



# Energy Savings and Energy Efficiency of Buildings Energy efficient Cooling and Climatization



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# watergy

Water



Energy

[www.watergy.de](http://www.watergy.de)

[www.watergy.eu](http://www.watergy.eu)



**700 kWh/ m<sup>3</sup>** at 45 °C

Water heated from 30 to 90°C = 70 kWh/m<sup>3</sup>

**Water**  **Energy**

Phase Change Material (PCM) = 61 kWh/m<sup>3</sup>



## Naturalistic Landscape:

- 80% evapotranspiration of the precipitation
- 20% groundwater recharge and runoff
- 86% of „consumed“ net radiation

*(Prec. Berlin: 680 mm, PET 760 mm)*

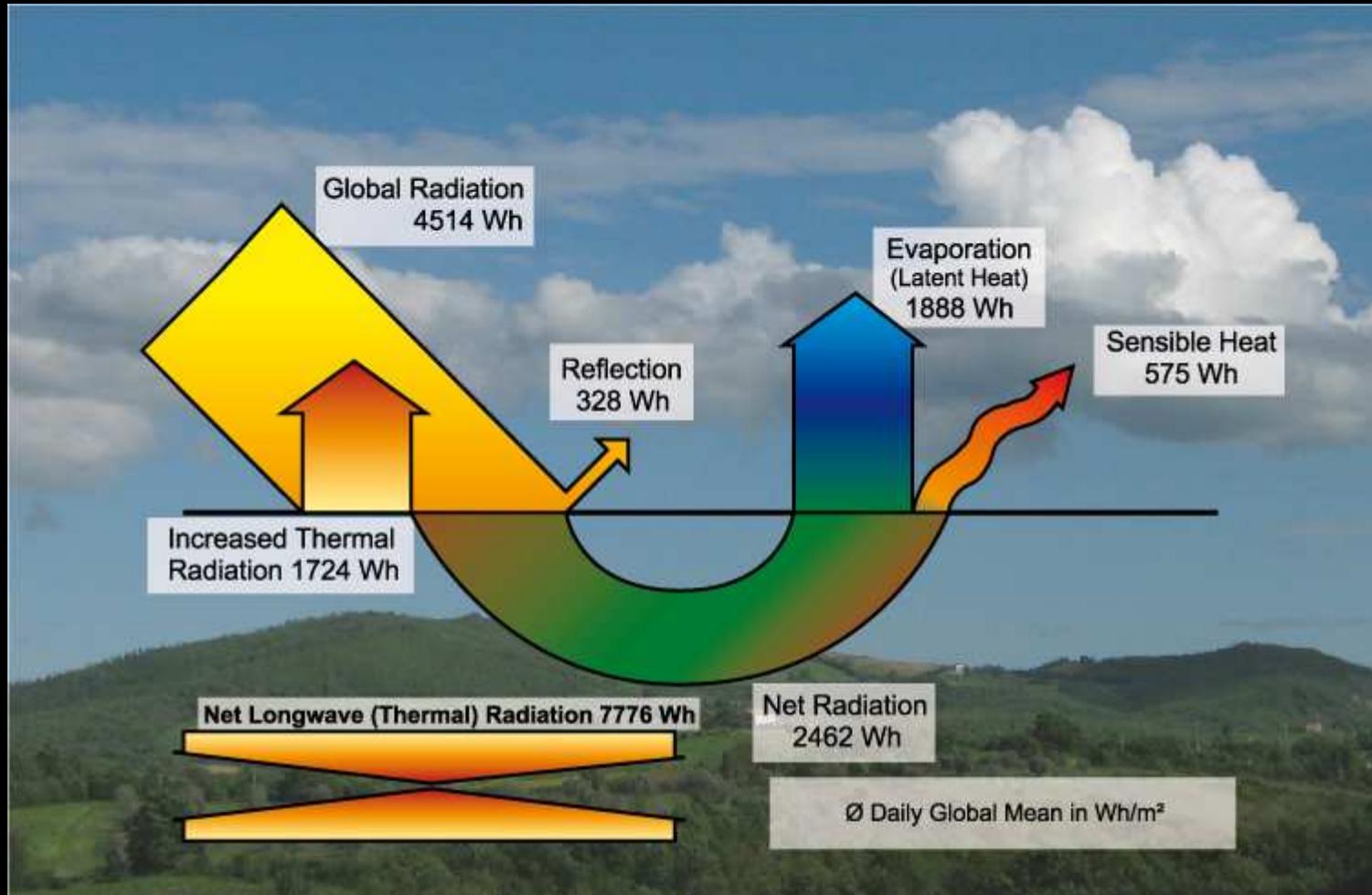


## Urbanization:

- reduced evapotranspiration
- increased thermal radiation
- increased heat, „urban heat island“

