

# Delft Days on Magnetocalorics

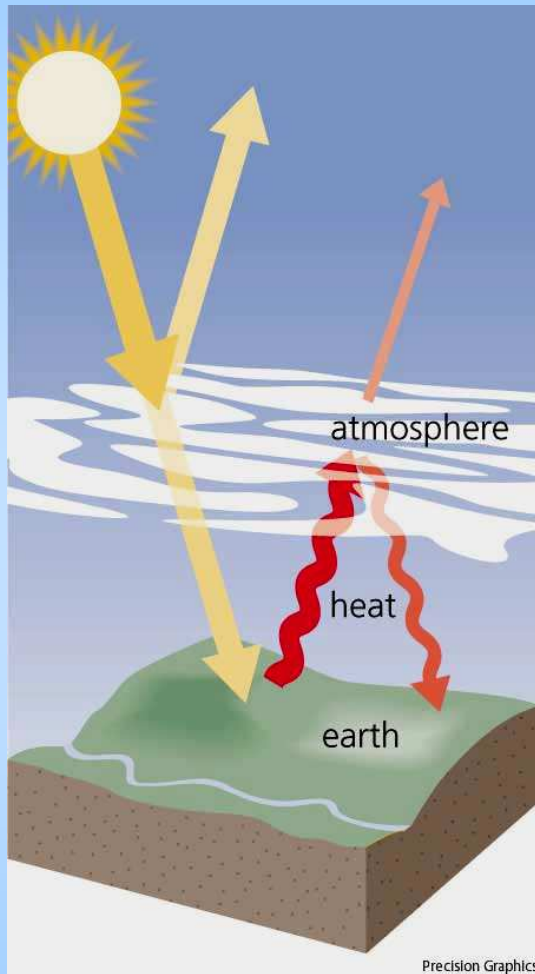
*Global warming and magnetic refrigeration:  
how we all can make a difference*

