



VAM processing and Climate Change



Richard Mattus

M2M EXPO in Delhi March 2010

Reducing VAM emissions



- Is an opportunity for significant positive impact on Global Warming.
- Will be very profitable when the price of Carbon Credits stabilize.
- Is based on established, well proven technology.

VAM processing

has been officially demonstrated



- In total at 6 installations on 4 continents.



- In more than year long operations on 3 continents.



- In a large scale, multiple processing units installation generating electricity since 3 years in Australia.



MEGTEC VAM Abatement so far at coal mine sites around the World



1st DEMO INSTALLATION AT A COAL MINE

abating vent air methane in 1994.

Trial unit at [British](#) Coal.



DEMO INSTALLATION LONG TERM ENERGY RECOVERY

-small scale trial unit at BHP in [Australia](#) 2001 – 2002,
12 months of utilizing VAM for generating steam.



LARGE SCALE DEMO ABATEMENT

CONSOL ENERGY in the [US](#).



LARGE SCALE COMMERCIAL ABATEMENT

First VAM project in [China](#).

Generation of hot water.

.. and ..

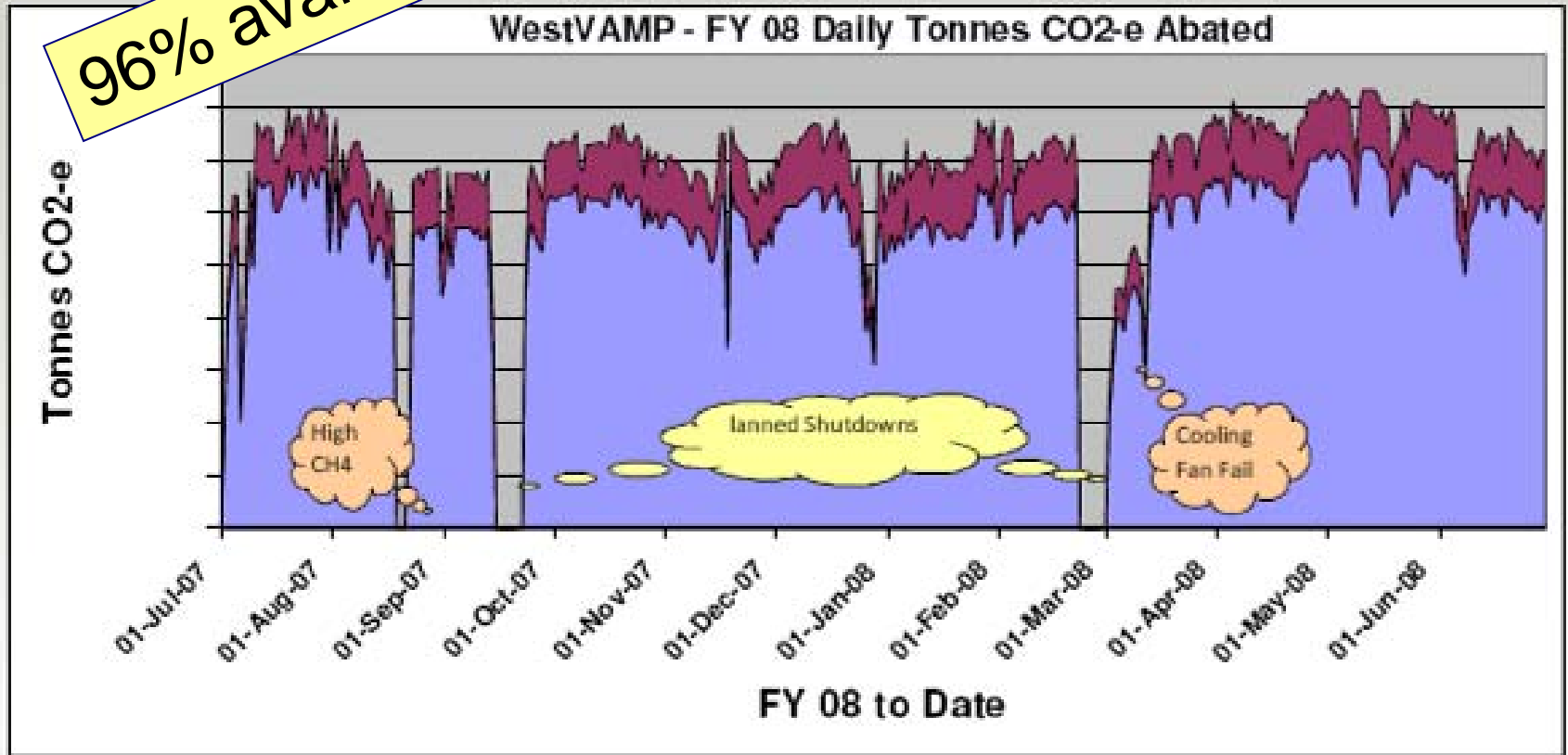
In full operation by April 2007
– the world's first VAM Power Plant



FIRST YEAR OF OPERATION



96% availability



Direct Methane Emissions Avoided (Blue) = 250,000 t CO2-e

Electricity Emissions Avoided (Purple) = 45,000 t CO2-e

Total Emissions Avoided to date = 295,000 t CO2-e

MEGTEC VAM Power Plant in Australia. By August 2009



- Over 500,000 carbon credits, traded locally
- Over 80,000 MW of electricity



**Globally leading supplier
of emission control equipment for
hydrocarbons to air.**

MEGTEC Worldwide



De Pere, WI

Columbus, OH

Vero Beach, FL

Manchester, UK

Maidenhead, UK

Ingre, France

Evry (Paris), France

Åmål, Sweden

Göteborg, Sweden

Maintal (Frankfurt) Germany

Shanghai, China

Pune, India

Singapore

Melbourne, Australia

Global head quarters

Global head office for the VAM application

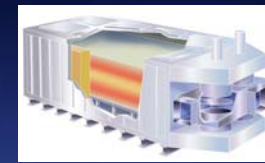


MEGTEC Systems Worldwide Headquarters



MEGTEC Systems Regional Offices

MEGTEC VOCSIDIZER INSTALLATIONS

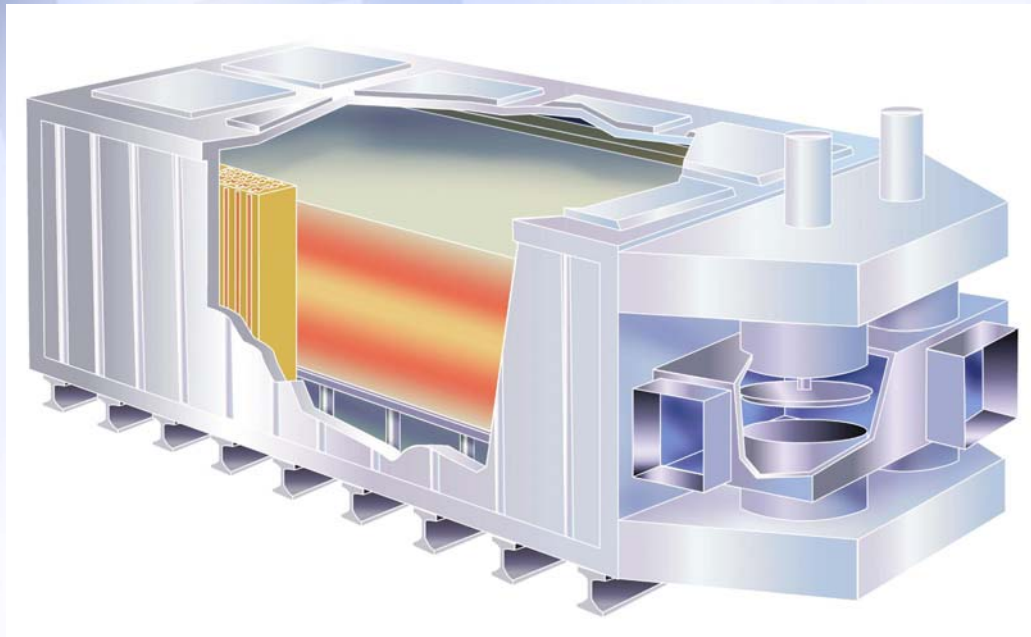


All types of industrial oxidizers.

In total 4000 oxidizers of MEGTEC design supplied to industry.

Over 800 VOCSIDIZERS to different industrial applications.

The Flameless VOCSIDIZER



No combustion chamber

No catalyst
operate at natural oxidizing temperature

Flameless: No combustion chamber – therefore flameless
:
Oxidation completely in-bed.

No NOx: No flame. Even though temp is high, it is not near where thermal
:
NOx is generated.



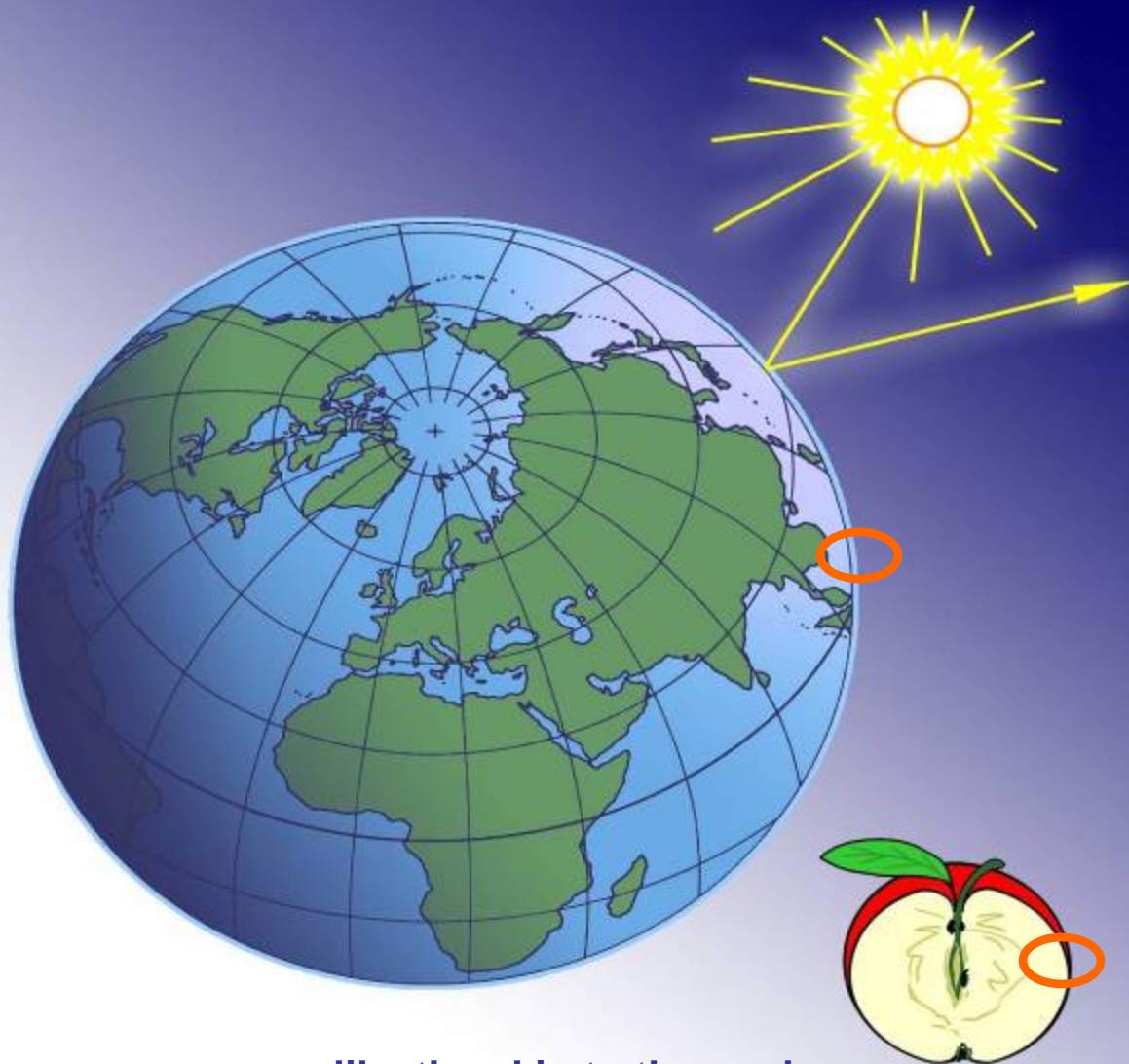
GLOBAL WARMING AND CLIMATE CHANGE

- What is happening with climate on Earth?
- What is carbon credits financing?
- Why is VAM of interest?

