

An Industry in Transition - DuPont's Perspective of the Mobile Air Conditioning Industry

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DuPont Fluoroproducts

The Science of



The miracles of science™

Agenda

•DuPont's Role in Environmental Issues

- Ozone depletion
- Climate change

•Mobile AC:

- Past
- Present
- Future
 - I-MAC

•Conclusions

Ozone Depletion - DuPont Role

•DuPont

- 1972 -- Formed group that sponsored atmospheric science research
- 1986 -- Supported international controls
- 1988 -- Committed to CFC/halon phase-out
- post-1988 -- Acceleration for CFC/halon; HCFC controls

•Support of global activities

- 1987 -- Montreal Protocol
- 1990 -- London Amendments
- 1992 -- Copenhagen Amendments
- post-1992 -- Additional Amendments



“DuPont is a science company that focuses its efforts on providing societal and shareholder value while reducing environmental impact. We are honored to be recognized for our role in addressing and helping resolve one of the most challenging environmental issues the world has faced.” ---- **DuPont CEO Chad Holliday Nov. 6, 2003**

2002 U.S. National Medal of Technology

CFC Policy and Technology Leadership

DuPont Position - Climate Change

“DuPont has participated in international scientific study of climate change and believes there is need for prudent action. We began taking action to reduce greenhouse gas emissions in the early 1990’s, have accomplished major global reductions and set ambitious goals for the current decade. We intend to meet those goals.”

Global Climate Change

•Basic Science is Sound

- Atmospheric concentrations of greenhouse gases are increasing (primarily carbon dioxide)
- Increasing concentrations will cause climate change
- Persistence of effects is a major issue

•Uncertainties

- Rate and magnitude of climate change
- Local and regional changes and impacts

DuPont Leadership

Corporate

- 1991 -- Internal commitments to reduce emissions; N₂O, HFC-23, energy
- 1999 -- Renewed and extended commitment
 - 65% reduction compared to 1990 by 2010
 - Energy consumption flat
 - 10% energy from renewable by 2010
- 2000 -- exceeded 1991 commitment
- 2002 -- exceeded 1999 65% goal

Fluorochemicals

- Ongoing -- Leading in “Responsible Use of HFCs”

Responsible Use Principles for HFCs

- **Select HFCs for applications where they provide health and safety, environmental, technical, economic, or unique societal benefits**
- **Minimize HFC emissions to the lowest practical level during manufacture of the chemical**
- **Engineer, operate and maintain HFC-using systems to minimize emissions and maximize energy efficiency**
- **Recover, recycle, reclaim and/or destroy used HFCs where technically and economically feasible**
- **Promote comprehensive technician training in HFC handling to assure compliance with regulations and stewardship practices**
- **Accurately report HFC production and promote models, that accurately estimate emissions**
- **Consider alternatives that are technically, environmentally, and economically feasible**

Responsible Use Principles - Mobile Air Conditioning

- **Contain refrigerants in tightened systems to minimize emissions**
- **Recover, recycle and reclaim all refrigerants**
- **Train service personnel in proper handling**
- **Design systems to minimize charge size**
- **Design, install and operate to maximize energy efficiency**
- **Minimize leakage of refrigerant during initial fill of systems**
- **Encourage repair before re-charging**
- **Continue research, development and evaluation of alternatives**

The MAC Industry Deserves Some Credit!

- **Transition from R-12 to R-134a:**
 - 0 ODP
 - ~ 85% reduction in GWP
 - Safety level maintained
 - Customer perspective - smooth, quick, relatively seamless transition
- **U.S. refrigerant emissions cut in half, while fleet has increased by ~ 30%**
 - Reduced charge sizes
 - Reduced system leaks
 - Recovery/Recycle
 - Improved service practices

Current Situation

- **MAC systems still contribute to climate change**
 - HFC-134a has a GWP of 1300
 - Refrigerant emissions can be minimized
 - System emissions
 - Emissions during/after service and end-of-life
 - MAC systems consume significant energy
 - 3.2% to 5.5% of total vehicle fuel use
 - Efficiency can be improved
- **Contribution will continue to grow as global AC fleet grows - unless action is taken**

What is I-MAC?

