TRANE

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

USA's military bases turning into slums

USAToday November 6, 2001

Deteriorating housing and work facilities drain morale, waste millions

By Andrea Stone
USA TODAY

HUNTER ARMY AIRFIELD, Ga. — Chief Warrant Officer Butch Zirpolo's soldiers are proud to maintain the world's most advanced combat helicopter, the Longbow Apache. They just wish they didn't have to work in such a decrepit hangar.

The cavernous structure was built nearly 50 years ago for massive B-52 bombers. It has no insulation, the roof leaks and windows are missing. The light fixtures are so high that maintenance crews have to use flashlights to work at night. And rotor blades have been damaged repeatedly as the helicopters maneuver around motorized bay doors that keep breaking down. The rotors cost $100,000 to replace.

"They have better facilities in Bosnia," Zirpolo says. "A lot of soldiers feel anger."

Welcome to today's U.S. military, where rundown housing and ramshackle work facilities are common on bases across the country.

Troops are asked to put their lives on the line in service to the nation. Yet they often are forced to work in dilapidated surroundings: runways are crumbling, piers are rusting, roofs leak, sewer lines are corroded, headquarters are cramped.

And when soldiers who live on base go home to their families, they often have to put up with tenement-like barracks with peeling paint, cracked walls and poor plumbing. Many compare the housing to inner-city public housing projects.

"It's unconscionable," says Rep. Edward Schrock, R-Va., a member of the House Armed Services Committee. "We owe our service people better."

By Sandy Huffaker for USA TODAY

In disrepair: Marine Cpl. Nathan Ferbert walks up a dilapidated set of stairs in the Fort Horno section of Camp Pendleton, Calif.

Neglected
How the U.S. military rates the condition of its base facilities:

Source: Defense Department
USA TODAY

By Stephen Morton for USA TODAY

"Don't drink": The water in the restrooms and water fountains in this World War II-era office building at Fort Stewart, Ga., is contaminated.

Cover story

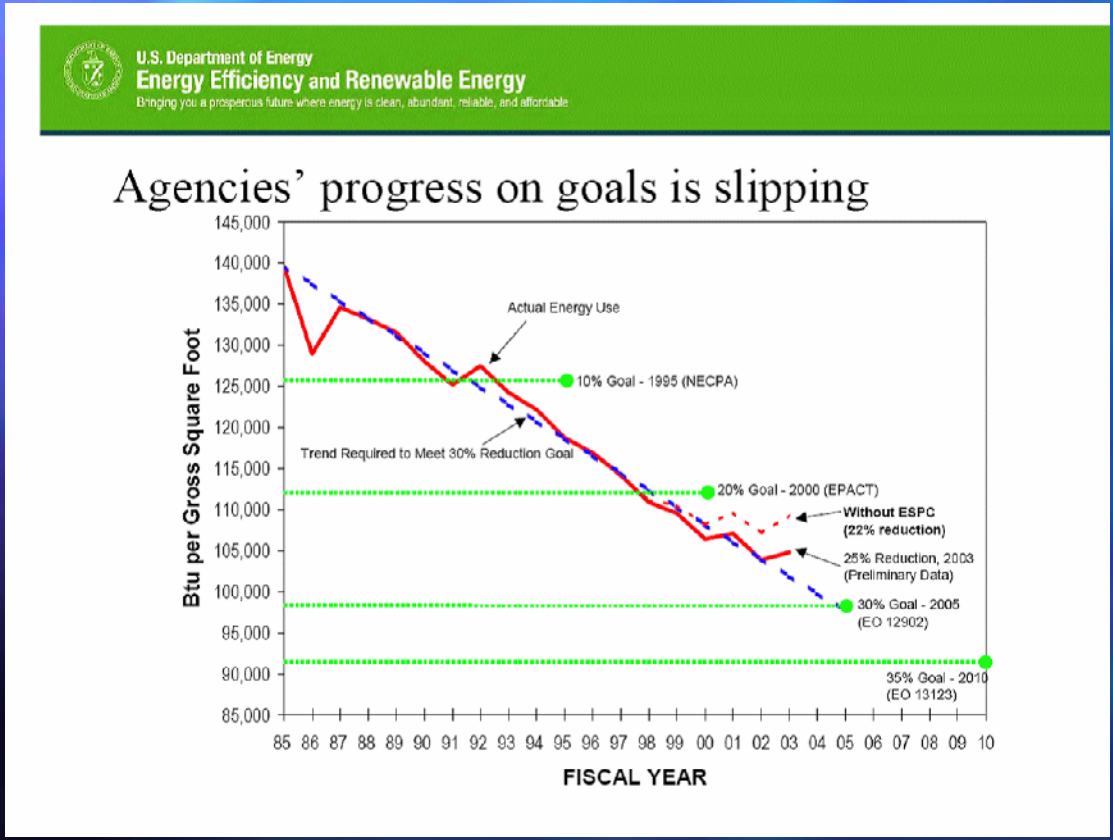
the dilapidated facilities by 2010. fense Department doesn't have

"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

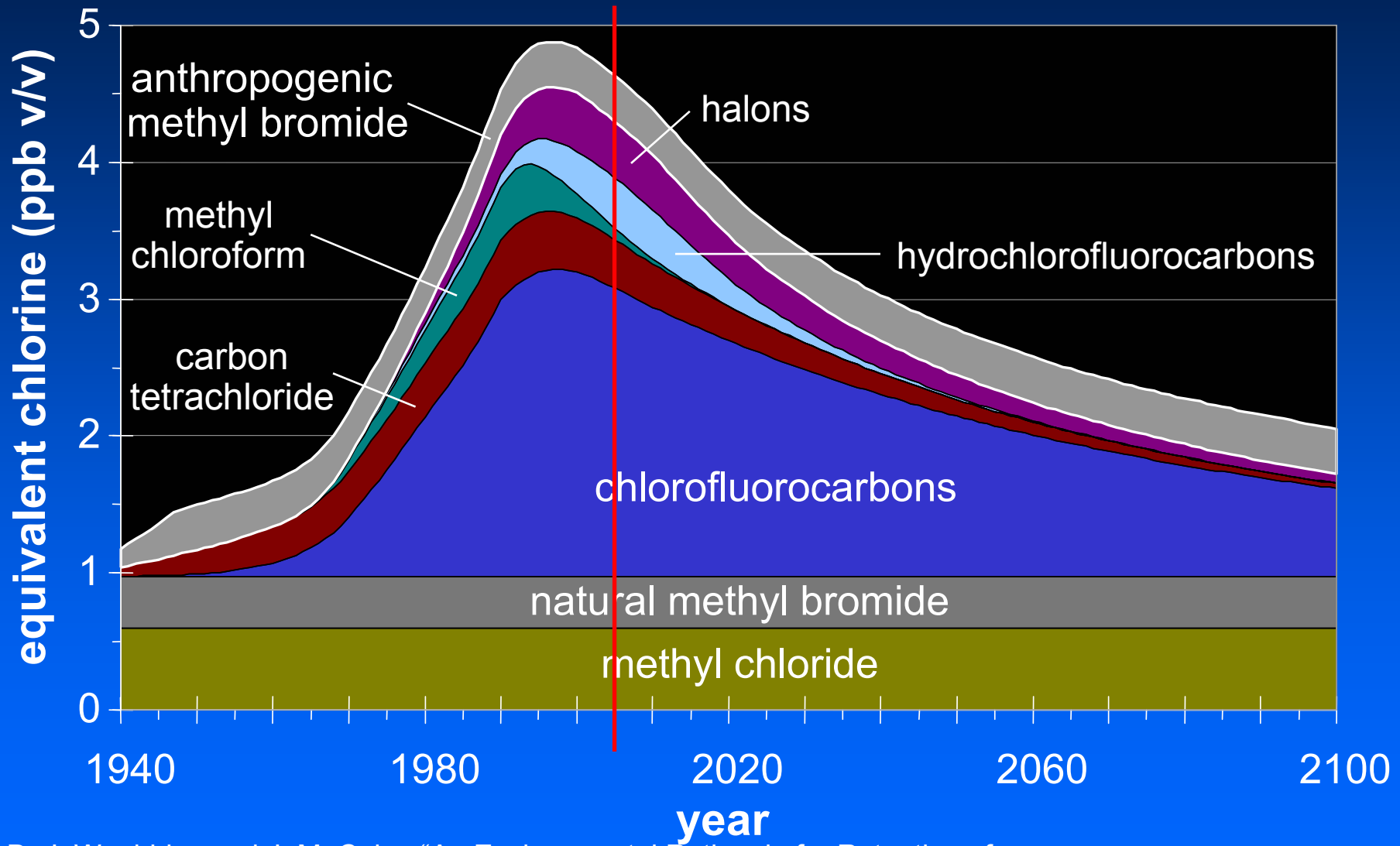
Update on Environmental Legislation

Mike Thompson
Director of Environmental Affairs
Trane

Agenda

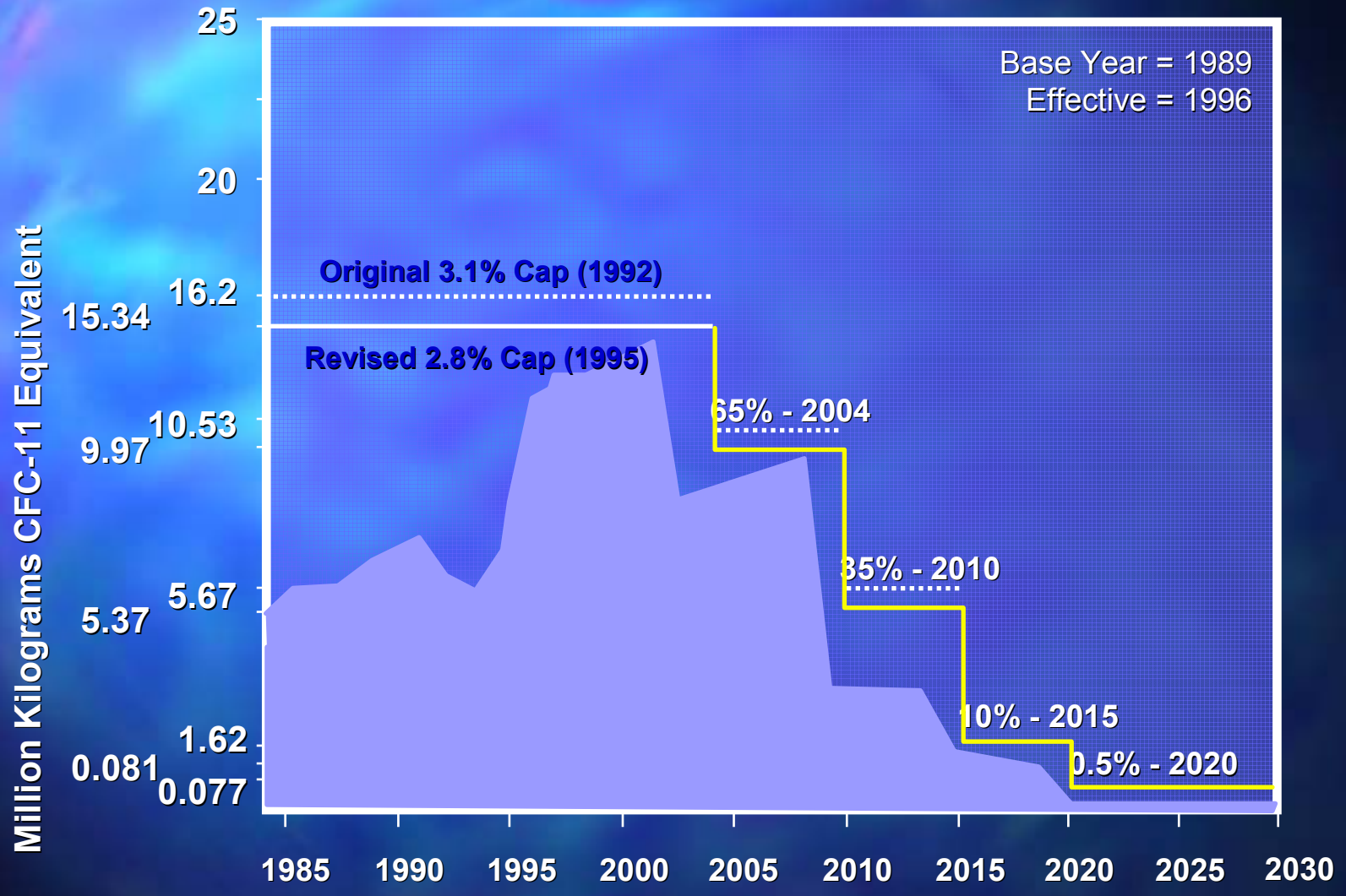
- The environmental story
- Refrigerants, Phase-outs, Alternatives
- Choosing the best overall refrigerant solution today
- What do the people outside the HVAC community say about refrigerant choice