One thin bubble of atmosphere

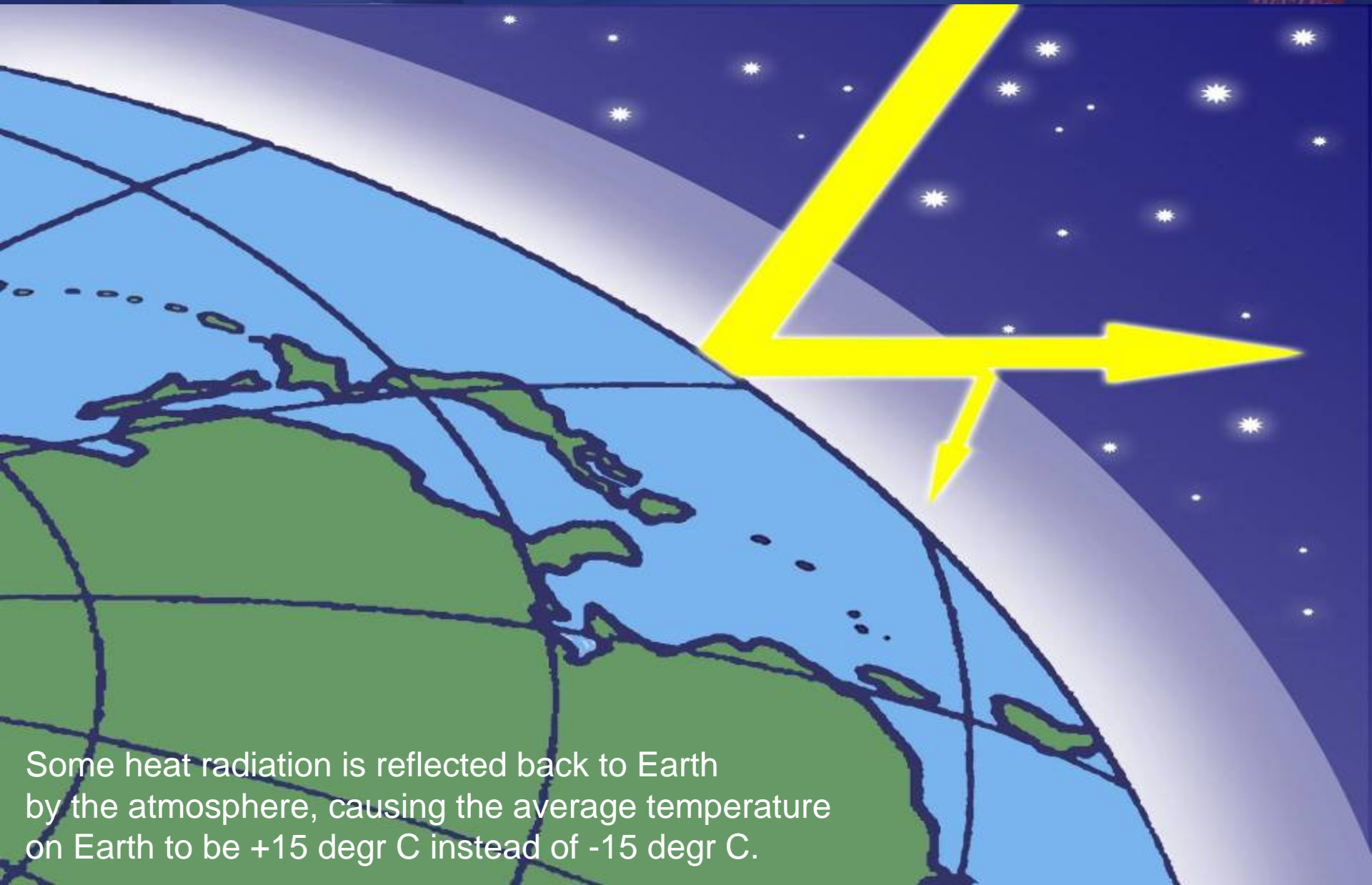


One thin bubble of atmosphere



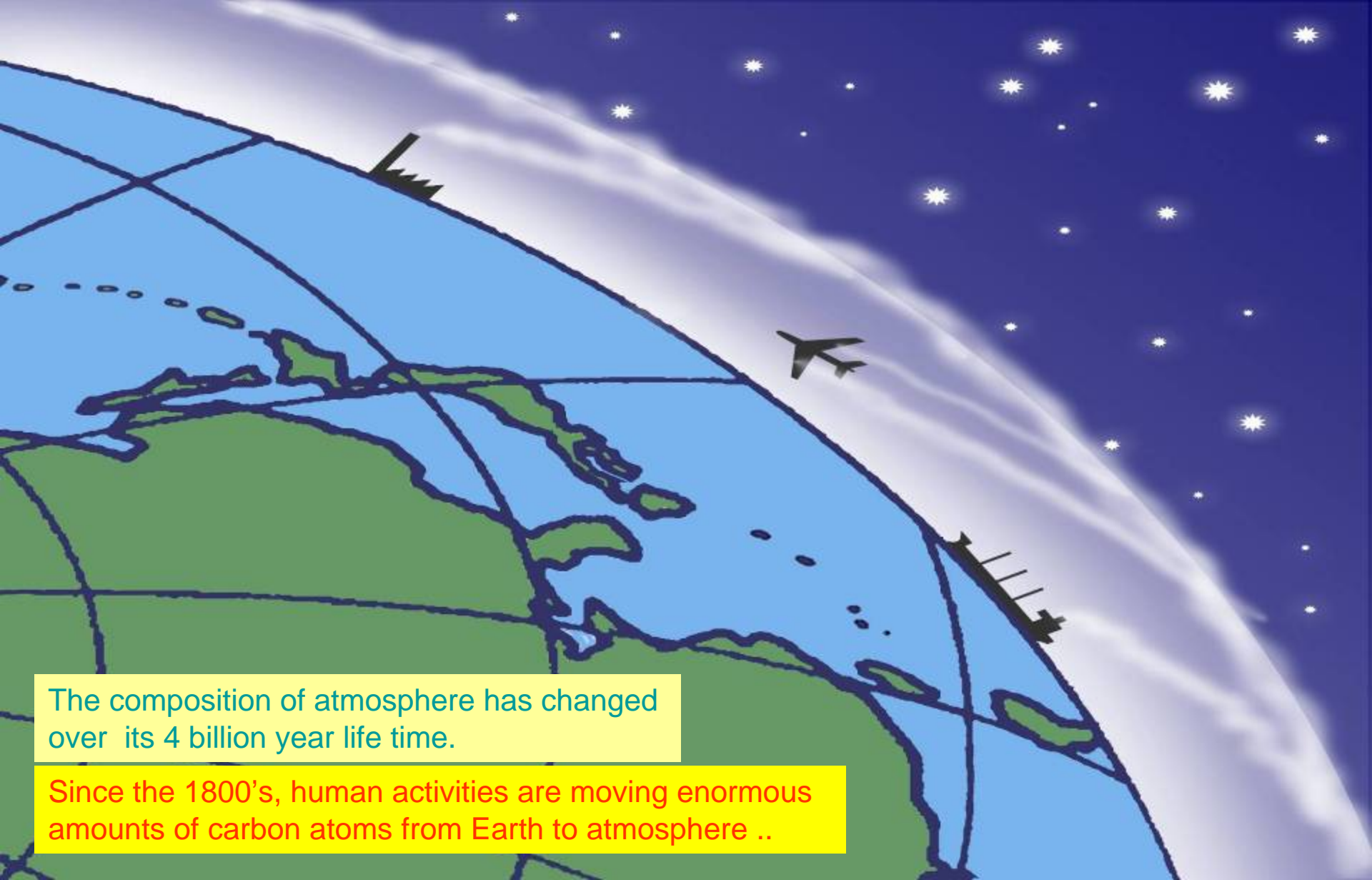
Atmosphere thickness to the Earth is **like the skin to the apple**

One thin bubble of atmosphere



Some heat radiation is reflected back to Earth by the atmosphere, causing the average temperature on Earth to be +15 degr C instead of -15 degr C.

One thin bubble of atmosphere



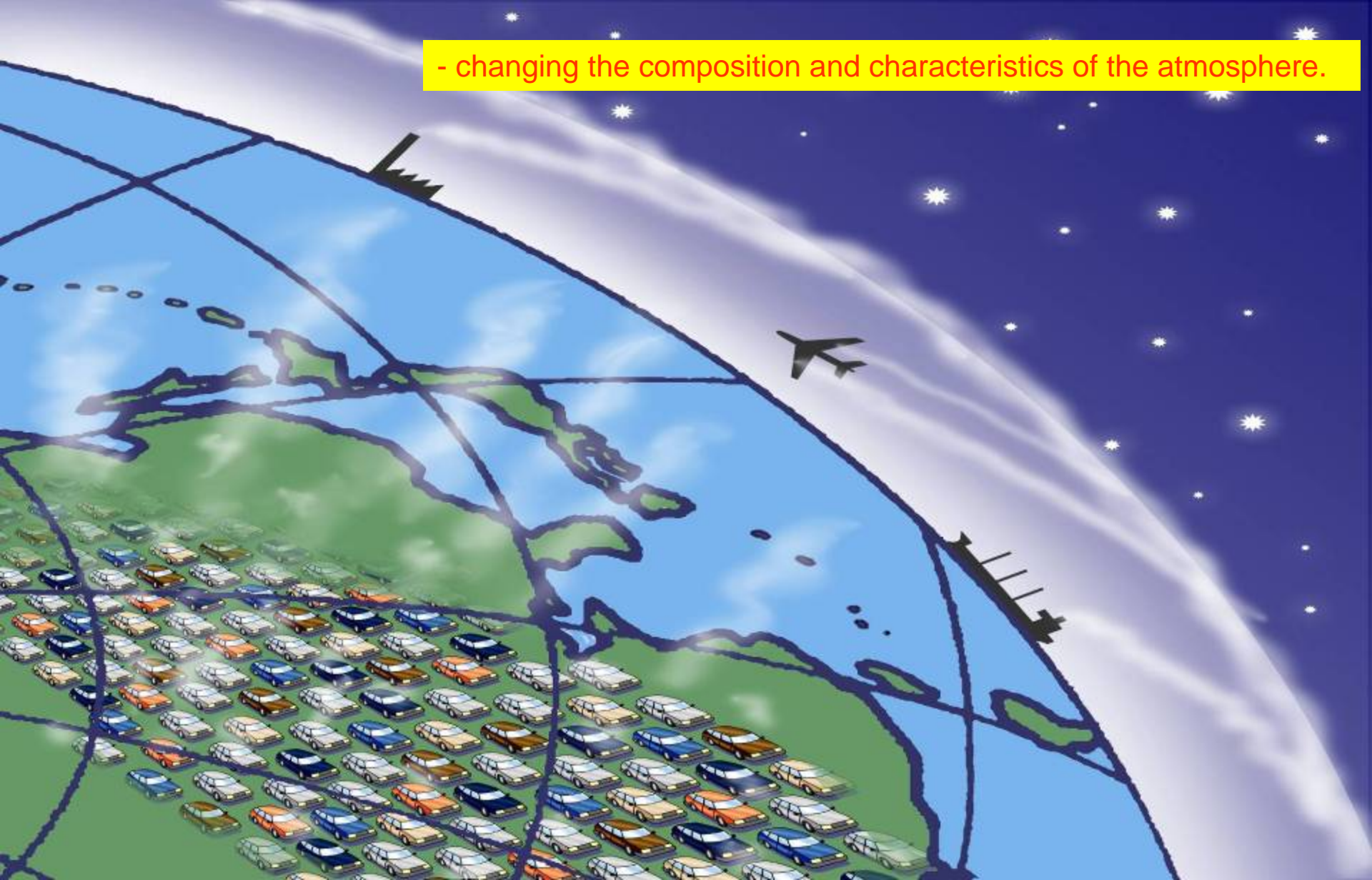
The composition of atmosphere has changed over its 4 billion year life time.