- **Improved Mobile Air Conditioning: 30% more efficient / 50% less HFC-134a emissions**
 - A program with broad international support
 - A program for the environment
 - A program for the consumer

A Program for the Environment

When Implemented Globally

- **Can save 10 to 20 billion liters of fuel annually**
- **Can avoid over 120 million tonnes CO₂eq. annually (refrigerant plus fuel)**

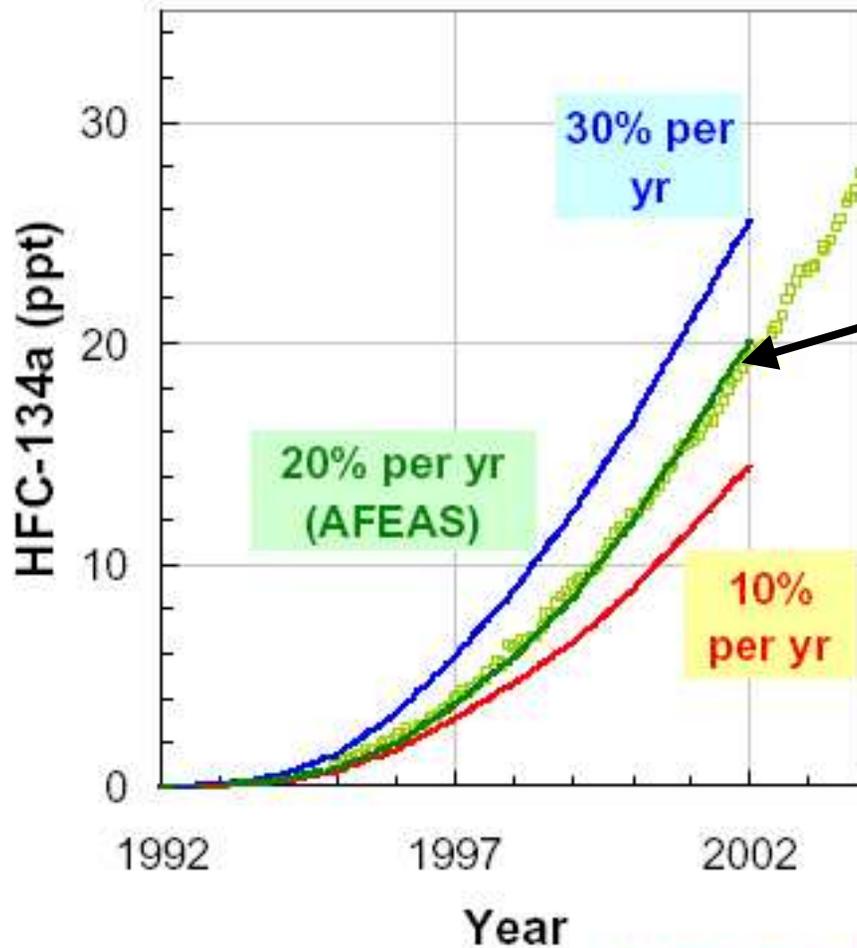
Assumptions for Scenarios

- **Base case**
- **Early global HFC-134a I-MAC implementation**
 - 50% service (and EOL) emission reduction: 2007-2011
 - 50% system emission reduction in new cars: 2010- 2013
 - 30% system efficiency improvement in new cars: 2010- 2013
- **EU proposal assumptions -- EU implementation**
 - HFC-134a refrigerant phase-out for new car models: 2011- 2017
 - System HFC-134a emissions reduced for new cars in 2007 to 40g/yr
 - 30% system efficiency improvement for new car models 2011- 2017 -- not part of EU proposal

Base Case Assumptions

- **Base case:**
 - Maintain R-134a globally; same energy efficiency
 - 20% of bank emitted each year
 - 60/40 split between service (EOL)/system leaks
- **Fleet growth based on data from Global Insight and Freedonia Group**
- **AC fuel consumption based on work done by Rugh, Hovland and Andersen (2004 ETF)**
 - Grows with AC fleet; same fuel economy
- **MAC R-134a bank: “AFEAS Production and Atmospheric Release of HFC-134a”**
 - Bank grows with global AC fleet
 - 13 year average life
 - Offset slightly with reduced charge size

