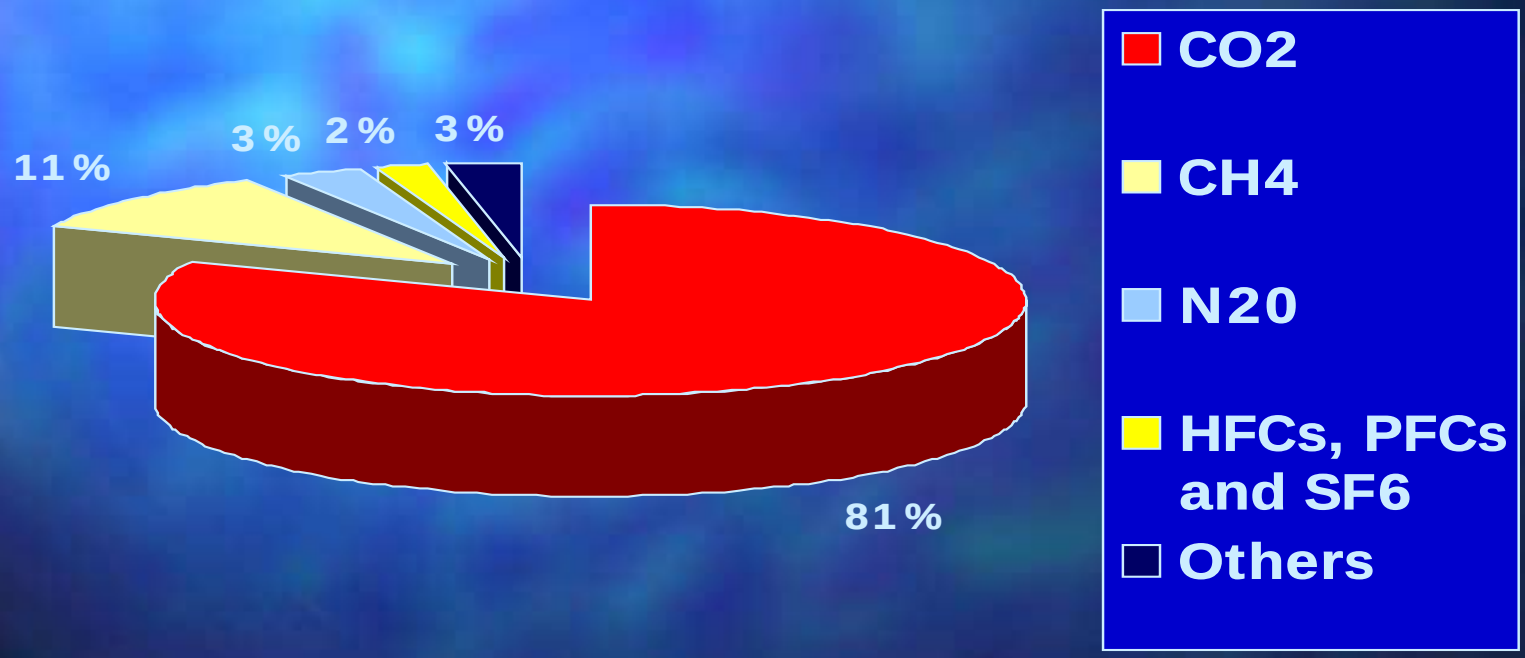
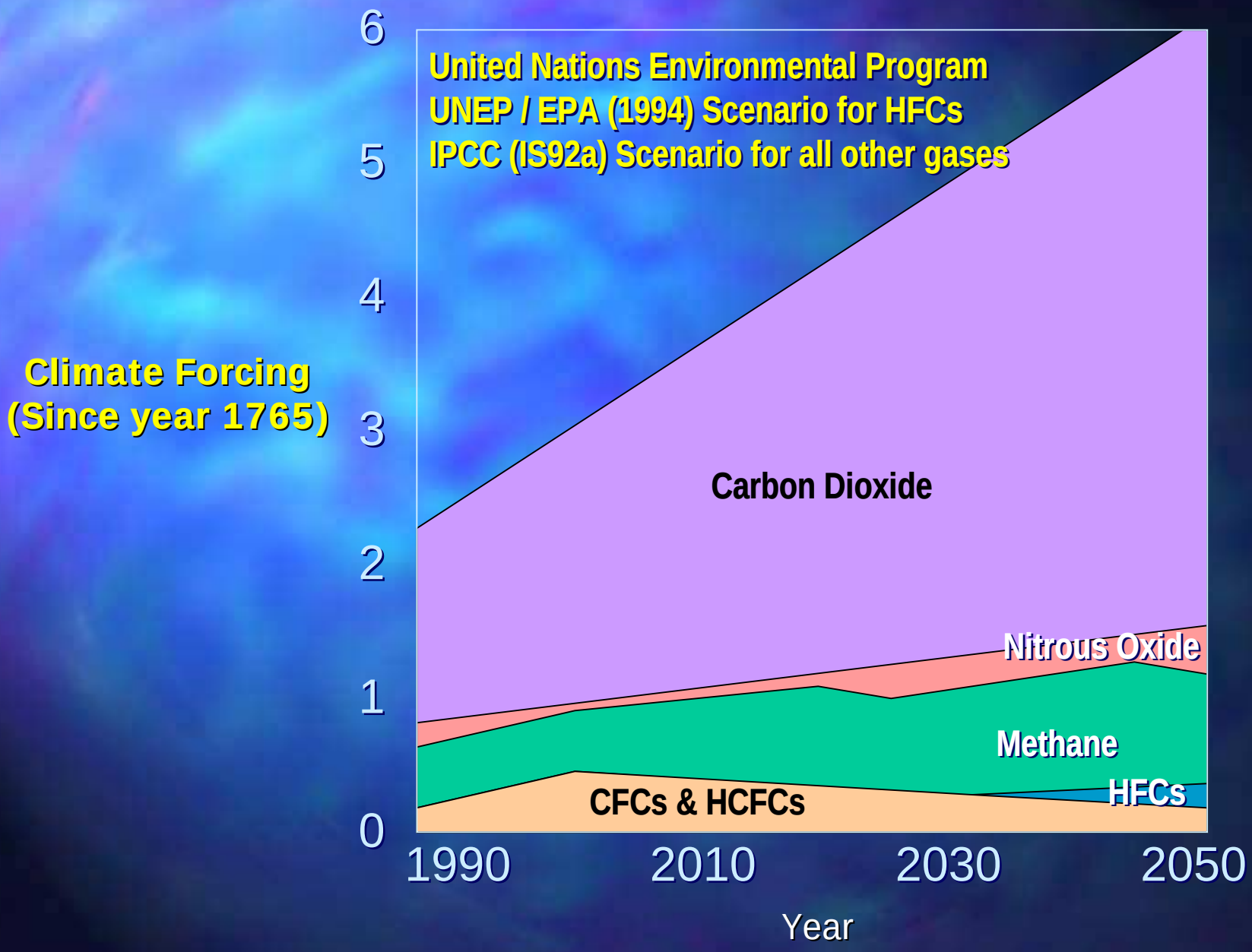
The Kyoto Protocol Impact on HVAC&R Technology