Since the 1800's, human activities are moving enormous amounts of carbon atoms from Earth to atmosphere ..

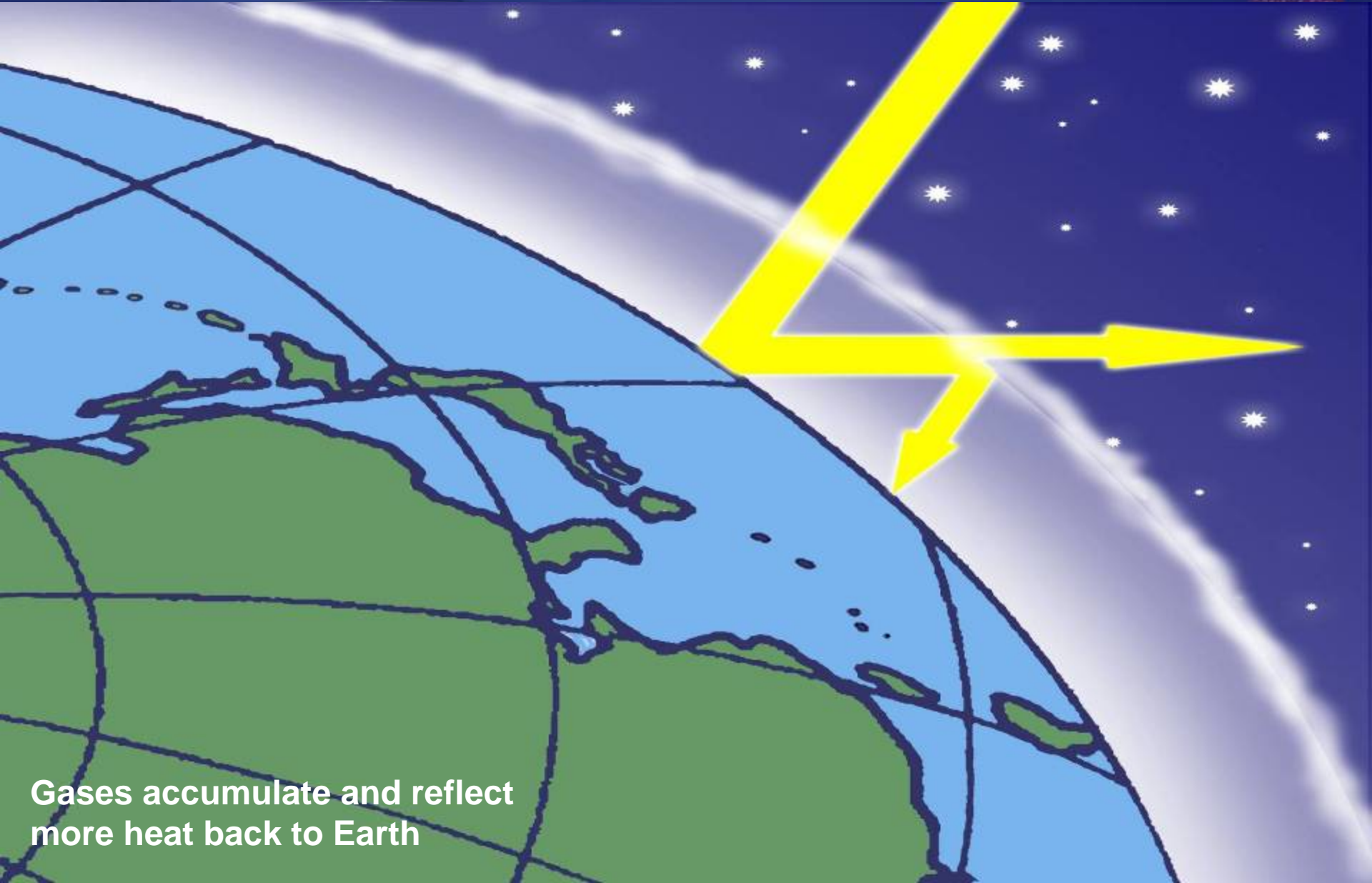
One thin bubble of atmosphere



- changing the composition and characteristics of the atmosphere.