HFC-134a Refrigerant Emissions



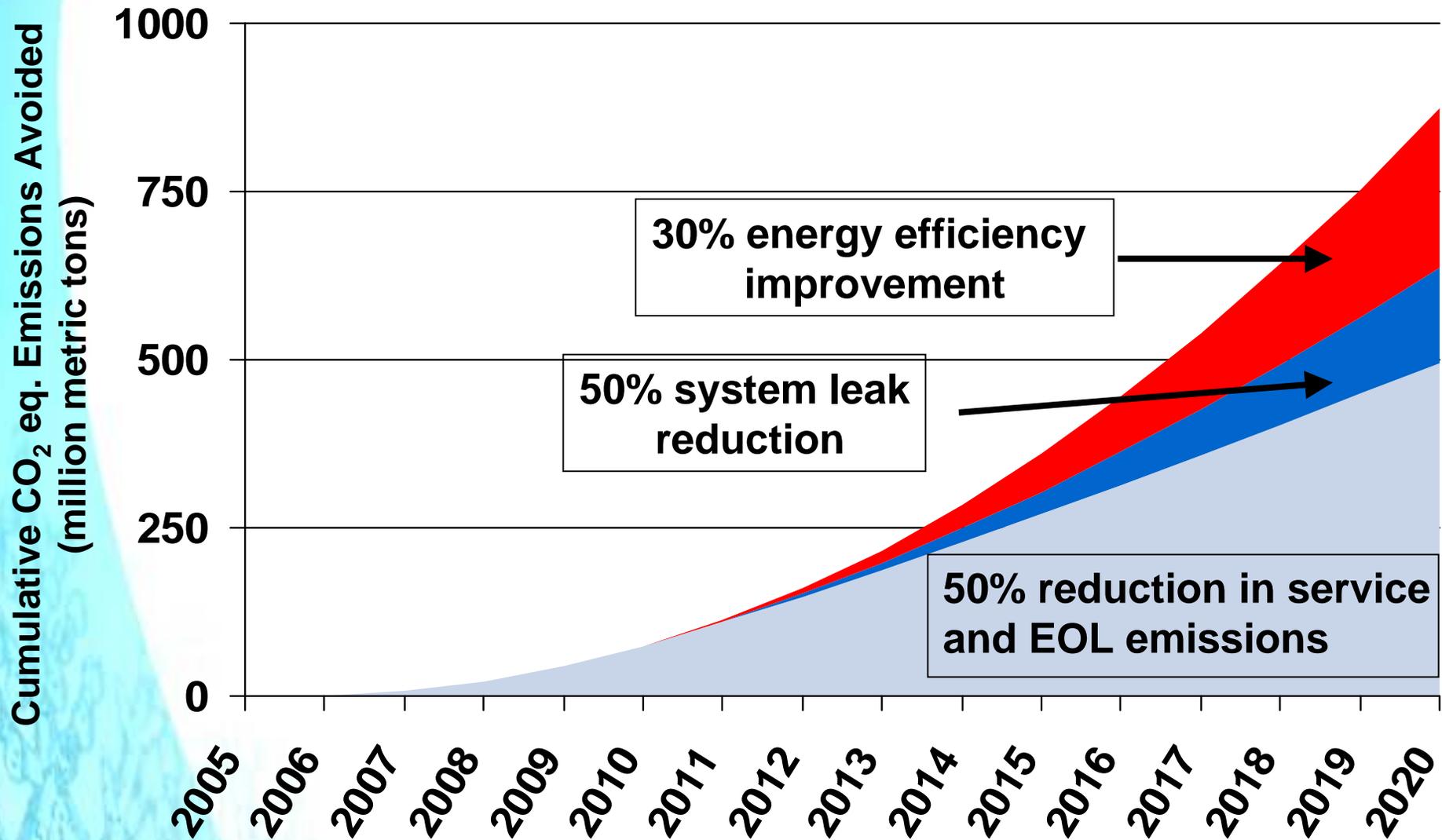
Comparison of calculated atmospheric concentrations to measured concentrations shows that about **20% of refrigerant in equipment is emitted to atmosphere each year**