Chlorine-Bromine Loading



D. J. Wuebbles and J. M. Calm, "An Environmental Rationale for Retention of Endangered Chemicals," *Science*, 278(5340):1090-1091, 7 November 1997

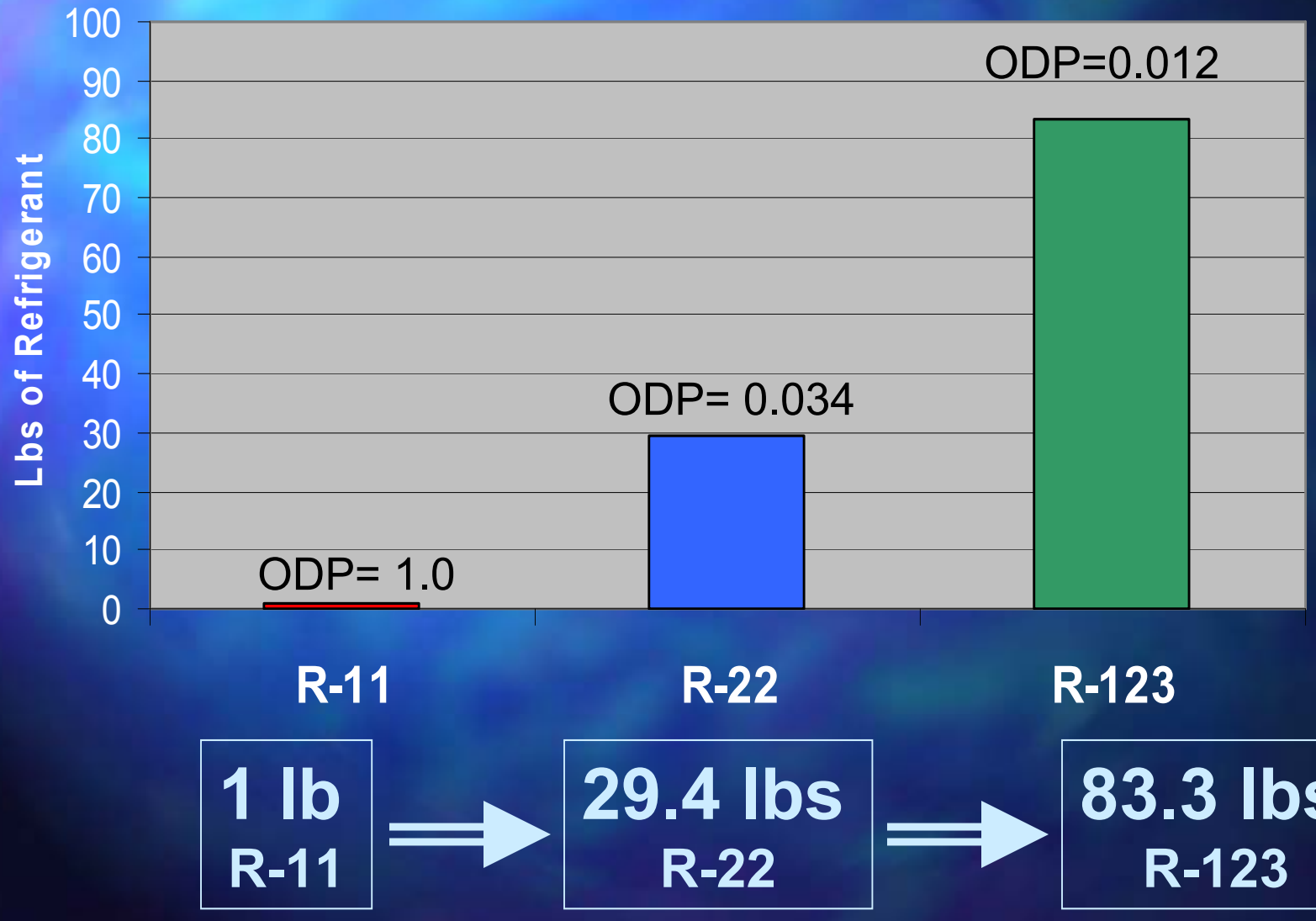
Weighted U.S. HCFC Use and Montreal Protocol HCFC Consumption Cap



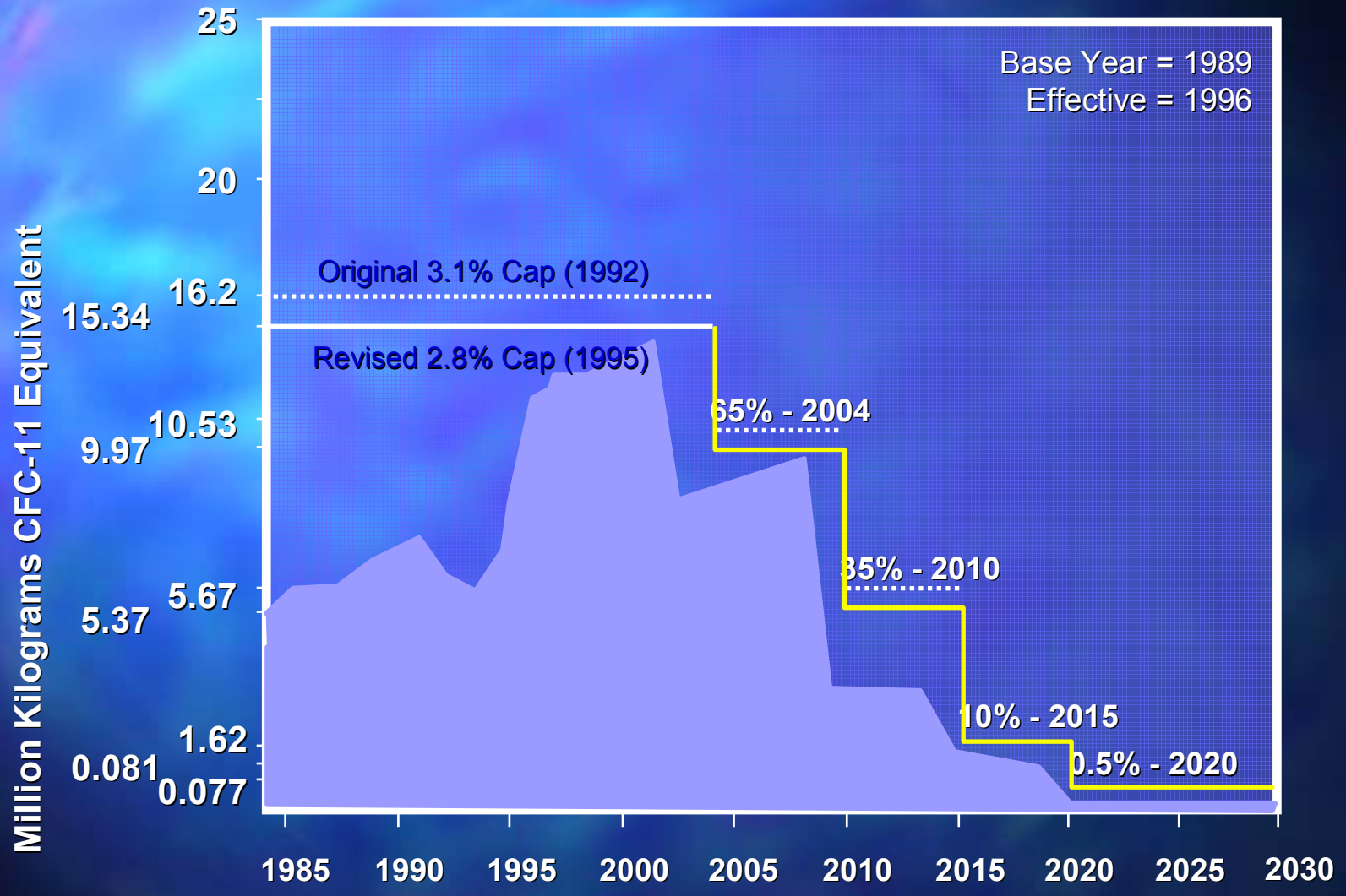
CAP = 1989 CFC consumption x 2.8% plus 100% of 1989 HCFC consumption (ODP weighted basis)

*0.5% of CAP from 2020 - 2030 only for service of existing refrigeration and air conditioning equipment

What Does Equivalent R-11 Mean?



Weighted U.S. HCFC Use and Montreal Protocol HCFC Consumption Cap



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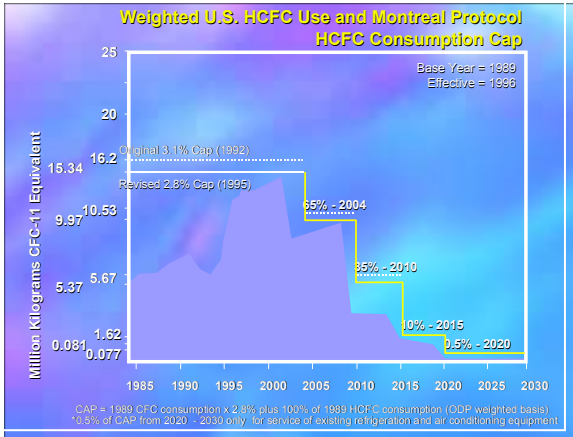


Will There Be Enough Volume in the Future Under These Caps?

