Trane Government Systems & Services

Products, Solutions and Contracts for Federal Agencies
Federal Government Facilities Issues

- Deteriorating and Aging Infrastructure
- Insufficient Budget to Handle S/R/M
- Manpower Concerns - Outsourcing, Privatization
- Executive Orders and Laws Mandating Efficiency
- EPA mandates for CFC Elimination
- Energy Supply / Utility Concerns / Reliability
- Security Concerns - Mission and Facility Reliability
Recapitalizing Military Facilities

“The reason is simple: The Defense Department doesn’t have the money. Based on its annual new construction budget of $3.9 billion, it would take 192 years to replace its outdated facilities - compared to 57 years in the private sector.”
Progress Is Slipping

Fresh and Innovative Approaches Are Needed

Federal Agency Reduction in Facilities Energy Usage per SF

- Product Innovations
- New Technologies
- Systems !!!
- Innovative and Creative Applications
- Facilities Integration and Controls
- Comprehensive Contract Solutions
- Identify and Evaluate Viability of all possible savings options
Trane Federal Systems & Services

- Federal Government Energy Conservation
  - Trane is an ESCO with an excellent record
  - ESPC - Energy Savings Performance Contracts
    - DOE Geothermal Super ESPC IDIQ Contract
    - GSA Schedule ESPC IDIQ Contract
Trane Federal Systems & Services

- Comprehensive Infrastructure Solutions
  - Turnkey Solutions Contracting
    - GSA Schedule 84 - Contract #: GS-07F-0248K
    - Trane HVAC Products, Systems, and Controls
    - Turnkey Installation
    - Project Financial Solutions
    - Open Market Items for complete solution
  - Coming Soon -- Facilities Management
    - GSA Schedule 03FAC
    - On-Site Facilities Management and Maintenance
    - HVAC Services, Maintenance, and Repair
    - Control Systems Service, Maintenance and Repair
Thank You For Attending Today

Our Program here in St. Louis
- Refrigerant Regulations and Implications for Products and Specifications
  - Mike Thompson, Director-Environmental Affairs

Post Conference Workshop (Thursday 1-5pm)
- Packaged Central Plants (New USACE ECB)
  - Trey Austin, TAS Inc (Trane Business Partner)
- HVAC Dehumidification Strategies
  - John Murphy, Senior Applications Engineer

Visit Trane Exhibit in the Conference Area
- Robert Johnson, Director Institutional Markets
- Mike Weise, Federal Segment Leader
- Jeff Rud, Federal Programs Manager
Update on Environmental Legislation

Mike Thompson
Director of Environmental Affairs
Trane
Agenda

- The environmental story
- Refrigerants, Phase-outs, Alternatives
- Choosing the best overall refrigerant solution today
- What do the people outside the HVAC community say about refrigerant choice
Chlorine-Bromine Loading

**Weighted U.S. HCFC Use and Montreal Protocol**

**HCFC Consumption Cap**

- **Base Year = 1989**
- **Effective = 1996**

**CAP = 1989 CFC consumption x 2.8% plus 100% of 1989 HCFC consumption (ODP weighted basis)**

*0.5% of CAP from 2020 - 2030 only for service of existing refrigeration and air conditioning equipment*
What Does Equivalent R-11 Mean?

- 1 lb of R-11 is equivalent to 29.4 lbs of R-22.
- 29.4 lbs of R-22 is equivalent to 83.3 lbs of R-123.
Weighted U.S. HCFC Use and Montreal Protocol

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Will There Be Enough Volume in the Future Under These Caps?

2020-2030 - 0.5% of 1989 level of “equivalent” R-11
Assumptions: All chillers in US are R-123 (80,000 chillers)
Average chiller size: 500 tons
Refrigerant charge: 2 lbs/ton
Average charge/chiller: 1000 lbs

(80,000 chillers) x (1000 lbs/chiller) x (0.5% leakage rate/year) = 400,000 lbs/yr

0.5% cap from 1989 levels equates to 12,100,000 lbs/year of R-123

More than 30 times the needed volume can be produced!
How Does the 12,100,000 lbs Compare to Today’s Usage?