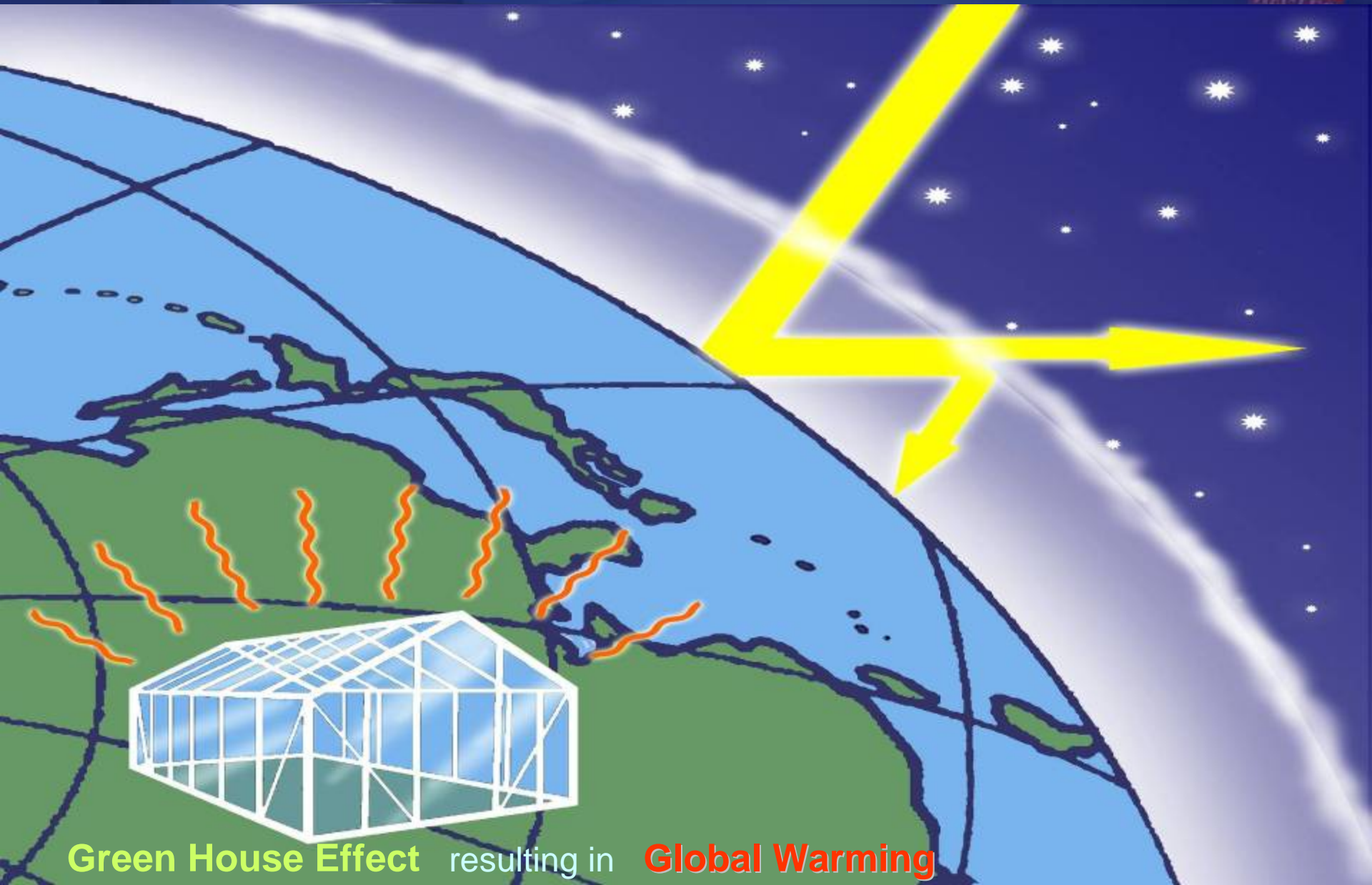


One thin bubble of atmosphere



**Gases accumulate and reflect
more heat back to Earth**

One thin bubble of atmosphere



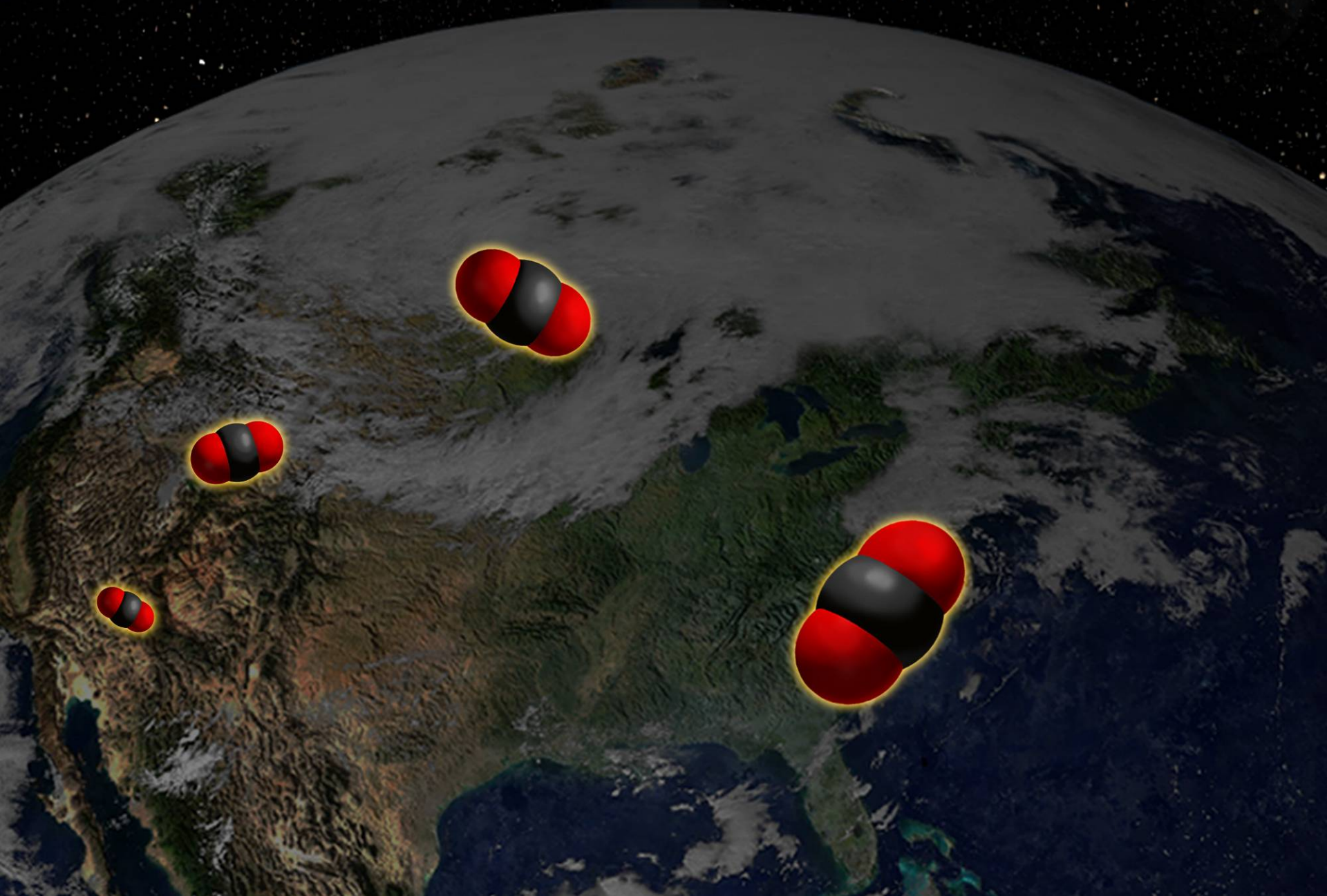
Green House Effect resulting in **Global Warming**

One thin bubble of atmosphere

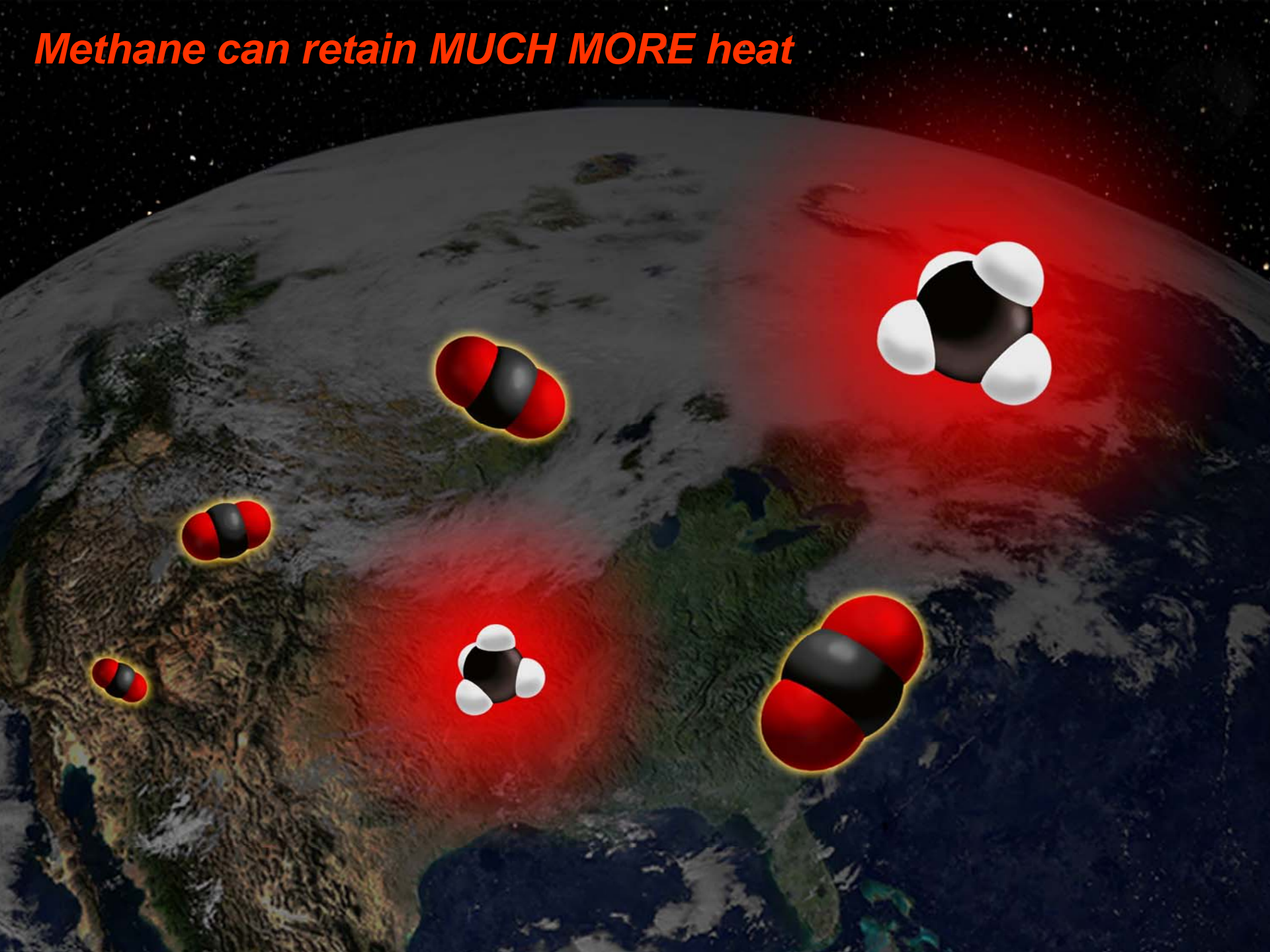


- All emissions are going into the same thin bubble of atmosphere.
- The recently established trading with Carbon Credits (emission reduction certificates) is an instrument guiding investments to where they most cost efficiently reduce GHG emissions.

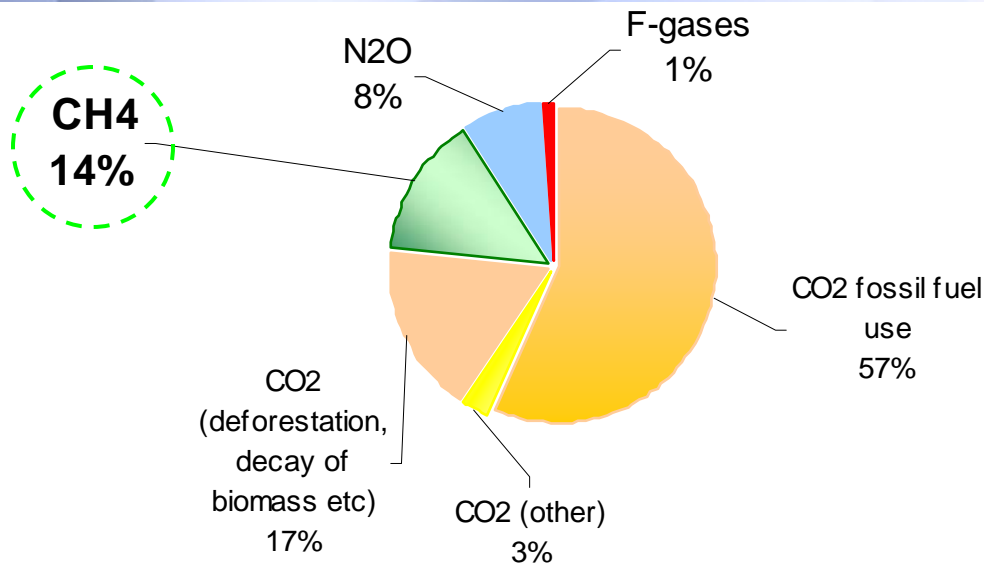
CO2 can retain some of the sun's heat in atmosphere



Methane can retain MUCH MORE heat



Green House Gas METHANE



Pie chart: Global Anthropogenic GHG Emissions in 2004, out of a total of 49 Gigatons CO₂e, according to IPCC 4th Assessment Report, Climate Change 2007 – Synthesis Report.

	CO ₂	CH ₄
Global Warming Power	1	23 (21 in the first Kyoto Period)
Life time in atmosphere (years)	20 000 – 50 000	12

METHANE :

- ✓ Second most important greenhouse gas
- ✓ Much more powerful greenhouse gas than CO₂
- ✓ Short life time in atmosphere, so emission reductions will have a quick, positive impact
- ✓ Generates energy when abated (oxidized)