2020-2030- 0.5% of 1989 level of “equivalent” R-11

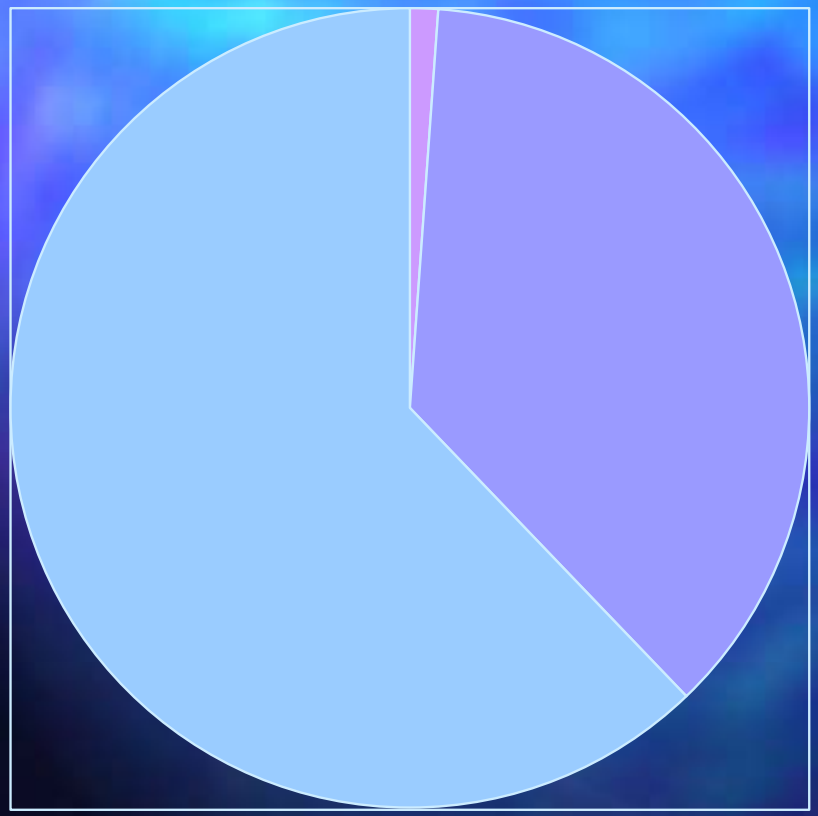
Assumptions: All chillers in US are R-123 (80,000 chillers)
Average chiller size: 500 tons
Refrigerant charge: 2 lbs/ton
Average charge/chiller: 1000 lbs

(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

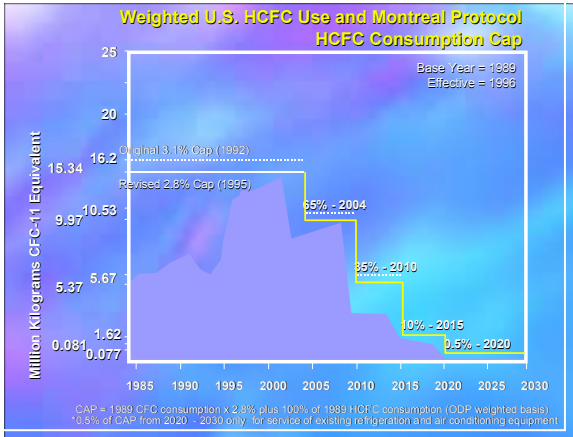
More than 30 times the needed volume can be produced!

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

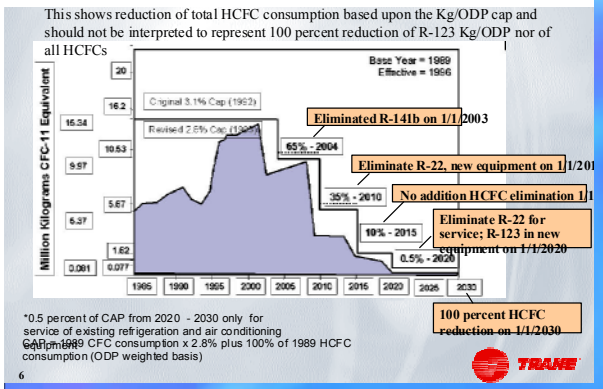
HCFC's used as a feedstock chemical to make other chemicals (like HFC's) are not subject to the Montreal Protocol phaseout

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

HCFC Consumption Caps

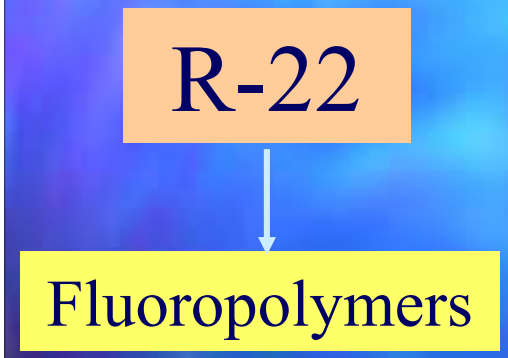


Will There Be Enough R22 Volume in the Future Under These Caps?

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

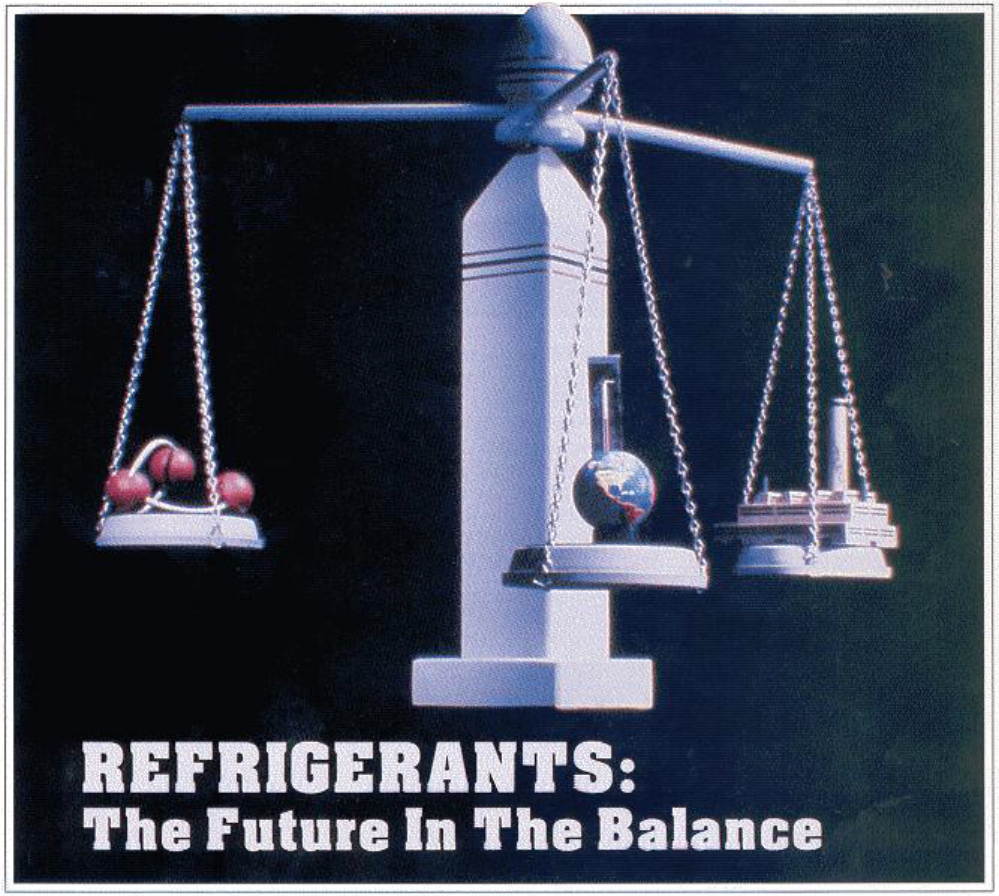


- Significant amount of world's R-22 production is used as a chemical intermediate (feedstock) to produce fluoropolymers (e.g. DuPont Teflon®)
- Fluoropolymer production will continue
- Feedstock use of R-22 is specifically excluded from control under the Montreal Protocol.
  - Reason: R-22 isn't released into atmosphere when used as a feedstock

