacement policy
- Identify and remove barriers

Phase II
- Established mechanism from Phase I to replace all CFC Chillers in African countries which fulfil criteria of the Secretariat of the Montreal Protocol

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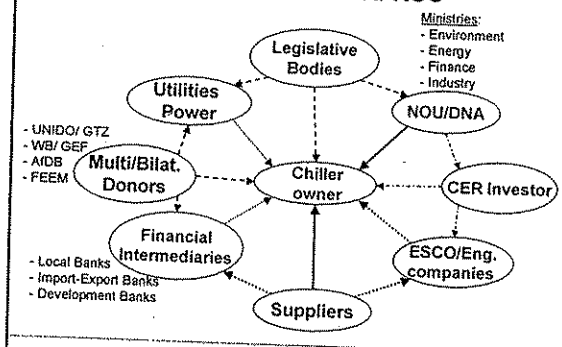
2) Network of AFROC



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3) Possibilities on Financing and Funding

Identified Barriers for chiller investments by Suppliers:

- Initial costs
- Operating costs
- Lack of awareness for new technologies
- Less knowledge on energy efficiency and environmental issues
- High customs duties

⇨ **Create conditions to remove these barriers through better access to:**

1) Capacity building / Technical assistance
2) Financial services

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3) Possibilities on Financing and Funding

Overcome Barriers by an improved framework for investments

1) Capacity building / Technical assistance

- Establishment of national network
- Coordination of Stakeholders and Funding partners
- Support in formulation and adaptation of regulations and standards
- Identification of suitable technology

⇨ **Reduction of transaction costs**

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3) Possibilities on Financing and Funding

Overcome Barriers by providing financial contributions

2) Interested financial institutions

- MLF: Funding of 19 chillers during Phase I
- FFEM: bilateral contribution and additional grants for TA and
- AfDB: Public and private loans, credit line; min. 3 Mio. US $
- Afreximbank: Credit lines to corporates and to local banks
- Development Bank Senegal: credit lines, guarantees
- KfW: commercial credits for energy efficiency
- CDM

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4) Possibilities on CDM Financing

1) Methodology:
- Small-scale (simplified PDD, 1 barrier sufficient, <15 GWh/year)

2) Bundling:
- Max. size 15 GWh/year; will change to 60 GWh/year
- Bundle parts must have same crediting period
- No change of composition of bundle over time

- Bundle with same technologies – one monitoring plan
- Bundle with different technology – separate monitoring and reports

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4) Possibilities on CDM Financing

CER sales from CDM are directly proportional to energy savings

$$\frac{\text{Gain from investment with CDM}}{\text{Gain from investment without CDM}} = \frac{\text{Emission factor x CER price}}{\text{Electricity price}}$$

Egypt: $\frac{0.525 \text{ CER / MWh} \times 12 \text{ € / CER}}{0.027 \text{ € / kWh}}$ = 23 % higher NPV with CDM

Nigeria: 0.540 CER/MWh, 0.067 €/kWh = 9.6 %

Cameroon: 0.880 CER/MWh, 0.09 €/kWh = 11.7 %

Namibia: 0.890 CER/MWh, 0.019 €/kWh = 56 %

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DAIKIN

Energy Saving Air conditioning, VRV system

K. Kanaoka
Daikin Industries Ltd.
May 23rd 2006
Side Event on Alternative Chiller Technoligies

DAIKIN

Environmental Consensus

☐1987:Montreal Protocol ▷ *Protection of the Ozone Layer*

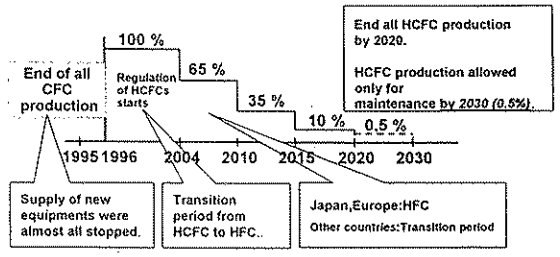
Set up to control emissions of Ozone Depleting Substances such as CFC and HCFC

☐1997:Kyoto Protocol ▷ *To stop Global Warning*

DAIKIN

Protection of the Ozone Layer

CFC & HCFC Phase out Schedule



Switching to HFC of New equipments : On going

DAIKIN

CFC and/or HCFC equipments in the market

- Renovation activities → *Slow moving*
- Existing equipments can be used till the end of their lives. → *No urgency so far*
- Additional investment → *Financial burden*

Some incentives are indispensable to accelerate renovation

DAIKIN

Solution

Energy Saving ⇨ Cutting utility cost, shorten payback period

Tail.i.d.