1998 Total HCFC Production

- **R-123**: 4,000,000 lbs
- **R-141b**: 130,000,000 lbs
- **R-22**: 220,000,000 lbs
Will Refrigerant Manufactures Continue To Make The Refrigerant Up Until 2030?

Yes- and Even Beyond 2030

HCFC’s used as a feedstock chemical to make other chemicals (like HFC’s) are not subject to the Montreal Protocol phaseout

R-123 is used as a feedstock to produce R-125
R-125 is 50% of the blend that makes R-410A
R-125 is 25% of the blend that makes R-407C

R-125 capacity will expand drastically in the coming years

Most facilities that produce R-125, will have the ability to co-produce R-123
Will There Be Enough R22 Volume in the Future Under These Caps?

2010-2020: Diversity and complexity associated with estimation process

Assumptions: EPA’s estimates
No consensus update on projections

Logic: Production may be tight, but will continue
Re-use & reclamation makes up difference
Enormous feedstock potential for re-use & reclamation
CFC-11 Example: Readily available with no price escalation

Why will R22 production continue through 2019?
Availability: R-22 Production Will Continue

- Significant amount of world’s R-22 production is used as a chemical intermediate (feedstock) to produce fluoropolymers (e.g. DuPont Teflon®)

- Fluoropolymer production will continue

- Feedstock use of R-22 is specifically excluded from control under the Montreal Protocol.
  - Reason: R-22 isn’t released into atmosphere when used as a feedstock
Heating Piping Air Conditioning

REFRIGERANTS: The Future In The Balance
Climate Forcing (Since year 1765) Wm²

United Nations Environmental Program
UNEP / EPA (1994) Scenario for HFCs
IPCC (IS92a) Scenario for all other gases

Year

1990 2010 2030 2050

United Nations Environmental Program

UNEP / EPA (1994) Scenario for HFCs

IPCC (IS92a) Scenario for all other gases

1990 2010 2030 2050

United Nations Environmental Program

UNEP / EPA (1994) Scenario for HFCs

IPCC (IS92a) Scenario for all other gases

Carbon Dioxide

Nitrous Oxide

Methane

CFCs & HCFCs

HFCs
Annex I and Non-Annex I Fossil Fuel Carbon Emissions:

Annex I Emissions = Non-Annex I Emissions in 2035

Non-Annex I (Developing Countries)

Annex I (Developed Countries)
Emissions Allocated to Economic Sectors

Note: Does not include U.S. territories
Kyoto Protocol
Greenhouse Gas Coverage

- Six (6) Gases
  - Carbon Dioxide -- CO$_2$
  - Methane -- CH$_4$
  - Nitrous Oxide -- N$_2$O
  - Hydrofluorocarbons -- HFCs
  - Perfluorocarbons -- PFCs
  - Sulfur hexafluoride -- SF$_6$

- Base Period
  - 1990 for CO$_2$, CH$_4$, and N$_2$O
  - 1990 or 1995 for HFCs, PFCs, and SF$_6$
## Kyoto Protocol -- Country Targets

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U.S. Greenhouse Gas Emissions Per Capita and Per Dollar of Gross Domestic Product

Source: BEA (2002), U.S. Census Bureau (2002), and emission estimates in this report
Denmark
HFC Phaseout Law

- General HFC Ban - 2006
- Cooling Plants, Heat Pumps & Air Conditioning Plants HFC Ban For Systems With 10kg or Higher - 2007
- Exempt from Ban
  - Cooling Plants, Heat Pumps & Air Conditioning Plants With 0.15 - 10kg.
  - Cooling Systems For Process Heat Recovery With Charge Less Than 50kg.
Austria

HFC Phaseout Law

- Appliance HFC Ban - 2008
- Air Conditioning and Mobile Refrigeration HFC Ban - 2008
Switzerland