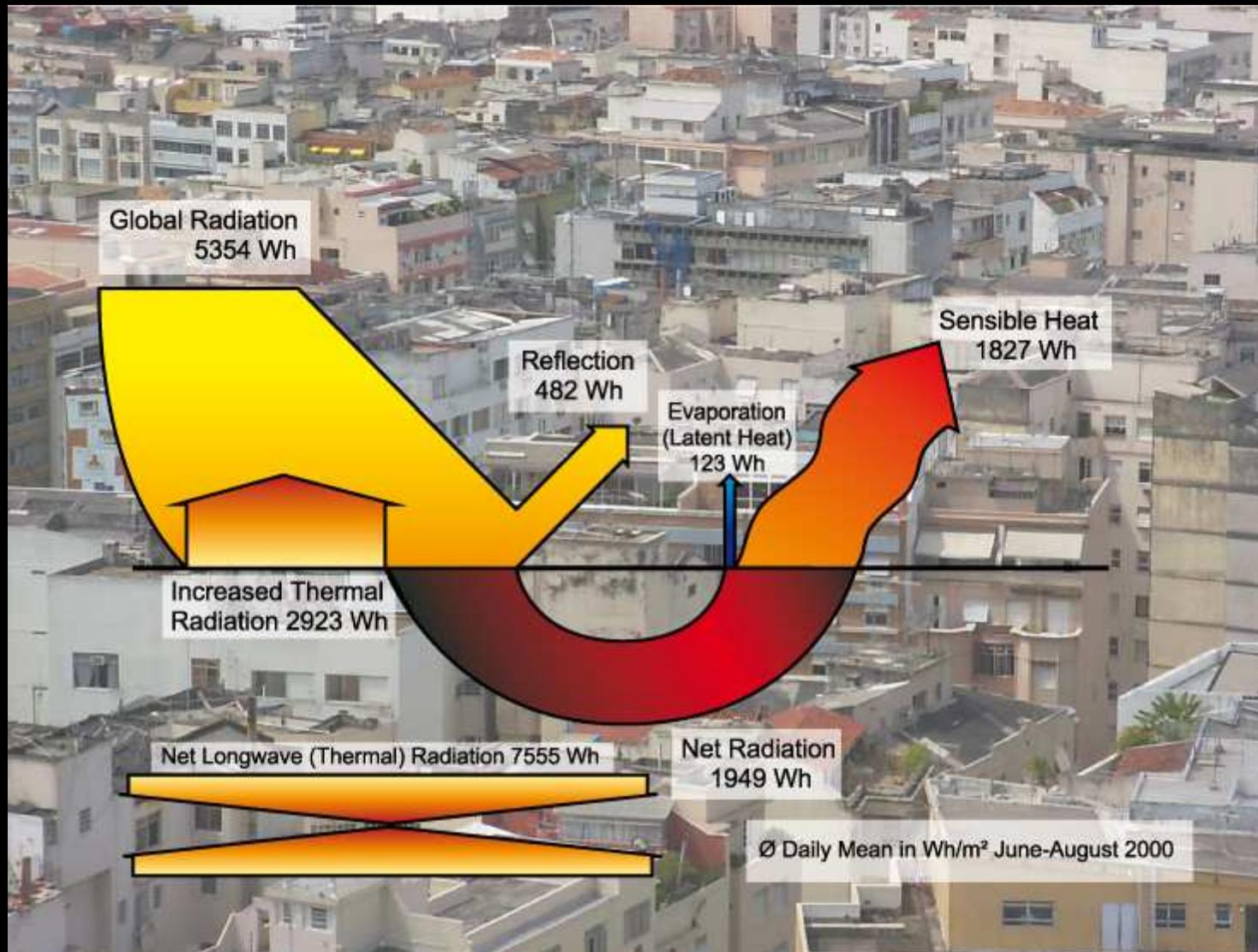


# Global Radiation Balance

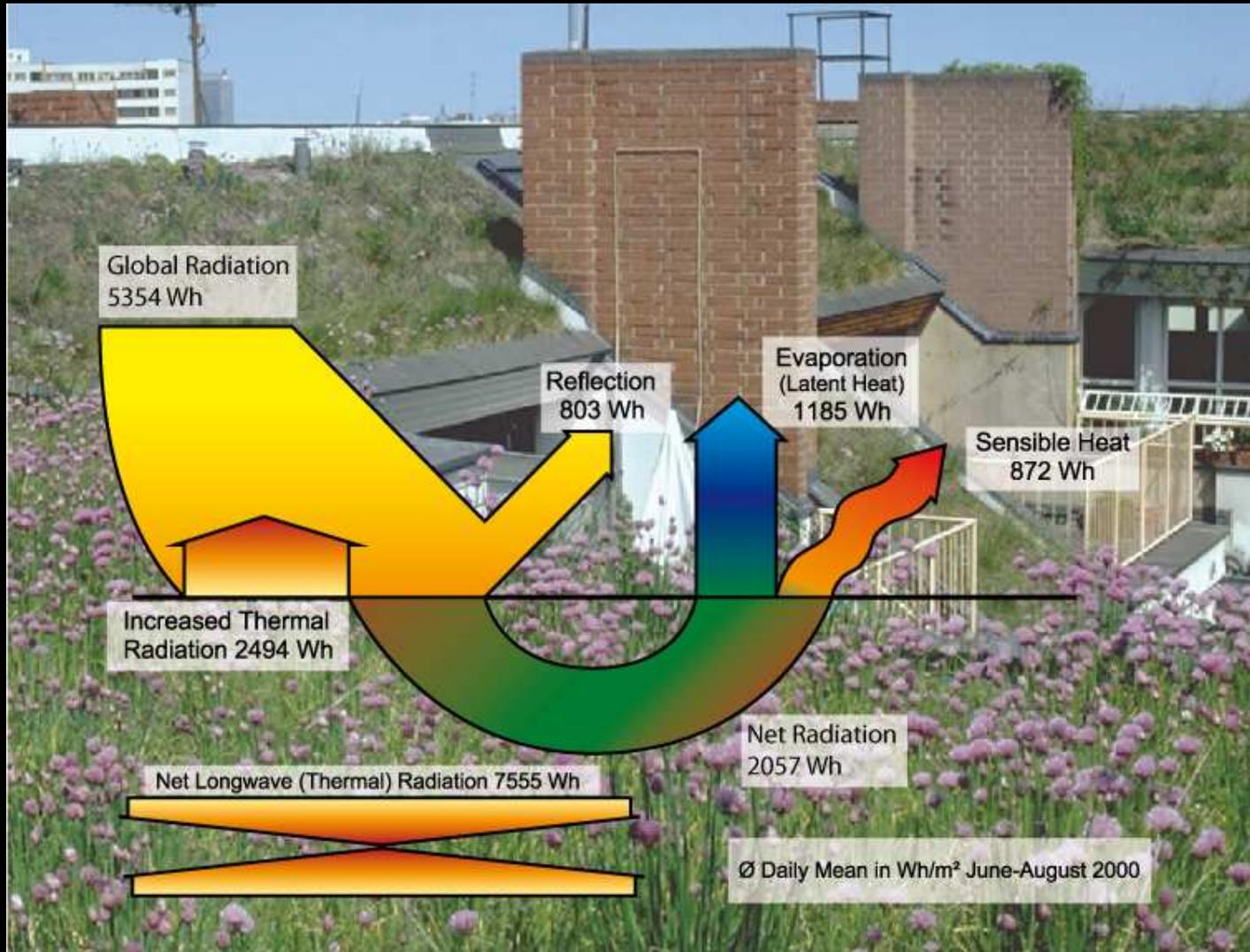


# Urban Radiation Balance

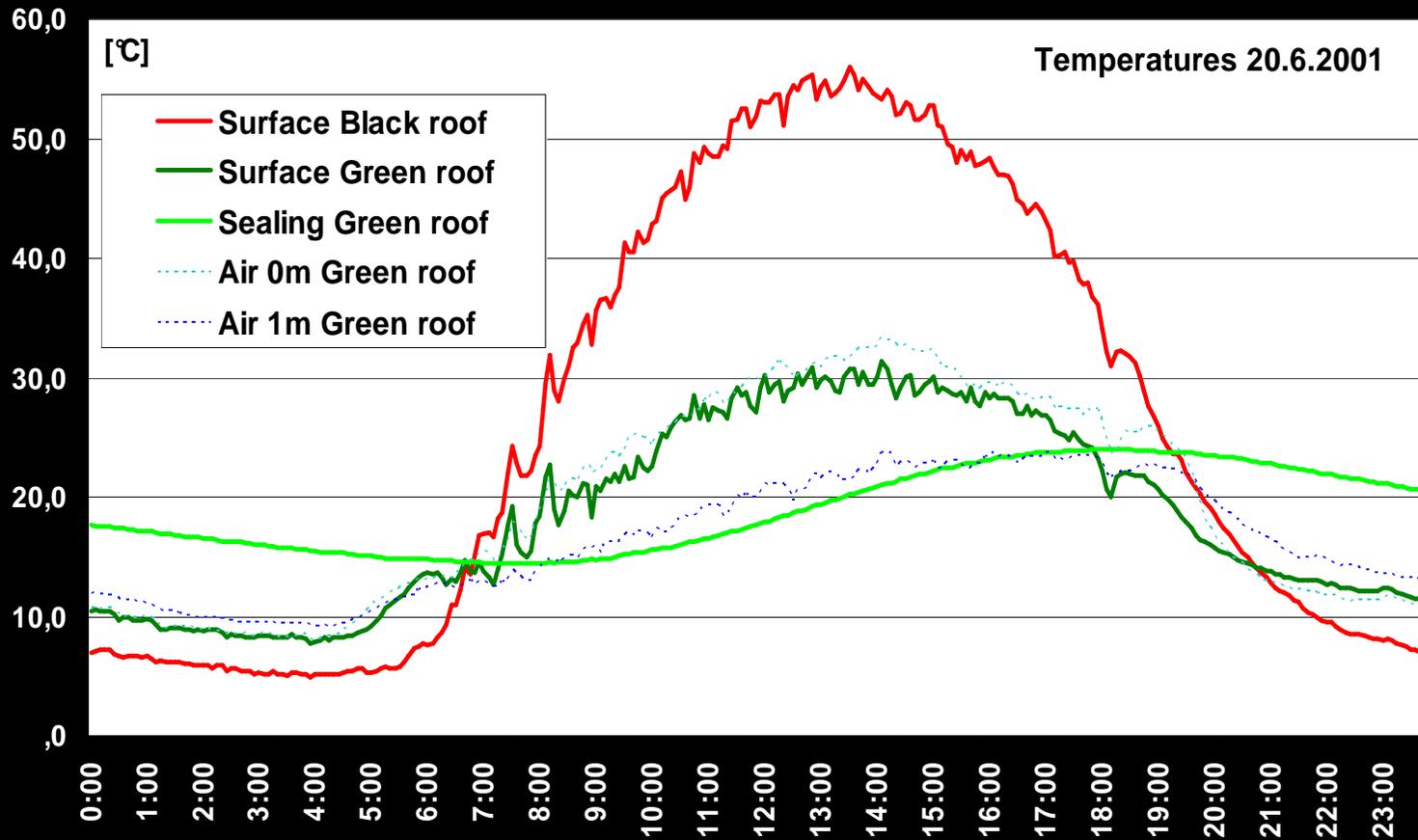
Example: Asphalt roof



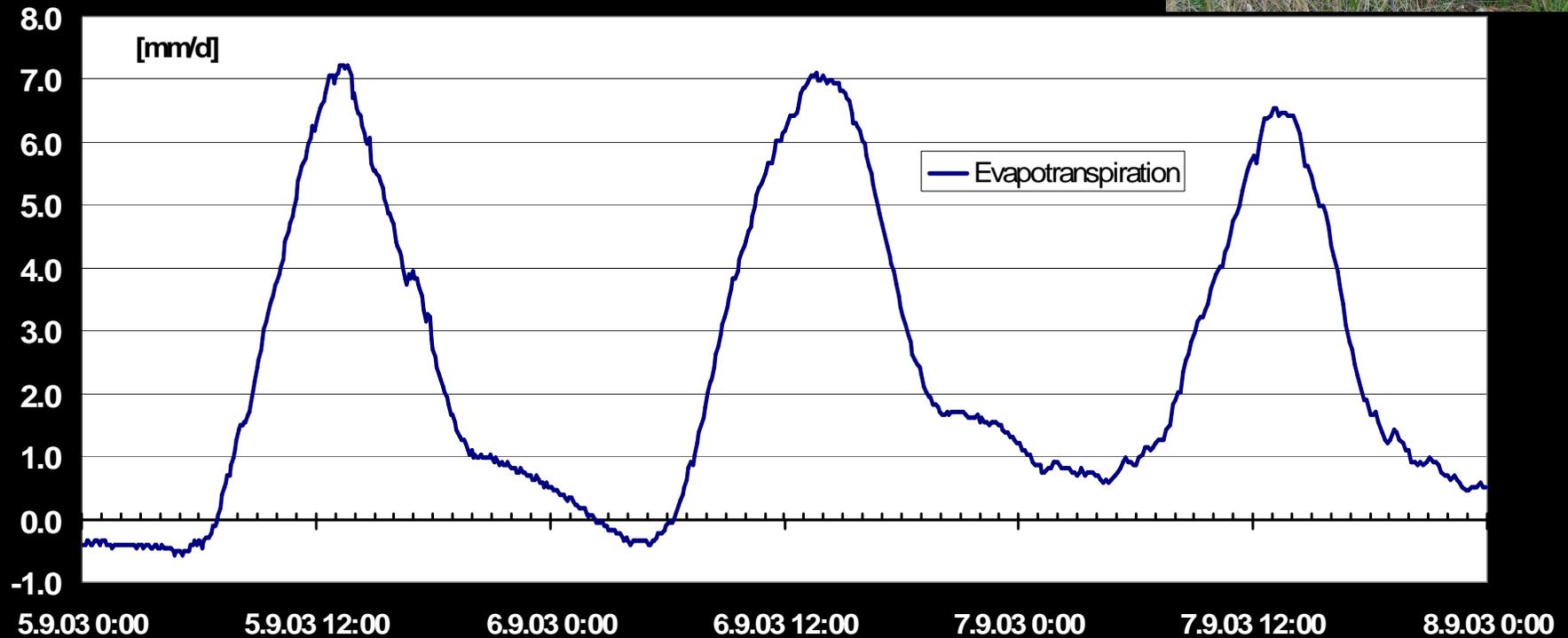
# Green Roof Radiation Balance



## Surface Temperatures Asphalt Roof – Green Roof (Infrared measurements)



# Green Roof