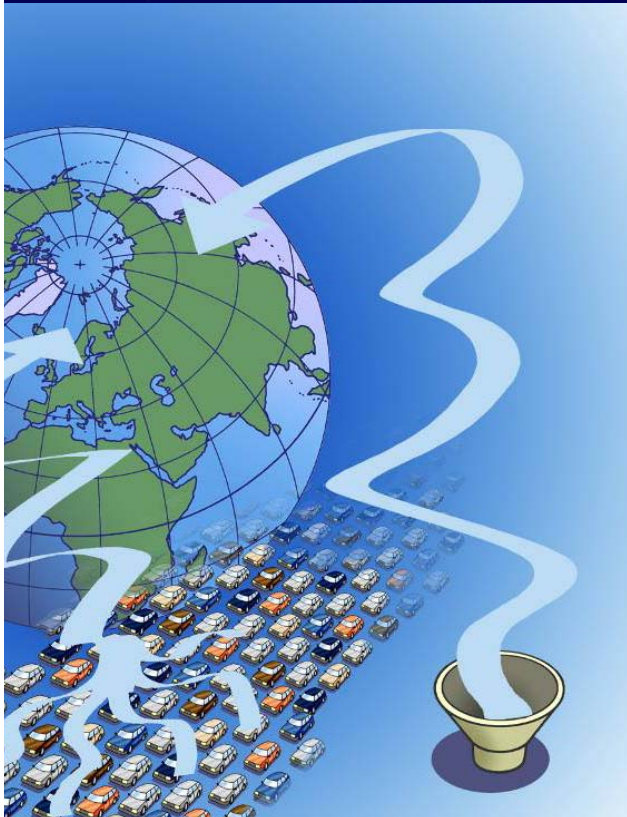


UN Ad Hoc Group of Experts  
on Coal Mine Methane, Geneva



# VAM PROCESSING;

- ITS IMPACT ON CLIMATE CHANGE
- WHY INVESTORS ARE HESITATING



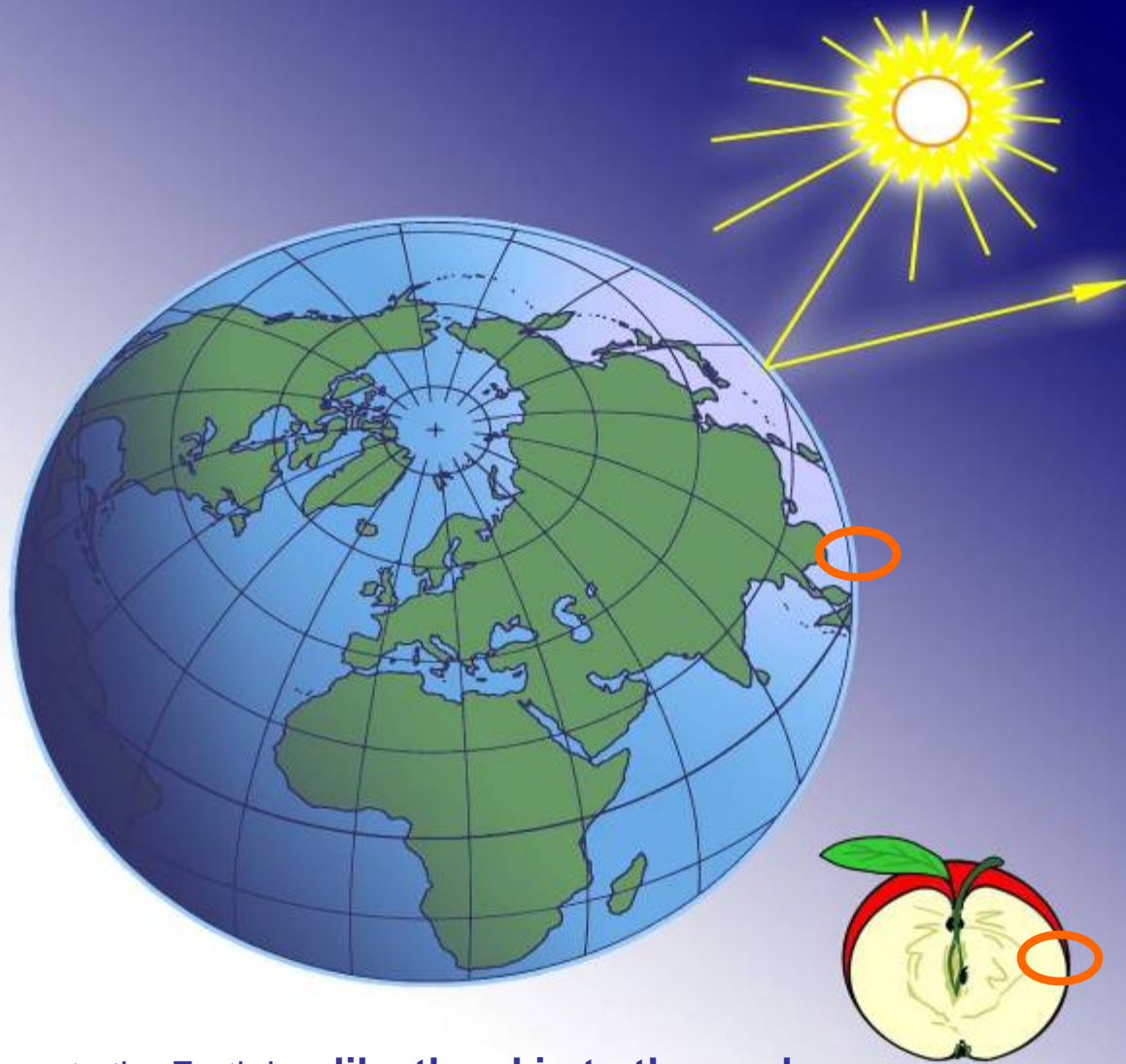
October 2009

RMATTUS@MEGTEC.SE

# One thin bubble of atmosphere

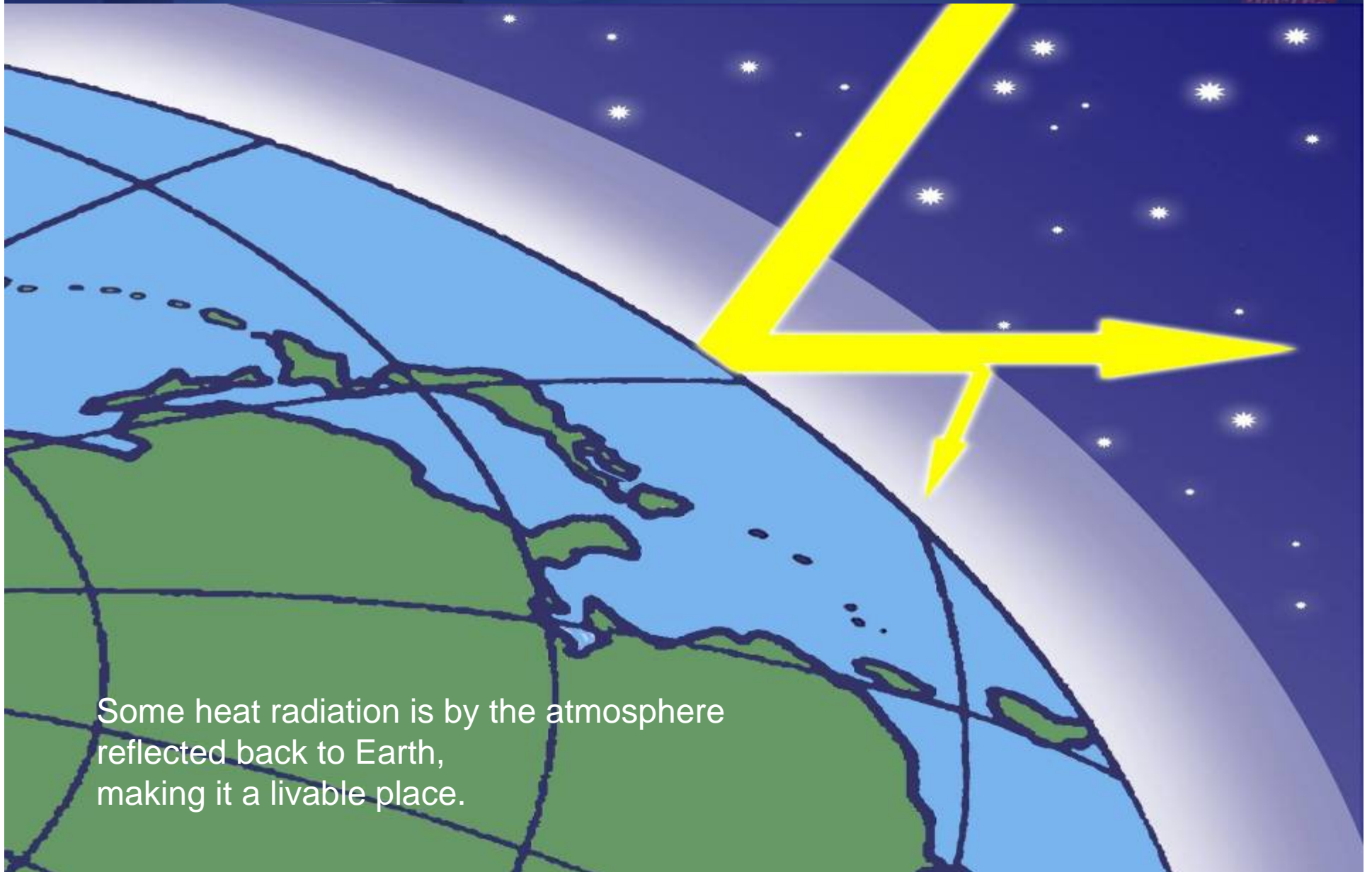


# One thin bubble of atmosphere



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

# One thin bubble of atmosphere



Some heat radiation is by the atmosphere reflected back to Earth, making it a livable place.