*Alessandro Pastore, Cambridge*

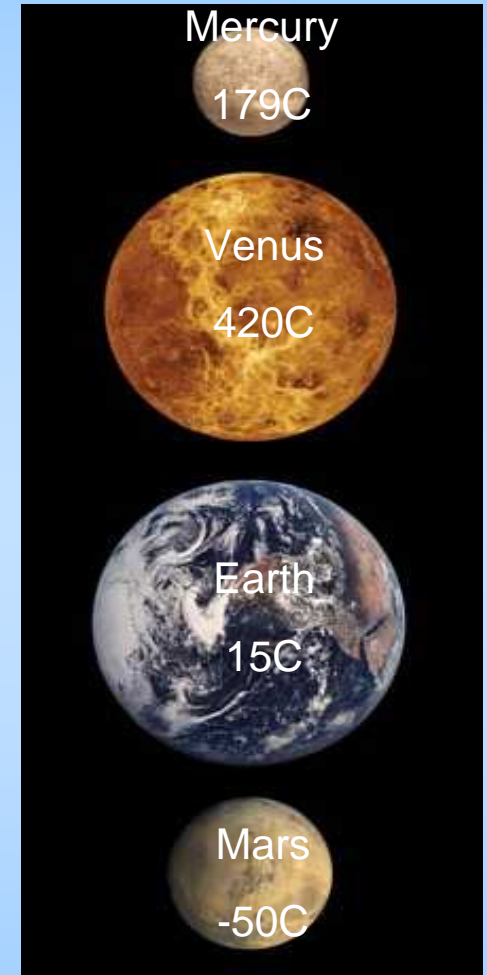
*October 30–31, 2008*

*Aula Congress Centre TU Delft, Mekelweg 2, Delft*

# Greenhouse Effect

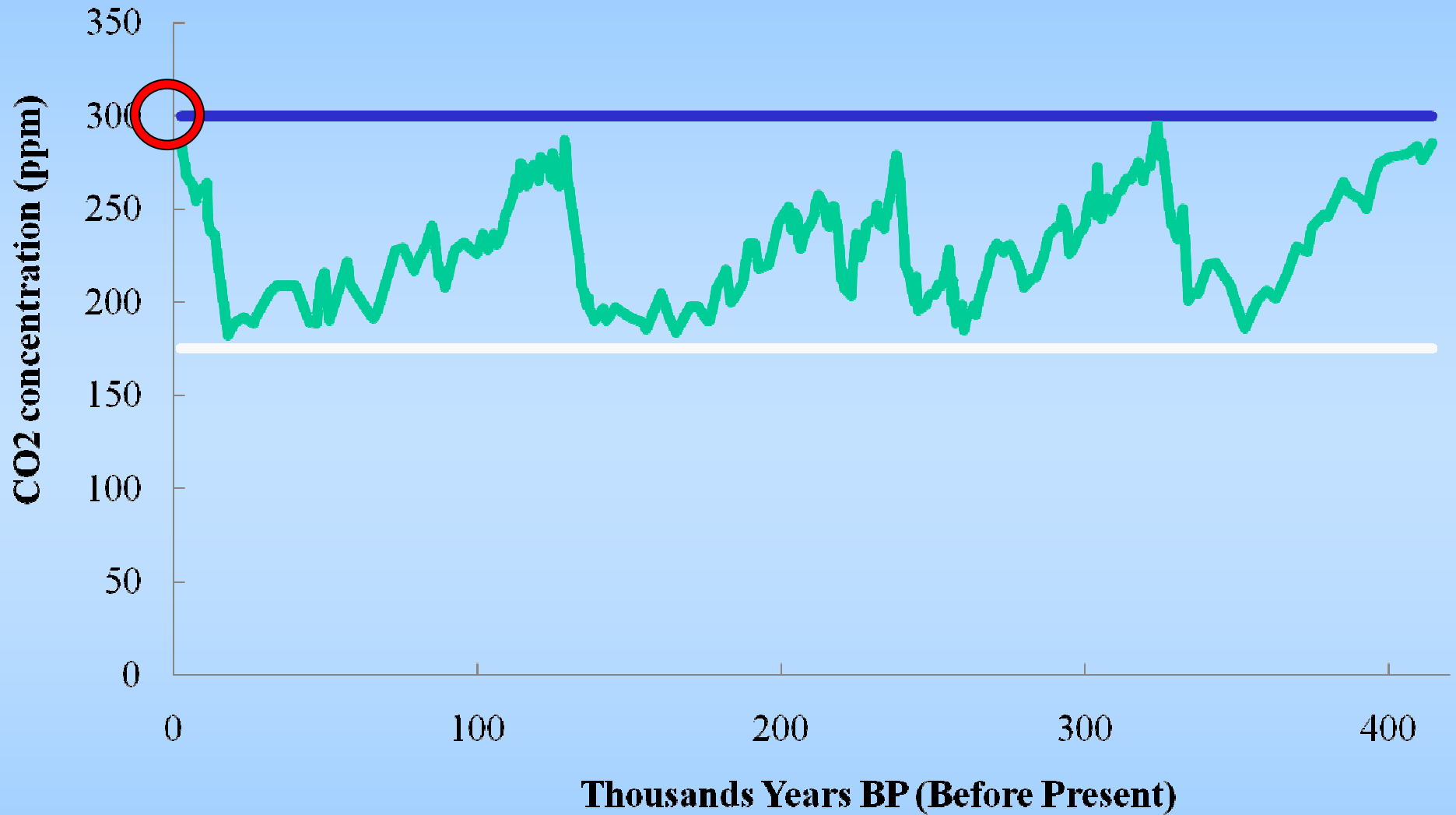


- **Well known physics**
- **Verified by data from Mars, Venus & Mercury**
- **Per se' a "good thing"**
- **Adding GHG (CO<sub>2</sub>, F-gases, methane) increases greenhouse effect directly**