Lysimeter Measured Evapotranspiration in mm/ day





# Institute of Physics Humboldt-University Berlin

Rainwater harvesting for climate control of the building

450 climbing plants in 150 planter boxes providing shade and evaporative cooling

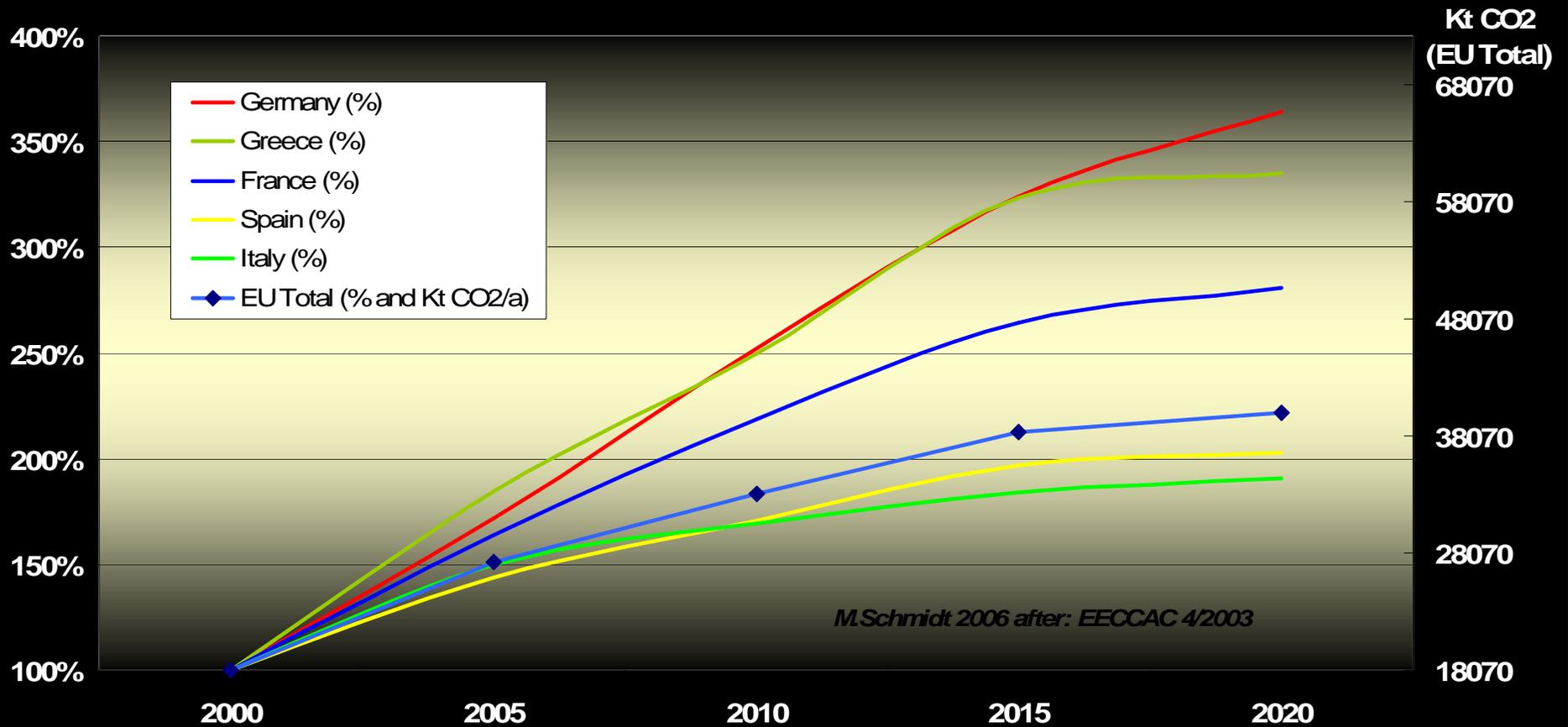
Evaporative exhaust air cooling in air conditioners

Reduction of operating costs