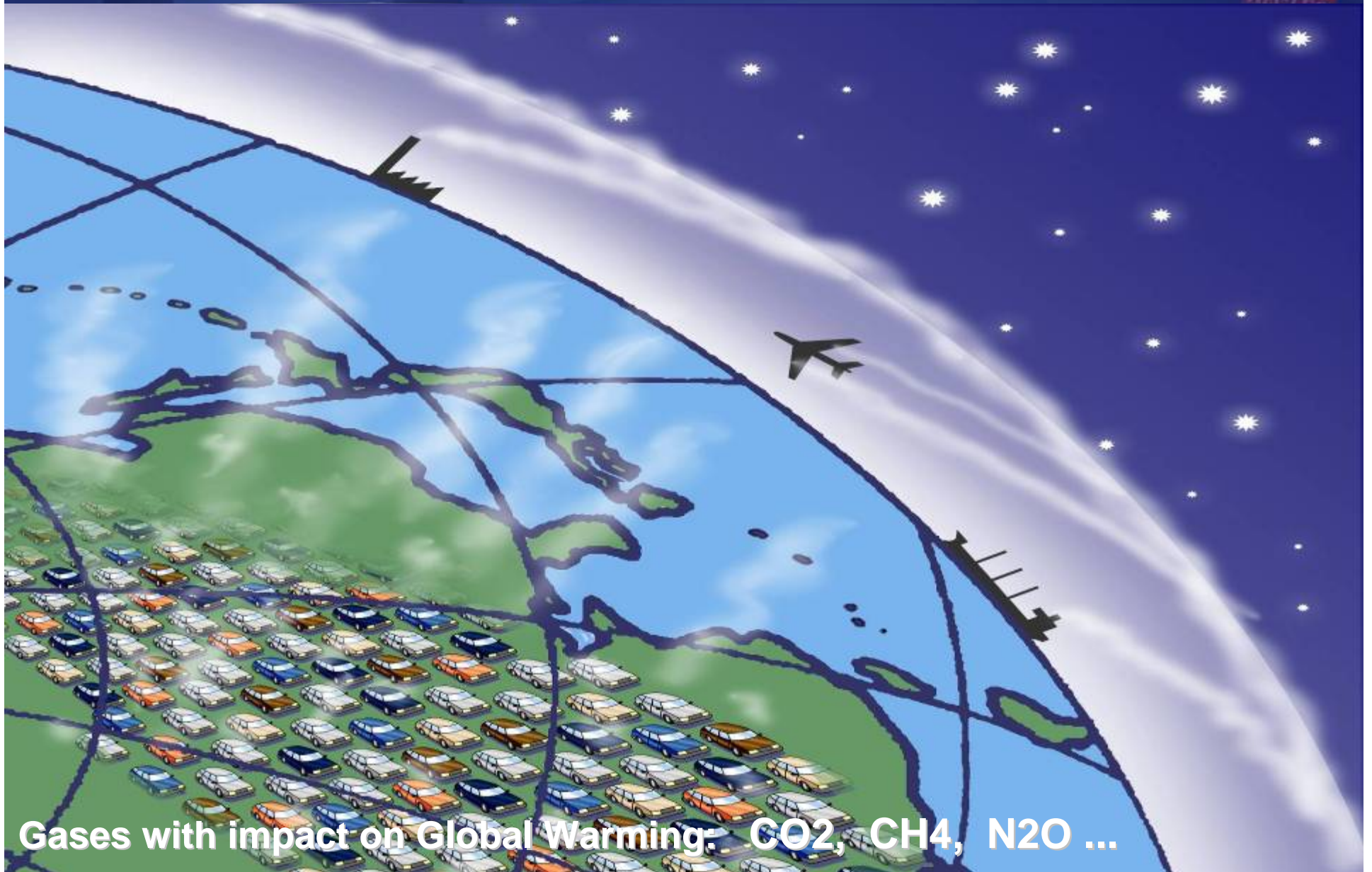
# One thin bubble of atmosphere



With global industrialisation, power generation and fuelling of vehicles, human activities are since over a century emitting large quantities of gases into the atmosphere.

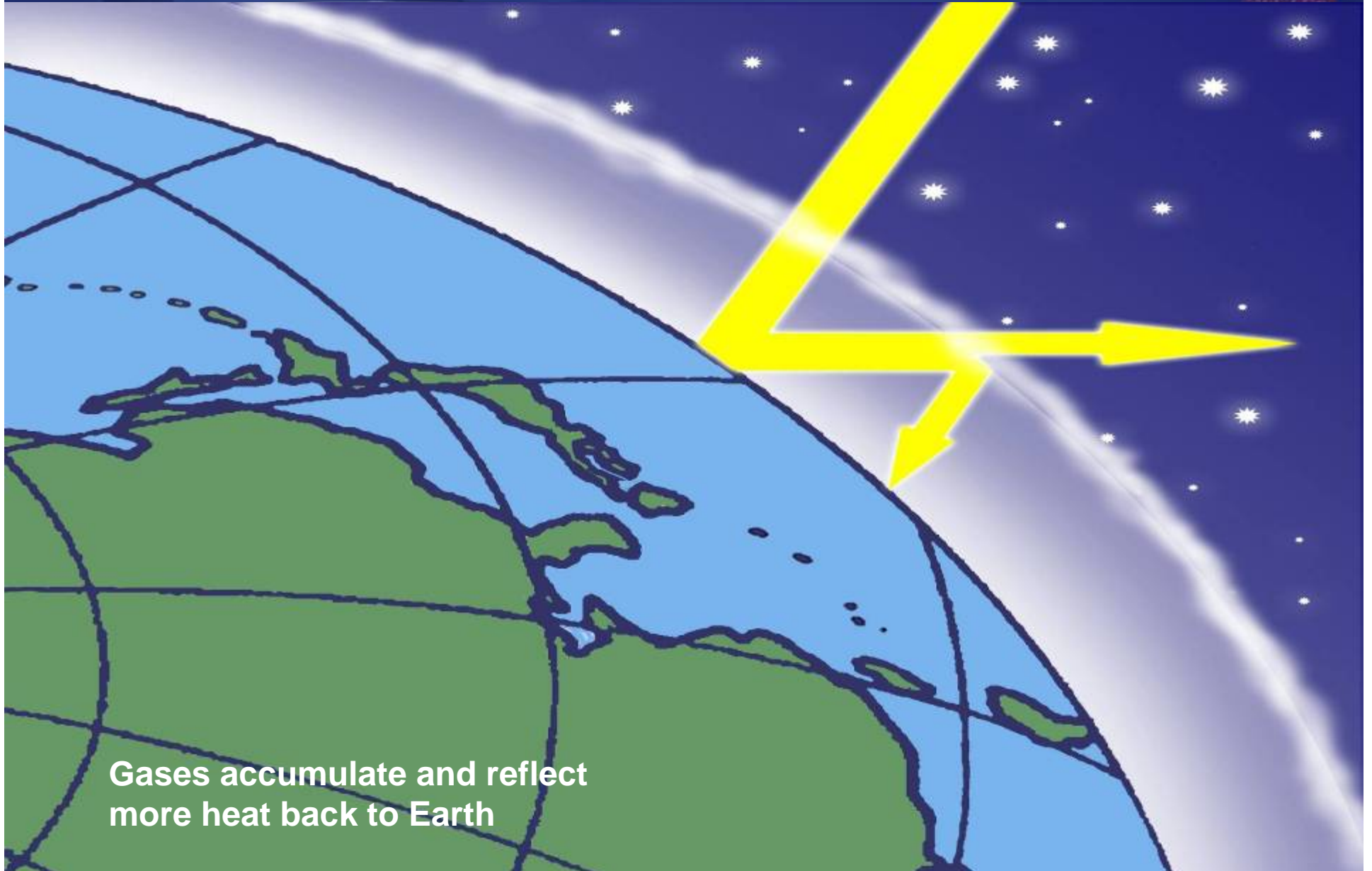
Huge amounts of atoms are transformed from earth bound state to being emitted in gas form, changing the composition of the atmosphere - its characteristics and intricate balances.

# One thin bubble of atmosphere



Gases with impact on Global Warming: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O ...

# One thin bubble of atmosphere



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



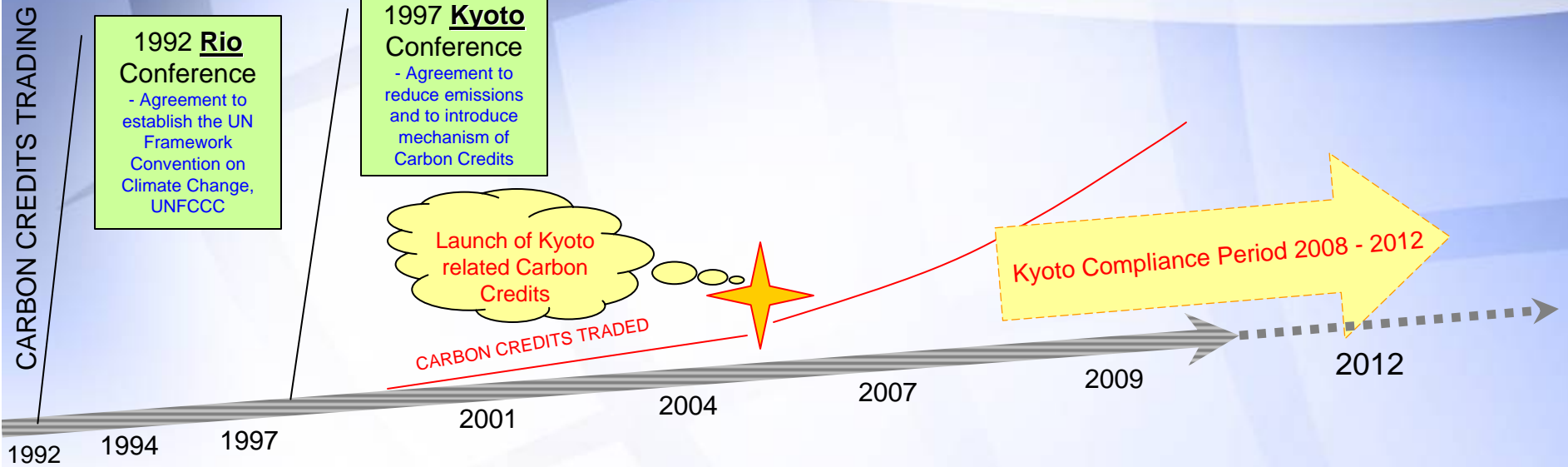
# One thin bubble of atmosphere



- Discussion concerns how much countries and industries are allowed to emit.
- The principle is that most emission reductions shall be done "at home" while some (typically 10-20%) can be done in other countries if that is more cost efficient.
- The recently established trading with Carbon Credits (emission reduction certificates) is a mechanism guiding investments to where on Earth they most cost efficiently reduce GHG emissions.