James Wolf

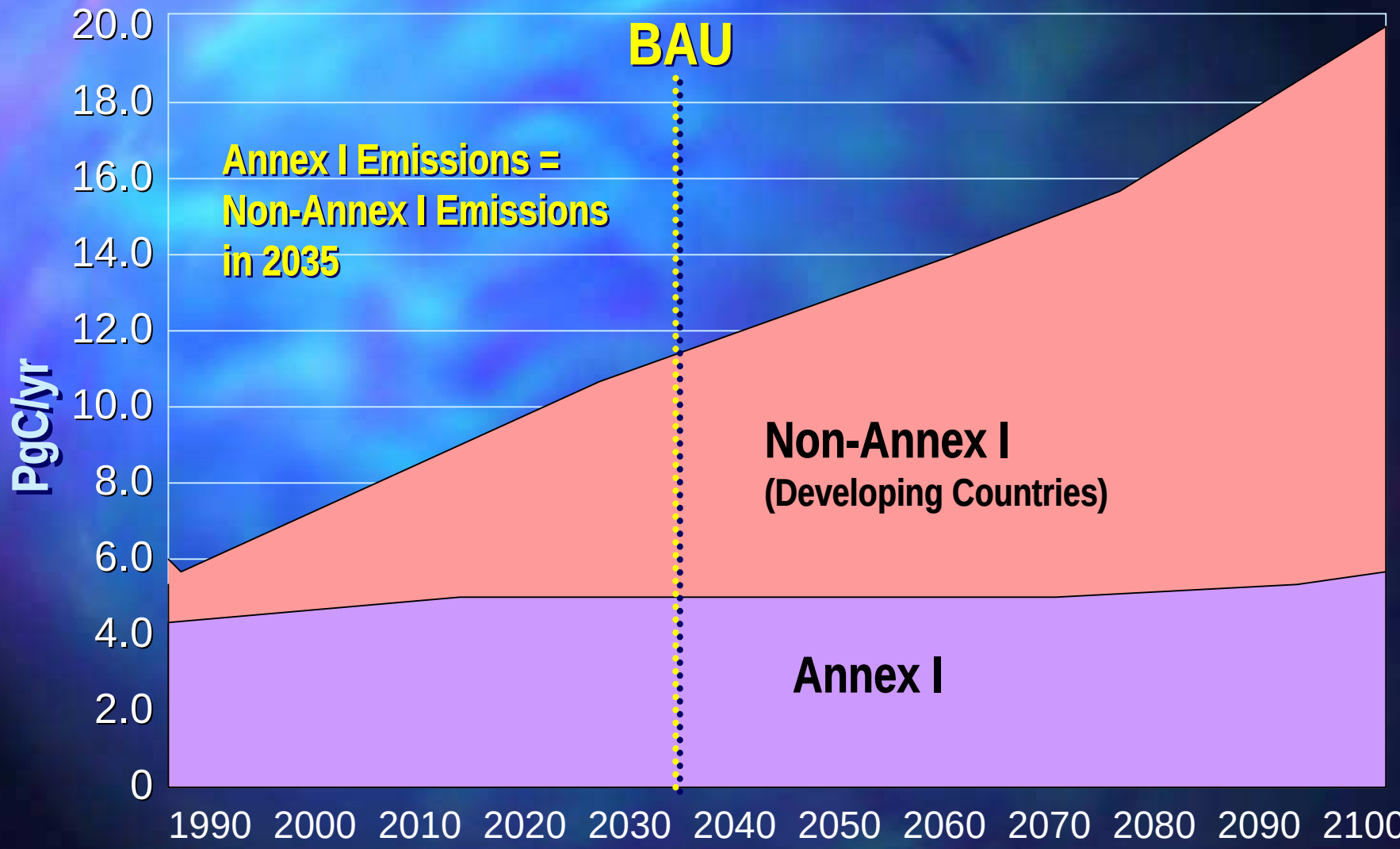
American Standard Companies

Relative Contribution of Greenhouse Gases in U.S.




United Nations Environmental Program
UNEP / EPA (1994) Scenario for HFCs
IPCC (IS92a) Scenario for all other gases
Climate Forcing
(Since year 1765)
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:



Global Climate Change - Berlin Mandate

- Science Assessment
  - "discernible human influence on global climate"
  - Increase of 2°C from 1990 - 2100
  - Sea Level rise by 50 cm 1990 - 2100
  - Stabilization at 2x pre-industrial levels requires 50% reduction
- Technical and Economic Assessment
  - Reductions are technically possible
  - Reductions are economically feasible
  - "No-Regrets" opportunities are available

Kyoto Protocol -- Developed Countries

- Targets & Timetables
  - 38 Countries
  - Differentiated Targets
  - 5.2 Percent Avg. reduction (versus 1990)
  - 6 Greenhouse gases
  - Commitment period 2008 - 2012
  - Demonstrate Progress to goal by 2005
  - Banking and Carry-over of reductions