**Goal: Decrease of energy consumption of buildings until 2020: 40% !!**

**But: Increase of energy consumption due to cooling: 260%**

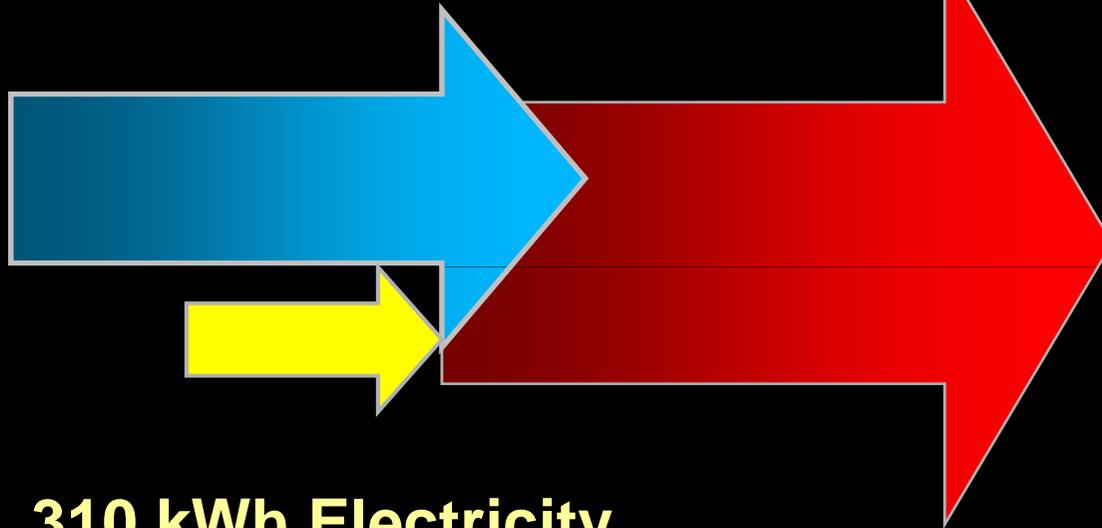


M.Schmidt 2006 after: EECCAC 4/2003

*Source: Energy Efficiency and Certification of Central Air Conditioners (EECCAC) Study for the D.G. Transportation-Energy (DGTREN) of the Commission of the E.U.*