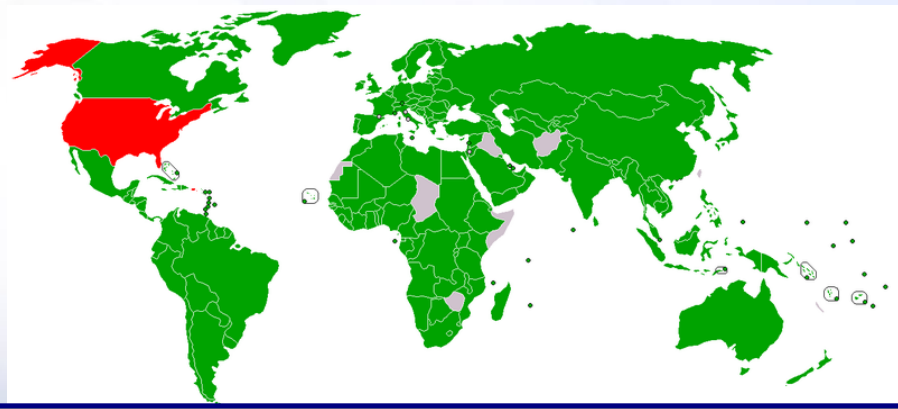
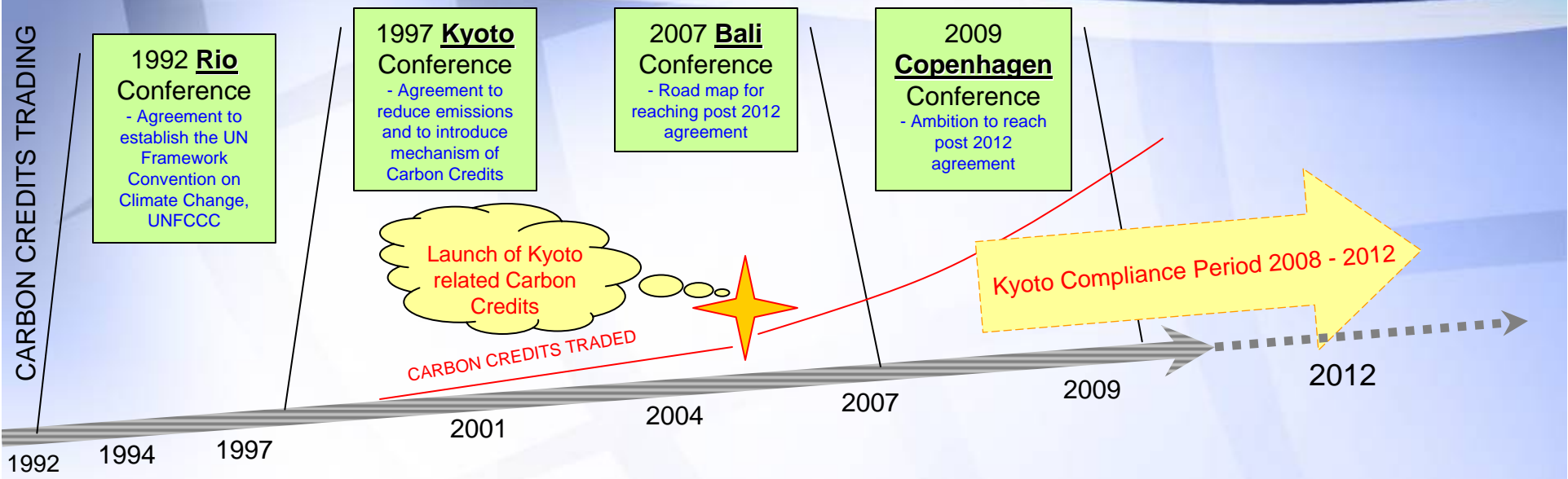
# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING



# DEVELOPMENT OF THE MARKETS

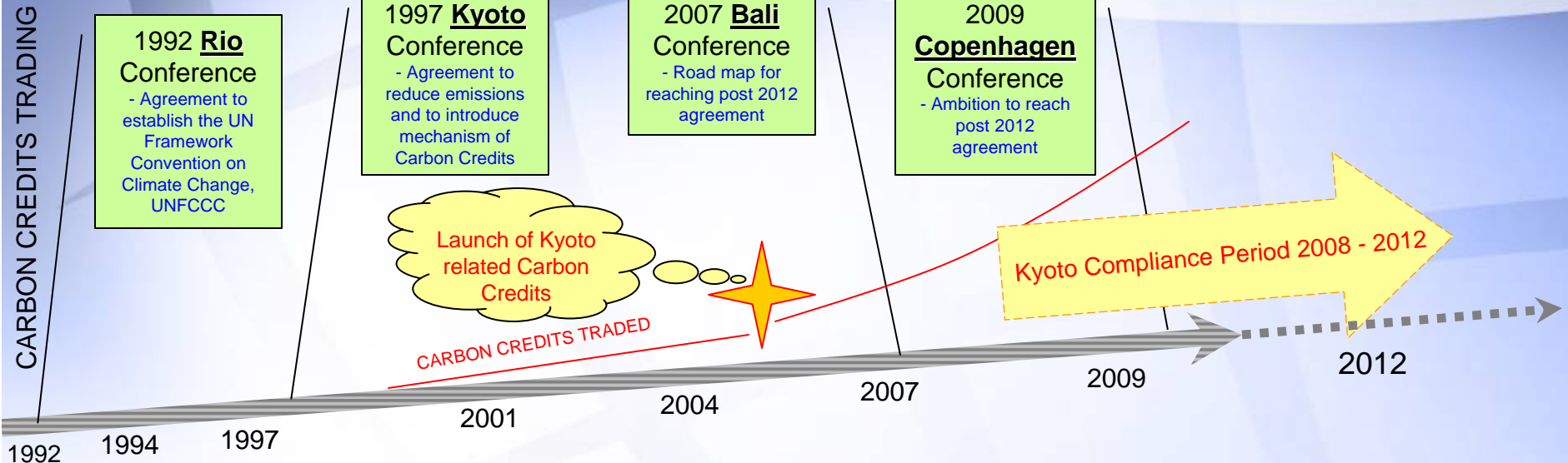
## CARBON CREDITS TRADING



As of 26 August 2009, 188 countries plus the EEC have signed up for the Kyoto Protocol

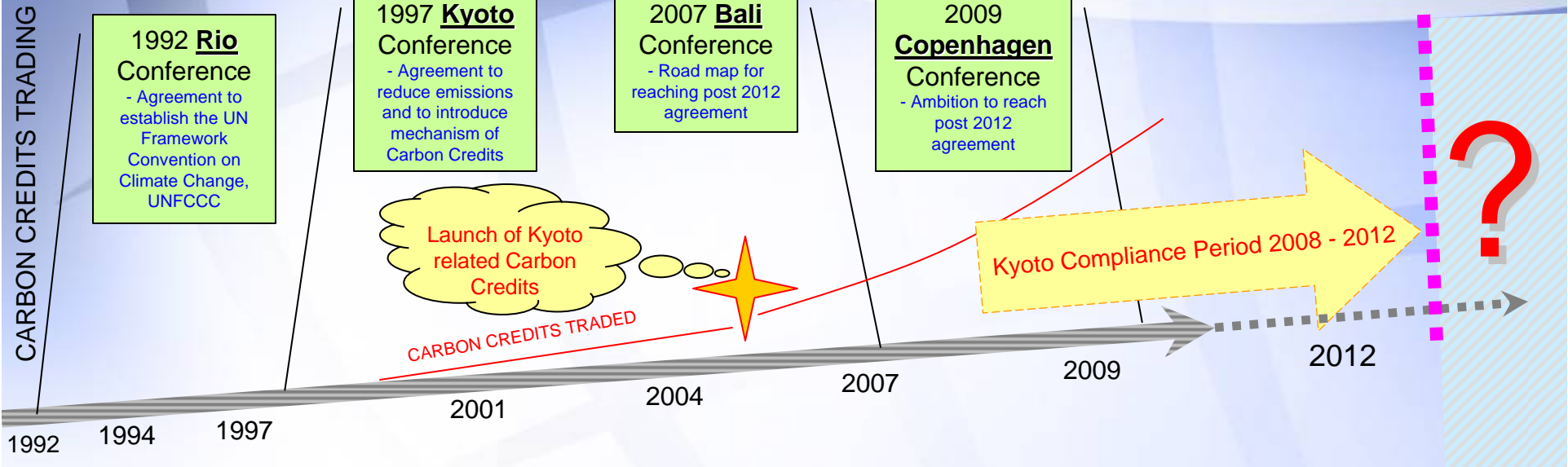
# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING



# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING



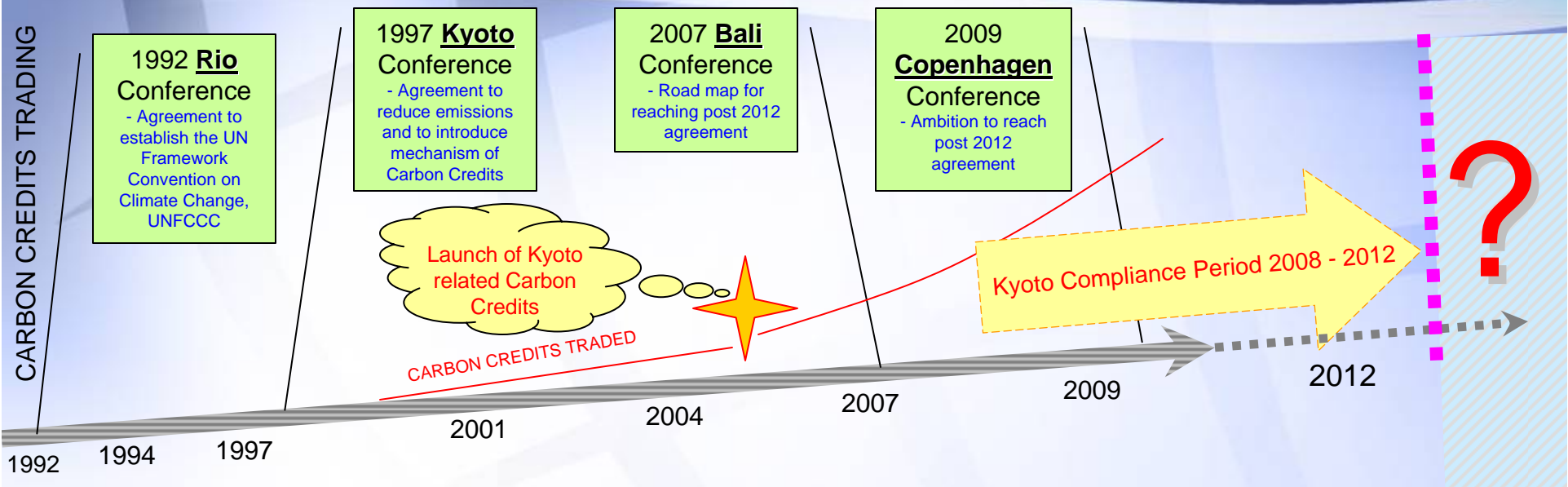
Main issue for post 2012 is for countries and regions to commit to new caps on emissions.

- In 2009: big game of positioning for Copenhagen negotiations.
- Key will be for the US and the large development countries (China, India, Brasil etc) to commit to caps.

Local  
y biggest  
national scheme  
coming.  
Price 8-12 A\$

# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING



THE LACK OF POLITICAL DECISIONS ON POST 2012 RULES IS DEPRESSING GLOBAL PRICES OF CARBON CREDITS

-MAKING INVESTORS HESITATE WITH INVESTMENT DECISION

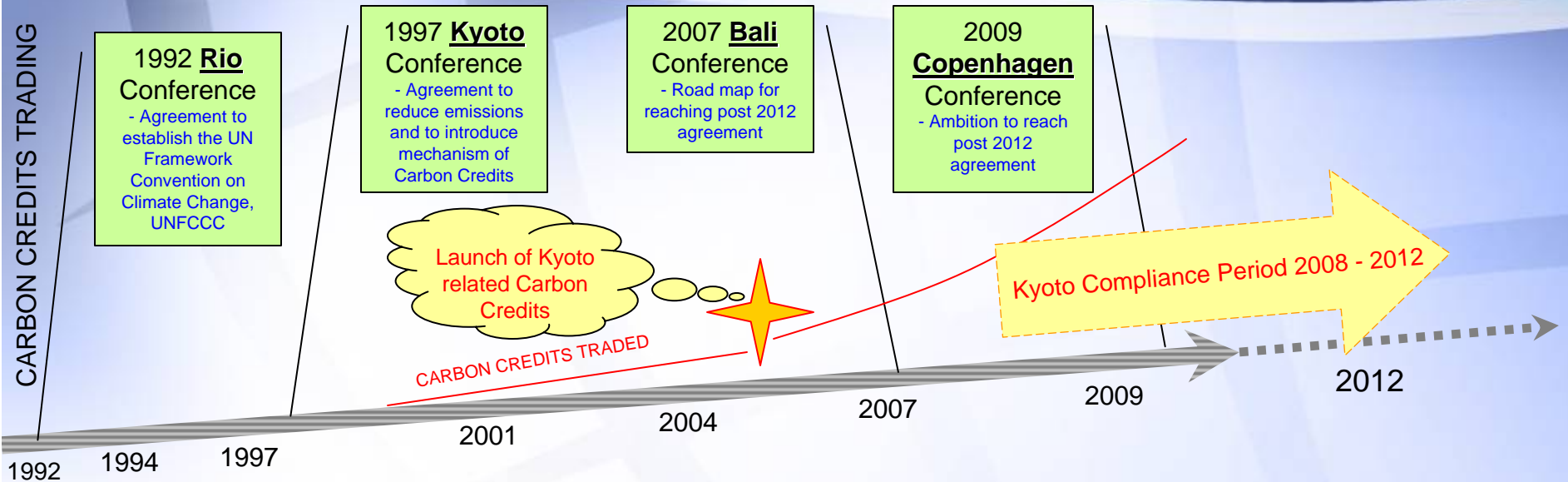
i.e. WAIT WITH ACTIONS ON EMISSION REDUCTIONS.

# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING and VAM PROCESSING



CARBON CREDITS TRADING



VAM PROCESSING

### COAL MINE METHANE and VAM PROCESSING

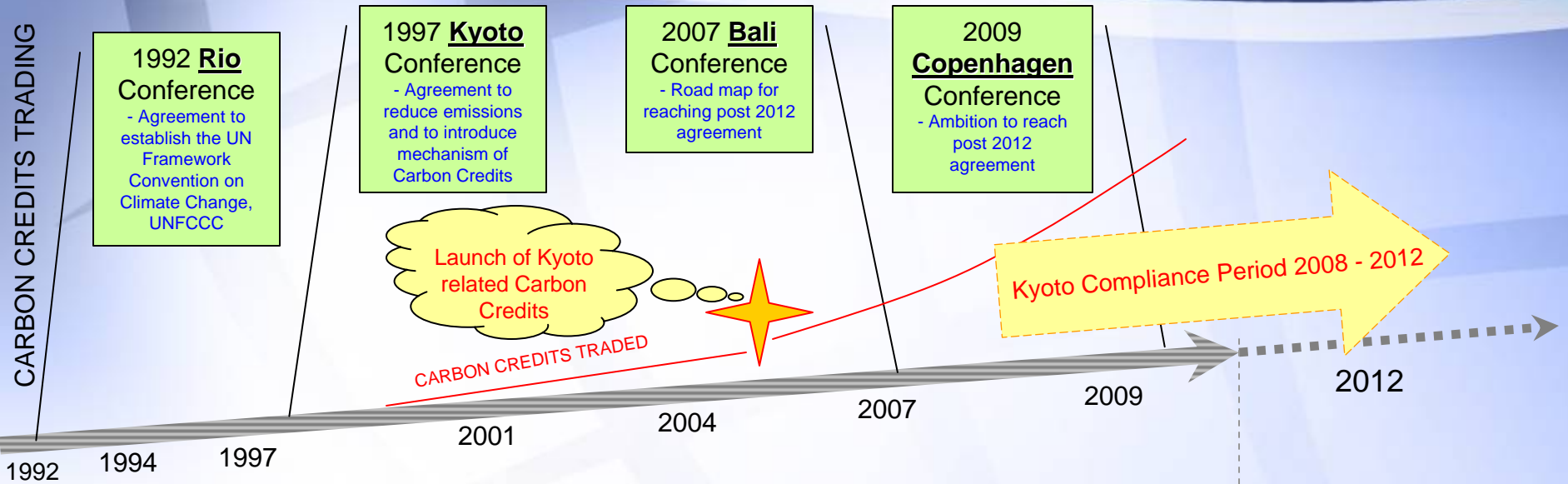
- Drainage gas, CMM, has been low hanging mine gas fruit, where you just apply a suitable gas engine, provided gas is at above 25% in concentration. This is more cost efficient than processing VAM.
- VAM is technically complicated due to very large air volumes and extremely dilute methane.
- So far, most VAM technologies have not passed lab & demo stage.
- Most of the coal mine methane is, however, emitted as VAM.

# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING and VAM PROCESSING

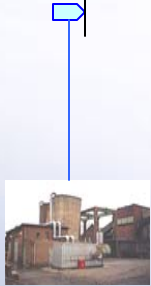


CARBON CREDITS TRADING



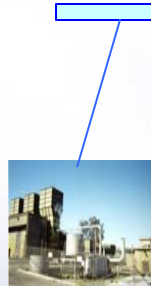
VAM PROCESSING

VAM PILOT



UK trial at British Coal  
Only a few months

VAM PILOT



Australian trial at BHP  
A full year

SINGLE UNIT VAM INSTALLATIONS

Abatement demo CONSOL, US



Abatement/hot water ZhengZhou, China



Abatement, JWR, US



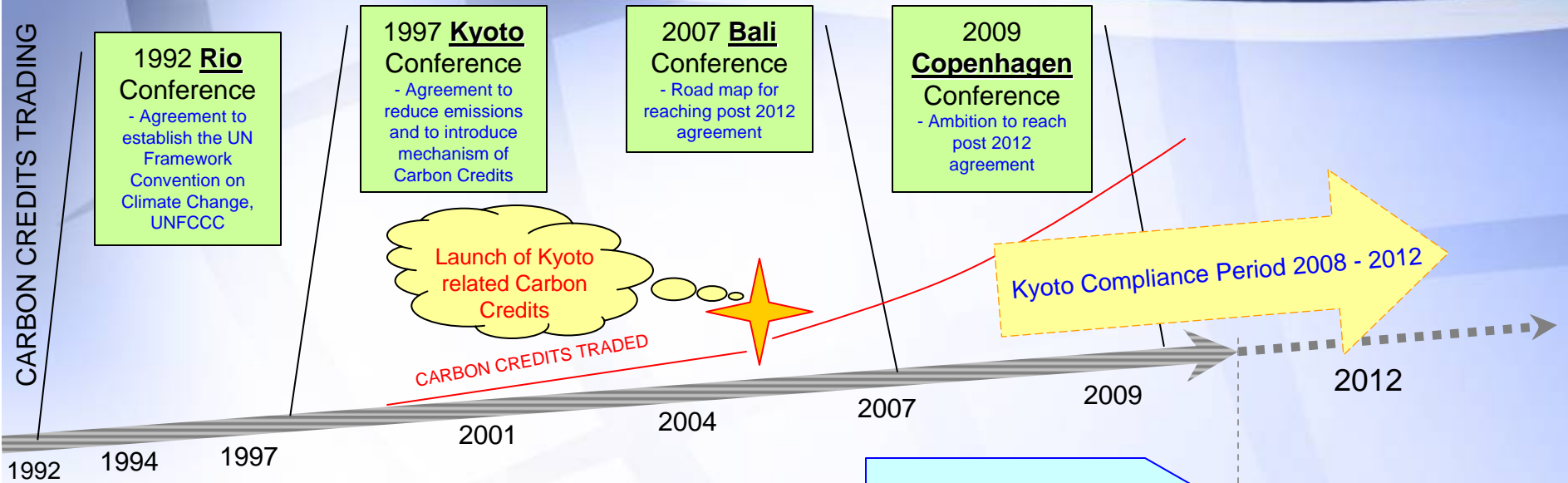
Biothermica

# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING and VAM PROCESSING



CARBON CREDITS TRADING



VAM PROCESSING

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UK trial at British Coal  
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LARGE SIZE VAM INSTALLATION

VAM Power Plant  
BHP Billiton, Australia



SINGLE UNIT VAM INSTALLATIONS

Abatement demo  
CONSOL, US



Abatement/hot water  
ZhengZhou, China



Abatement, JWR, US



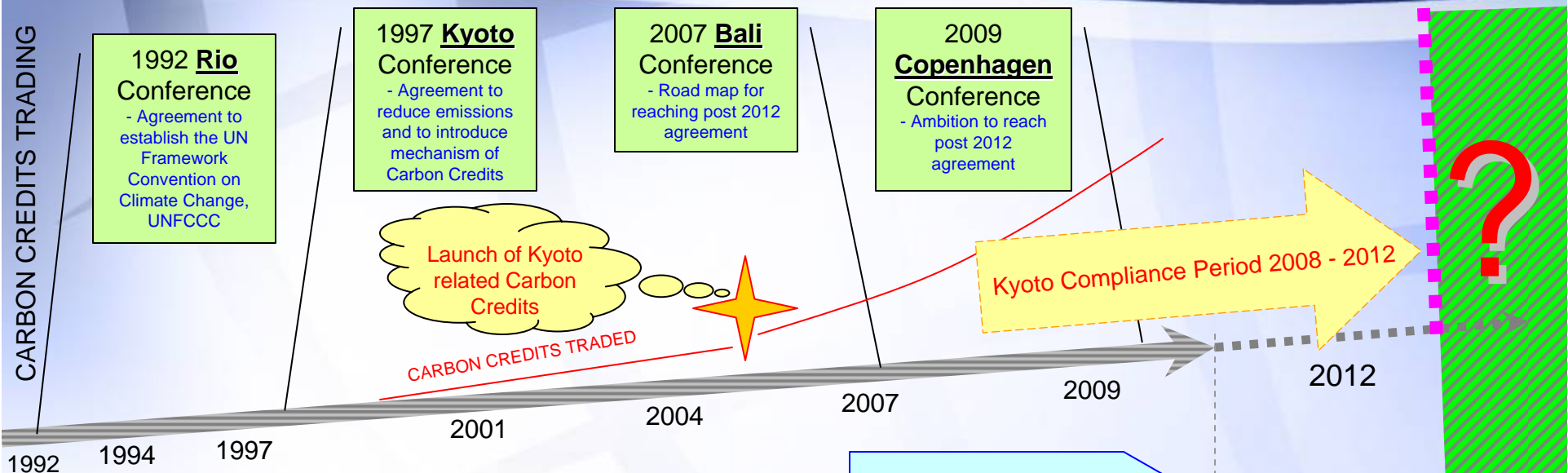
Biothermica

# DEVELOPMENT OF THE MARKETS

## CARBON CREDITS TRADING and VAM PROCESSING



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SINGLE UNIT VAM INSTALLATIONS