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

Kyoto Protocol

Policies and Measures

- Enhancement of energy efficiency
- Increase use of new and renewable forms of energy
- Phase out market imperfections
- Limit or reduce emissions of greenhouse gases

Kyoto Protocol
Clean Development Mechanisms

- Emission reduction credits for projects between all parties
- Early Credits -- 2000 to 2008
- Sharing Technologies
- Exporting Technologies
- Assist other countries jointly with projects
- Sharing in results

Kyoto Protocol

Emissions Trading

- Developed Countries
- Details at COP - 4

Kyoto Protocol

- Signature and Ratification
  - March 1998 - March 1999
  - US likely 2004 - 2005 timeframe
  - Entry in Force
  - After 55 countries ratify
  - Amounts to 55% of Developed Country Emissions
- Second Commitment Period
  - Agreement by 2005

United Nations, Kyoto Protocol Press Release

" It (The Protocol) creates new incentives for technological creativity and the adoption of "no-regrets" solutions that make economic and environmental sense irrespective of climate change. Because activities and products with zero or low emissions will gain competitive advantage, the energy, transport, industrial, housing, and agricultural sectors will gradually move toward more climate-friendly technologies and practices."

FCC/SBSTA/1999/CRP.7
1 November 1999
ENGLISH ONLY

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE

Eleventh session

Bonn, 25 October - 5 November 1999

Agenda item 10 (b)

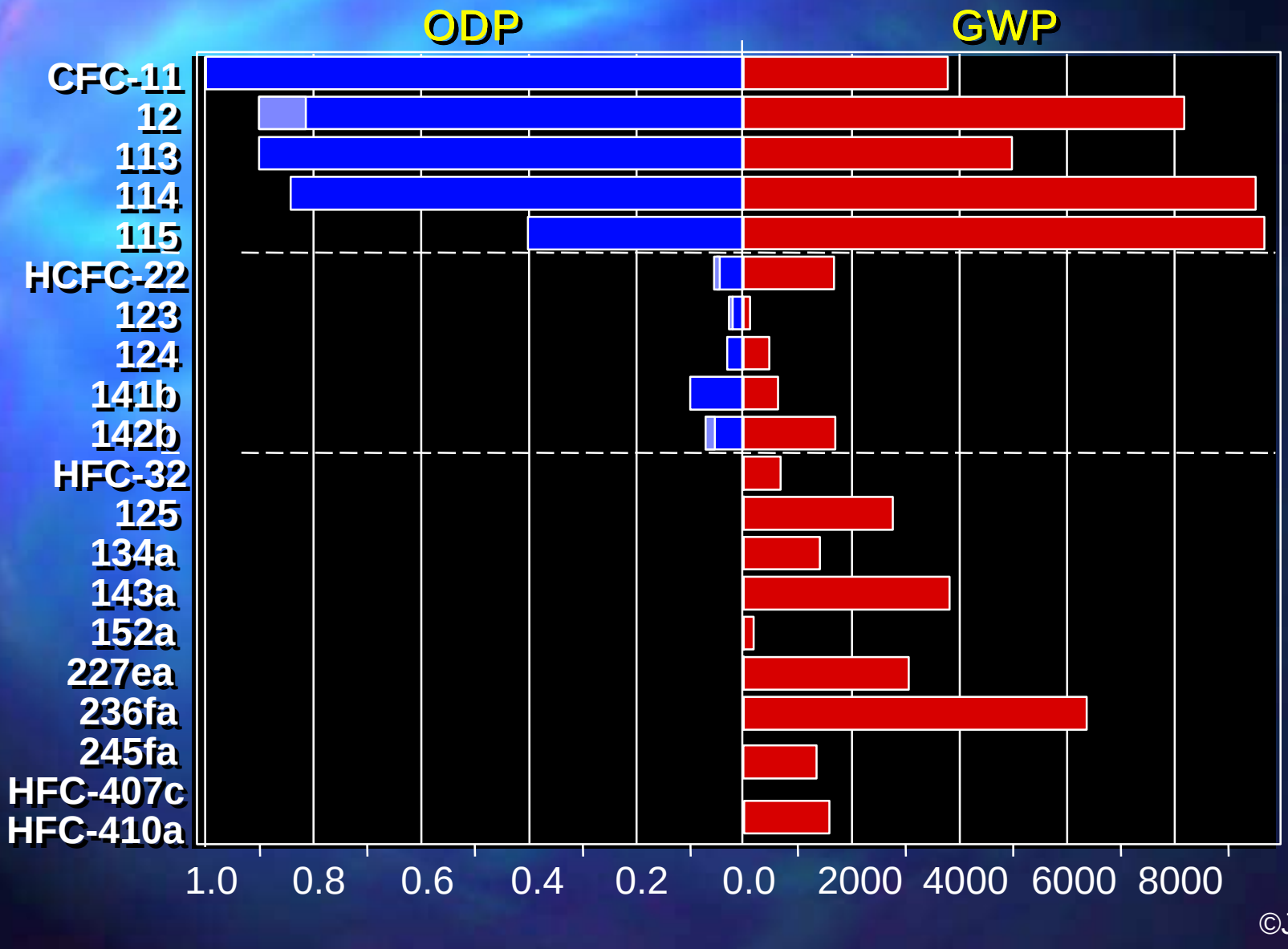
The relationship between efforts to protect the stratospheric ozone layer and efforts to safeguard the global climate system