# Never use electricity to cool a building !

680 kWh Cold

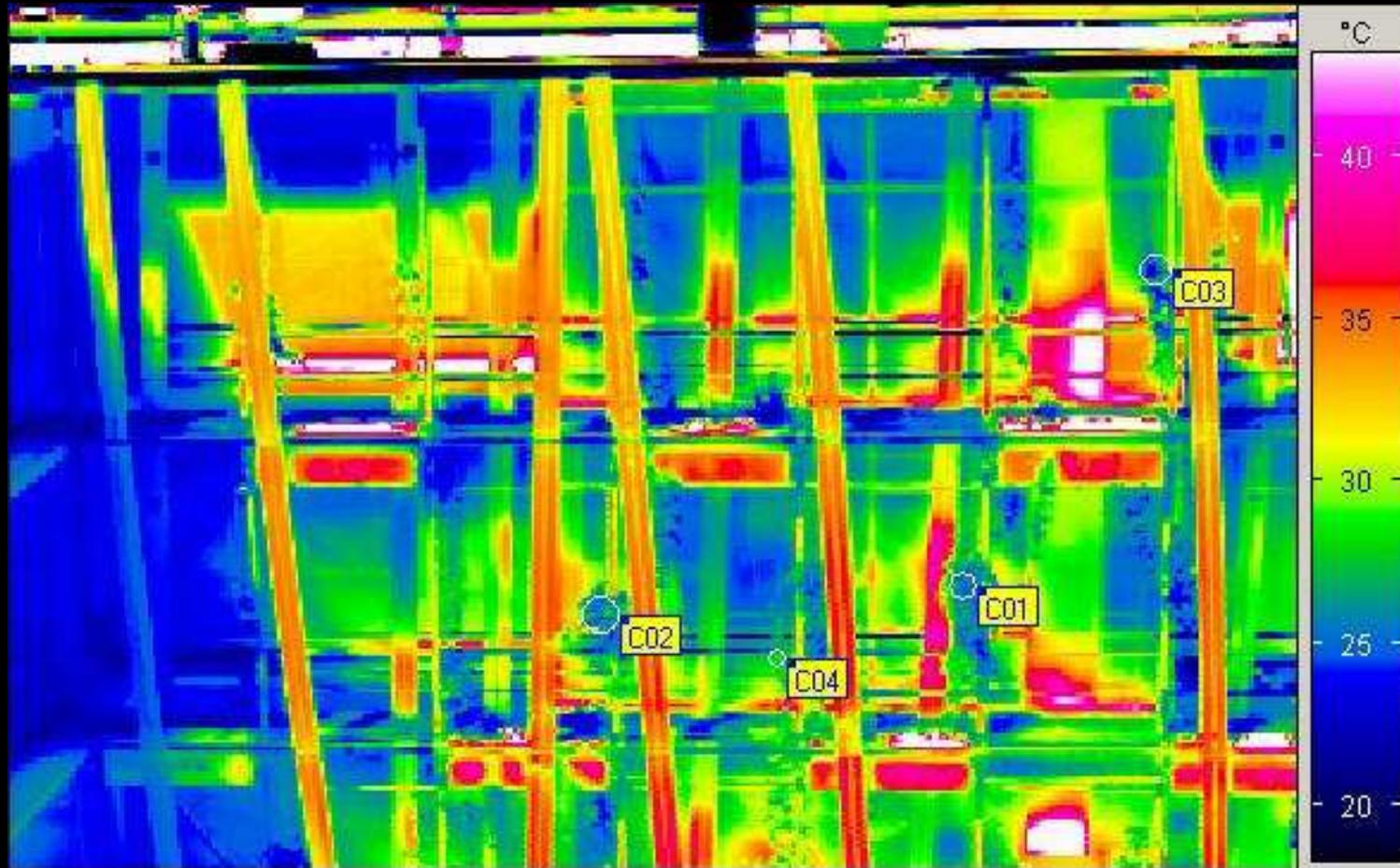


310 kWh Electricity  
(COP 2,2)