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Abatement, JWR, US

Globally 1st UNFCCC approved VAM project

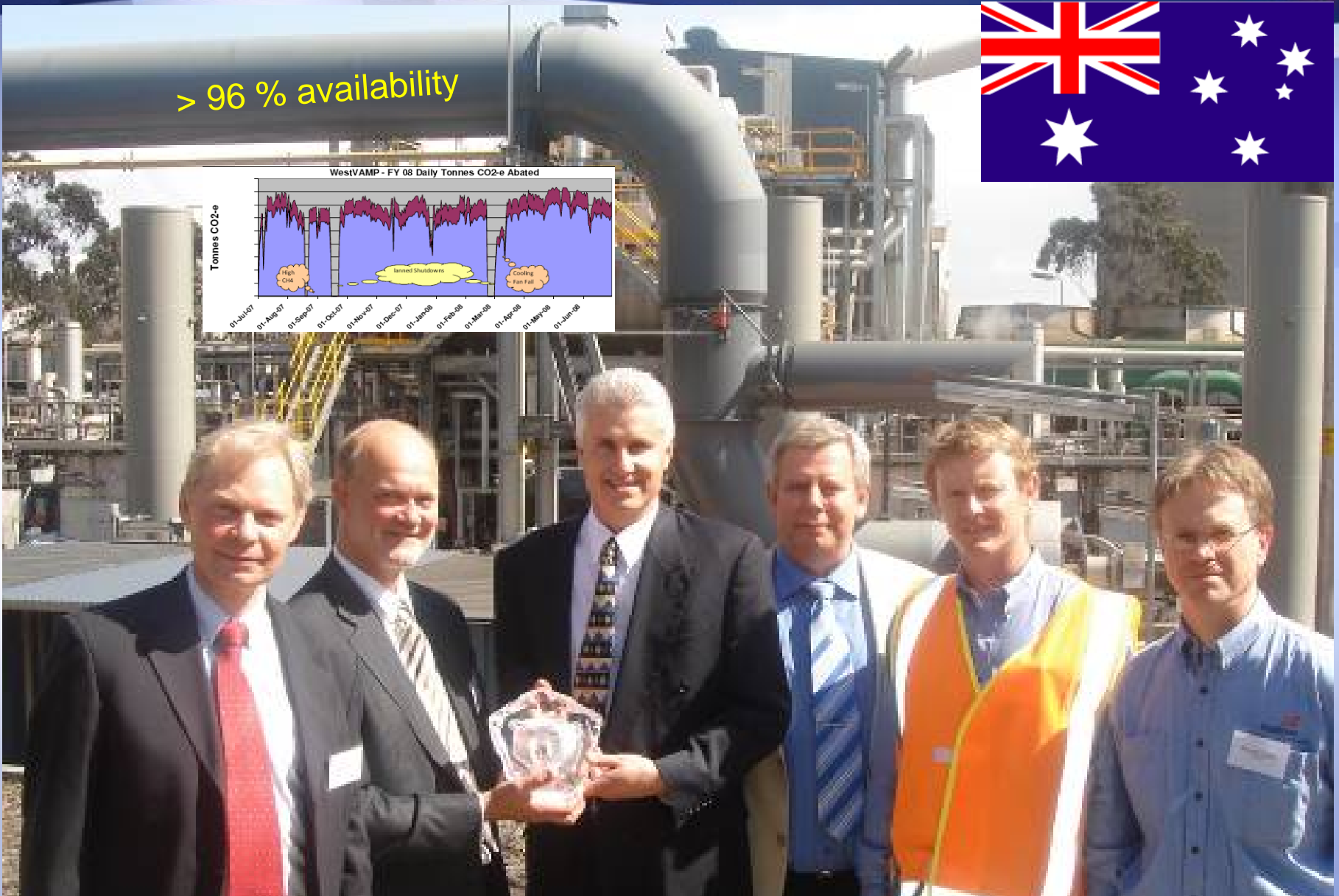
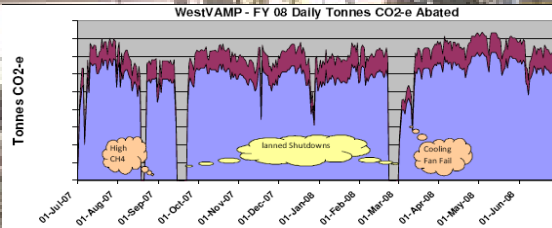
Biothermica

# In full operation by April 2007

- the world's first VAM Power Plant
- still the world's only large scale VAM processing plant – of any kind



> 96 % availability



# VAM POWER PLANT – at BHP Billiton in Australia



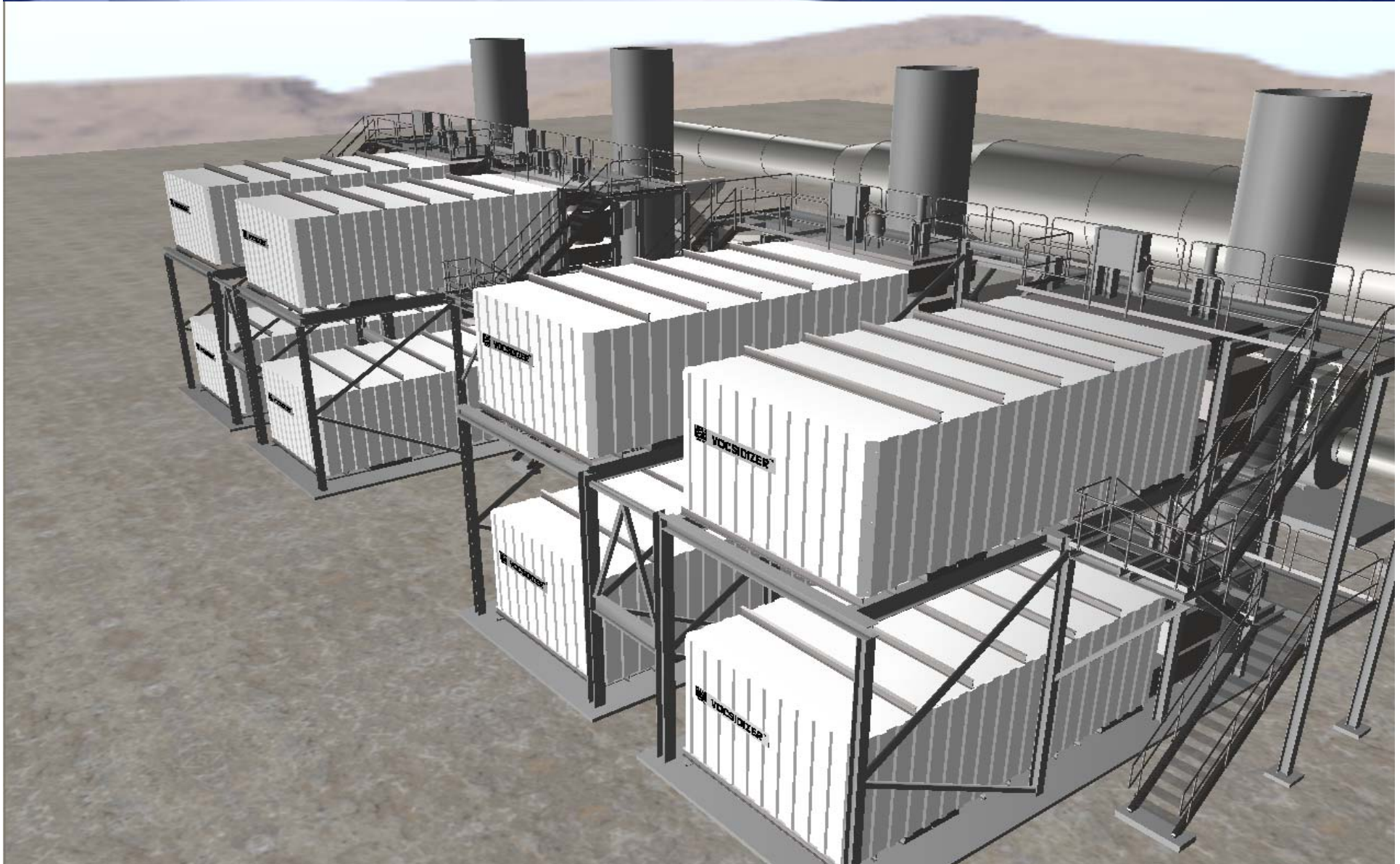
By 2009 ;

Has generated over 500 000 carbon credits

Has generated over 80,000 MWh of electricity

Processing only 20% of ventilation air volume

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



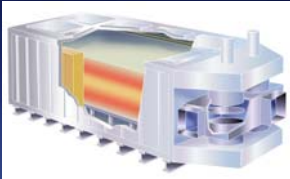
# MEGTEC VAM processing plant for 500 000 Nm<sup>3</sup>/h based on the VAM Cube.



**VAM  
Cube**

**FOOTPRINT  
20 m x 25 m**

# Calculations of CERs



For calculation of amount to CERs, consider:

- Vocsidizer cleaning efficiency and availability
- conversion rate of CH4 into CO2e (-equivalents)

Examples:

VAM Cube - 250 000 Nm<sup>3</sup>/h @ 0.9 % VAM comes to 240 000 tonnes of CO<sub>2</sub>e

Twin Unit - **125 000** Nm<sup>3</sup>/h @ 0,9 % VAM comes to 120 000 t CO<sub>2</sub>e

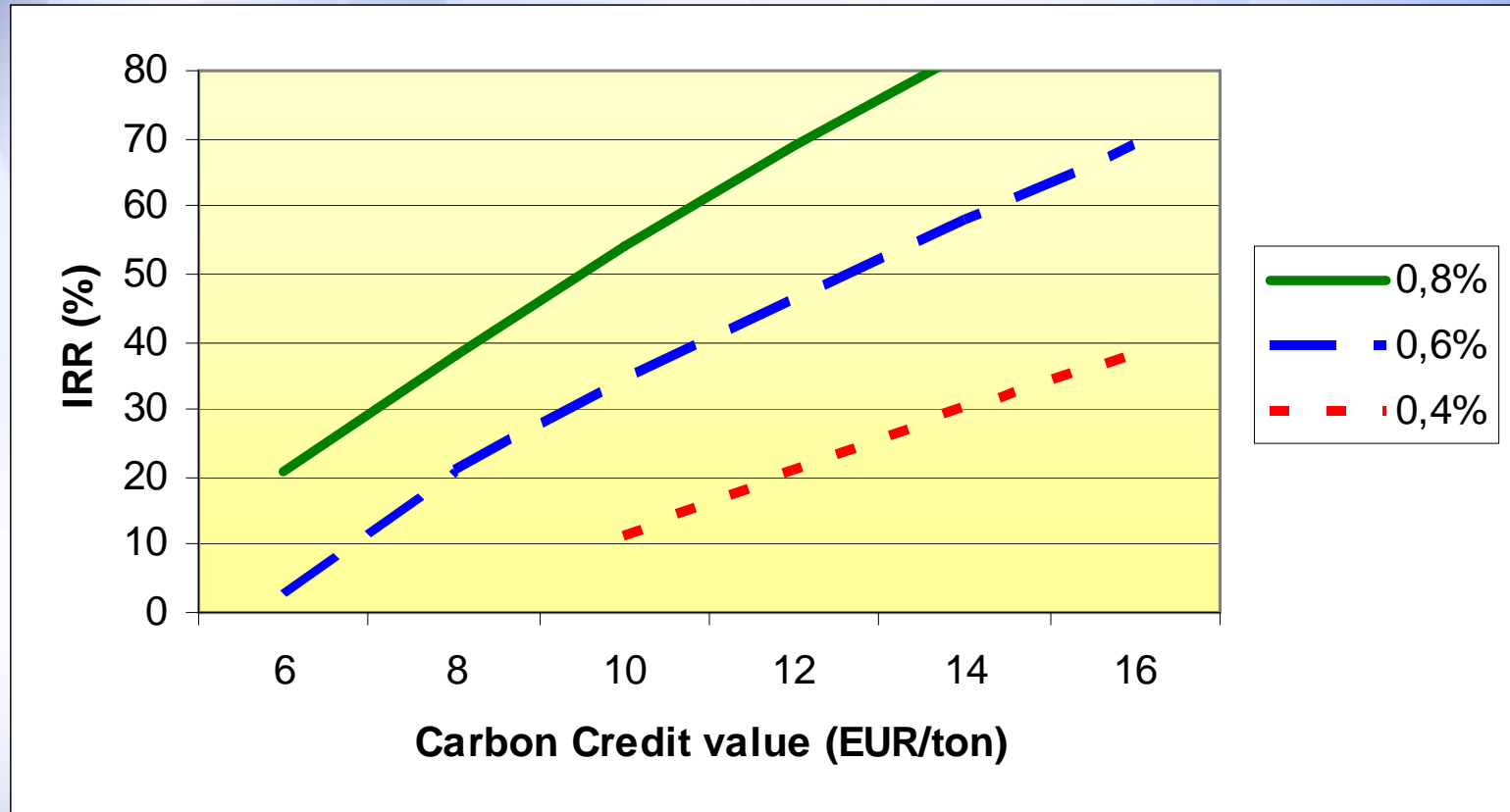
Twin Unit - 125 000 Nm<sup>3</sup>/h @ **0.3 %** VAM comes to 40 000 t CO<sub>2</sub>e