The Conference of the Parties

1. *Invites* each Party to give consideration to this information on available and potential ways and means of limiting emissions of hydrofluorocarbons and perfluorocarbons, taking into account, *inter alia*, health, medical, environmental and safety considerations, energy efficiency and associated emissions in carbon dioxide equivalent, and technical and economic considerations;


POLICY FORUM
An Environmental Rationale for Retention of Endangered Chemicals
Donald J. Wuebbles and James M. Calm
SCIENCE
frontiers in CANCER RESEARCH

ODP vs. GWP for common refrigerants and candidates



Arthur D. Little

Global Comparative Analysis of HFC Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire Protection Applications

Final Report to the Alliance for Responsible Atmospheric Policy

August 23, 1999

Prepared by:
John Dieckmann
Arthur D. Little, Inc.
And
Hillel Magid
Consultant

Table 7-1: Chiller Technology Alternatives

Cycle	Compressor	Typical Capacity Range	Refrigerant Alternative
Vapor Compression	Centrifugal	>700 kW (200 ton)	HCFC-123 HFC-245fa HFC-134a HCFC-22 R-410A
	Screw	200-1500 kW (50-400 ton)	HFC-134a HCFC-22 R-410A
	Scroll	75-300 kW (20-80 ton)	HFC-134a HCHC-22 R-410A
	Reciprocating	75-500 kW (20-150 ton)	HCFC-22 R-407C R-410A
Absorption	N/A	> 700 kW (200 ton)	Libr/Water