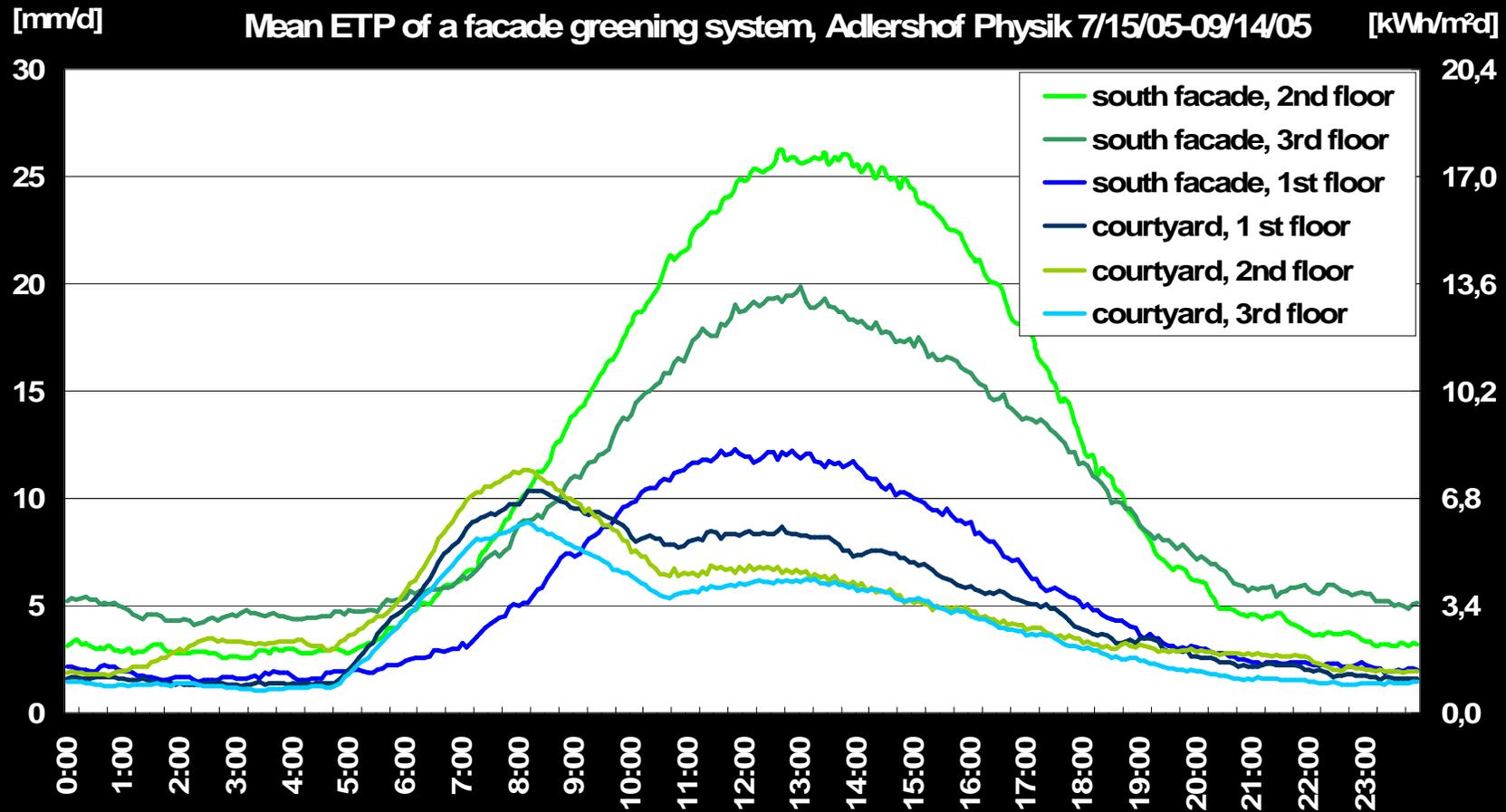


990 kWh  
Sensible Heat





# Mean daily evapotranspiration 7/15/05-09/14/05 correspondent cooling rate: 280 kWh per day

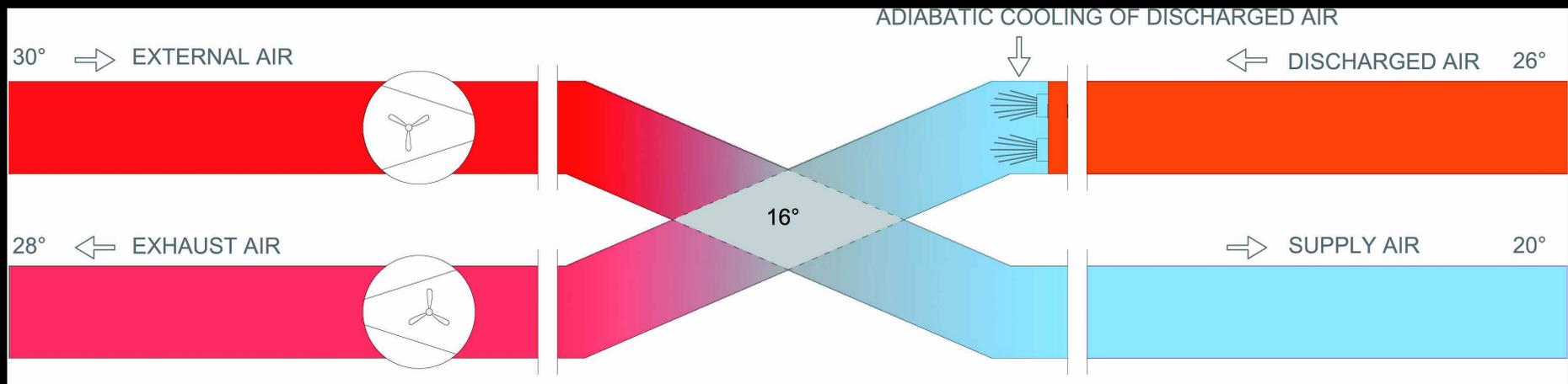


# Exhaust Air Cooling

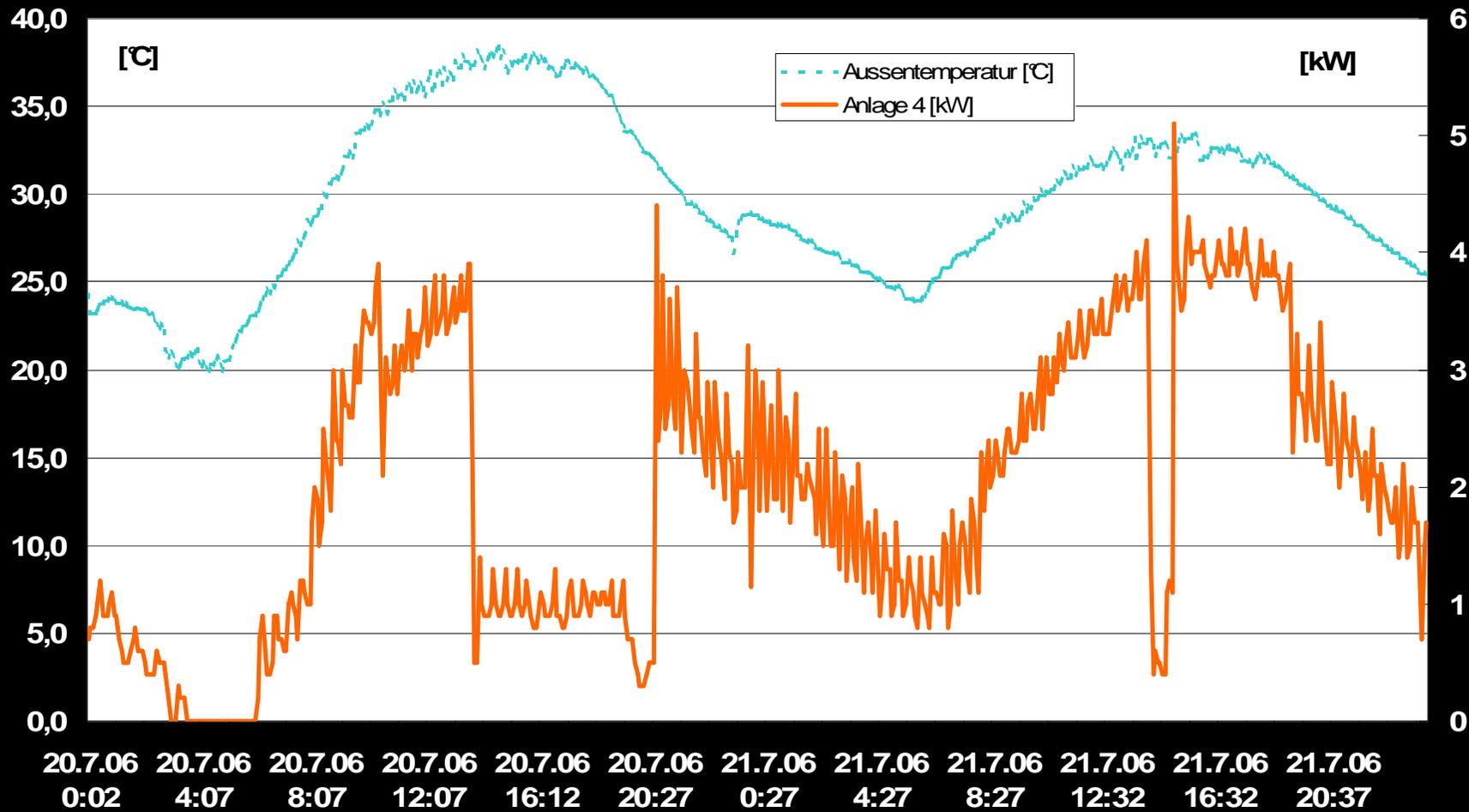




# Exhaust Air Cooling



## Difference in konv. Energy Consumption with and without Evaporative Cooling



## Costs Adabatic Cooling/ Compression/ Absorpton Chiller

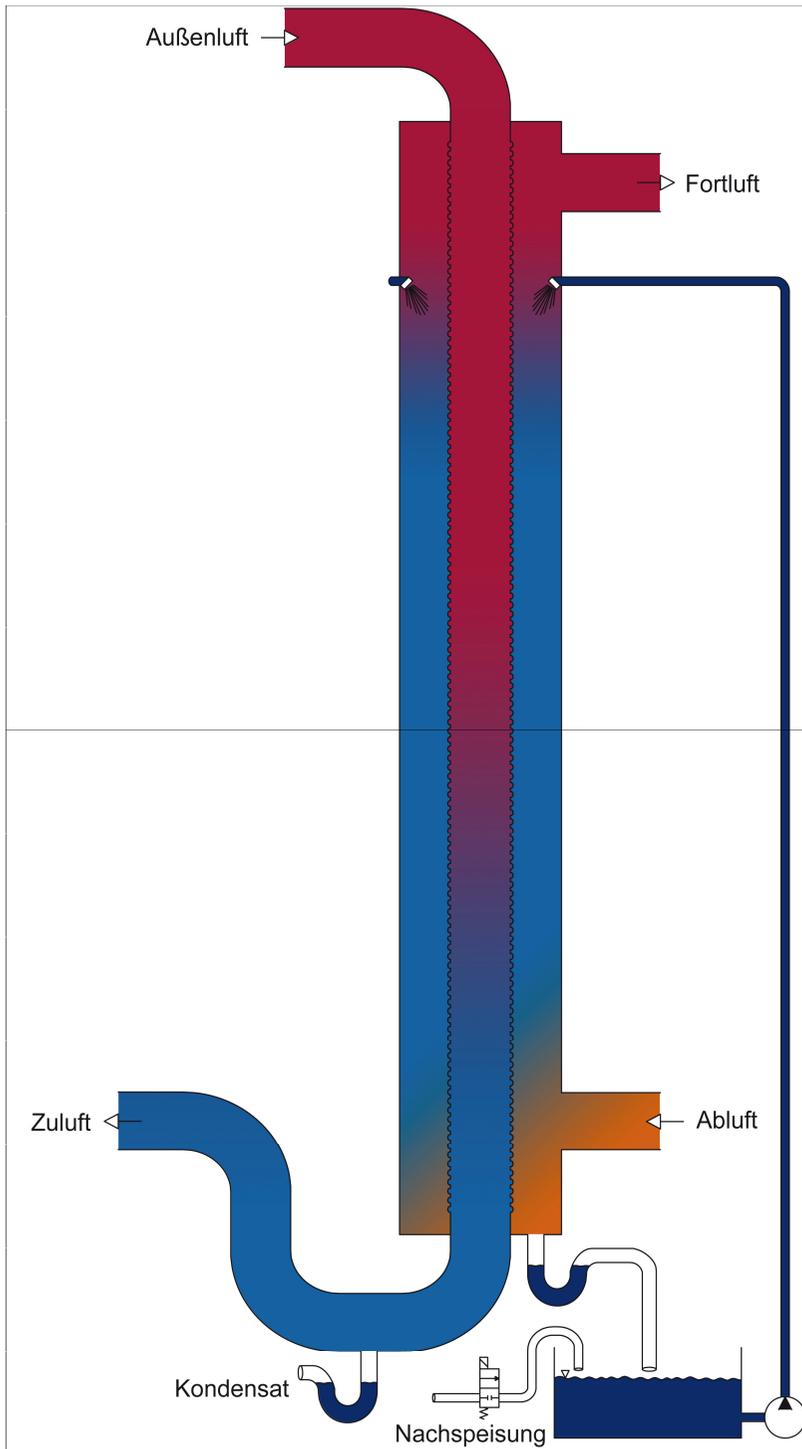