Indications of annual emission reductions in thousand tons of CO<sub>2</sub>e

VOCSIDIZER	Nm <sup>3</sup> /h	0.3% VAM	0.6% VAM	0.9%VAM
1 Twin Unit	125 000	<b>40</b>	<b>80</b>	<b>120</b>
1 VAM Cube	250 000	<b>80</b>	<b>160</b>	<b>240</b>
2 VAM Cubes	500 000	<b>160</b>	<b>320</b>	<b>480</b>
4 VAM Cubes	1 000 000	<b>320</b>	<b>640</b>	<b>960</b>

# VAM Cube profitability

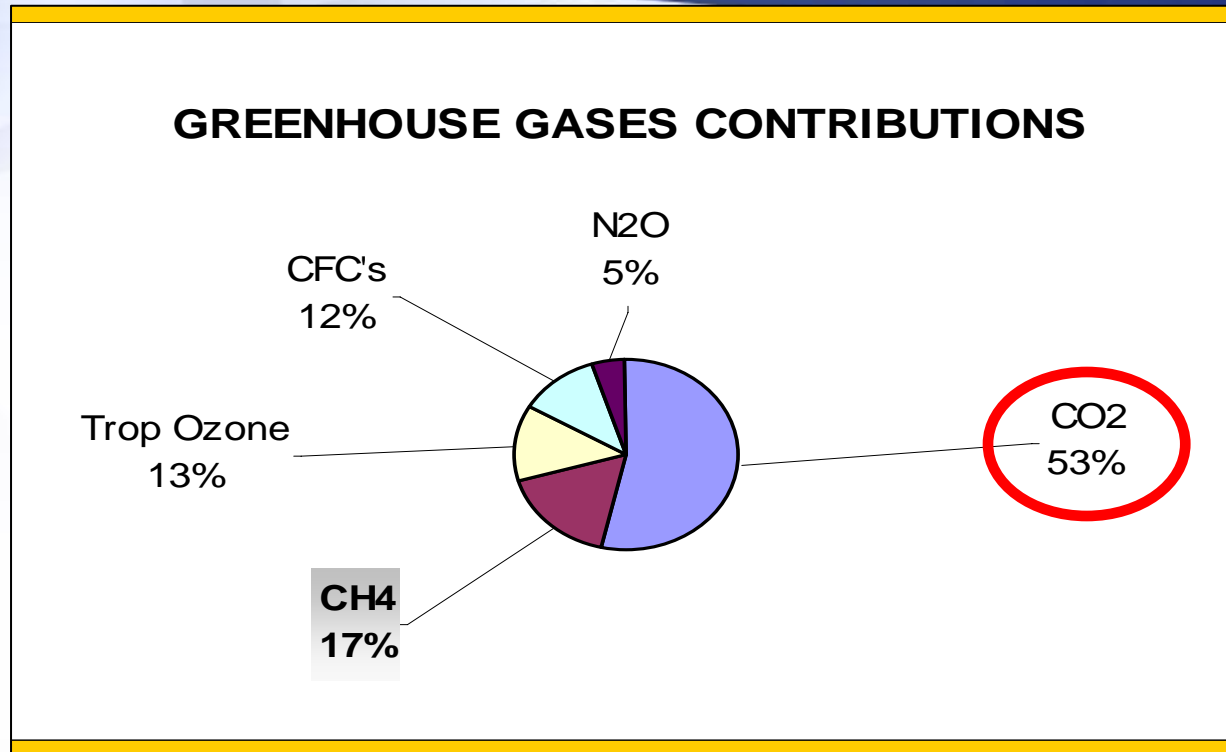
- IRR indications at various VAM concentrations



## HIGHLY INTERESTING INVESTMENT WHEN:

- VAM concentrations above ½ percent and/or
- Carbon Credits above EUR 10/t

# Green House Gases - conclusions

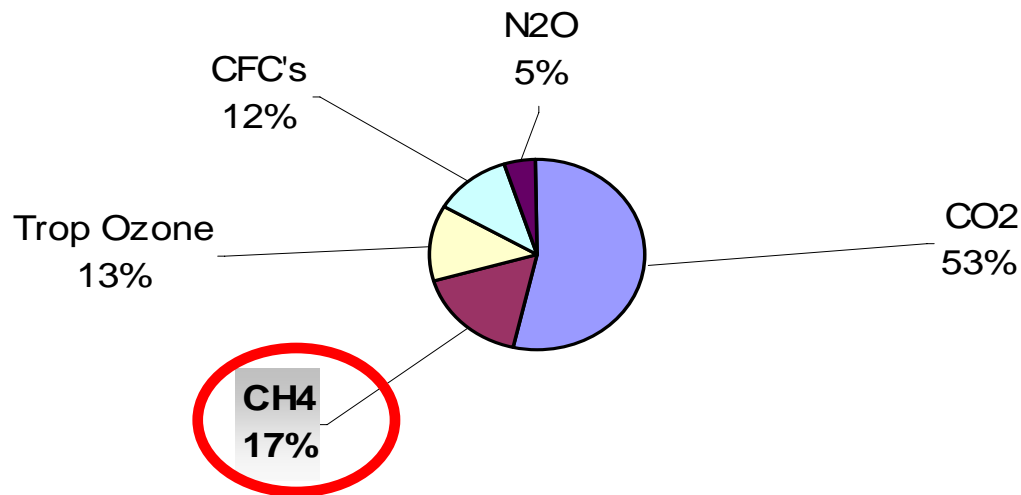


- CO2 stays "forever" in atmosphere, i.e. keeps accumulating.
- Major CO2 emissions must be avoided – by introducing new technology or by sequestered back into the ground. Both these alternatives need decades of development.
- There is an urgent, mid term (1-3 decades) need for drastic reduction of impact on Global Warming!

# Green House Gas METHANE



## GREENHOUSE GASES CONTRIBUTIONS



	Global Warming Power	Life time in atmosphere (years)
CO <sub>2</sub>	1	20 000 to 50 000 Years
CH <sub>4</sub>	23* times CO <sub>2</sub>	12 years

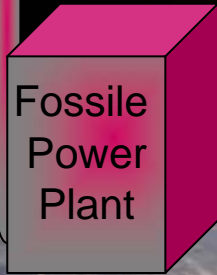
\* Acc to IPCC (International Panel on Climate Change). 21 in the first Kyoto Period

- ✓ Second most important greenhouse gas
- ✓ Much more powerful greenhouse gas than CO<sub>2</sub>
- ✓ Short life time in atmosphere, so emission reductions will have a quick, positive impact
- ✓ Generates energy when abated (oxidized)

# CONSIDER Green House Gas METHANE



CO<sub>2</sub>



GW impact



CO<sub>2</sub>

	Life time in atmosphere
CO <sub>2</sub>	20 000 to 50 000 Years
CH <sub>4</sub>	12 years

CH<sub>4</sub>



GW impact



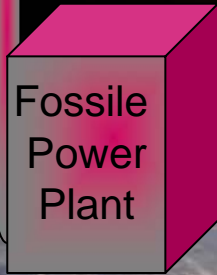
CH<sub>4</sub>

12 years

# CONSIDER Green House Gas METHANE



CO<sub>2</sub>



GW impact

Major Emission reductions

## CONCLUSIONS ON MAJOR EMISSION REDUCTIONS:

- CO<sub>2</sub> continues to accumulate, but at a slower rate.