- Soaring oil price ⇨ More than triple in a decade
- Inventing new energy saving technologies ⇨ Electricity consumption: less than half in a decade
- Reasonable price and availability of HFC equipments

DAIKIN Corporate Data

Energy Saving Approach

Energy Saving Approach

To reduce heat transfer power
- Water : Pumps
- Air : Fans

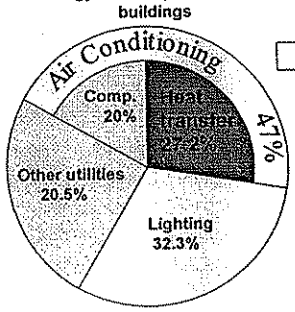
⇨ Use efficient heat transfer media

To reduce energy consumption in partial load
- Big gap between peak & actual use
- Random occupancy

⇨ Improve partial load performance

Energy saving approach

Energy consumption in office buildings



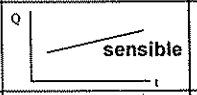
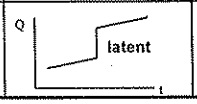
⇨ Decrease AC running cost is prime target of energy saving

⇩

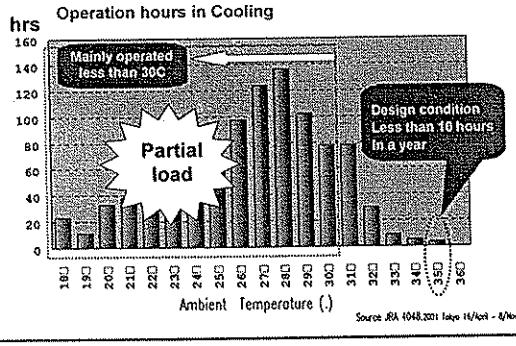
Decrease energy consumption of heat transfer, pumps & fans

Reduction of Heat Transfer Power

Use efficient heat transfer media

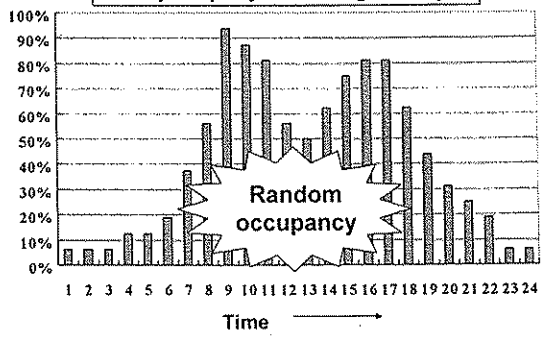
Medium	Kind of Heat	Heat Quantity
Water		21 kJ/kg
Air		10 kJ/kg
Refrigerant R410A		210 kJ/kg