**1 g H<sub>2</sub>O: 2450 J = 2450 Ws**

**1 m<sup>3</sup> = 2450 MJ = 680 kWh**

**Compr: 680 kWh = 40 \$ (at 0,13 \$/kWh COP 2,2)**

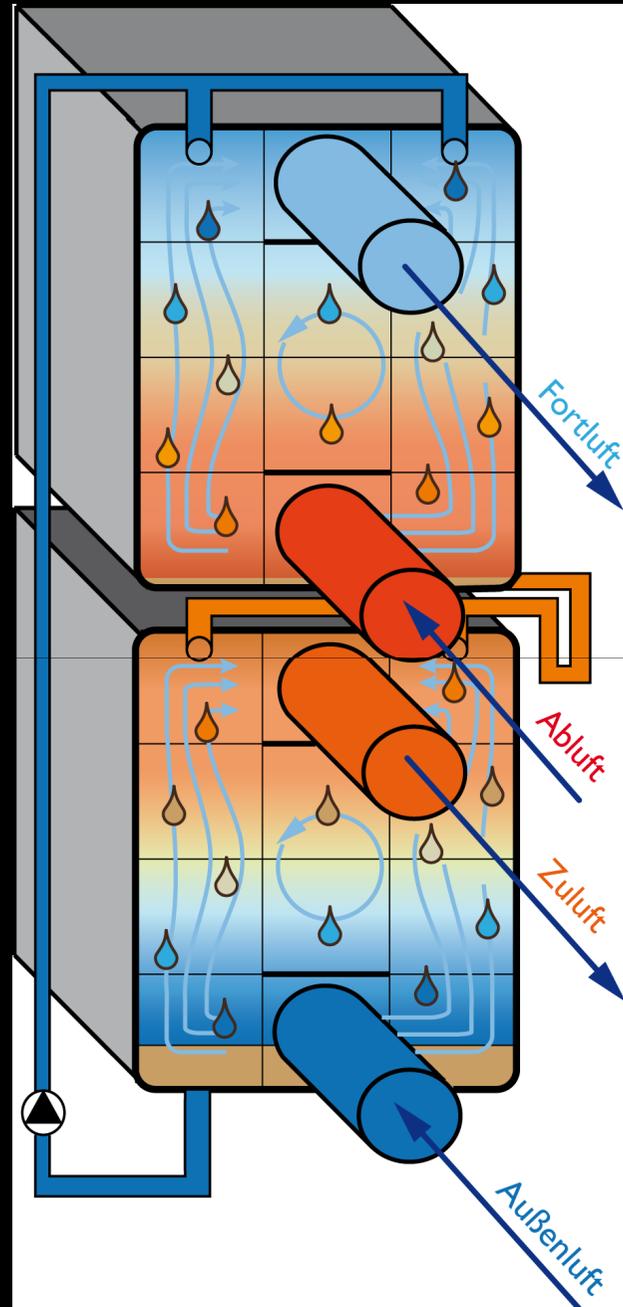
**Abs. Ch: 680 kWh = 104 \$ (at 0,042 \$/kWh COP 0,45)**

	Conductivity	max
Rainwater	30 $\mu$ S	1600 $\mu$ S
Tap water	700 $\mu$ S	1600 $\mu$ S



## Easy & cheap: “Pipe in Pipe” System

# Desiccant Systems



**Open Heat Exchanger:**  
**NSW Nor Pac 1 1/2"**  
**140 m<sup>2</sup> per m<sup>3</sup>    450 \$/m<sup>3</sup>**

**Salt Solution: MgCl**  
**22% to 33% (dilluted / concentrated)**  
**Costs: ca. 100 \$/ m<sup>3</sup>**  
**(LiCl expensive !)**