CO<sub>2</sub>

Time

CH<sub>4</sub>

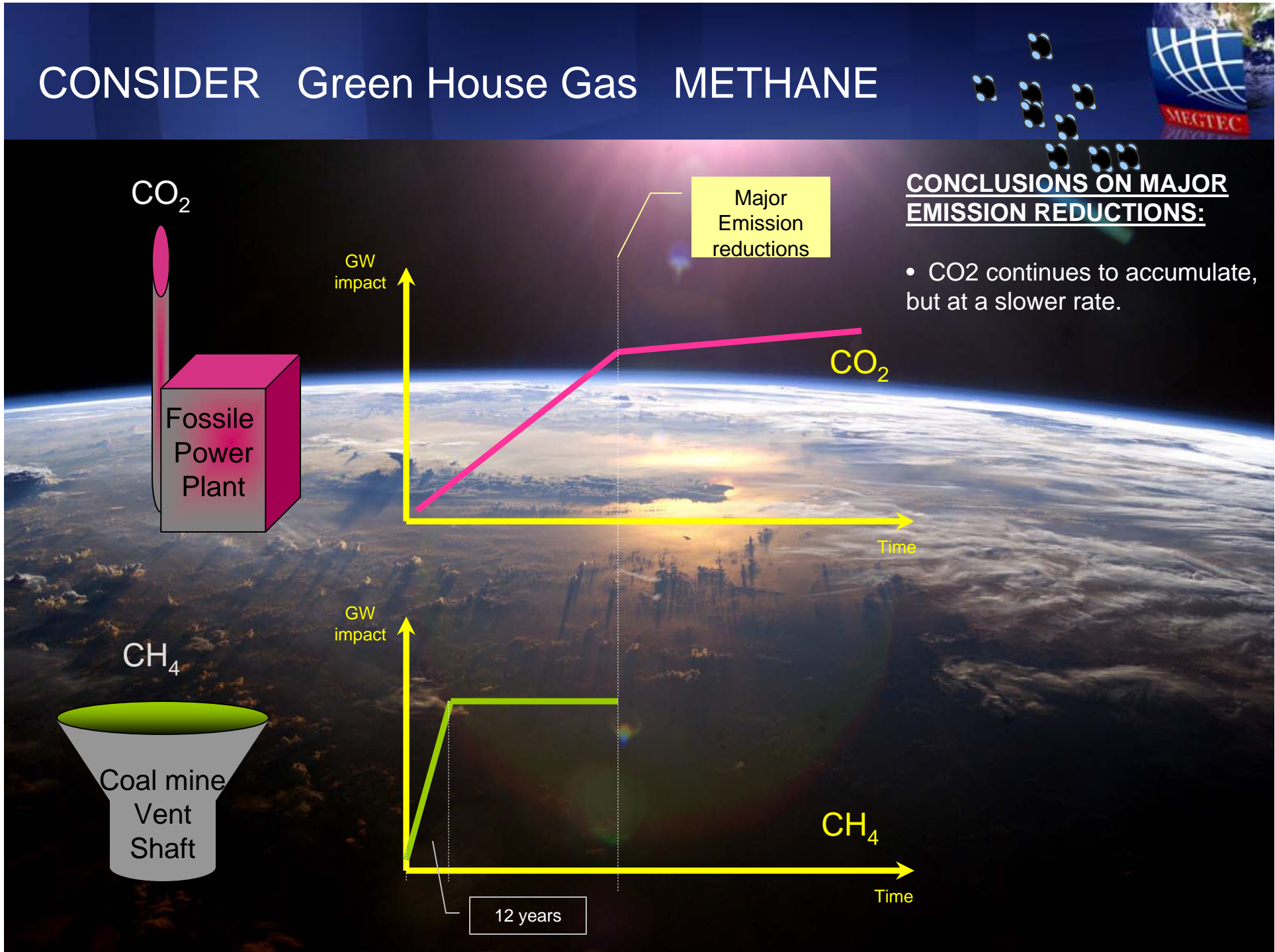


GW impact

CH<sub>4</sub>

Time

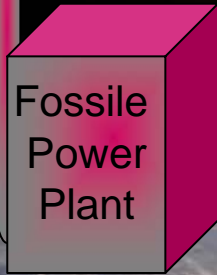
12 years



# CONSIDER Green House Gas METHANE



CO<sub>2</sub>



GW impact

Major Emission reductions

CO<sub>2</sub>

Time

## CONCLUSIONS ON MAJOR EMISSION REDUCTIONS:

- CO<sub>2</sub> continues to accumulate, but at a slower rate.
- Methane reductions have full impact quickly - in only 12 years!

CH<sub>4</sub>



GW impact

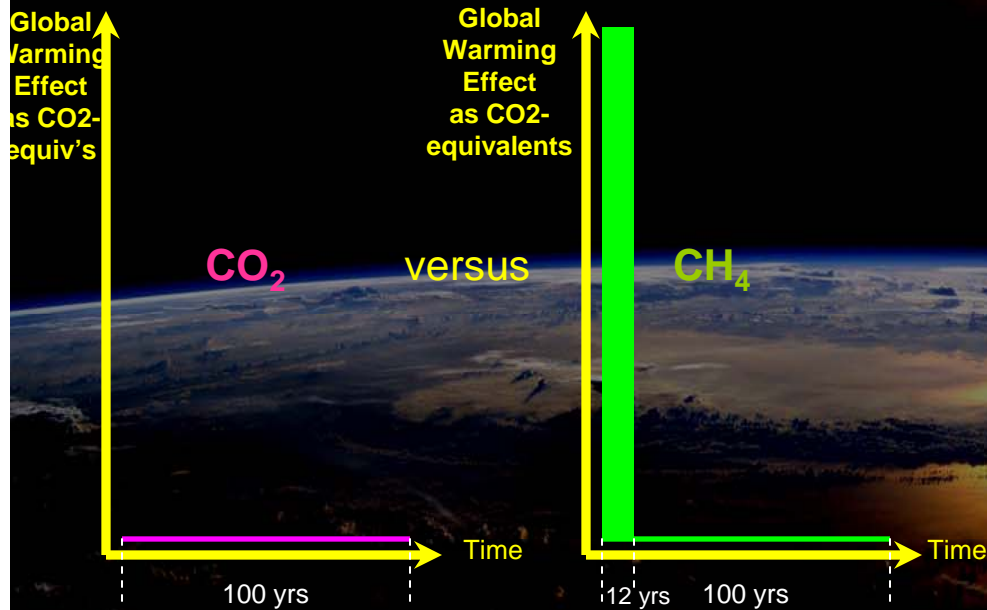
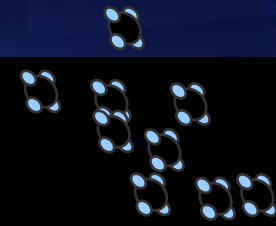
*On a midterm (some decades) basis, reducing methane emissions CONTRADICT increasing global warming!*

CH<sub>4</sub>

Time

12 years

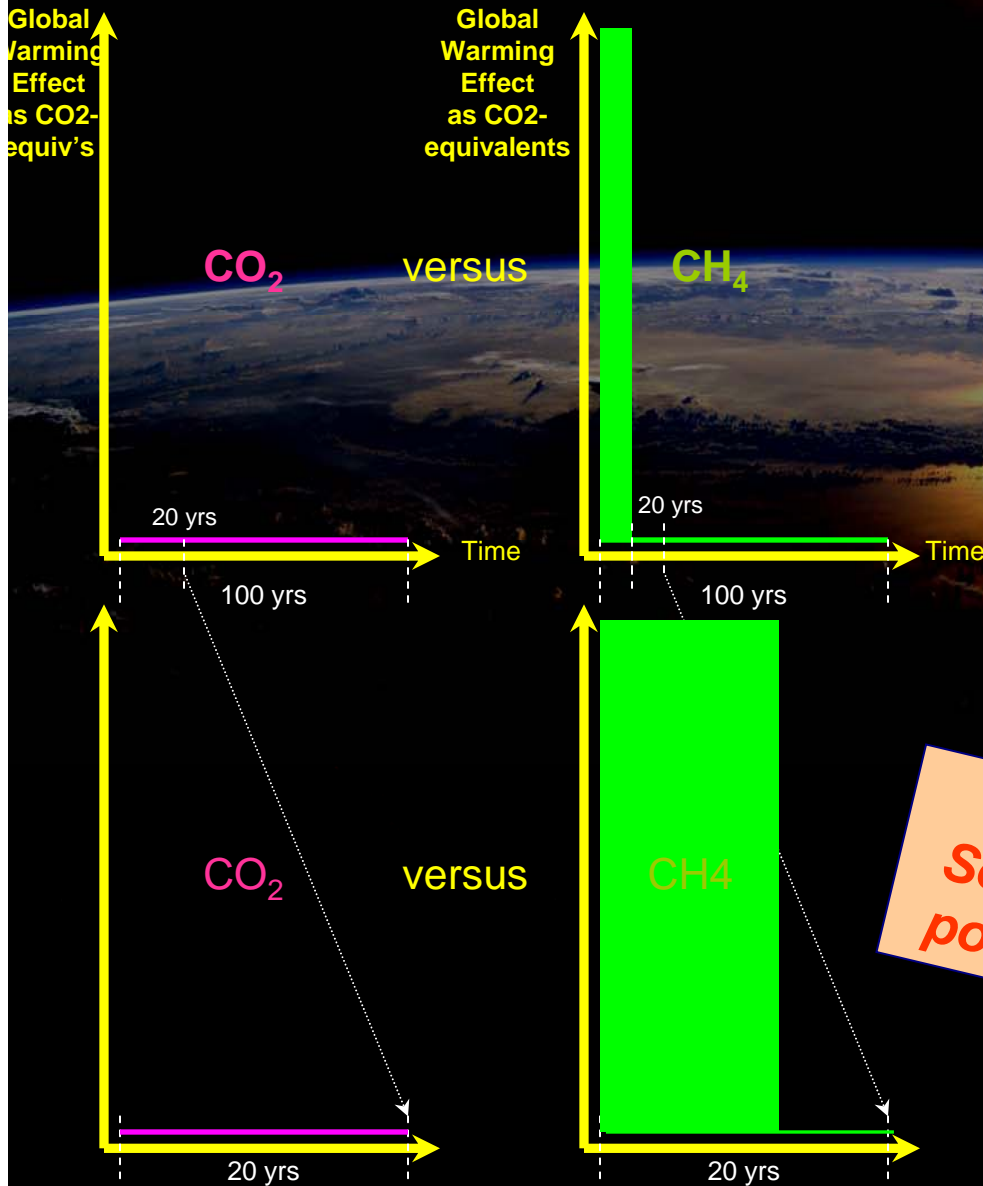
# CONSIDER Green House Gas METHANE



On a 100 yr basis, 1 ton of methane corresponds to 23\* tons of CO<sub>2</sub>. Full effect in the first 12 years.

\* Acc to IPCC. 21 tons based on 1st Kyoto Period

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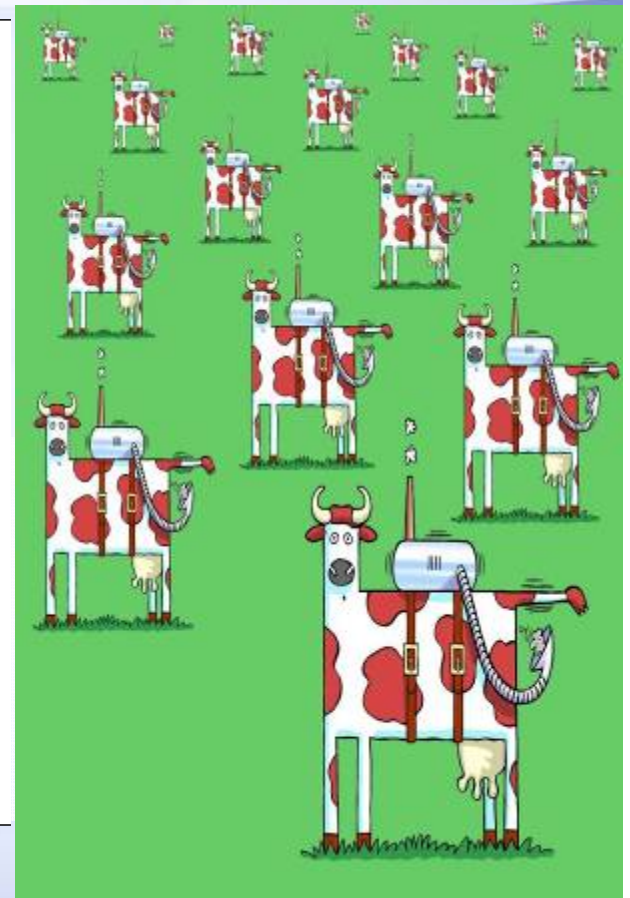
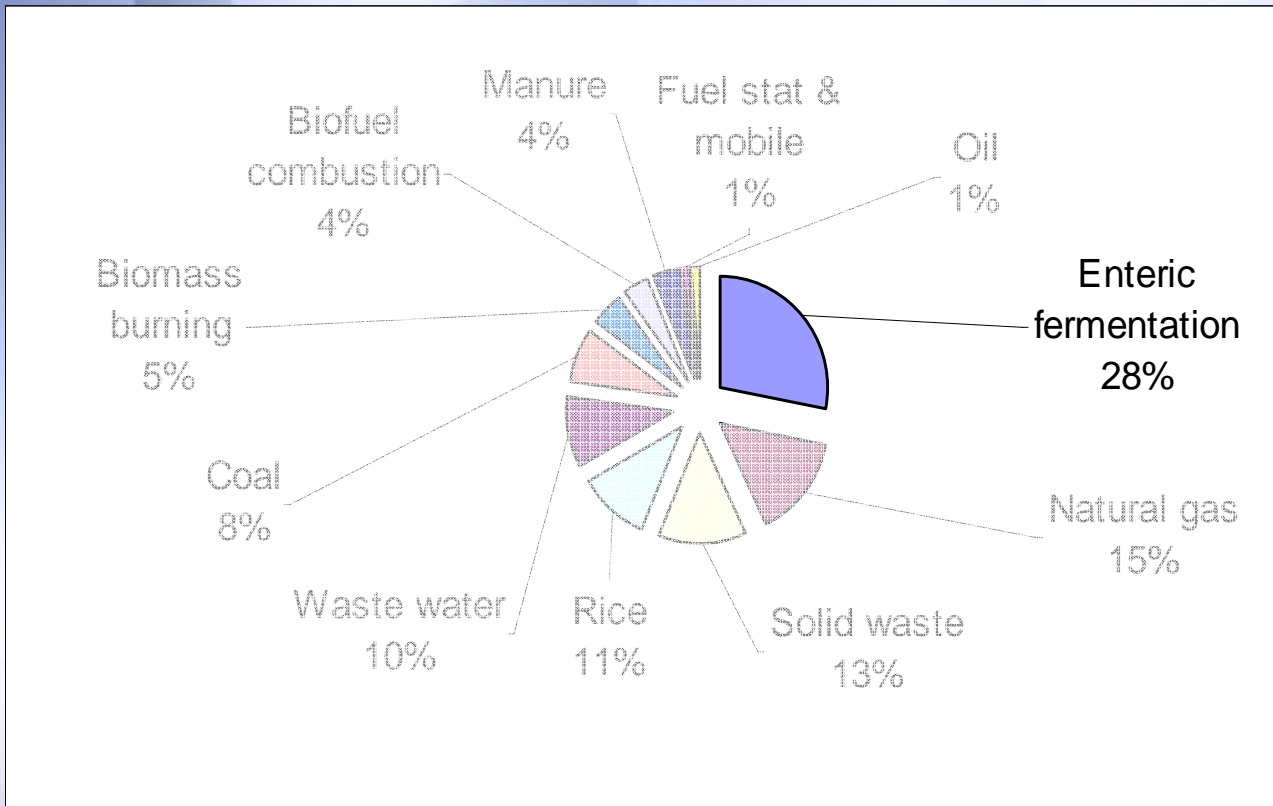
\* Acc to IPCC. 21 tons based on 1st Kyoto Period