Partial load efficiency improvement



Partial load efficiency improvement

Daily occupancy ratio in a large building



Advanced Air conditioning System

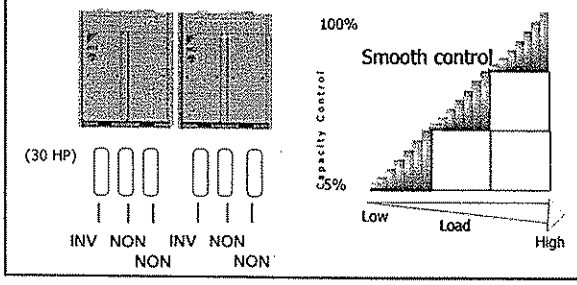
VRV

Comfort, Energy saving, Individual air conditioning system

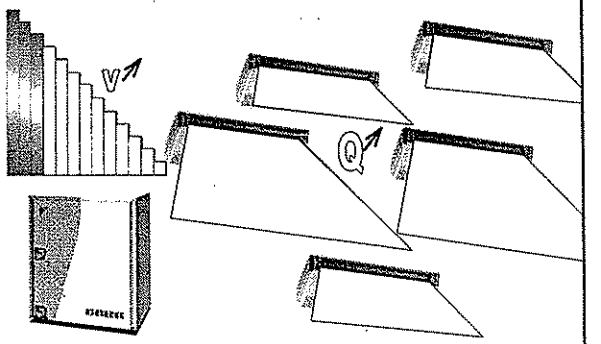
PID tempetature control in every indoor unit

40% Electricity cut

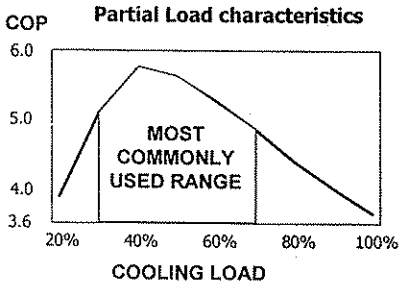
Linear Capacity Control



Inverter controlled compressor

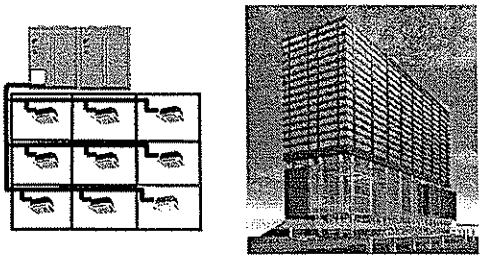


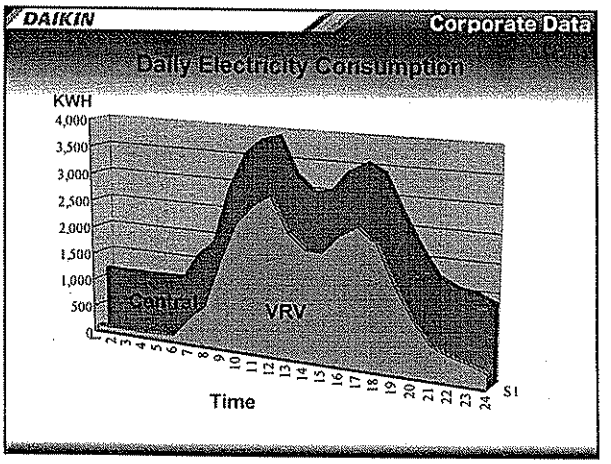
Low Energy Consumption



Individual Operation

- Ideal for Random Occupancy
- Individual temp. control





Annual power consumption

Location	System	Consumption (KW/m2/Year)	Bldg. Size (m2)
Singapore	VRV	105	10,000
Malaysia	VRV	93	800
Brazil	VRV	126	51,200
Brazil	Chiller	271	51,200

2005 New Product

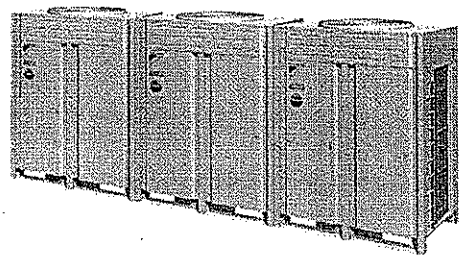
VRV II

RXYQ-MA Series Heat Pump

RXQ-MA Series Cooling Only

VRV

Advanced individual air conditioning system



Market Leading Technology

- Aero fitting grille
- Aero Spiral Fan
  - Airflow increase and reduction of a fan input can be achieved .
- e-Pass heat exchanger
  - Improving heat exchange efficiency
- e-Bridge circuit
  - Effective condenser surface is increased
- Oil Balancing Circuit
  - Ensures balanced oil levels between compressors.
- "DC" fan motor
  - Improved efficiency saves power.
- Sine Wave DC Inverter
  - A smooth Sine Wave provides improved motor efficiency
- Reluctance DC compressor
  - Higher torque results in better efficiencies at low and medium RPM
- Refrigerant Stabilization Control
  - Ensures balanced refrigerant flow between units