HFC Phaseout Law

- Domestic Refrigeration HFC Ban - 2003
- Air Conditioners HFC Ban - 2005
- Mobile Air Conditioning HFC Ban - 2008
European Union Draft HFC Regulation

- Containment of HFCs
  - Prevent and minimize leakage
  - Mandatory inspections
  - Leakage detection systems
  - Maintenance of records

- Recovery of HFCs

- Training and Certification

- Automobile HFC-134a Ban
  - No new vehicles with HFCs - GWP greater than 150 in 2012
  - Prohibit sale of vehicles with HFCs greater than 150 in 2018
The latest assessment report from the Refrigeration, A/C and Heat Pumps Technical Options Committee (RTOC), contains a great quote. The assessment is part of the United Nations Environment Programme (UNEP) review pursuant to Article 6 of the Montreal Protocol.

“8.4.2.7 Environmental Evaluation for Retention of HCFC-123 as a Refrigerant for Centrifugal Chillers

Refrigerant HCFC-123 has a favorable overall impact on the environment that is attributable to five factors:

(1) a low ODP
(2) a very low GWP
(3) a very short atmospheric lifetime
(4) the extremely low emissions of current designs for HCFC-123 chillers
(5) the highest efficiency of all current options

Based on integrated assessments, considering the tradeoffs between negligible impacts on stratospheric ozone and important benefits in addressing global warming, these studies recommend consideration of a phase-out exemption for HCFC-123.”
The Best Environmental Solution

1. Low ODP (Ozone Depletion Potential)
2. Low GWP (Global Warming Potential)
3. High operating efficiency
4. Short atmospheric life
5. Low toxicity
6. Low operating pressure
7. Low flammability
8. Good cost Vs efficiency relationship
Ozone Depletion Potential (ODP)

ODP (R-11=1.0)

- CFC-11
- CFC-12
- HCFC-22
- HCFC-123
- HFC-134a
- HFC-410A
- HFC-407C
- HFC-245fa
Global Warming Potential (GWP)

- CFC-11
- CFC-12
- HCFC-22
- HCFC-123
- HFC-134a
- HFC-410A
- HFC-407C
- HFC-245fa

GWP (CO₂=1.0)
ODP versus GWP

CFC-11
12
113
114
115
HCFC-22
123
124
141b
142b
HFC-32
125
134a
143a
152a
227ea
236fa
245fa

Efficiency for Chillers (COP)
Atmospheric Life (Years)

*Atmospheric life of the R-125 component for R-410A, and R-407C blends*
Operating Pressure

- HCFC-123
  - Evaporator (38F)
  - Off Line (72 F)
  - Condenser (100 F)

- HFC-134a

- HCFC-22

Operating Pressure (psi)
Chiller Emissions Study

Number of Trane R-123 CenTraVacs: 2768
Total Pounds of Charge: 3,547,612 lbs
Total Pounds of Charge Added: 16,229 lbs/yr
Annualized Total Loss Rate: 0.4575 %

The Trane Company 1997 Survey Results

Study corroborated in “Impact on Global Ozone and Climate From Use and Emission of (HCFC-123)” By Calm, Wuebbles an Jain
The Future

Emissions

Focusing on Emissions and Efficiency is fundamental to doing what’s right.

Energy Efficiency
Building Owners
Save Money,
Save the Earth

Replace Your CFC
Air Conditioning Chiller
albeit low. Energy efficiency is the main environmental consideration in the selection of a chiller as long as the equipment is carefully maintained and refrigerant emissions are kept near zero.
Several refrigerants are environmentally acceptable. However, if you want the highest environmental performance, follow the “Responsible Use” criteria, focusing on the Life-Cycle Climate Performance (LCCP), not the refrigerant. LCCP takes into account the emissions during the manufacturing of the refrigerant, the transportation to the site, during charging of the chiller, lifetime leakage, and finally during recovery and disposal. And, very importantly, this calculation must include emissions from the generation of electricity to power the chillers and account for any additional energy that may be necessary to assure safe operation. Insist that financial calculations consider both partial and full load operation, that the performance of equipment based on alternate refrigerants is compared, and that available energy efficiency options are considered, including variable speed motor drives, heat recovery, and free-cooling. Select the investment with the best LCCP with emissions minimized.