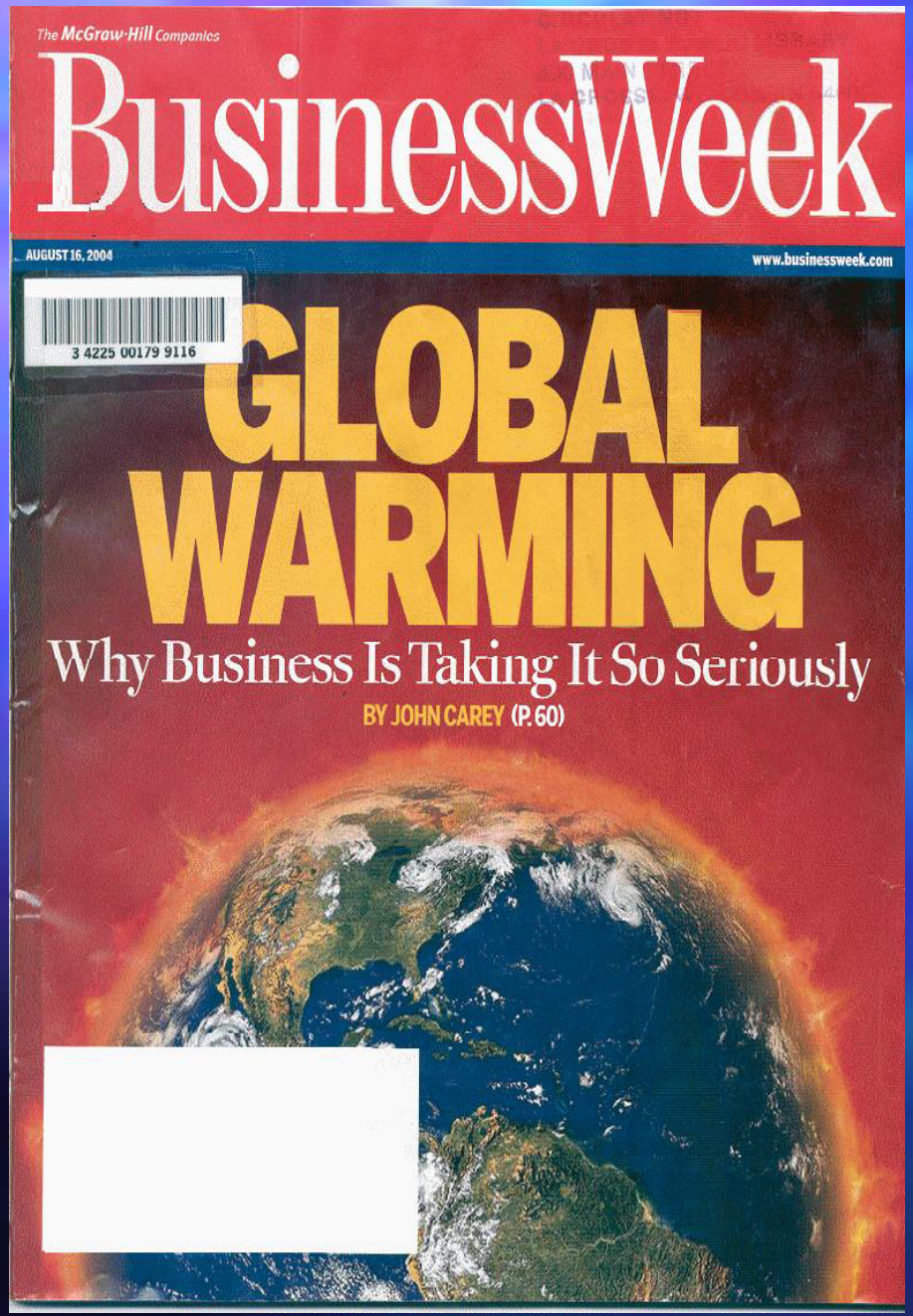
APRIL 1991 SECOND CLASS POSTAGE PAID

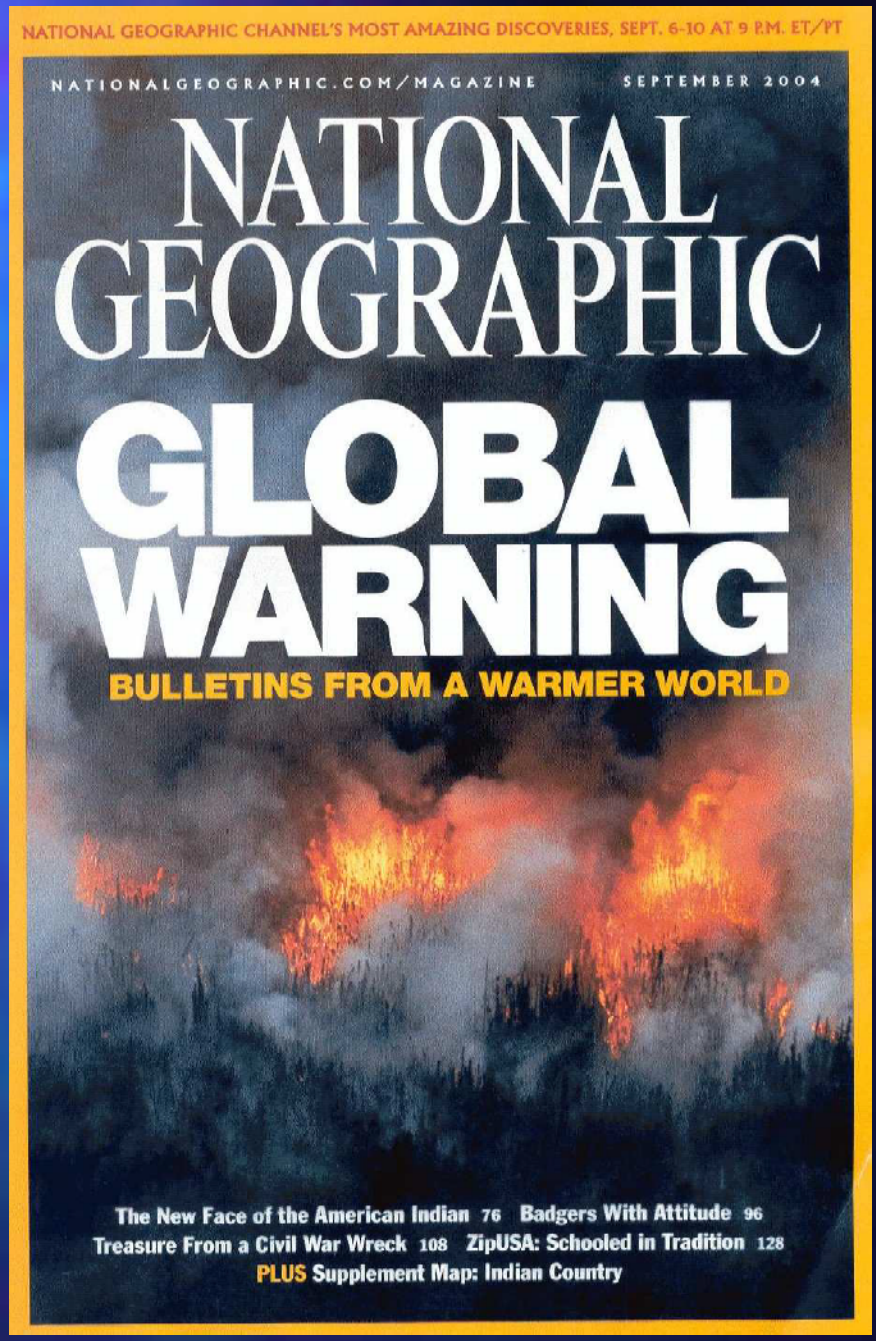
THE MAGAZINE OF MECHANICAL SYSTEMS ENGINEERING

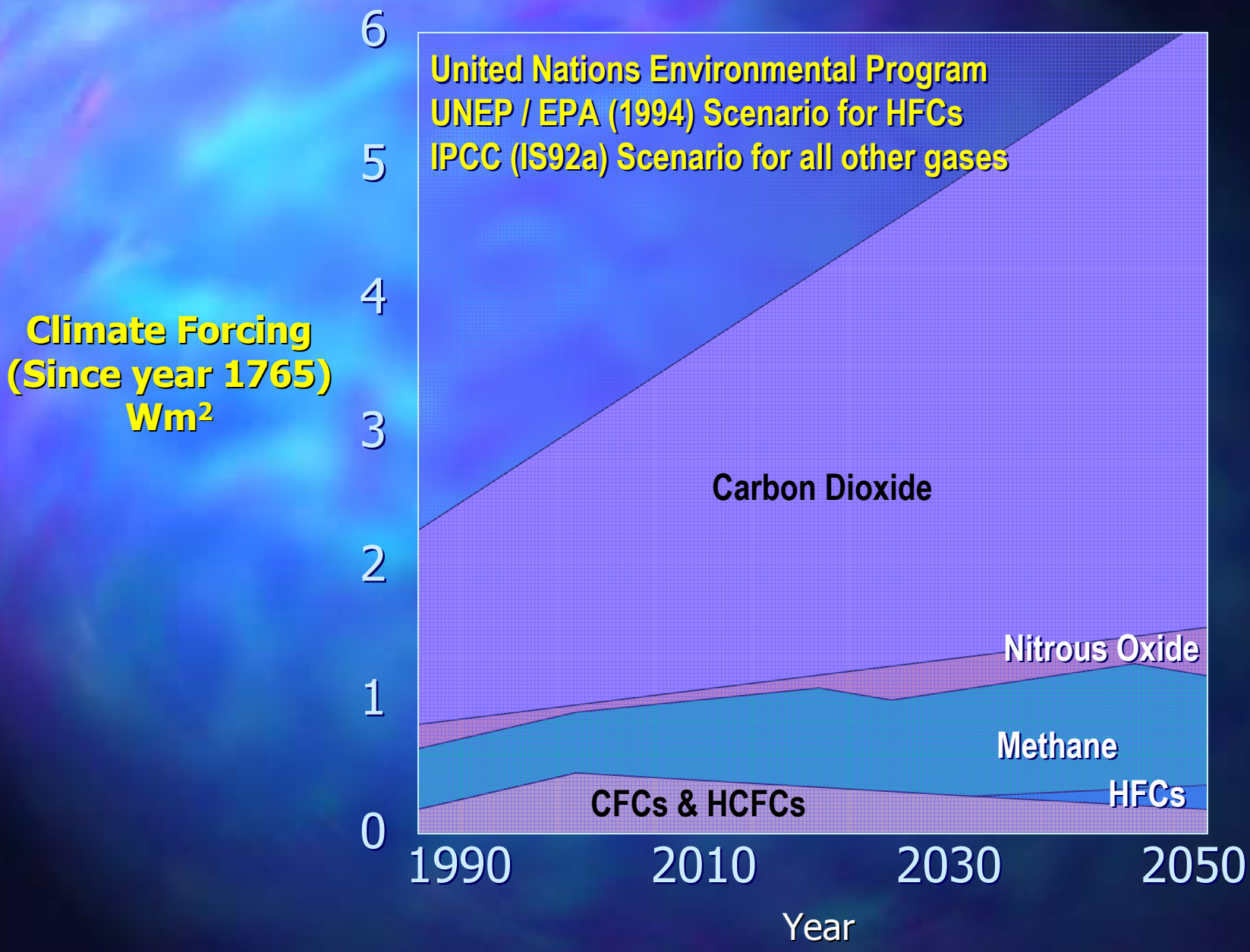
Heating Piping AirConditioning



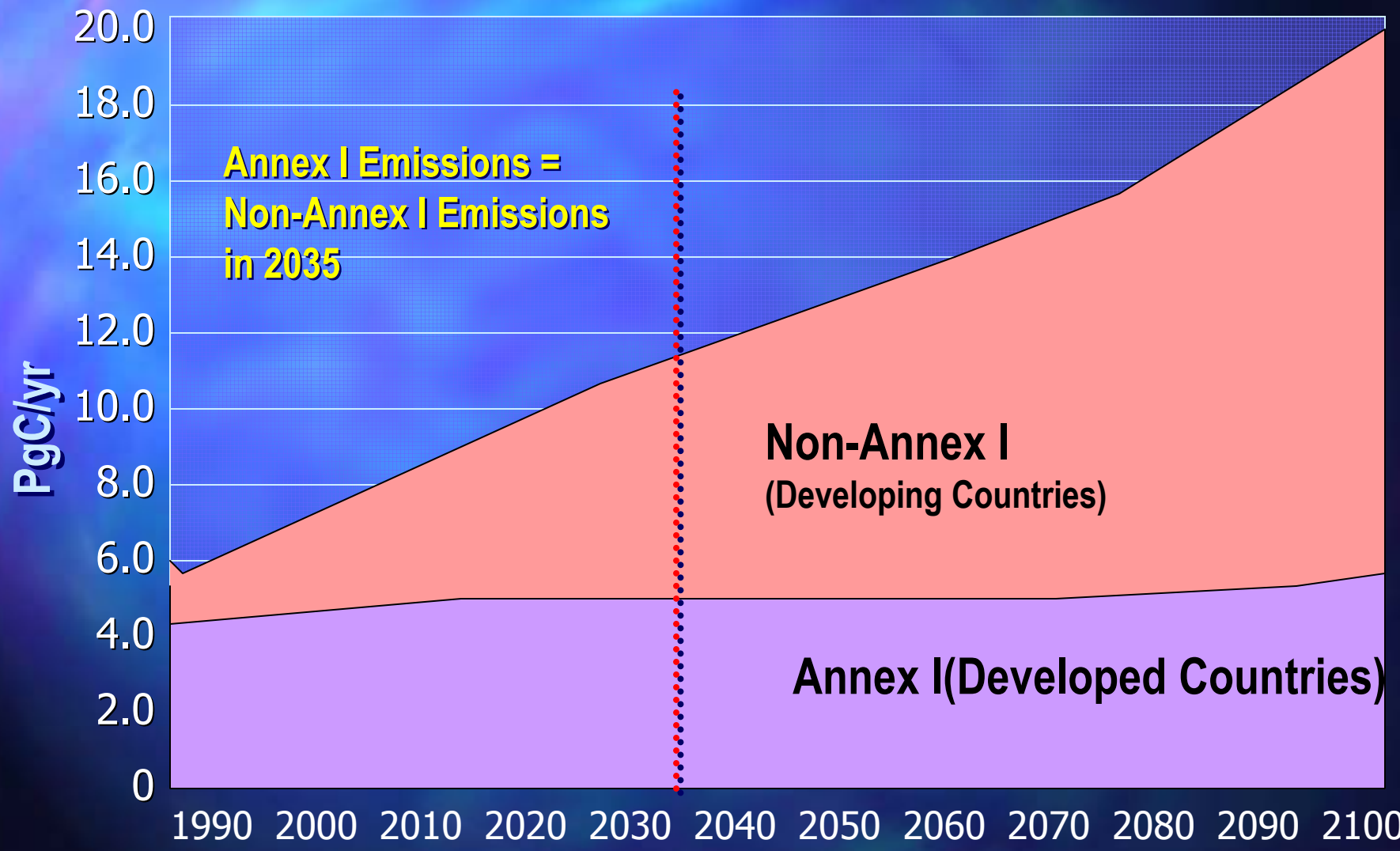
REFRIGERANTS:
The Future In The Balance


The McGraw-Hill Companies
BusinessWeek
AUGUST 16, 2004
www.businessweek.com
3 4225 00179 9116
GLOBAL WARMING
Why Business Is Taking It So Seriously
BY JOHN CAREY (P. 60)