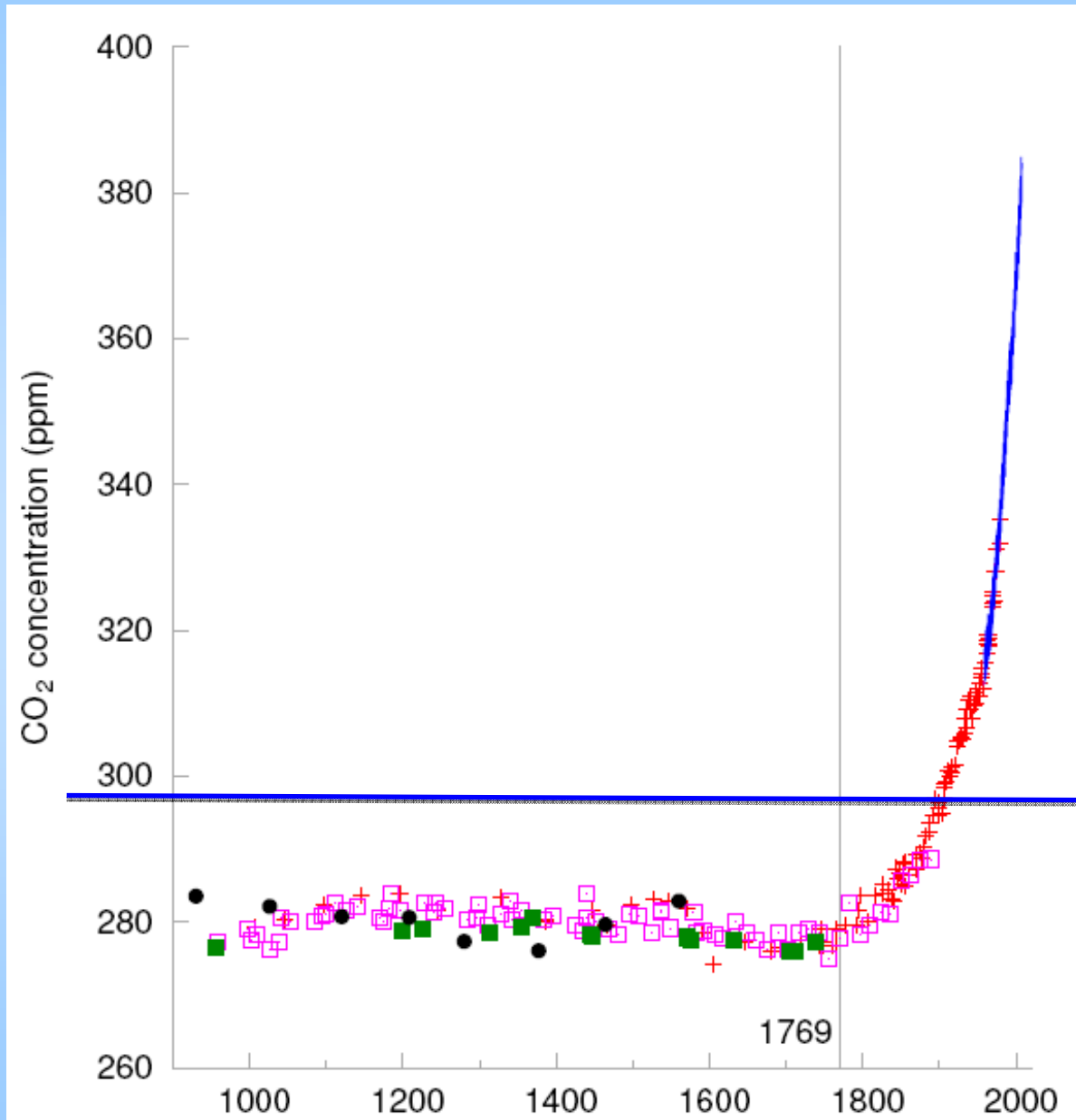
Source: Prof. President of SCAR, Member ICSU-WMO Joint Committee for the IPY 2007-2008, Director British Antarctic Survey

# Historical CO2 concentration (ppm)



Source: Petit, J.R., et al., 2001, Vostok Ice Core Data for 420,000 Years, IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series #2001-076. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA

# CO<sub>2</sub> concentration (ppm): the last 1000 years

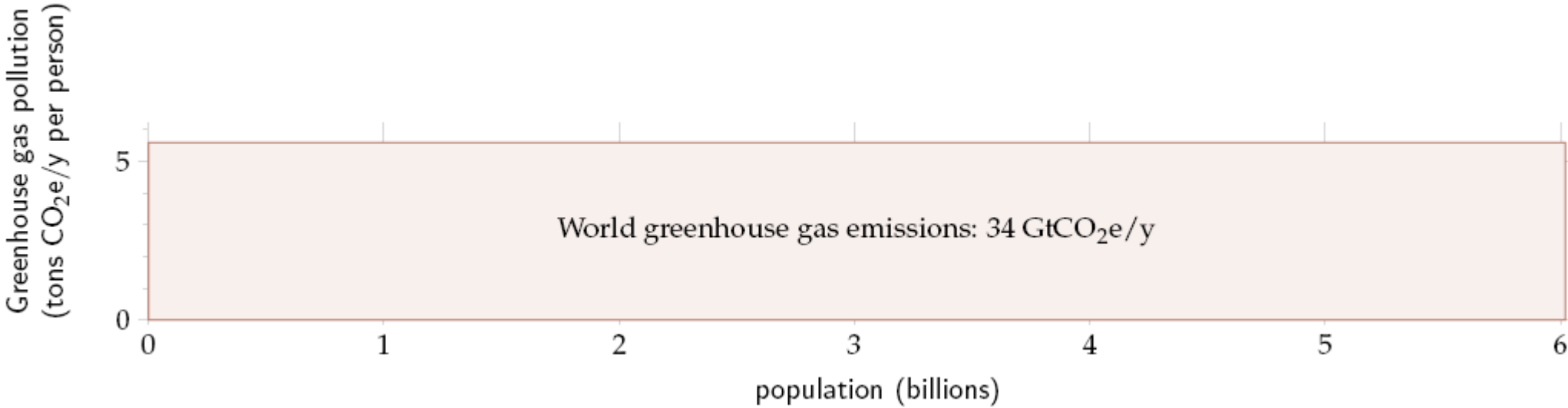


Source: Sustainable Energy — without the hot air, Prof. David JC MacKay, UIT Cambridge

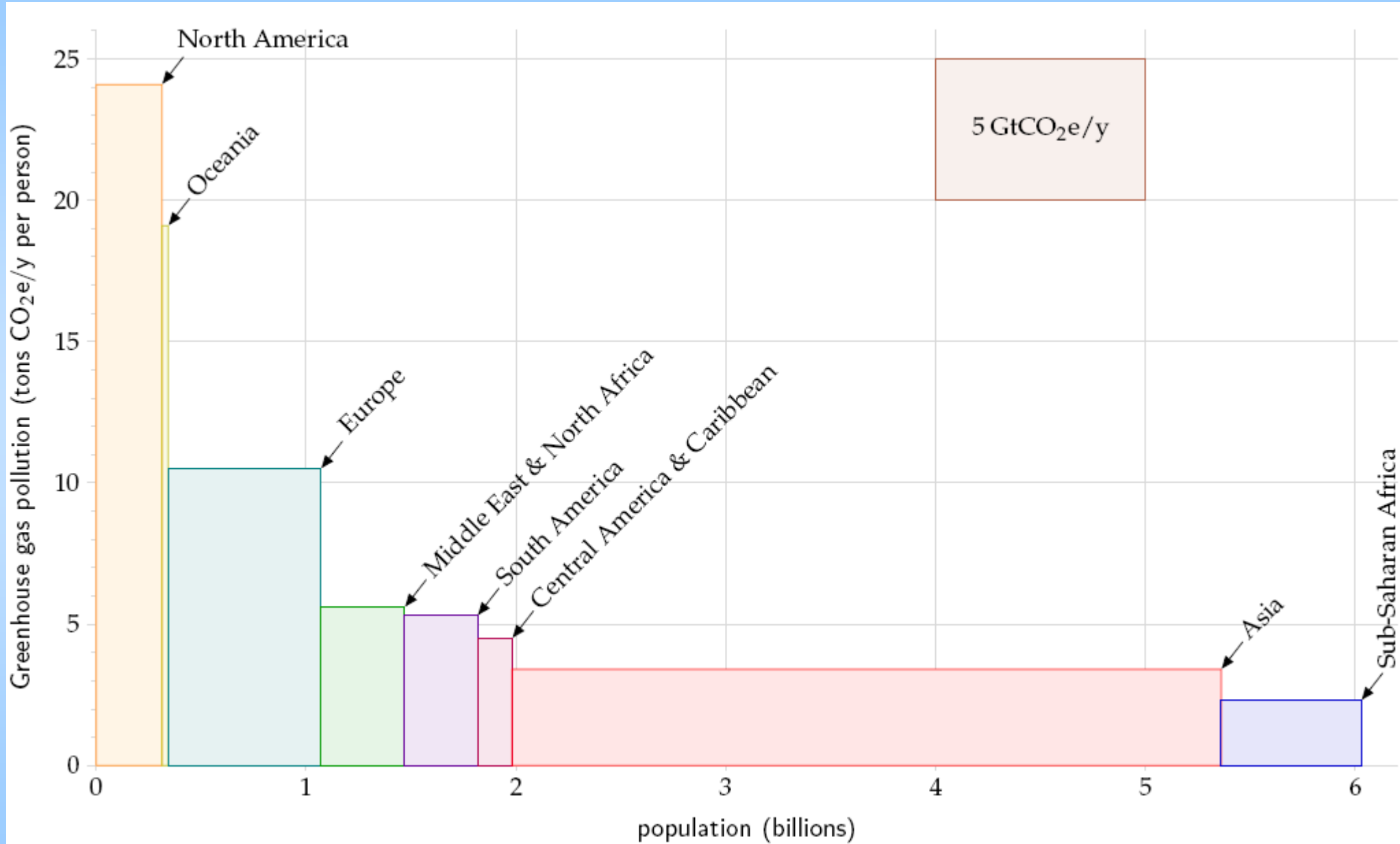
# IPCC Fourth Assessment Report Climate Change 2007 : The Physical Science Basis – Summary for Policy Makers