VRV-II

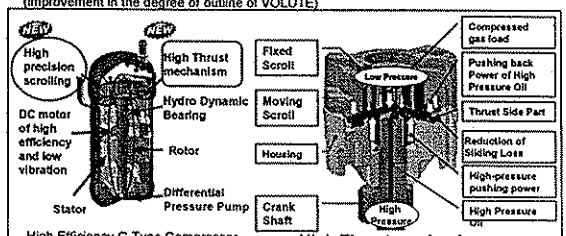
High efficiency scroll compressor

Energy Saving

The efficient scroll G type compressor realized further energy saving

High Thrust mechanism realized a reduction of friction loss and leaks of refrigerant and high efficiency.

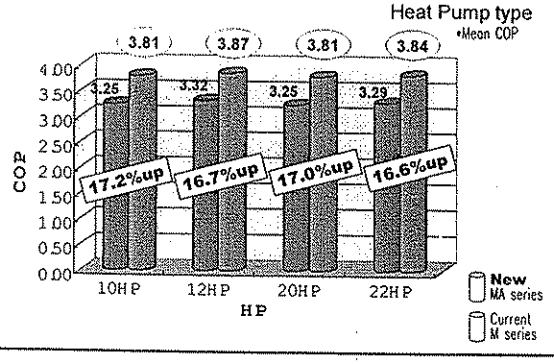
- Improvement in scroll performance by high precision processing technology (improvement in the degree of outline of VOLUTE)



High Efficiency G Type Compressor

High Thrust mechanism

Improvement in COP



Transition to Non-CFC Chillers: Manufacturers' Perspective

Dave Stirpe
Executive Director
Alliance for Responsible Atmospheric Policy

New Delhi
October 29, 2006

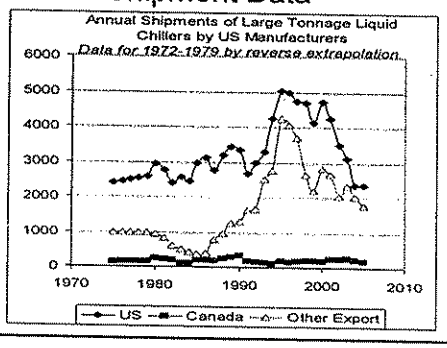
Alliance Membership List

Air Conditioning Contractors of America
Air-Conditioning & Refrigeration Institute
Alliance for the Polyurethanes Industry
American Pacific Corp.
American Plastics Council
Arkema
Association of Home Appliance Manufacturers
Bard Manufacturing Co.
Brooks Automation
Cap & Seal Company
Carrier Corporation
Copeland Corporation
Dow Chemical U.S.A.
Dupont
Dupont/Dow
E.V. Dunbar Co.
Falcon Safety Products
FP International
General Electric
General Motors
Gilman Corporation
H.C. Duke & Son
Halotron
Honeywell
Hudson Technologies
Ineos
Ingersoll-Rand
Institute of International Container Lessors
International Pharmaceutical Aerosol Consortium
Lennox International
Luce, Schwab & Kase
Maytag Corporation
McQuay International
Metl-Span Corporation
National Refrigerants
Owens Corning Specialty & Foam Products Center
Refrigeration Service Engineers Society
Refron
RemTec International
Ritchie Engineering
Siemens Building Technology
Solvay
Spray Foam Alliance
Sub-Zero
Tech Spray
ThermoQuest-Forma Scientific Division
Trane Company
Tyler Refrigeration
Whirlpool Corporation
Worthington Cylinder
York International
Zero Zone

CFC Chiller Background

- CFCs were used primarily in large centrifugal chillers
- CFC chillers in operation
  - Approximately 50,000 worldwide
  - Includes approximately 37,000 in N. America (2004 ARI survey)
- CFC chiller replacement has been slow
  - High level of activity in early 1990s
  - 58% of U.S. CFC chillers have been replaced