CONSIDER Green House Gas METHANE

- effect of life time

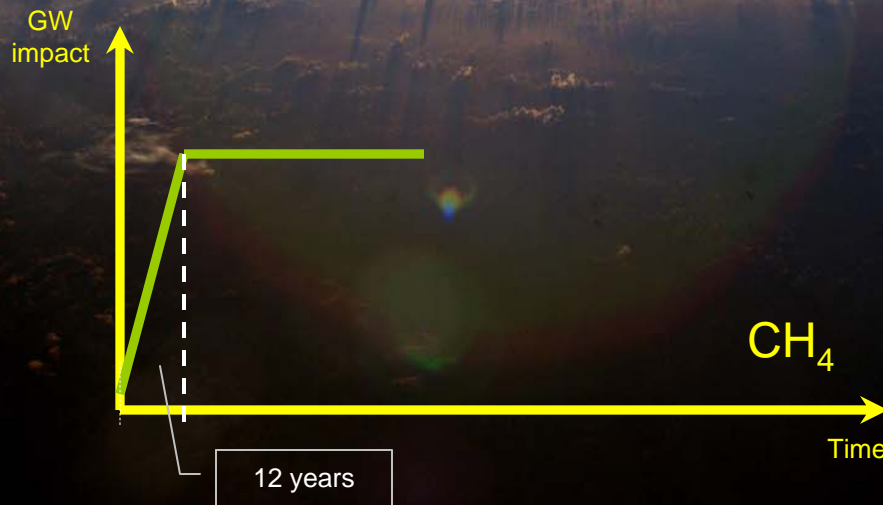


CO₂



	Life time in atmosphere
CO ₂	>>10 000 years
CH ₄	12 years

CH₄



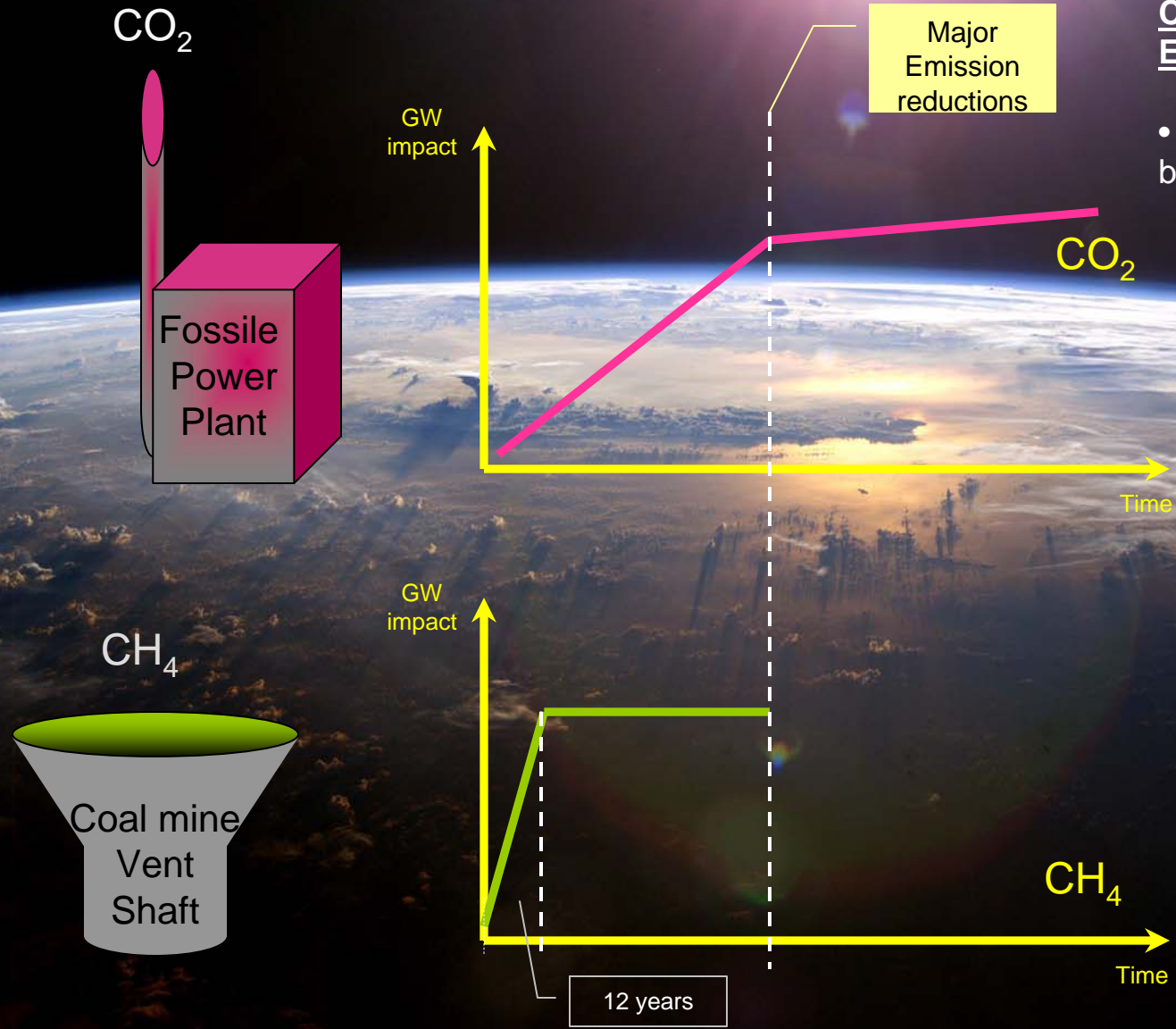
CONSIDER Green House Gas METHANE

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CONCLUSIONS ON MAJOR EMISSION REDUCTIONS:

- CO₂ continues to accumulate, but at a slower rate.

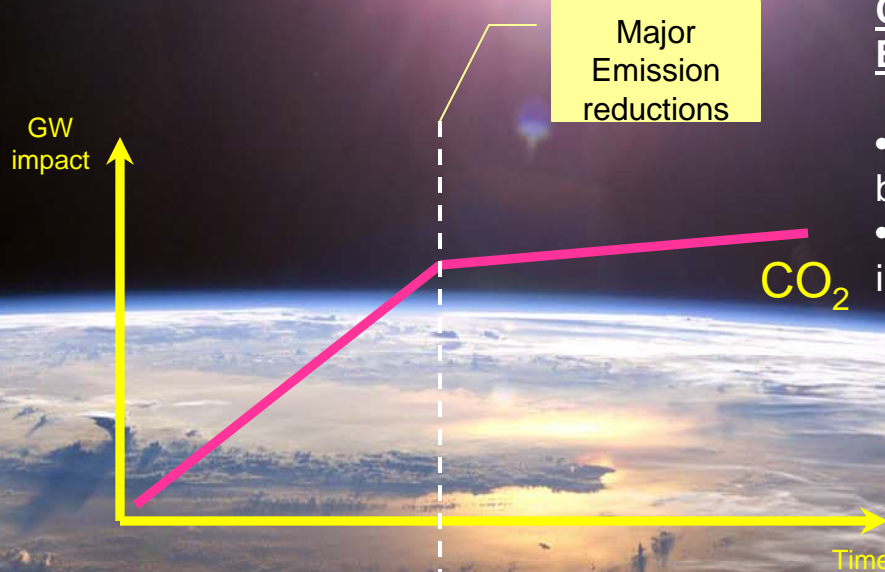
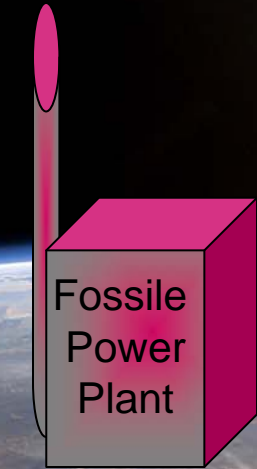


CONSIDER Green House Gas METHANE

- effect of life time



CO₂



CONCLUSIONS ON MAJOR EMISSION REDUCTIONS:

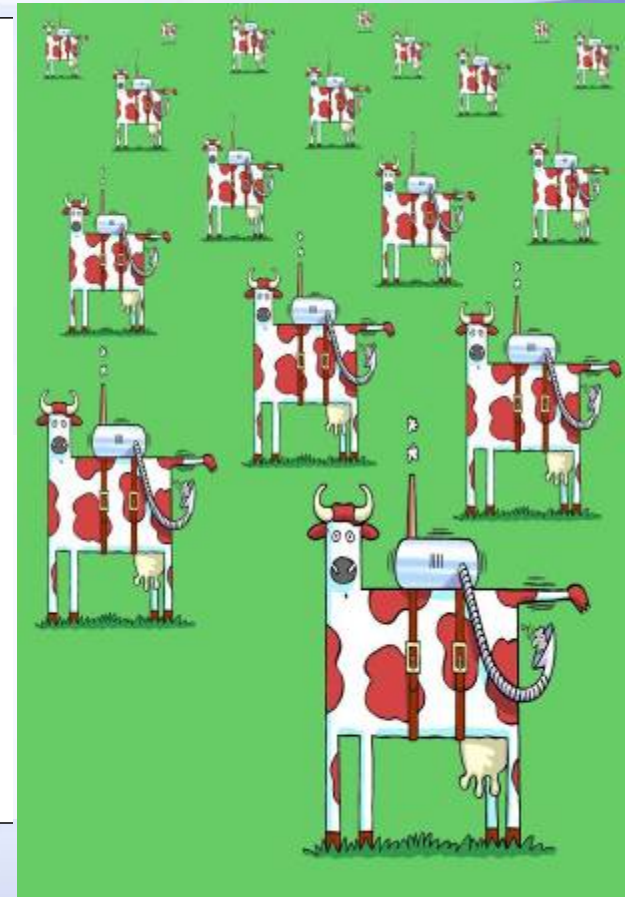
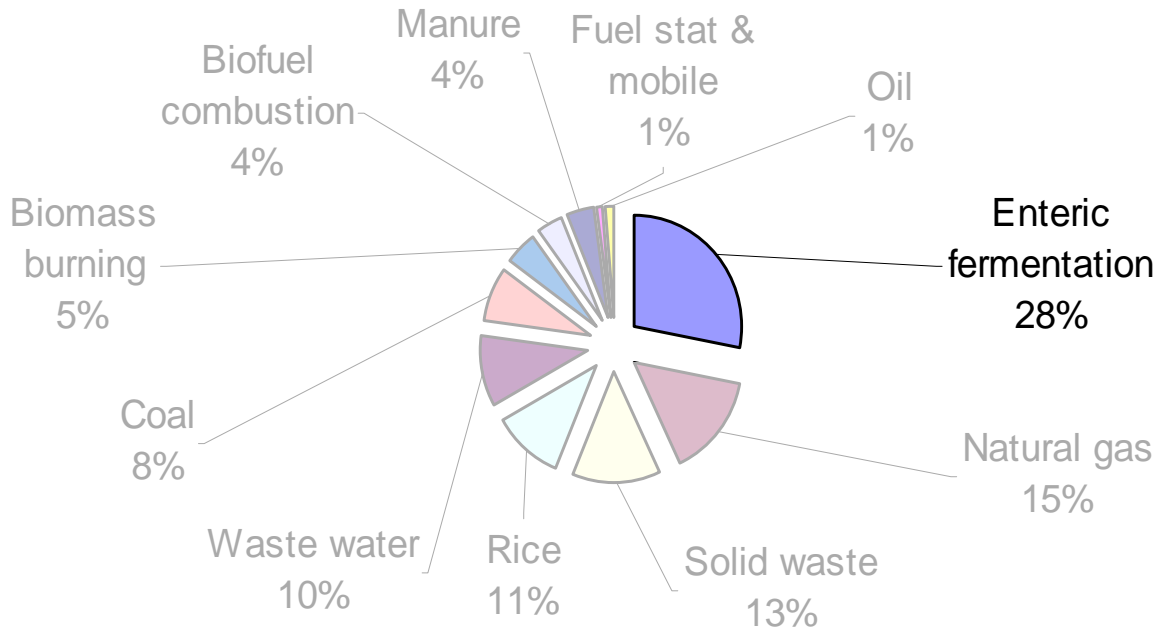
- CO₂ continues to accumulate, but at a slower rate.
- Methane reductions have full impact quickly - in only 12 years!

CH₄



Reducing methane emissions
CONTRADICT increasing
global warming!

Global Methane Emissions - by source



BIGGEST TOTAL SOURCE:

Cows, sheep etc

PROBLEM:

Each source is very small

50-100 kg CH₄ per cow
and year = 1-2 t CO₂e

ANNUAL GREENHOUSE EFFECT on Global Warming



ANNUAL GREENHOUSE EFFECT on Global Warming

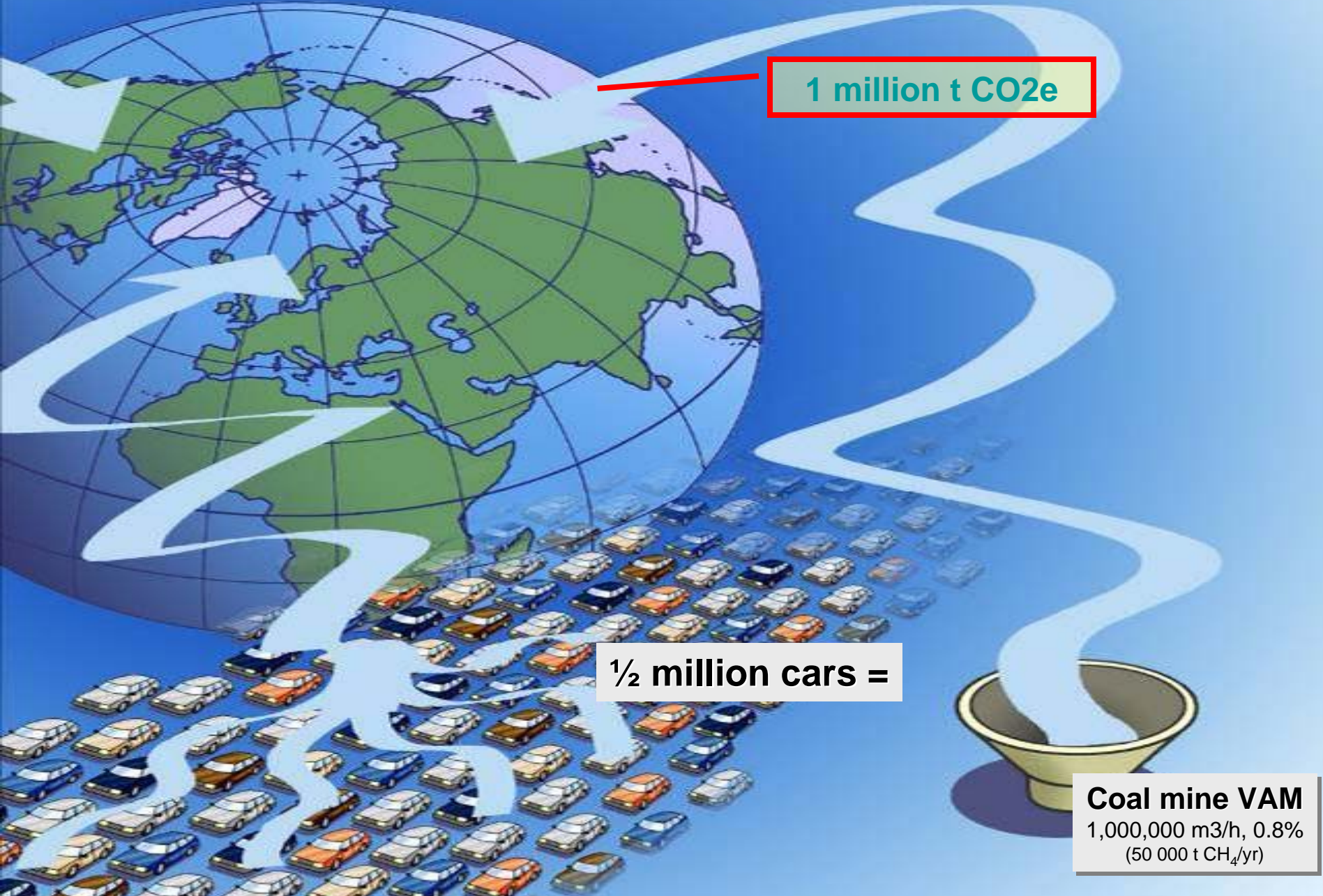


1 million t CO₂e



Coal mine VAM
1,000,000 m³/h, 0.8%
(50 000 t CH₄/yr)

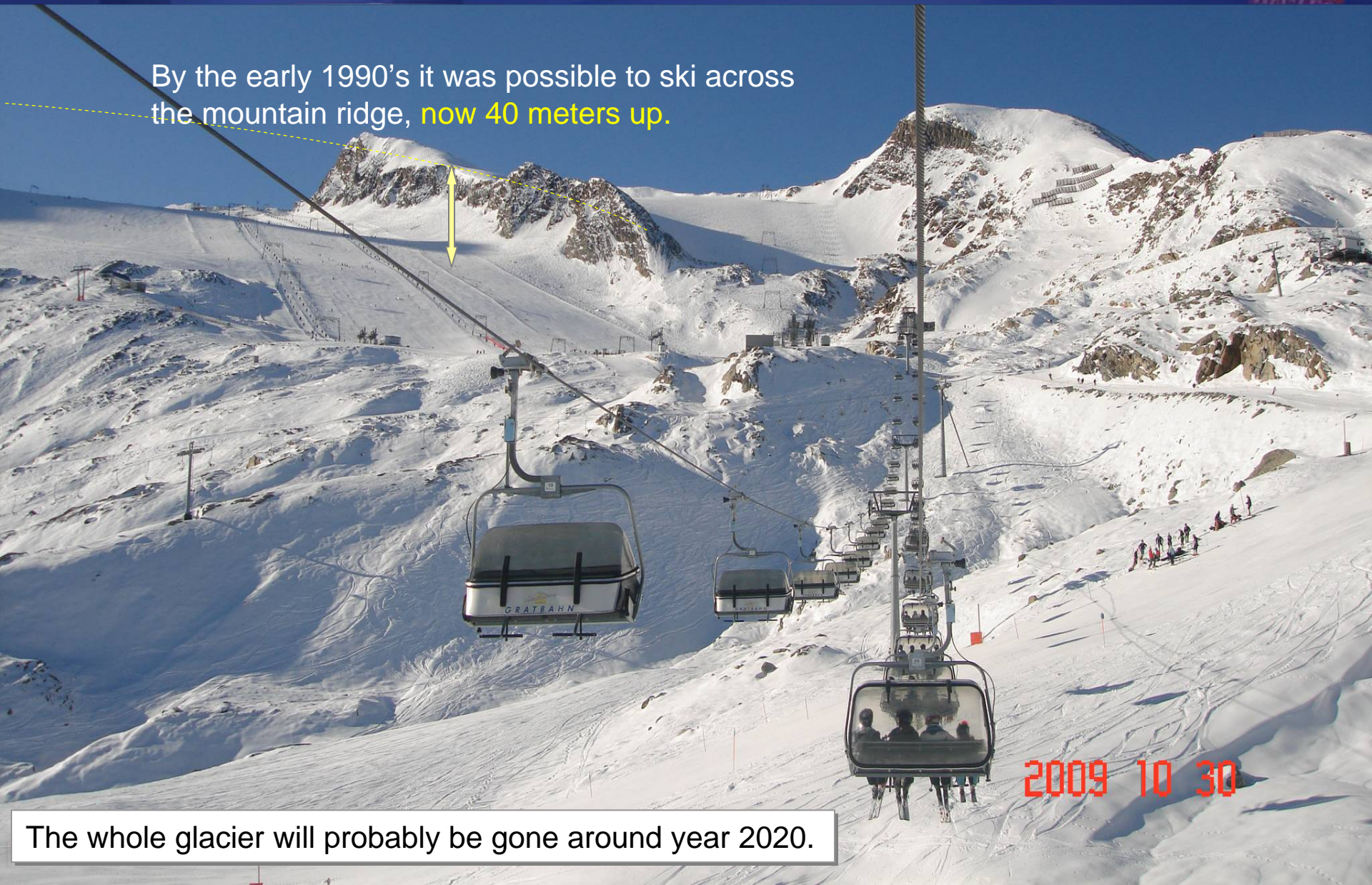
ANNUAL GREENHOUSE EFFECT on Global Warming



This is a European glacier with skiing all year.



By the early 1990's it was possible to ski across the mountain ridge, **now 40 meters up.**



The whole glacier will probably be gone around year 2020.

DEVELOPMENT OF THE MARKETS

CARBON CREDITS TRADING and VAM PROCESSING



CARBON CREDITS TRADING

1992 Rio Conference
- Agreement to establish the UN Framework Convention on Climate Change, UNFCCC

1997 Kyoto Conference
- Agreement to reduce emissions and to introduce mechanism of Carbon Credits

Launch of Kyoto related Carbon Credits

CARBON CREDITS TRADED

Kyoto Compliance Period 2008 - 2012

1992 1994 1997 2001 2004 2007 2009 2010 2012

VAM PROCESSING

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VAM PROCESSING



UK trial at British Coal



Australian trial at BHP

Abatement demo CONSOL, US



Abatement/hot water ZhengZhou, China



Abatement, JWR, US



VAMOX BioThermica

SINGLE UNIT INSTALLATIONS

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VAM PROCESSING



UK trial at British Coal

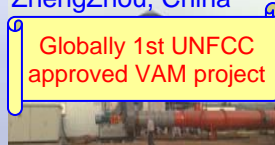


Australian trial at BHP

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MULTIPLE UNIT INSTALLATION

VAM Power Plant BHP Billiton, Australia

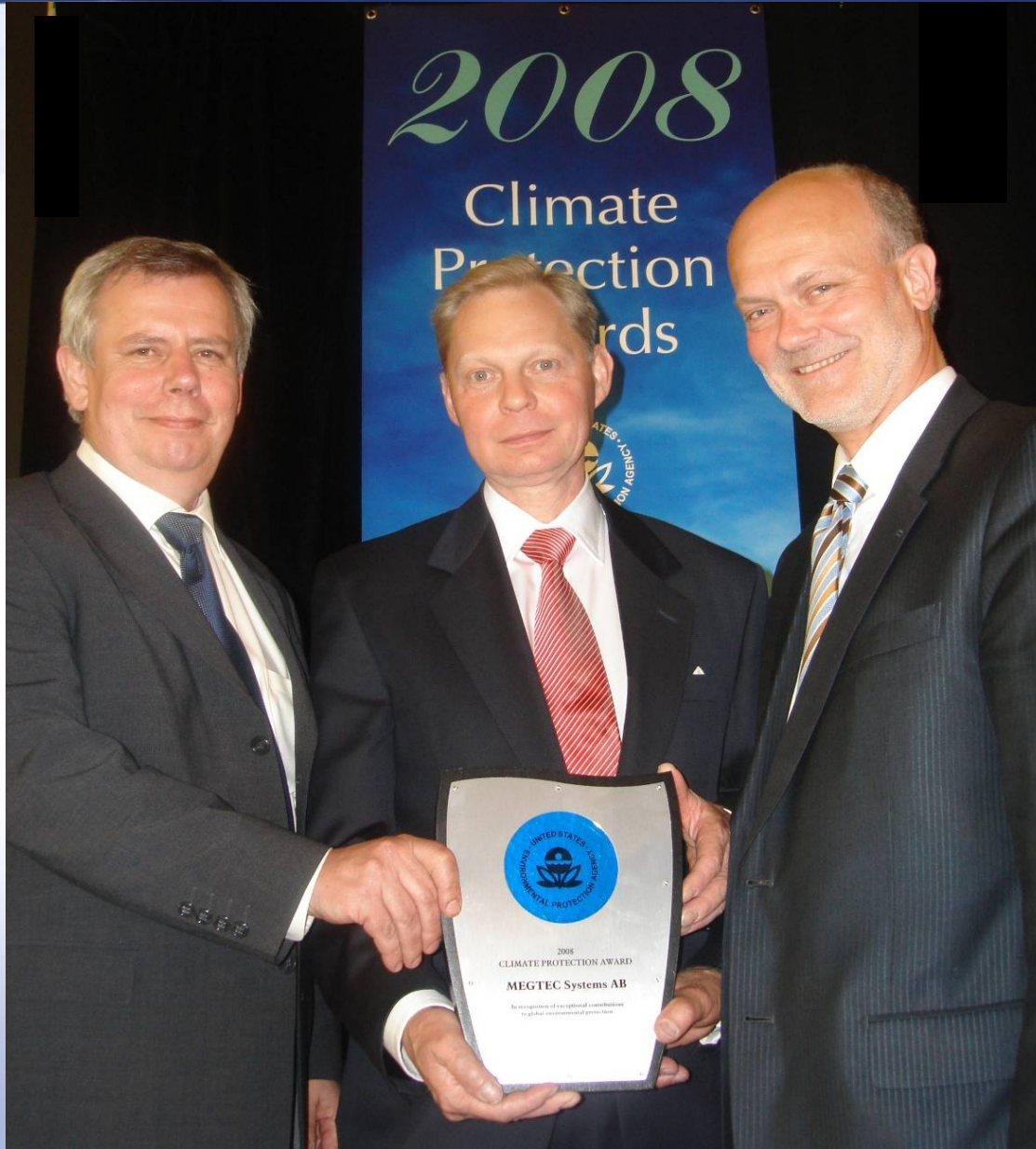


VAMOX BioThermica

SINGLE UNIT INSTALLATIONS

With WestVAMP, BHP Billiton in Australia has won several prestigious awards, and MEGTEC, for developing the VAM technology and for bringing it to the global market, won the:

US EPA Climate Protection Award 2008



MEGTEC VAM in China



Host/Customer is ZhengZhou Coal Mining Group, Henan Province

PDD administrator is EcoCarbone, France



System capacity: 62 500 Nm³/h

VAM concentration:

0.3% to 0.7 %

MEGTEC VAM in China



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MEGTEC VAM in China



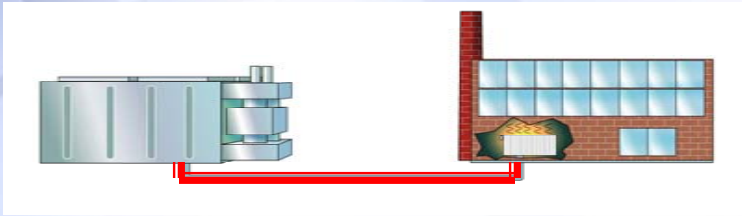
The complete installation includes VAM abatement and energy recovery in the form of hot water for local use

The MEGTEC delivery was fully commissioned and taken over by customer October 2008.