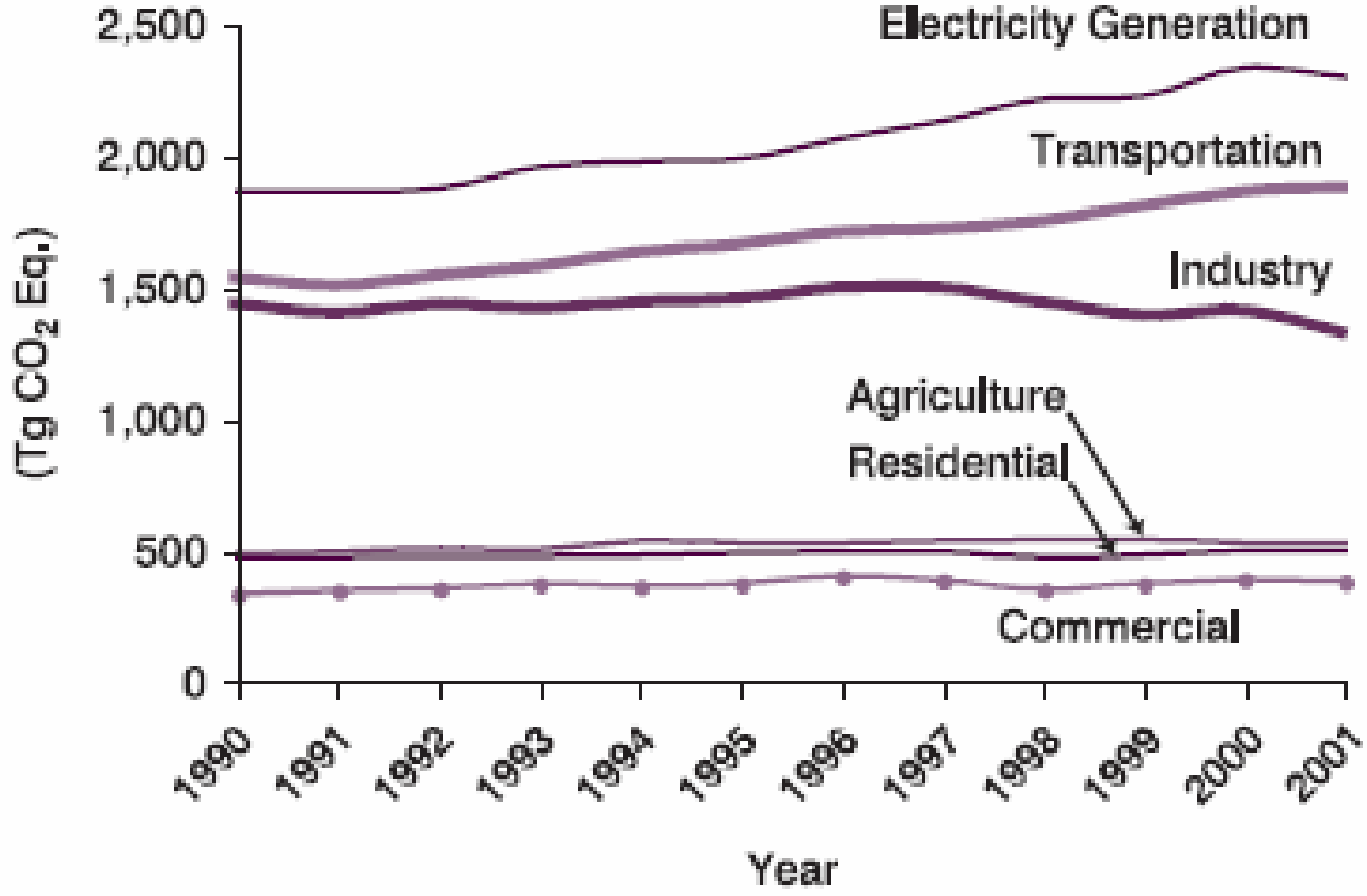

NATIONAL GEOGRAPHIC CHANNEL'S MOST AMAZING DISCOVERIES, SEPT. 6-10 AT 9 P.M. ET/PT
NATIONALGEOGRAPHIC.COM/MAGAZINE
SEPTEMBER 2004
NATIONAL GEOGRAPHIC
GLOBAL WARNING
BULLETINS FROM A WARMER WORLD
The New Face of the American Indian 76
Badgers With Attitude 96
Treasure From a Civil War Wreck 108
ZipUSA: Schooled in Tradition 128
PLUS Supplement Map: Indian Country


United Nations Environmental Program
UNEP / EPA (1994) Scenario for HFCs
IPCC (IS92a) Scenario for all other gases
Climate Forcing
(Since year 1765)
Wm²
6
5
4
3
2
1
0
Carbon Dioxide
Nitrous Oxide
Methane
HFCs
CFCs & HCFCs
1990
2010
2030
2050
Year

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



Emissions Allocated to Economic Sectors



Note: Does not include U.S. territories

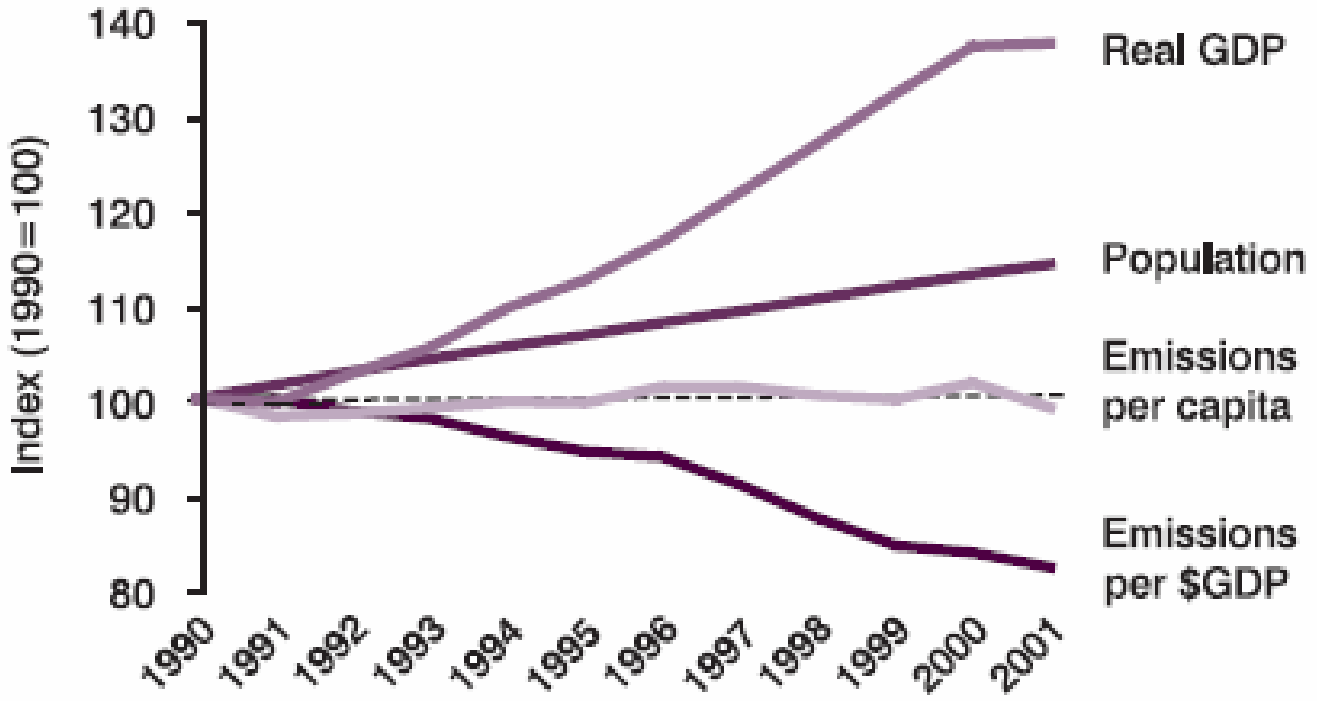
Kyoto Protocol Greenhouse Gas Coverage

- Six (6) Gases
  - Carbon Dioxide -- CO_2
  - Methane -- CH_4
  - Nitrous Oxide -- N_2O
  - Hydrofluorocarbons -- HFCs
  - Perfluorocarbons -- PFCs
  - Sulfur hexafluoride -- SF_6
- Base Period
  - 1990 for CO_2 , CH_4 , and N_2O
  - 1990 or 1995 for HFCs, PFCs, and SF_6

Kyoto Protocol -- Country Targets

Country	% of base	Country	% of base
Australia	108	Italy	92
Austria	92	Japan	94
Belgium	92	Lithuania	92
Bulgaria	92	Netherlands	92
Canada	94	New Zealand	100
Croatia	92	Norway	101
Czech Republic	92	Poland	94
Denmark	92	Portugal	92
Estonia	92	Romania	92
European Community	92	Russian Federation	100
Finland	92	Spain	92
France	92	Sweden	92
Germany	92	Switzerland	92
Greece	92	Ukraine	100
Hungary	94	United Kingdom	92
Iceland	110	United States	(93)

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:

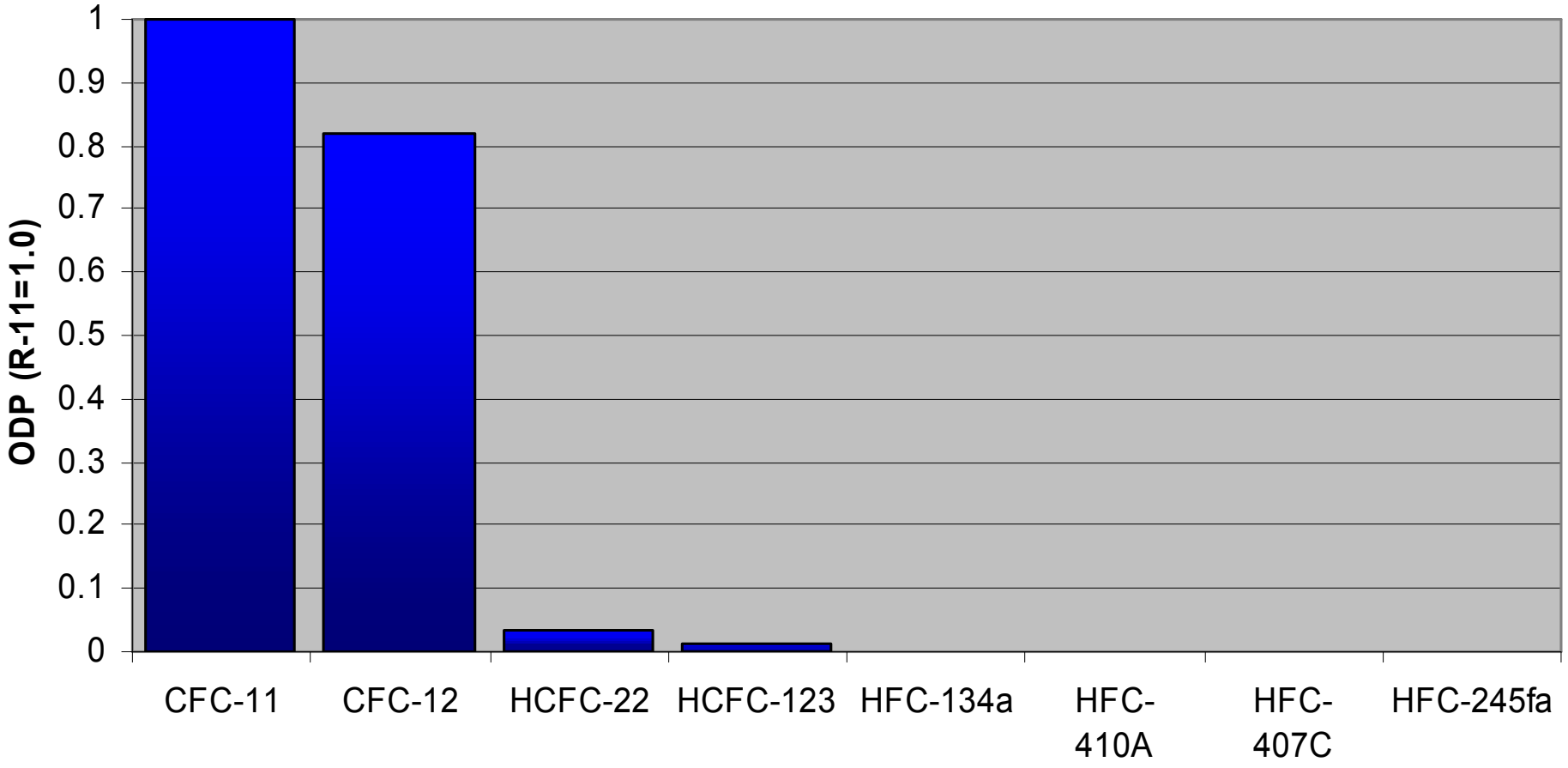
(1) a low ODP
(2) a very low GWP
(3) a very short atmospheric lifetime
(4) the extremely low emissions of current designs for HCFC-123 chillers
(5) the highest efficiency of all current options

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."

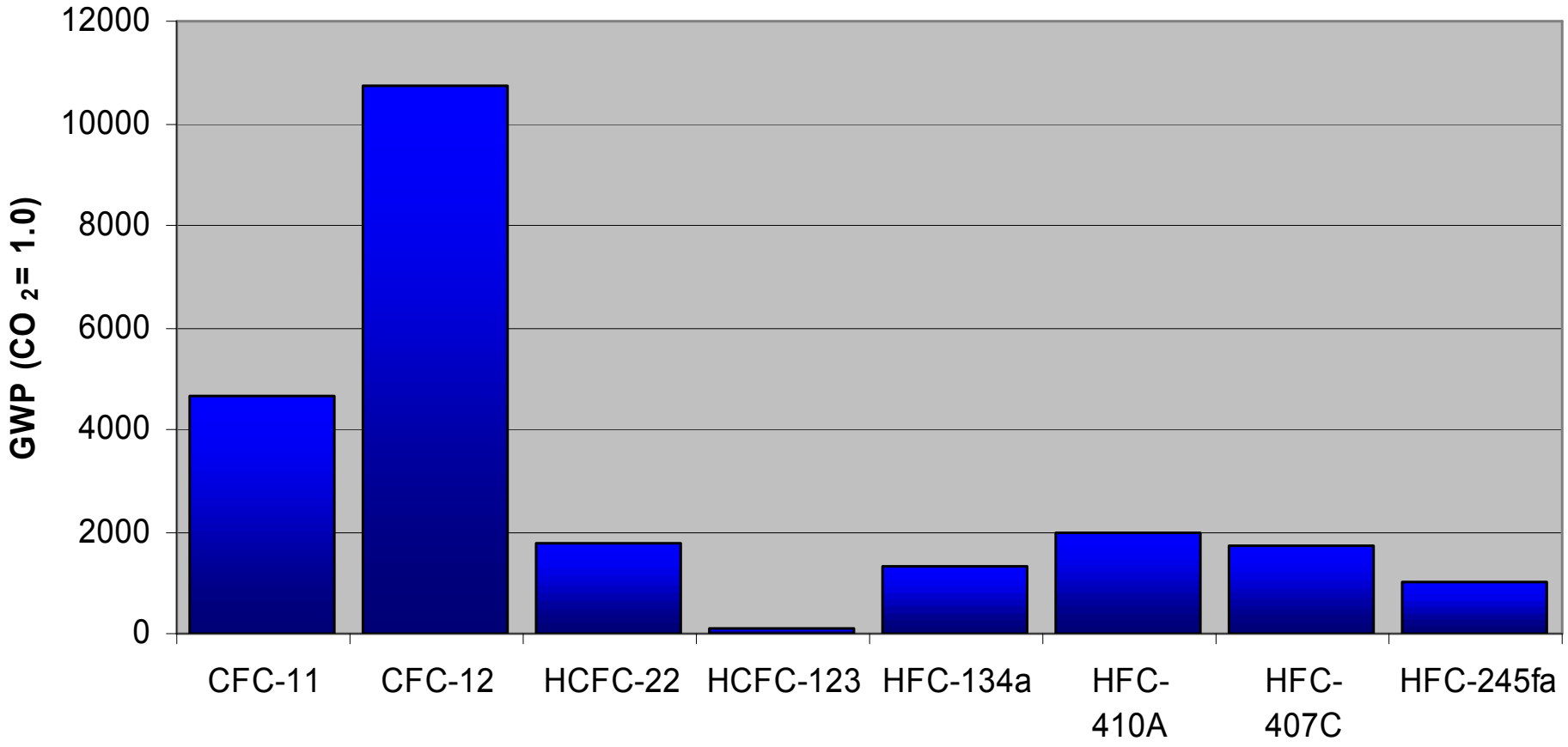
The Best Environmental Solution

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

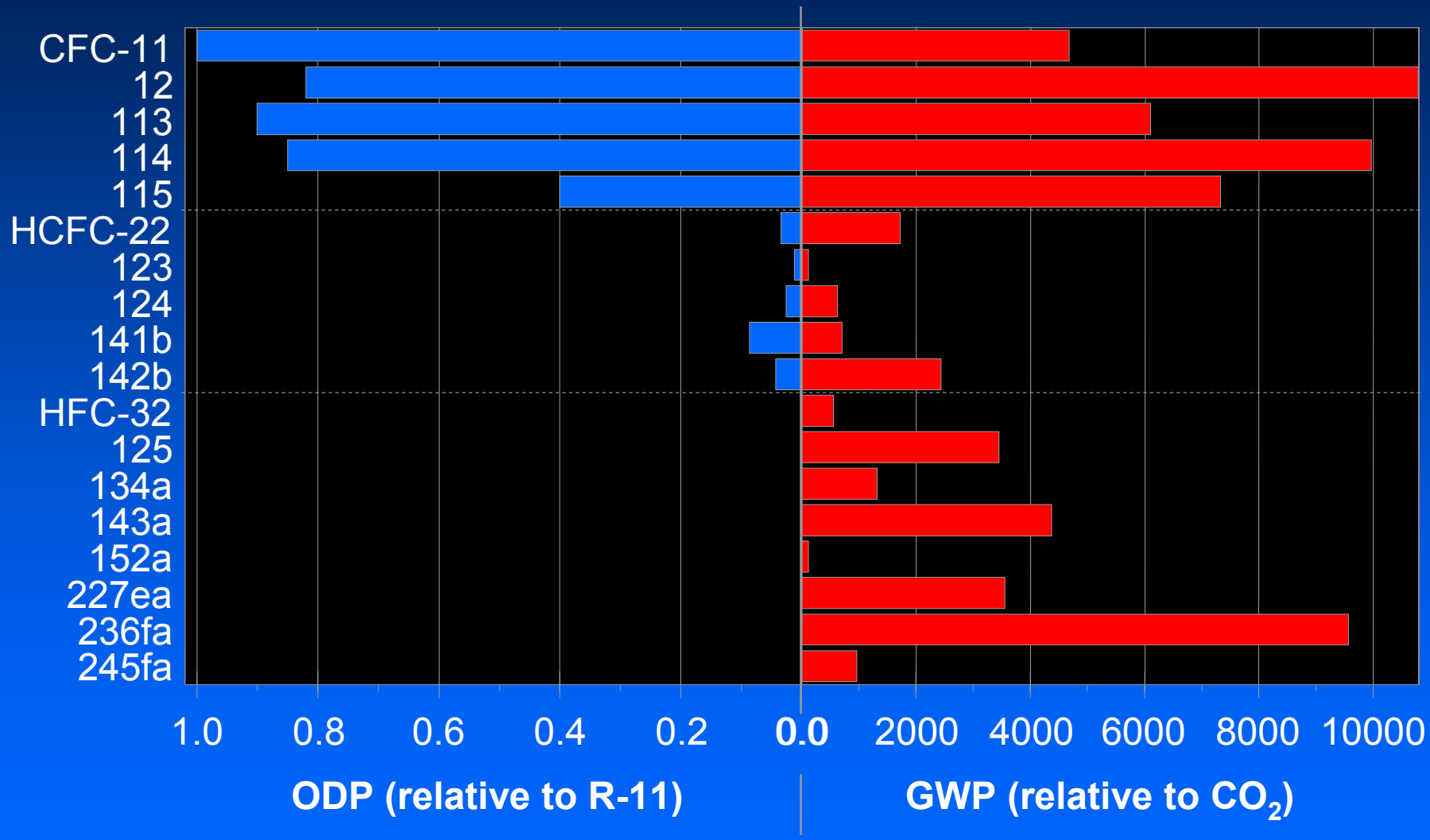
Ozone Depletion Potential (ODP)