- **Atmospheric GHG concentrations far exceed levels of last 450,000y as a result of human emissions**
- **Warming of the climate system is “Unequivocal”**
- **Climate forcing primarily Human (x10 solar)**
- **Agreed by Delegates of 113 nations**

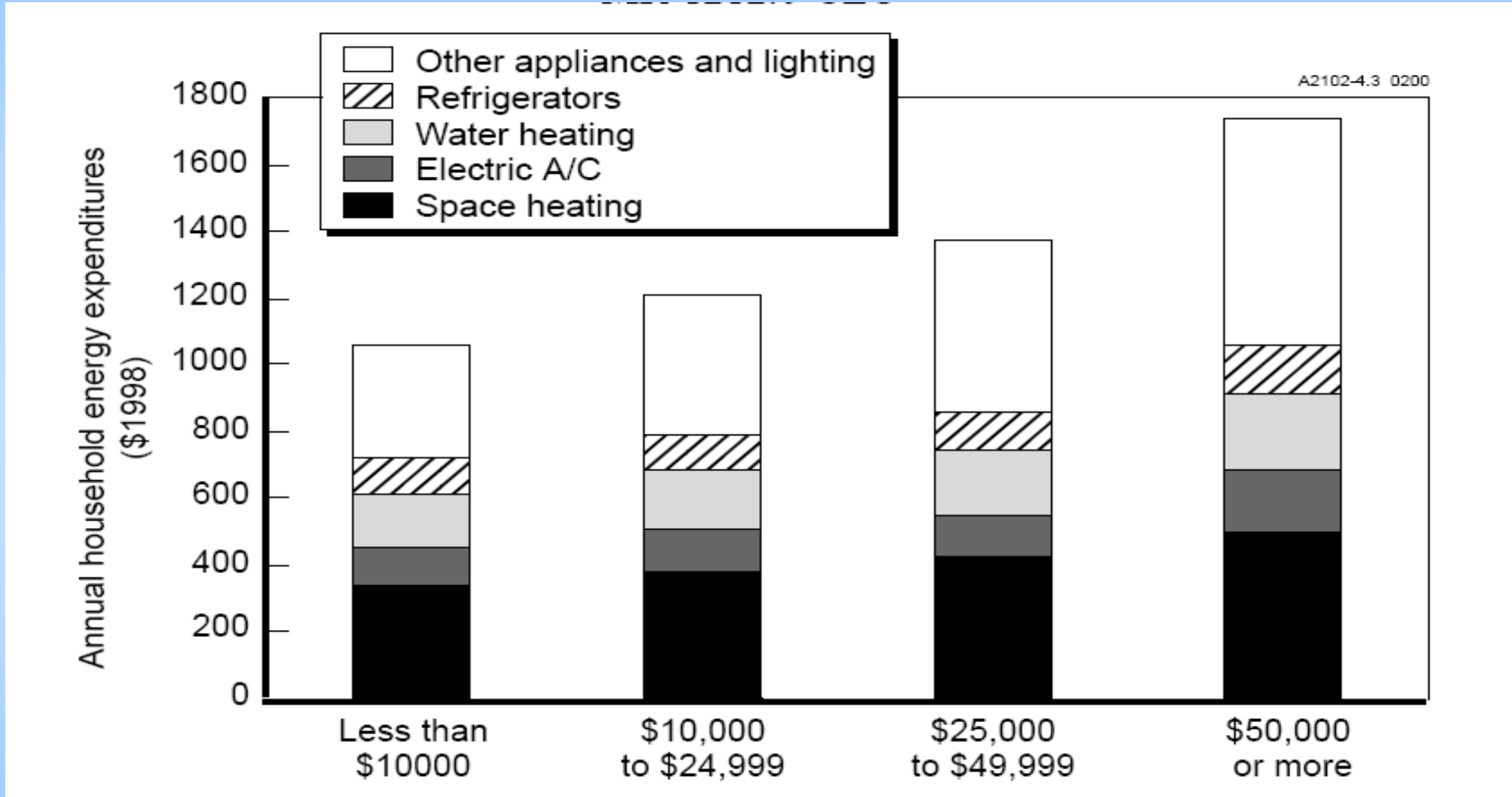
# Year 2000 world's fossil-fuel burning greenhouse gas emissions