Small-Scale Screw Chillers
New screw chiller technologies with high full- and part-load energy efficiency are replacing existing CFC centrifugal chillers primarily in the smaller tonnage ranges. These chillers are ideal for buildings with highly variable daily cooling loads. These screw chillers use a wide range of refrigerants including HCFC-22, HFC-134a, and the HFC blends R-407C and R-410A.

Medium-Sized Large-Scale Ammonia Chillers
Building owners will want to consider ammonia chillers using screw compressors where they can safely achieve higher energy efficiency. Emissions of ammonia refrigerants are ozone- and climate-safe, but because ammonia is toxic and moderately flammable, safety precautions are necessary. Ammonia is particularly attractive if higher efficiencies can be achieved for new installations involving ice-making, commercial refrigeration, cold storage warehouses, and in district cooling applications.

Large-Scale HCFC-123 and HFC-134a Centrifugal Chillers
For centrifugal chillers, choose either HCFC or HFC chillers with the highest cost-effective energy efficiency, and focus on maintaining the equipment’s peak performance and minimal refrigerant emissions. Any refrigerant is environmentally safe as long as it is never emitted, and all refrigerants require careful handling to avoid worker exposure. By retrofitting or replacing chillers, emissions can be substantially reduced or eliminated. The goal of near-zero refrigerant emissions is possible with new equipment, modern refrigeration monitoring technology, and a proper maintenance program. Computerized controls and building automation systems can cost-effectively sustain and document the performance of the chiller plant.

Save Money, Save the Earth
Large-Scale HCFC-123 and HFC-134a Centrifugal Chillers

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Supporting Organizations

★ United Nations and World Bank
  • United Nations Development Programme
  • United Nations Environment Programme
  • The World Bank

★ National Governments and Regional Authorities
  • Australian Greenhouse Office
  • Environment Canada
  • Industry Canada
  • Japan Ministry of Economy, Trade and Industry
  • Japan Ministry of the Environment
  • Singapore Ministry of the Environment
  • Thailand, Department of Industrial Works, Ministry of Industry
  • U.S. Environmental Protection Agency
  • Vietnam National Office for Climate Change and Ozone Protection

★ Air Conditioning Equipment Manufacturers
  • Carrier
  • Daikin
  • Lennox (Europe)
  • McQuay
  • Mitsubishi Heavy Industries
  • Toshiba-Carrier
  • Trane
  • Turbocor
  • York

★ Energy and Supply Companies
  • Cryo-Line Supplies
  • Exelon Services
  • McKenney’s Mechanical Contractors and Engineers
  • Pacific Gas and Electric Company

★ Industry and Environmental Non-Governmental Organizations
  • Air Conditioning and Refrigeration Institute
  • Alliance for Responsible Atmospheric Policy
  • Alliance to Save Energy
  • Americans for an Energy Efficient Economy
  • Australian Fluorocarbon Council
  • China Building Research Institute
  • Ecole des Mines de Paris Center for Energy Studies
  • Friends of the Earth
  • Heating, Piping, Air Conditioning Engineering Magazine
  • Heating, Refrigeration and Air Conditioning Institute of Canada
  • Industrial Technology Research Institute
  • International Climate Change Partnership
  • Japan Industrial Conference for Ozone Layer Protection
  • Japan Refrigeration and Air Conditioning Industry Association
  • Natural Resources Defense Council
Summary

- There are global pressures on the use of all fluorocarbons.
- The ODP of a refrigerant is not the only factor in determining impact on the environment.
- The scientific community favors the use of high efficiency/low emissions products.
Questions