On a 20 yr basis, 1 ton of methane corresponds to 62\* tons of CO<sub>2</sub>.

\* Acc to IPCC. Also 56 and 72 tons noted in various sources

**CONCLUSION:**  
Seen mid term, methane has a very powerful effect on Global Warming.

# Global Methane Emissions - by source



**BIGGEST TOTAL SOURCE:**  
Cows, sheep etc

**PROBLEM:**  
Each source is very small

50-100 kg CH<sub>4</sub> per cow  
and year = 1-2 t CO<sub>2</sub>e

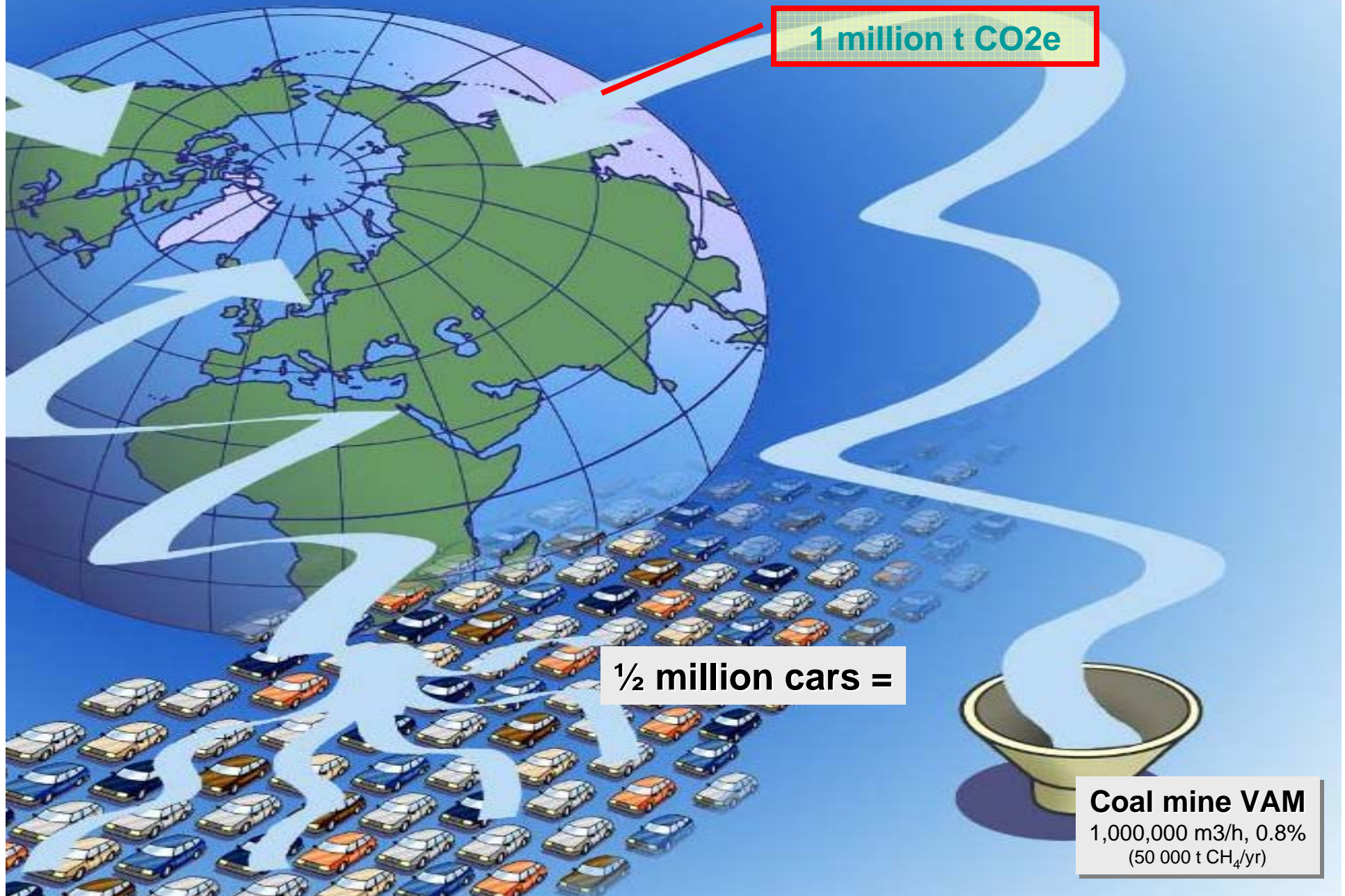
# ANNUAL GREENHOUSE EFFECT on Global Warming



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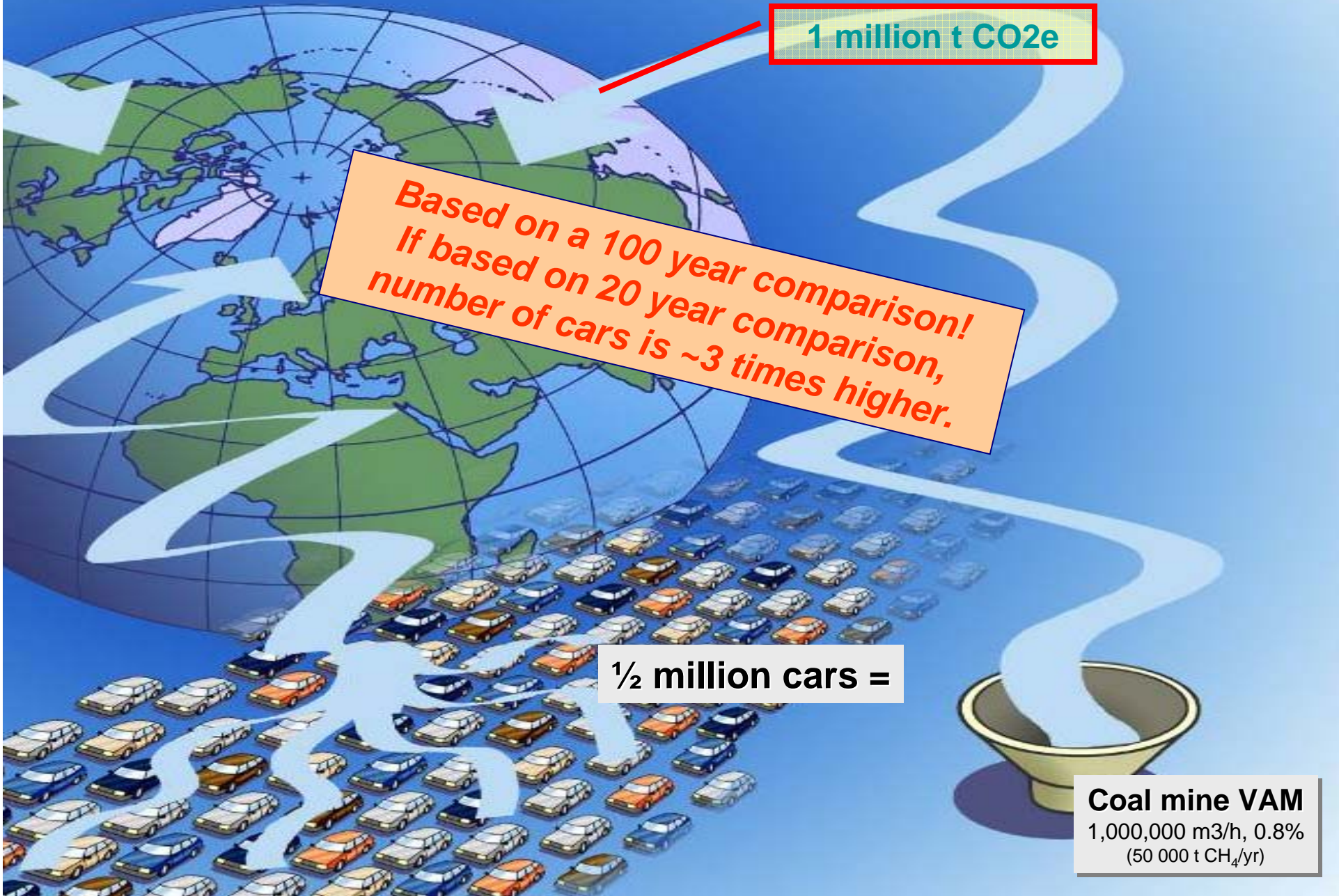
# ANNUAL GREENHOUSE EFFECT on Global Warming

1 million t CO<sub>2</sub>e

*Based on a 100 year comparison!  
If based on 20 year comparison,  
number of cars is ~3 times higher.*

1/2 million cars =

**Coal mine VAM**  
1,000,000 m<sup>3</sup>/h, 0.8%  
(50 000 t CH<sub>4</sub>/yr)



# INTERNATIONAL CLIMATE CHANGE



## MUST NOW FOCUS ON:

- reducing both CO<sub>2</sub> **AND METHANE**
- **LARGE PROJECTS** and other reduction efforts that can make a difference  
by having significant positive impact on Global Warming

One cost efficient answer to this  
is VAM processing

Thank you!

RMATTUS@MEGTEC.SE