# Year 2000 world's greenhouse gas emissions per region



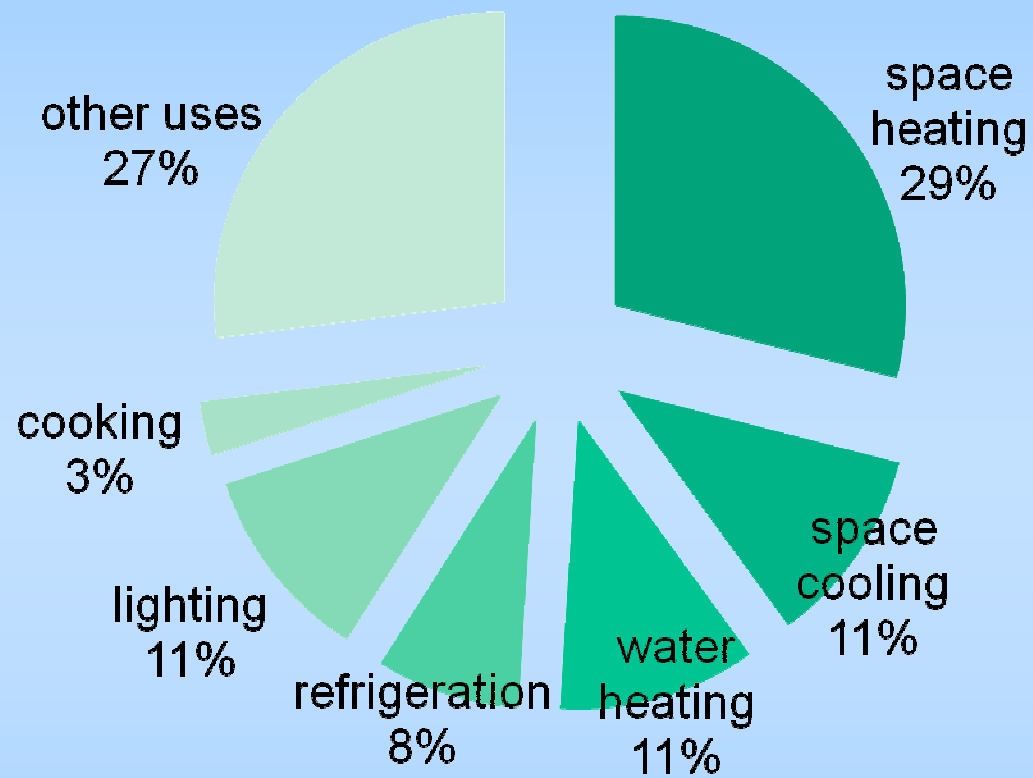
# In California, regardless of income, up to two-thirds of household energy use is for space heating, water heating, and refrigeration



Source: Bernstein, M., R. Lempert, D. Lougharn, and D. Ortiz. 2000. The public benefit of California's investments in energy efficiency. Prepared for the California Energy Commission. RAND Monograph Report MR-1212.0-CEC.