Global Warming Potential (GWP)

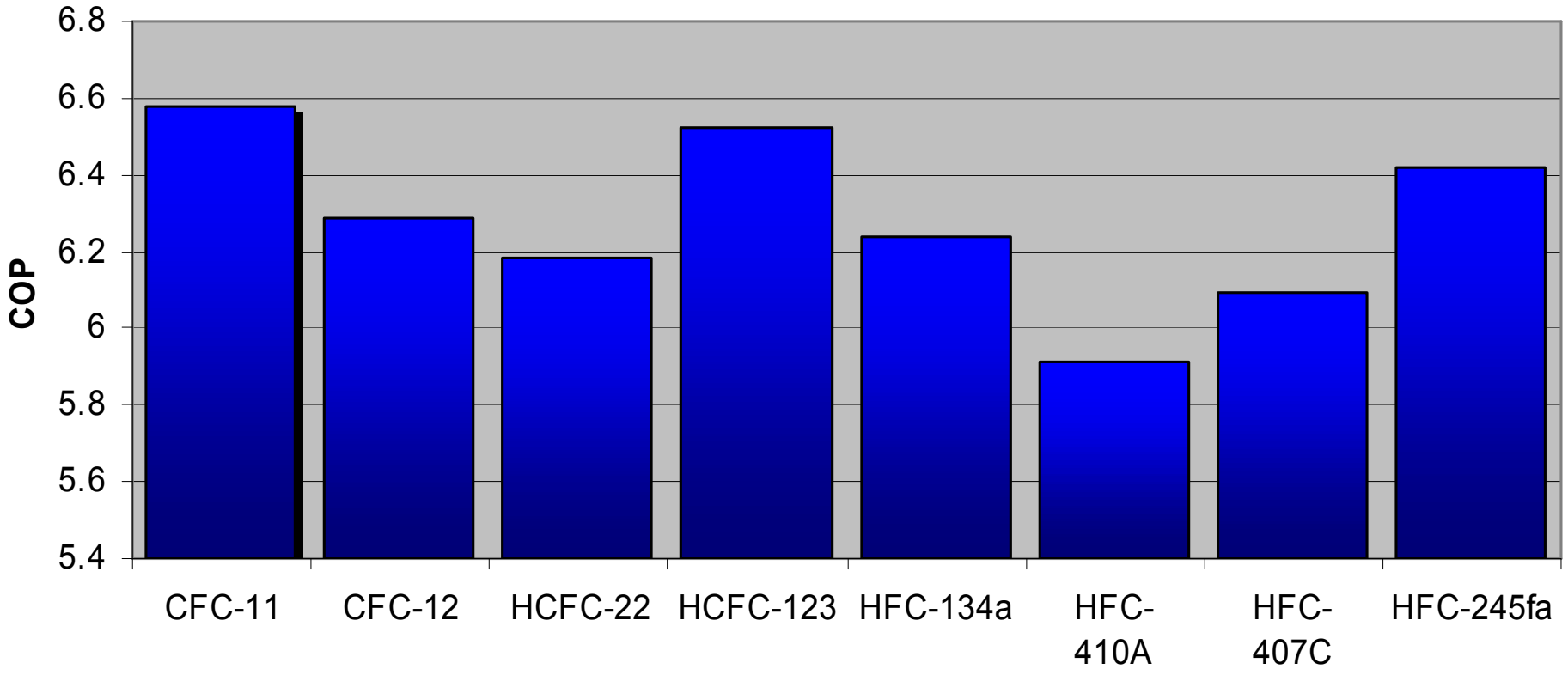


ODP versus GWP

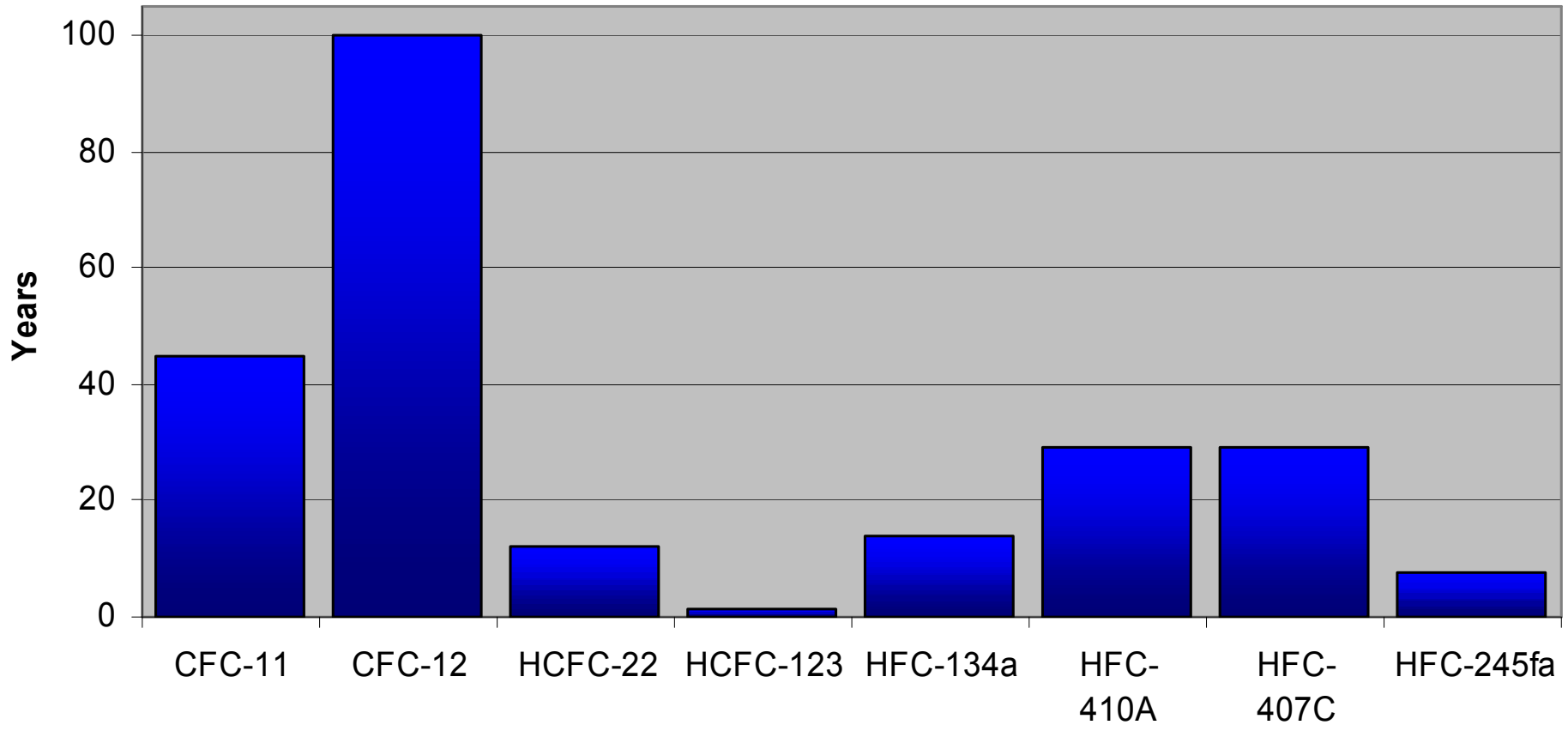


J. M. Calm and G. C. Hourahan, "Refrigerant Data Summary," *Engineered Systems*, 18(11):74-88, November 2001 (based on 1998 WMO and 2001 IPCC assessments)

Efficiency for Chillers (COP)