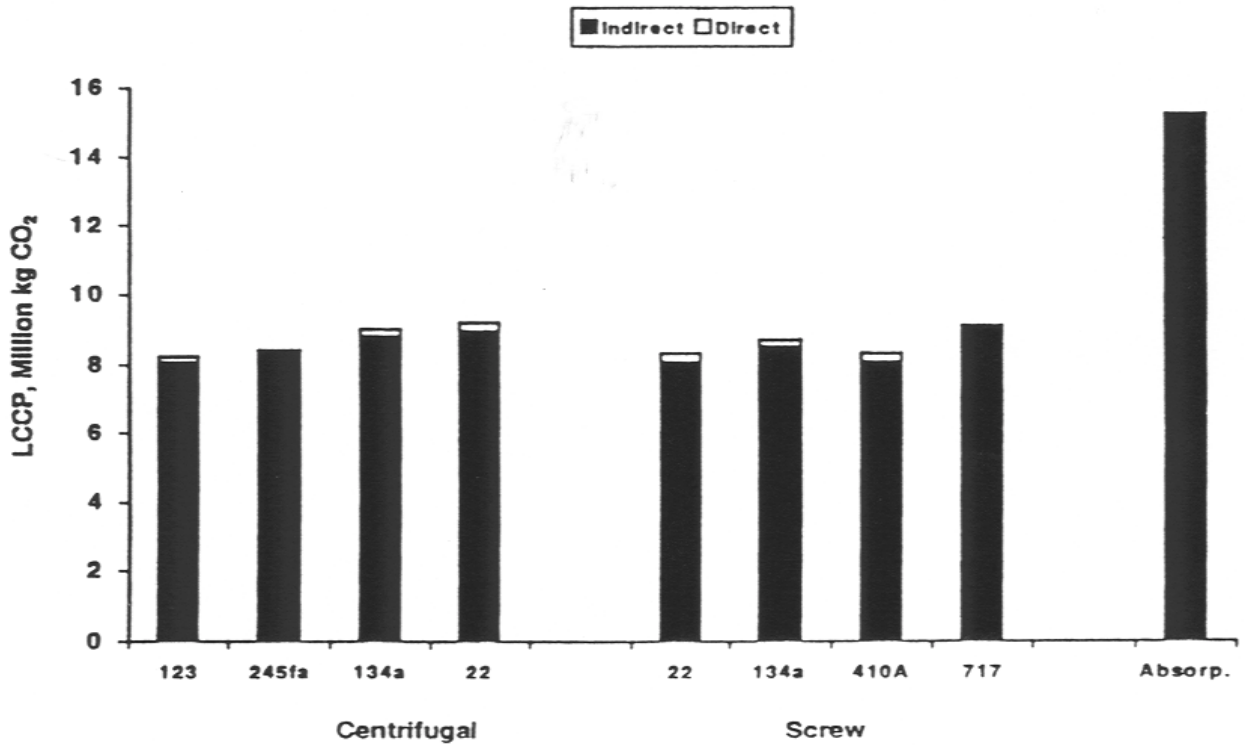


Figure E-7: LCCP for Chillers – Best Current Technology, Atlanta Office Building

The LCCP of a typical direct-fired, double-effect Lithium Bromide -Water absorption chiller is about 