The globally first project to be awarded VAM-based CER's (Kyoto related Carbon Credits).

Hot water from VAM

Main MEGTEC concept in China

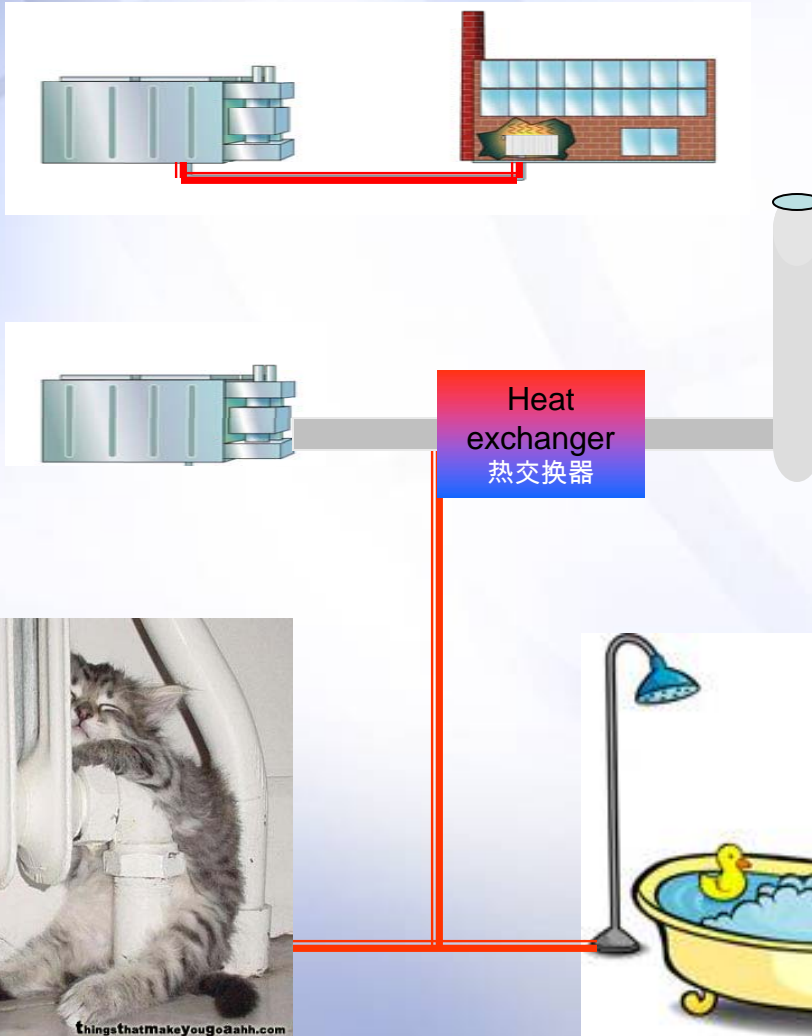


In China typical VAM concentrations are 0.3–0.7%

	0.3%	0.5%	0.7%
Heat straight from bed. Water at 70 - 150°C	1.5 MW	3.8 MW	6.1 MW
<i>--- For each 125 000 Nm³/h of ventilation air ---</i>			

Hot water from VAM

Main MEGTEC concept in China

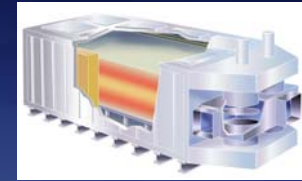


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Heat straight from bed. Water at 70 - 150°C	1.5 MW	3.8 MW	6.1 MW
- - - For each 125 000 Nm ³ /h of ventilation air - - -			
Secondary heat-exchanger. Water at 70°C	0.5 MW	2.7 MW	5 MW
Secondary heat-exchanger. Water at 150°C	-	-	1.5 MW



Calculations of CERs



Examples:

250 000 Nm³/h @ 0.9 % VAM comes to 240 000 tonnes of CO₂e

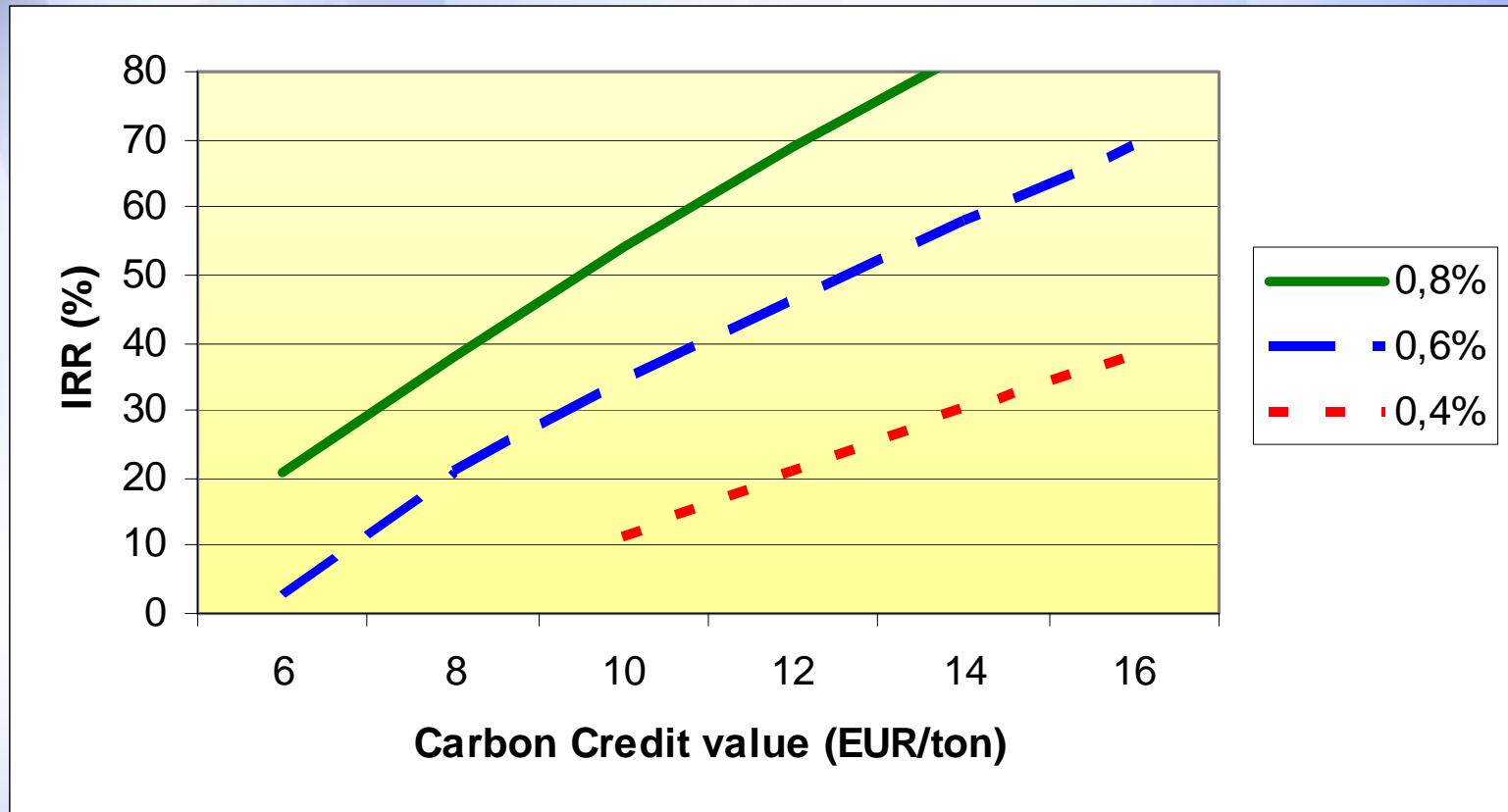
125 000 Nm³/h @ 0,9 % VAM comes to 120 000 t CO₂e

125 000 Nm³/h @ 0,3 % VAM comes to 40 000 t CO₂e

	0.3	0.6	0.9
125 000	40	80	120
250 000	80	160	240
500 000	160	320	480
1 000 000	320	640	960

Annual emission reductions in thousand tons of CO₂e

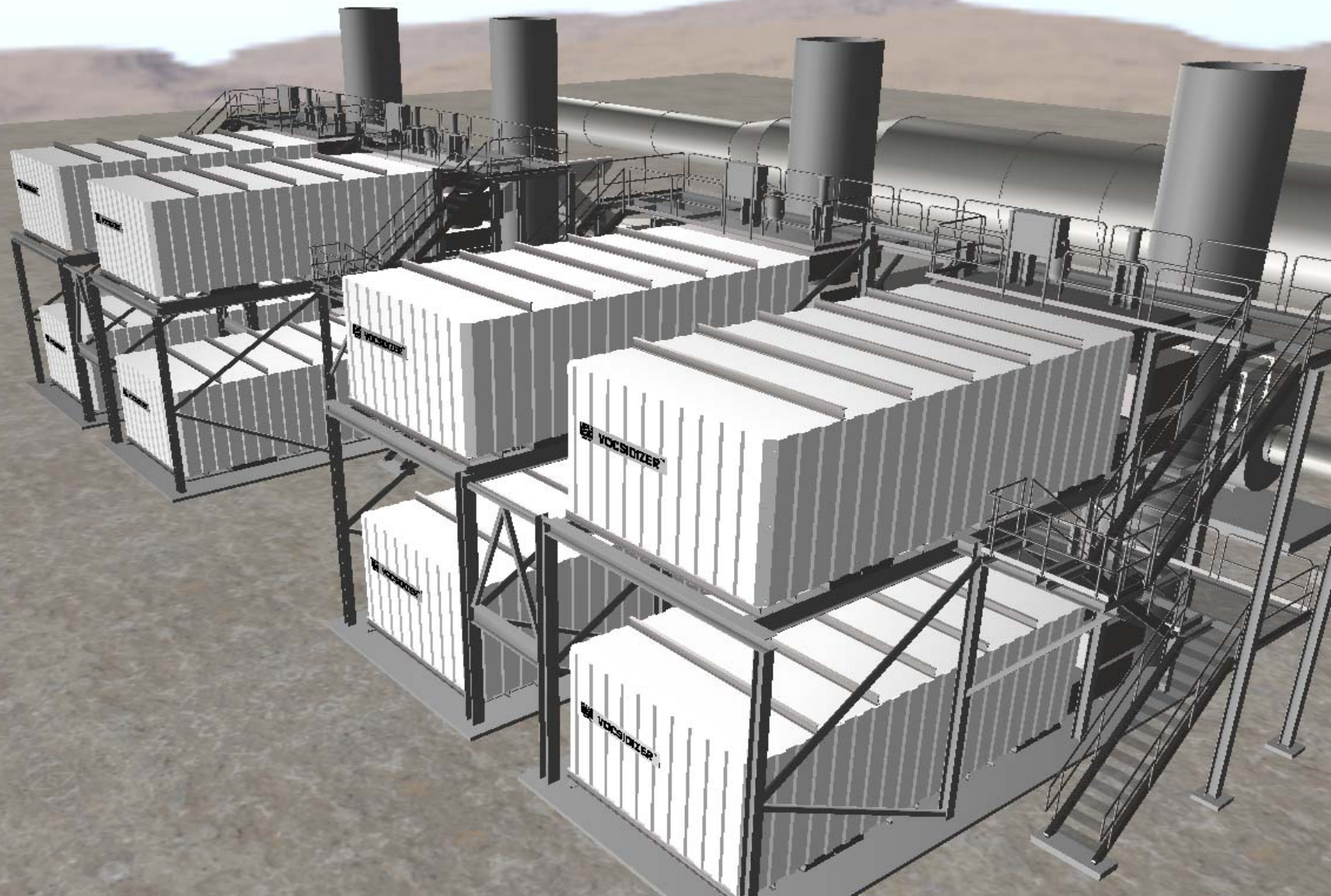
VAM project economics - indication



CONCLUSIONS:

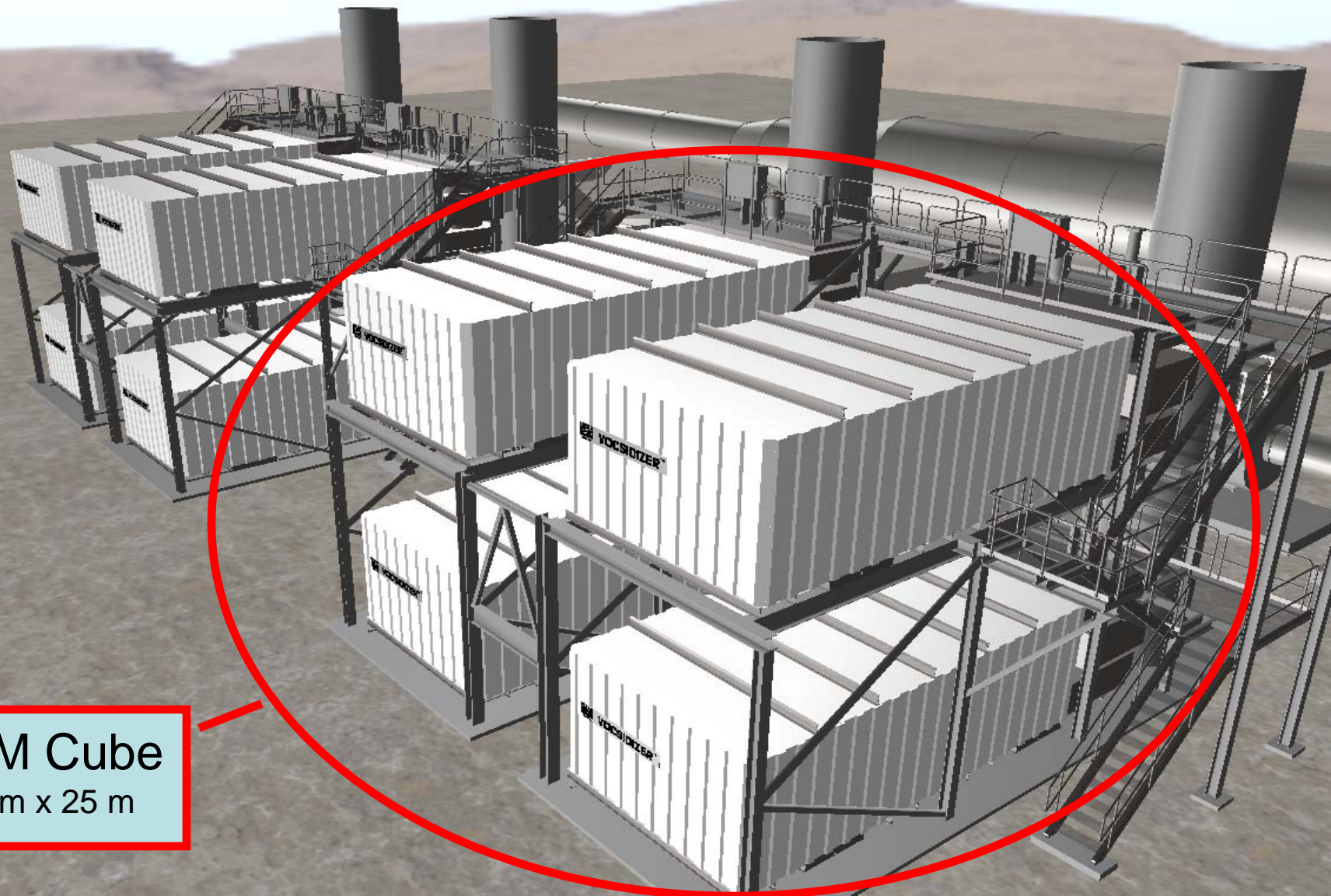
- VAM concentrations should be min ½ percent
- Carbon Credits above EUR 10/t

MEGTEC VAM processing concept is modular,
based on VOCSIDIZERS,
stacked in arrangements of VAM Cubes.





Each VAM Cube can process 250,000 Nm³/h



VAM Cube
20 m x 25 m

MAJOR VAM PROJECT IN CHINA

JV deal signed in presens of many high Chinese and US dignitaries

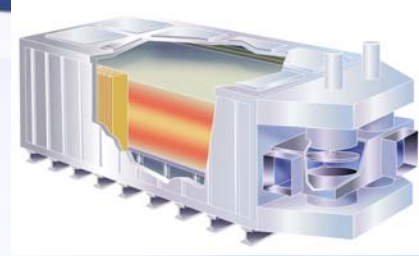


- International, US based power company **AES** has announced a **major VAM project in China**
 - processing 375,000 Nm³/h of ventilation air
 - based on MEGTEC VAM technology
 - SongZao coal mine, ChongQing Province
 - installation in 2010



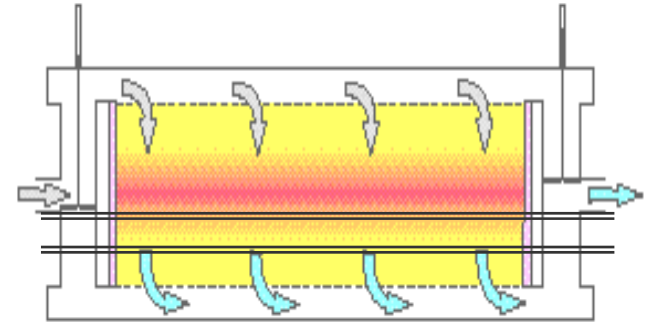
5 CONCLUSIONS on VAM (Ventilation Air Methane)

1. VOCSIDIZER and VAMOX can abate VAM



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2. VOCSIDIZER can convert VAM into useful energy



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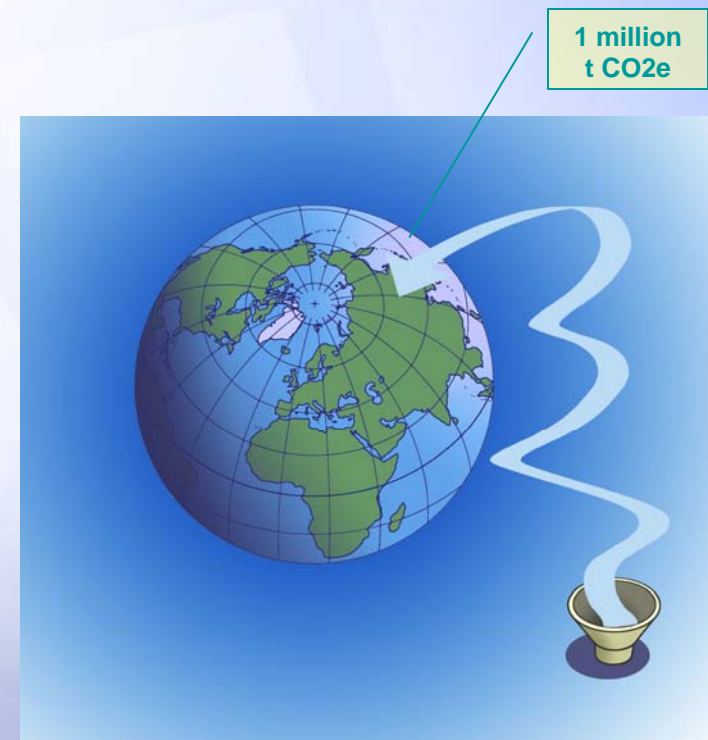
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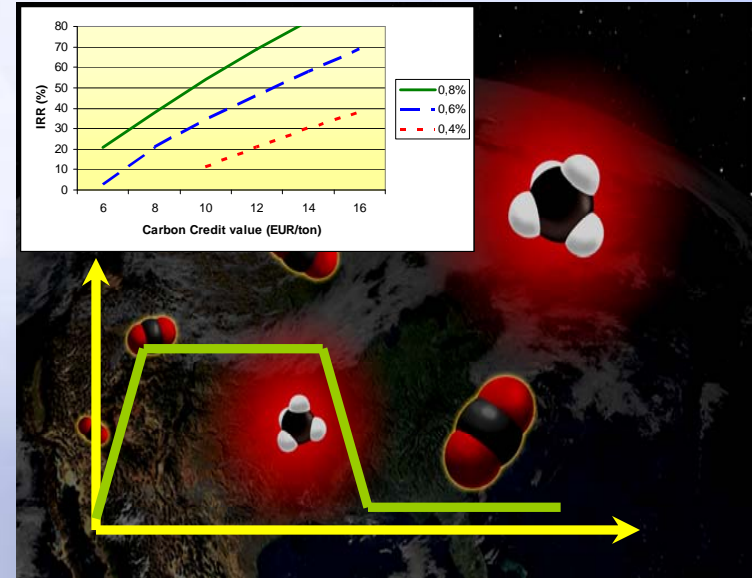
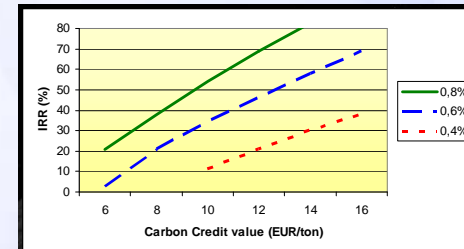
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4. A full scale VAM processing plant can reduce annual emissions of 1 million tons CO_{2e} providing significant positive impact on Global Warming



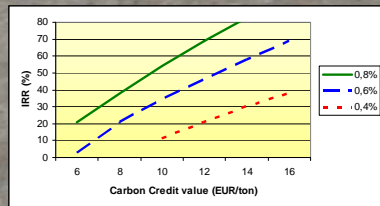
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4. A full scale VAM processing plant can reduce annual emissions of 1 million tons CO_{2e} providing significant positive impact on Global Warming
5. Most likely, the VAM market will boom when there is a political agreement on post 2012



MEGTEC VAM VOCSIDIZER



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