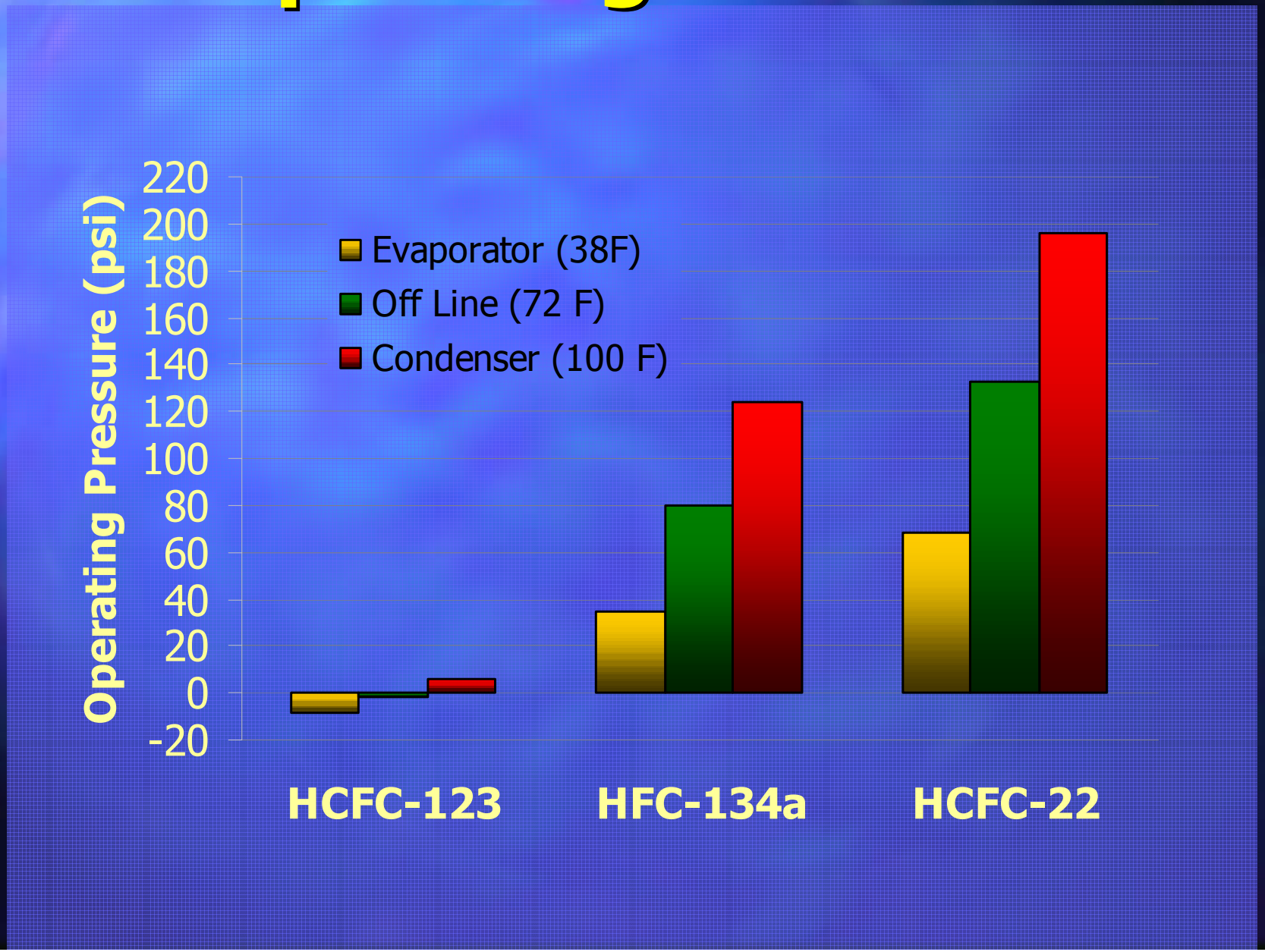


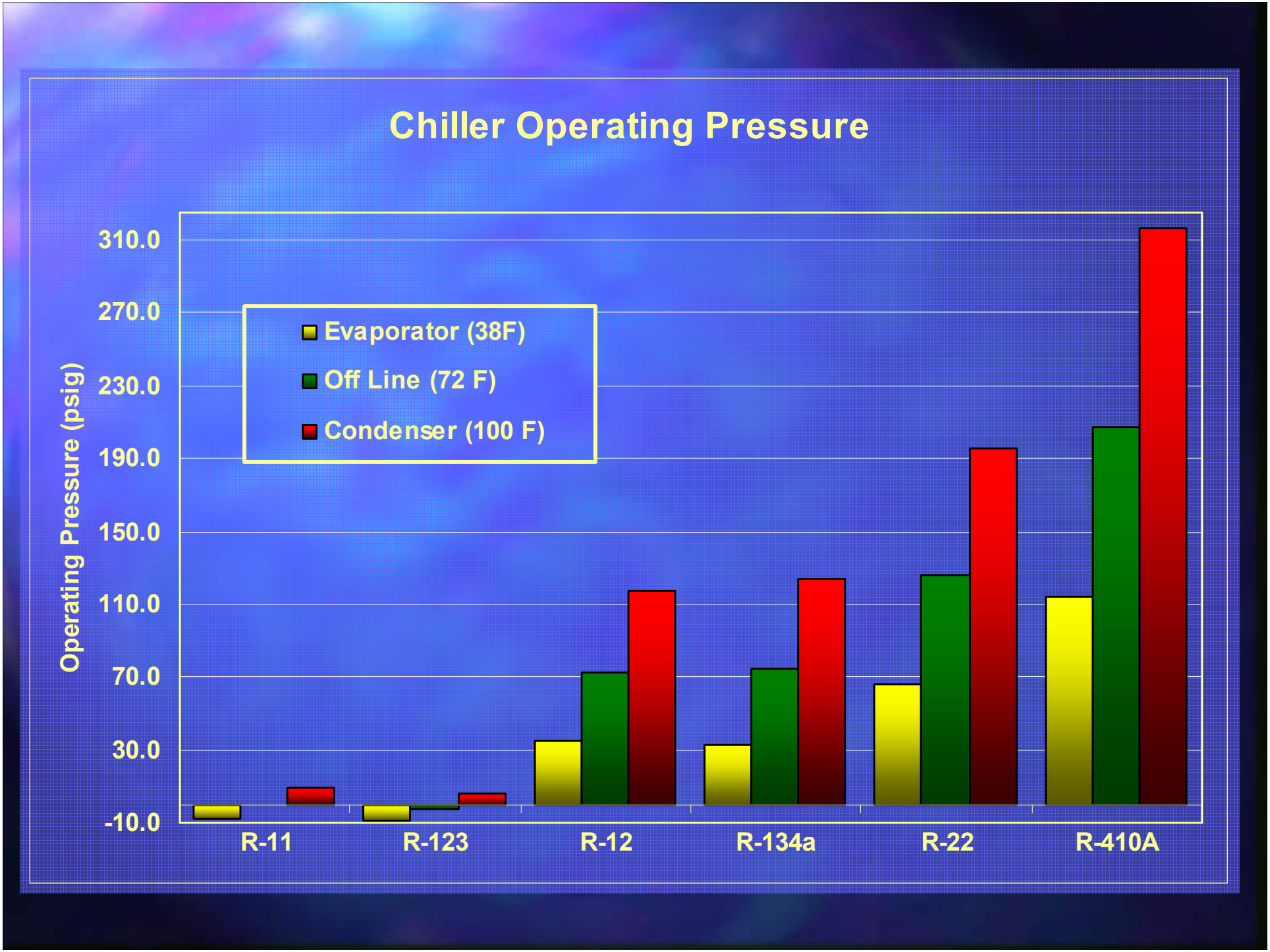
Atmospheric Life (Years)



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

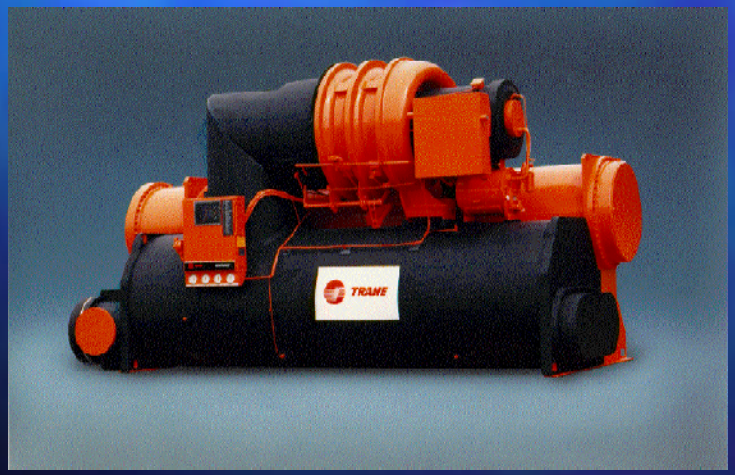
Operating Pressure




Chiller Operating Pressure
Operating Pressure (psig)
310.0
270.0
230.0
190.0
150.0
110.0
70.0
30.0
-10.0
Evaporator (38F)
Off Line (72 F)
Condenser (100 F)
R-11
R-123
R-12
R-134a
R-22
R-410A

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

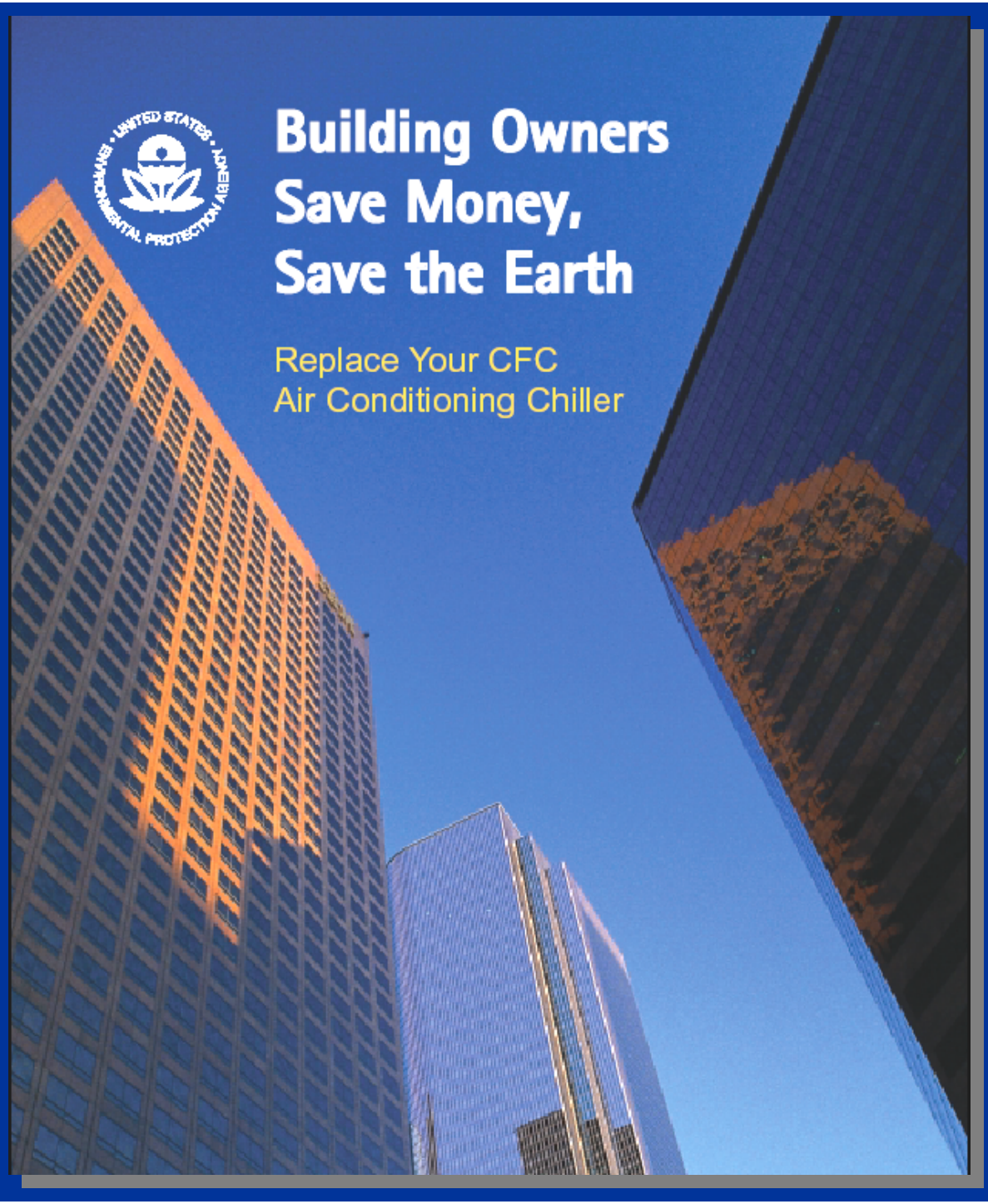
Study corroborated in "Impact on Global Ozone and Climate From Use and Emission of (HCFC-123)" By Calm, Wuebbles an Jain

The Future

Emissions

Energy Efficiency

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


Building Owners
Save Money,
Save the Earth
Replace Your CFC
Air Conditioning Chiller

achieve high energy efficiency and is ozone-safe, but refrigerant emissions are relatively potent greenhouse gases. HCFC-123 can achieve high energy efficiency and is not a potent greenhouse gas, but does have an ozone-depleting potential 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.

Building owners can make a significant contribution to environmental protection by replacing old chillers. Properly monitored and maintained, high-efficiency HCFC-123 and HFC-134a chillers minimize the effect of air conditioning systems on climate change and do not significantly affect the ozone layer. By using less electricity, energy-efficient equipment helps protect the environment by reducing nitrous oxides, sulfur dioxide, particulate matter, carbon dioxide, and mercury emissions from power plants supplying electricity to the buildings.

Electric utilities sometimes use their least efficient power plants for the peak periods of electricity demand, which is when chiller loads are usually highest. Therefore, reduced electricity use has an even larger benefit for local air quality and climate protection.

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.

Which Chiller Should I Purchase?

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- and 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 refrigerant 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.

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 cal-

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

Which Chiller Should I Purchase?

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- and 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 refrigerant 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.

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

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

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Global Programs Division (6205J) and Climate Protection Partnerships Division (6202J)

www.epa.gov/ozone/

www.energystar.gov/

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


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Questions