65% higher than the average LCCP for the vapor compression cycle chillers.

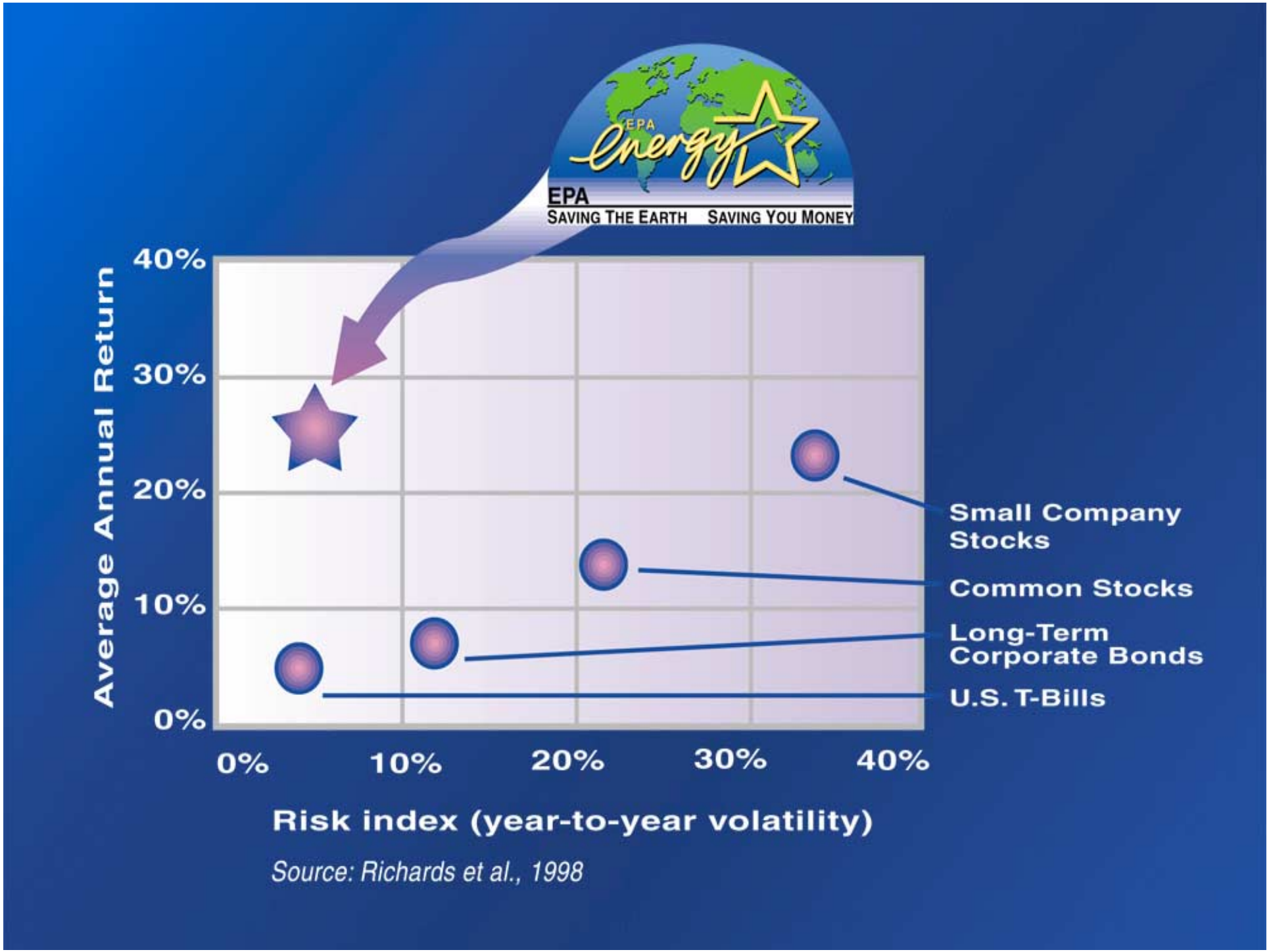
Table 7-8: LCCP for 1200 kW (350 ton) Chiller in Atlanta Office Building, Current (1999) Efficiency Level