# US residential building energy use 2005



Source: EIA, Building energy data book 2006

# Part 2

# The Business Opportunity

**The refrigeration equipment market is worth \$60 billion p.a.**

**Commercial refrigeration equipment industry is worth \$10 billion**

**The associated services, maintenance and installation market is worth over \$140 billion p.a.**

Mobile Air Conditioning	30%
Unitary Air Conditioning	29%
Domestic Refrigerators	22%
Commercial Refrigeration	13%
Chillers	3%
Refrigerated Transport	2%
Cold Storage	1%

*Relative Market Segment Size*

US	33%	<b>Japan, Europe and North America have low growth</b>
Japan	33%	
Europe	10%	<b>Environmental legislation is creating a large replacement market in developed countries</b>
China	9%	
Korea	5%	<b>Natural growth is found in Asia, Latin America and Eastern Europe</b>
Brazil	4%	
Taiwan	2%	
Other	4%	

*Regional breakdown of refrigeration equipment*

**Addressable Market (billions \$)**

Mobile Air Conditioning	\$6.5
Unitary Air Conditioning	\$6.3
Domestic Refrigerators	\$4.8
Commercial Refrigeration	\$2.7
Chillers	\$0.6
Refrigerated Transport	\$0.5
Cold Storage	\$0.3
<b>Total</b>	<b>\$21.7</b>

*Based on % of Camridge Components*

**Target markets are “packaged” applications like domestic refrigeration, room air conditioning and heat pumps - growing markets, technically achievable, high-efficiency solutions drives margins**

# Business Landscape

Regulatory  
authorities

Refrigerant  
Suppliers

Camfridge

Packaged cooling  
application  
manufacturers

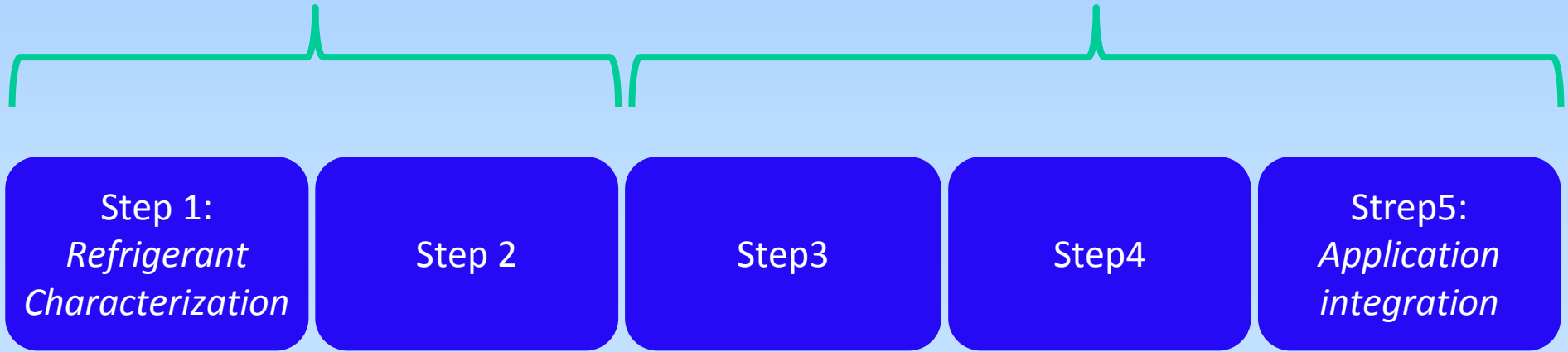
R&D Ecosystem

End-users

# Cambridge five steps process to market

Design team

Engineering team



Business Development Team

# Motivations and criteria of manufacturing and buying refrigeration appliances with higher efficiency

## Manufacturers

- Regulatory compliance
- Standardization
- Financial incentives
- Voluntary commitment
- Lower maintenance

## The end user commercial

- Price
- Aesthetics
- Operational cost (lower maintenance, lower energy consumption)
- Environmental performance
- Application coverage
- Regulatory compliance.

## Regulatory authorities

- Strong commitment towards reduction of greenhouse gases (i.e. UK, Japan)
- International treaties (i.e. Kyoto)
- Sustain innovation of the industry

## The end users Consumers

- Brand
- Price
- Need new appliances
- Aesthetics
- Lifestyle
- Environmental consciousness
- Lower energy consumption
- Financial incentives (TVA)

Sources: EuP Preparatory Study – Lot 12 Commercial Refrigerators and Freezers, Business Transformation Program, BNC08, Direct interviews

# Cambridge

- Help research groups to raise research money
- Provide precise requirements for your material
- Route to market to monetize your research

**Cambridge**

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