Information from:
Stephen Montzka

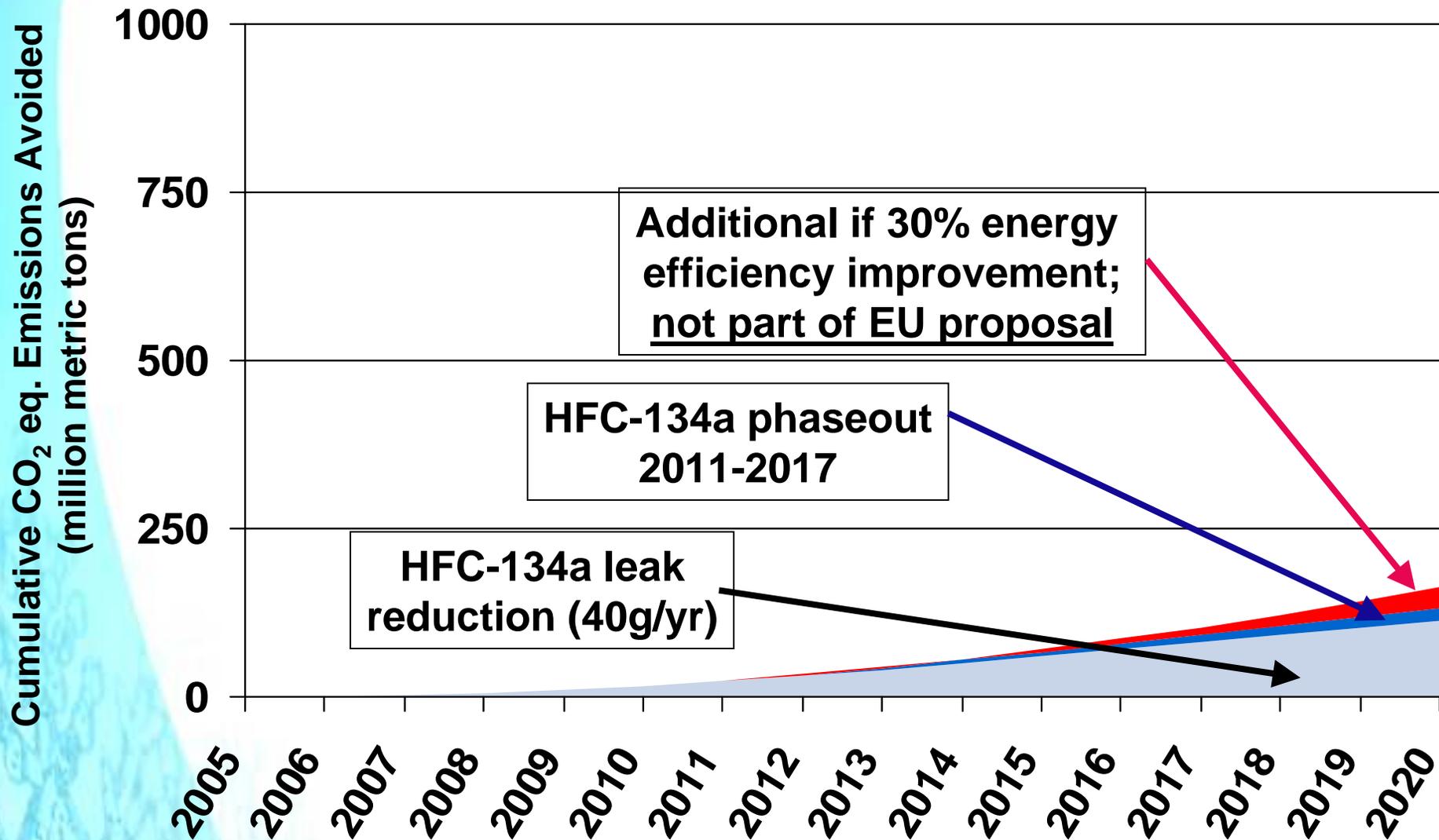
NOAA – CMDL, Boulder, CO USA

Points are global mean measurements

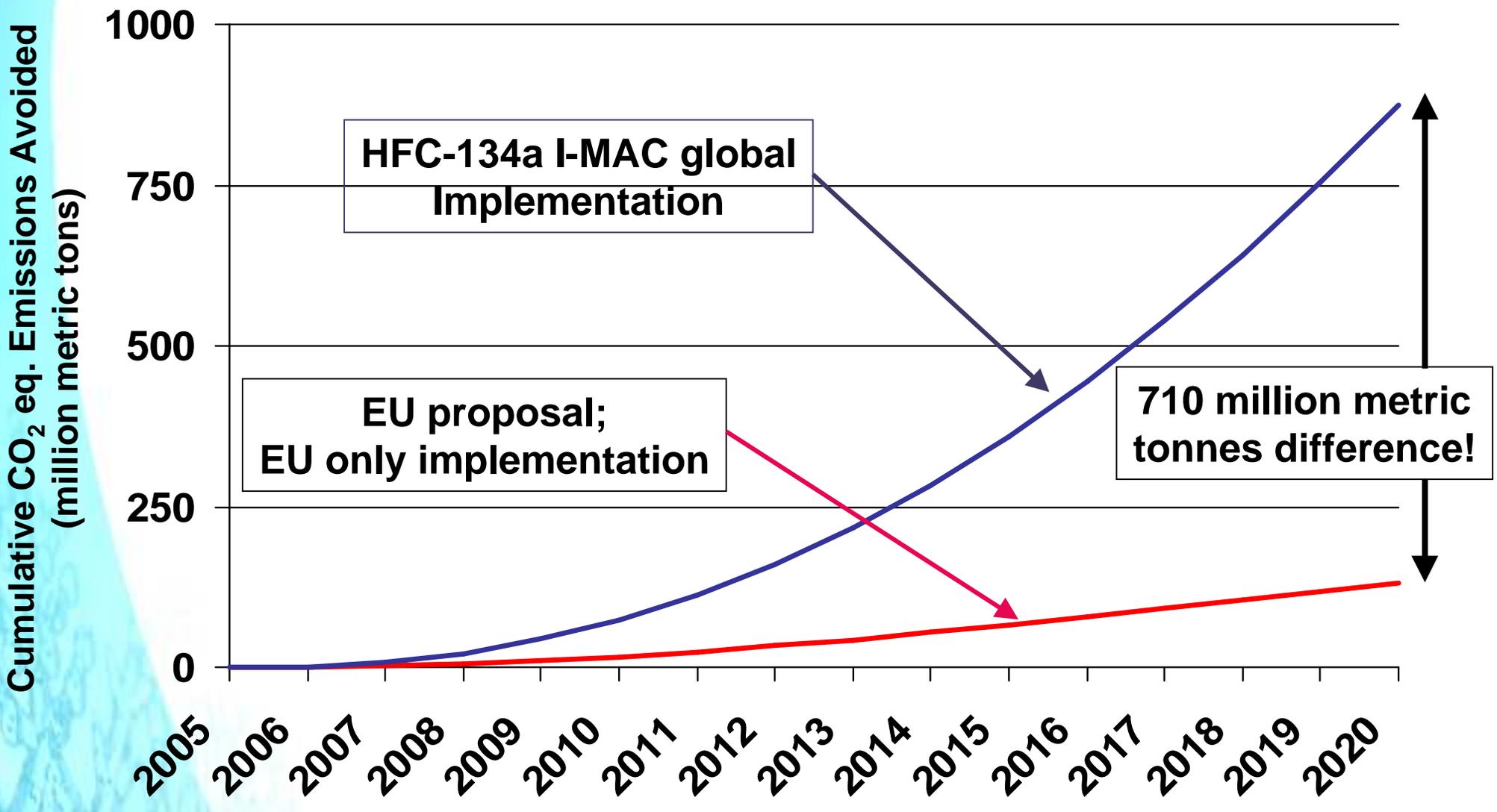
CO₂ equivalent emissions avoided with HFC-134a I-MAC global implementation



CO₂ equivalent emissions avoided with EU proposal; EU only implementation



Global HFC-134a I-MAC Compared to EU Proposal with EU only Implementation



A Program for the Consumer

Savings to Consumer (U.S. basis)

- **\$20 to \$35 annually from fuel savings**
- **\$420 from fuel savings and reduced servicing over life of vehicle**

With an Estimated Cost of ~ \$40

What's next? (near term)

- **DuPont strongly supports the early global implementation of I-MAC. The program will provide significant environmental and performance benefits: a “win - win” for the environment and the consumer**
 - **Reduce fuel consumption by 10 to 20 billion liters annually**
 - **Avoid over 120 million tons CO₂ eq. annually**
 - **Provide improved performance and \$\$ savings to the consumer**

What's next? (longer term)

- **Transition from R-12 to R-134a was relatively straightforward.....**
 - Similar chemistry, pressure, performance, safety, etc
- **But expensive: ~ \$5 billion for the US market**
- **The next transition will likely be more difficult/complex, with higher cost**
- **Focus longer term efforts on developing climate control systems that will be compatible with emerging automotive technologies; rather than looking for an interim solution**
 - Hybrids, fuel cell vehicles
 - Heating, as well as cooling and demisting
 - Operation while the engine is off
- **These emerging technologies present an opportunity for significant change in climate control technology and will require broad collaboration among industry stakeholders**

Conclusions

- **The basic science of climate change is sound and there is a need to take prudent action**
- **Progress has already been made in reducing the environmental impact of mobile AC systems**
- **DuPont supports efforts to further reduce this impact**
- **Global implementation of I-MAC will provide significant environmental benefit**
 - **Build global consensus**
 - **Start early**
 - **Address service and EOL emissions**
 - **Energy efficiency is important**
- **Future development work should focus on new climate control systems compatible with emerging automotive technologies**