Refrigerant/ Technology	Indirect (energy) kg. CO_2	Lifetime Refrigerant Emissions, kg	100 Yr. GWP & Manufacturing kg CO/kg	Direct Warming kg CO_2	LCCP kg Co_2 eq.
Centrifugal:					
HCFC-123	8,088,600	144	100	14,400	8,103,000
HFC-245fa	8,312,800	144	832	119,800	8,432,600
HFC-134a	8,827,600	129	1,313	169,380	8,997,000
HCFC-22	8,975,800	129	1,890	243,800	9,219,600
Screw:					
HCFC-22	8,088,600	129	1.890	243,800	8,232,400
HFC-134a	8,535,000	129	1,313	169,380	8,704,400
R-410A	9/088,600	129	1,739	224,330	8,312,900
R-717	9,126,00	72	2	144	9,126,100
Double-effect LiBr-Water	13,080,600 2,174,200 15,254,800	--	--	--	15,254,800

For all the alternatives in Table 708, the major portion of the LCCP is the indirect warming associated with the energy consumption, with direct warming due to refrigerant emissions only amounting to between 0.2 and 3 percent of the total LCCP.

Future Means Thinking Green

- Designing “best value versus lowest cost” buildings
- The green of money
- The green of energy efficiency
- The green of resource sustainability


EPA
Energy
EPA
SAVING THE EARTH SAVING YOU MONEY
Average Annual Return
40%
30%
20%
10%
0%
0%
10%
20%
30%
40%
Small Company Stocks
Common Stocks
Long-Term Corporate Bonds
U.S. T-Bills
Risk index (year-to-year volatility)
Source: Richards et al., 1998

"Green" Opportunities are Tremendous for:

- Manufacturers
- Consulting Engineers
- Contractors
- Facility Engineers

Summary and Expectations

- Energy Efficiency will be Strongly Encouraged
  - Replacement of Inefficient HVAC, Lighting, and other appliances
  - Life Cycle Cost purchasing will be the preferable process for obtaining energy efficient systems, appliances, buildings, and automobiles