Large Tonnage Chillers Shipment Data



CFC Refrigerant Use - Chillers

- Age of all CFC chillers in service
  - 29,000 units (approx.) ---- 10-20 years old
  - 21,000 units (approx.) ---- 20-30 years old
- Refrigerant inventory in CFC chillers
  - 24,000 MT (approx.)
- Chillers service needs
  - Recycled and reclaimed CFCs (Article 5 and non-Article 5)
  - Virgin CFCs (Article 5)

Impediments to Chiller Replacement

- Scarce capital and economic return
  - Available capital goes to replacement projects having the fastest economic return
- Useful life of existing equipment
  - Centrifugal chillers have a long service life – estimated between 20-30 years
- Confidence in CFC service supply and regulations
  - Adequate supplies of virgin/recycled/reclaimed CFCs exist
  - Regulations in most countries allow for the continued use and servicing of CFC chillers

Incentives for Chiller Replacement

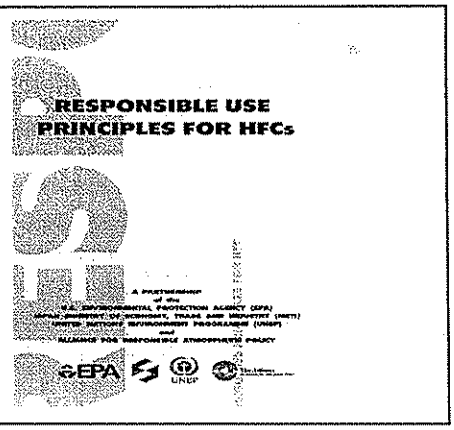
- Access to capital
  - Encourage measures to increase access to capital
    - Assistance from Multilateral Fund implementing agencies
    - Other governmental and commercial funding
- Change in current tax and incentive policies
  - Provide tax credits or accelerated depreciation
  - Institute rebate programs
- Increased awareness and leadership
  - Provide education for building owners
  - Protect the stratospheric ozone layer and the climate
  - Save energy and money; and create jobs
  - Support Montreal Protocol and Kyoto Protocol

Ozone and Climate Benefits of CFC Chiller Replacement

- New liquid centrifugal chillers use non-CFC refrigerants (lower ODP & lower GWP)
- Refrigerant emissions are negligible
  - Leak tight design – 0.5-2% annual leak rate today compared to 10-12% in 1980s
  - Venting prohibitions in many countries
  - Technician certification for equipment service and repair
- Chiller efficiencies have significantly improved -- over 30% since the 1980s
  - Indirect emissions account for 98% of a chiller's lifetime contribution to global climate change
  - Increased efficiency results in less carbon dioxide emissions from power generation

Technical and Economic Feasibility of CFC Chiller Replacement

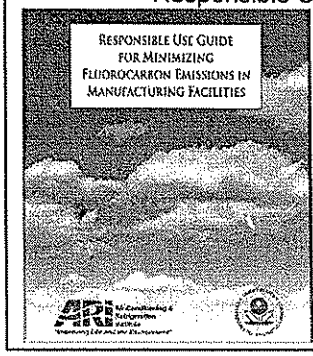
- New chillers have 3 to 5-year economic return in most locations that need cooling for more than 3 months per year
- Variable pump and cooling tower are used to optimize chiller system efficiency
- Variable speed drive (VSD) gaining popularity to dramatically improve part load energy efficiency (IPLV)



Responsible Use

- New chillers should minimize environmental impact and incorporate Responsible Use Principles
  - Contain refrigerants in tight or closed systems and containers minimizing atmospheric releases
  - Encourage monitoring after installations to minimize direct refrigerant emissions and to maintain energy efficiency
  - Train all personnel in proper refrigerant handling
  - Comply with standards on refrigerant safety, proper installation and maintenance (e.g., ASHRAE-15 and ISO- 5149)
  - Design, select, install and operate to optimize energy efficiency
  - Recover, recycle and reclaim refrigerants
  - Continue to improve equipment energy efficiency when cost effective

Air-Conditioning & Refrigeration Institute Responsible Use Guide



- Encourages refrigerant containment in air conditioning and refrigeration equipment manufacturing facilities
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- ICARMA will undertake translations:
  - Spanish
  - French
  - Chinese

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