**Decrease in the small water cycle**  
**Dramatic reduction in evapotranspiration on land**

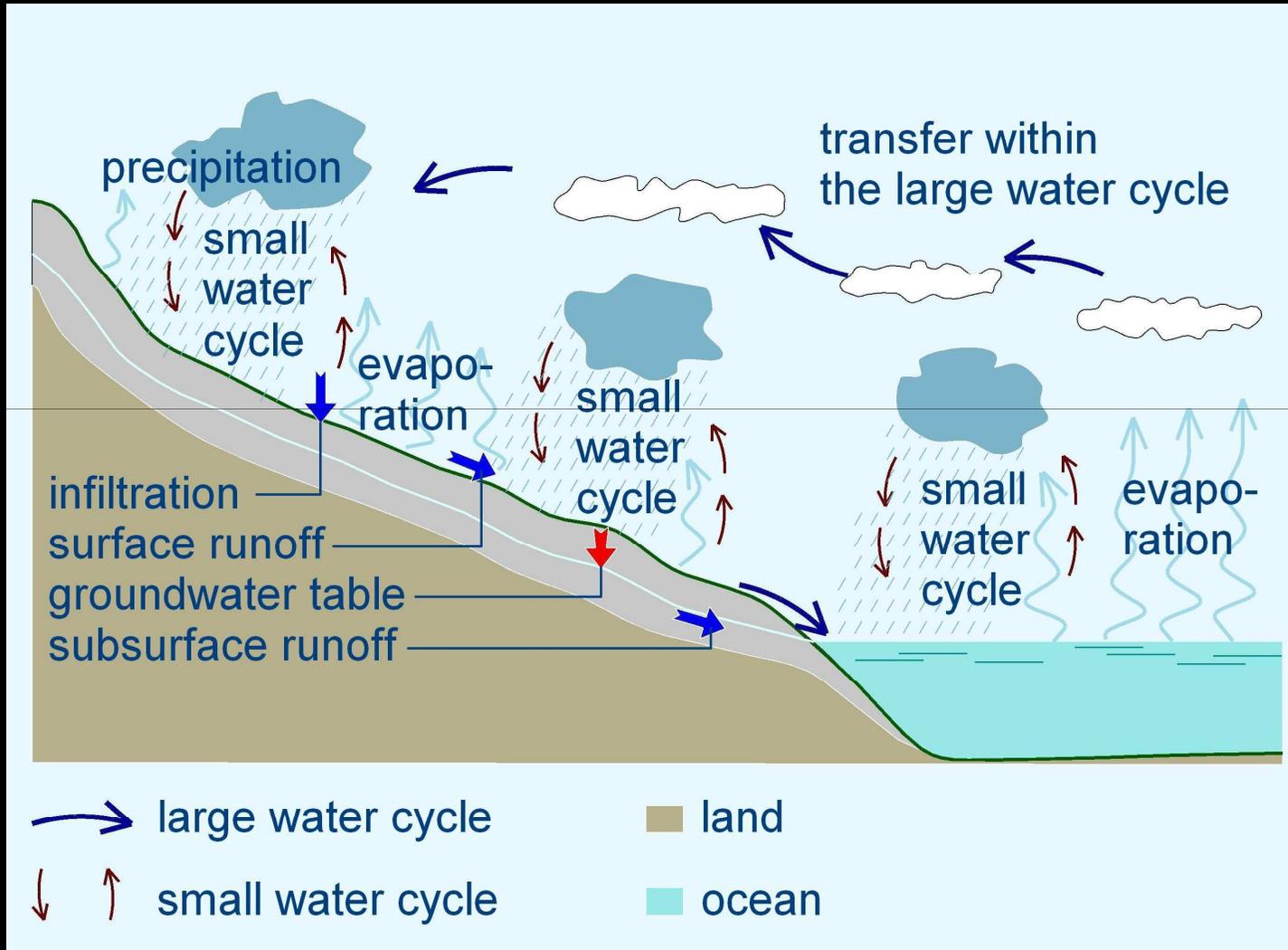
Daily loss of forests worldwide: ***350 km<sup>2</sup>***

Daily ongoing global urbanization: ***150 km<sup>2</sup>***

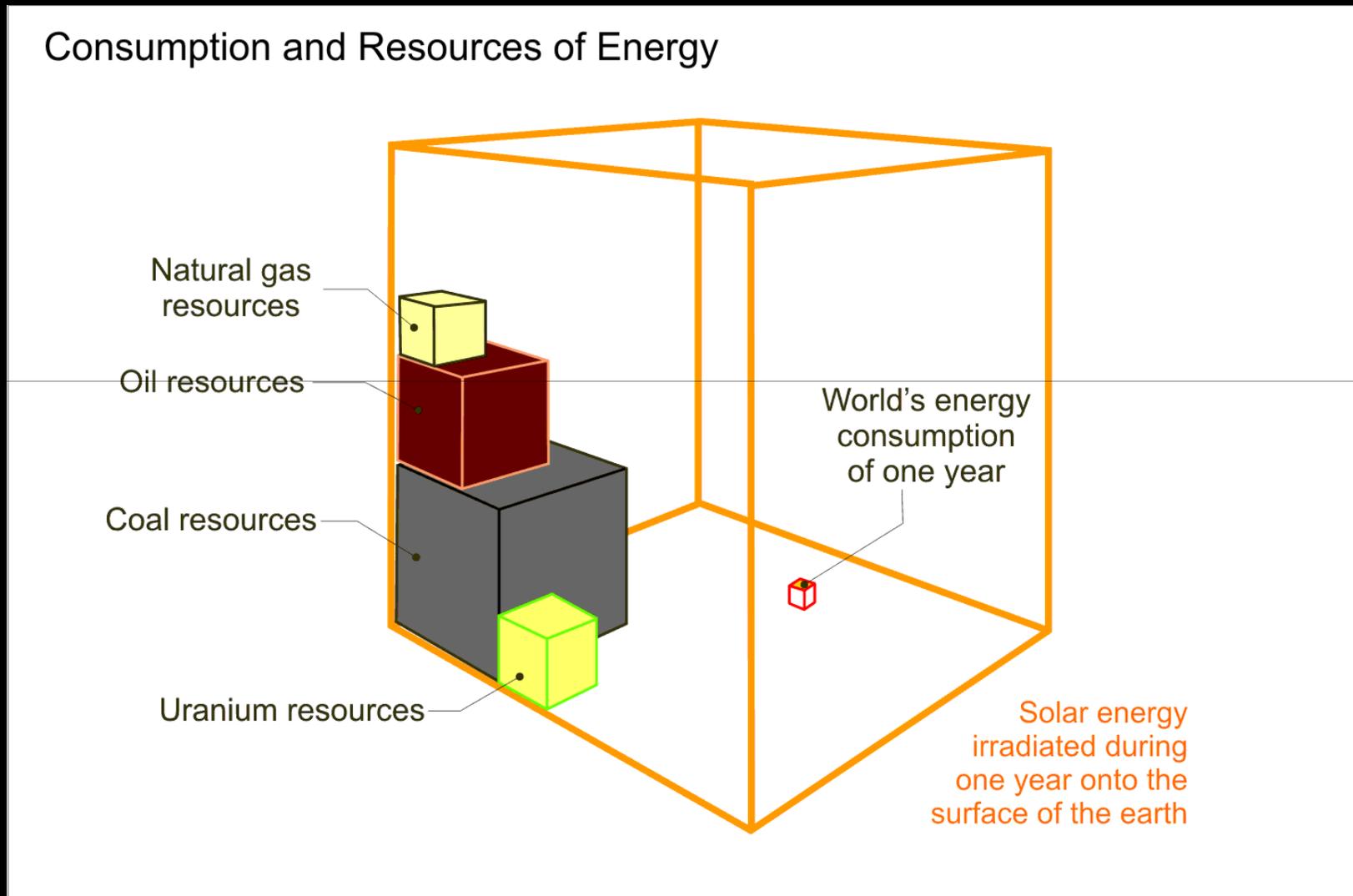
Daily global desertification: ***300 km<sup>2</sup>***

# Large and Small Water Cycle

[www.waterparadigm.org](http://www.waterparadigm.org) (Kravcik 2007)

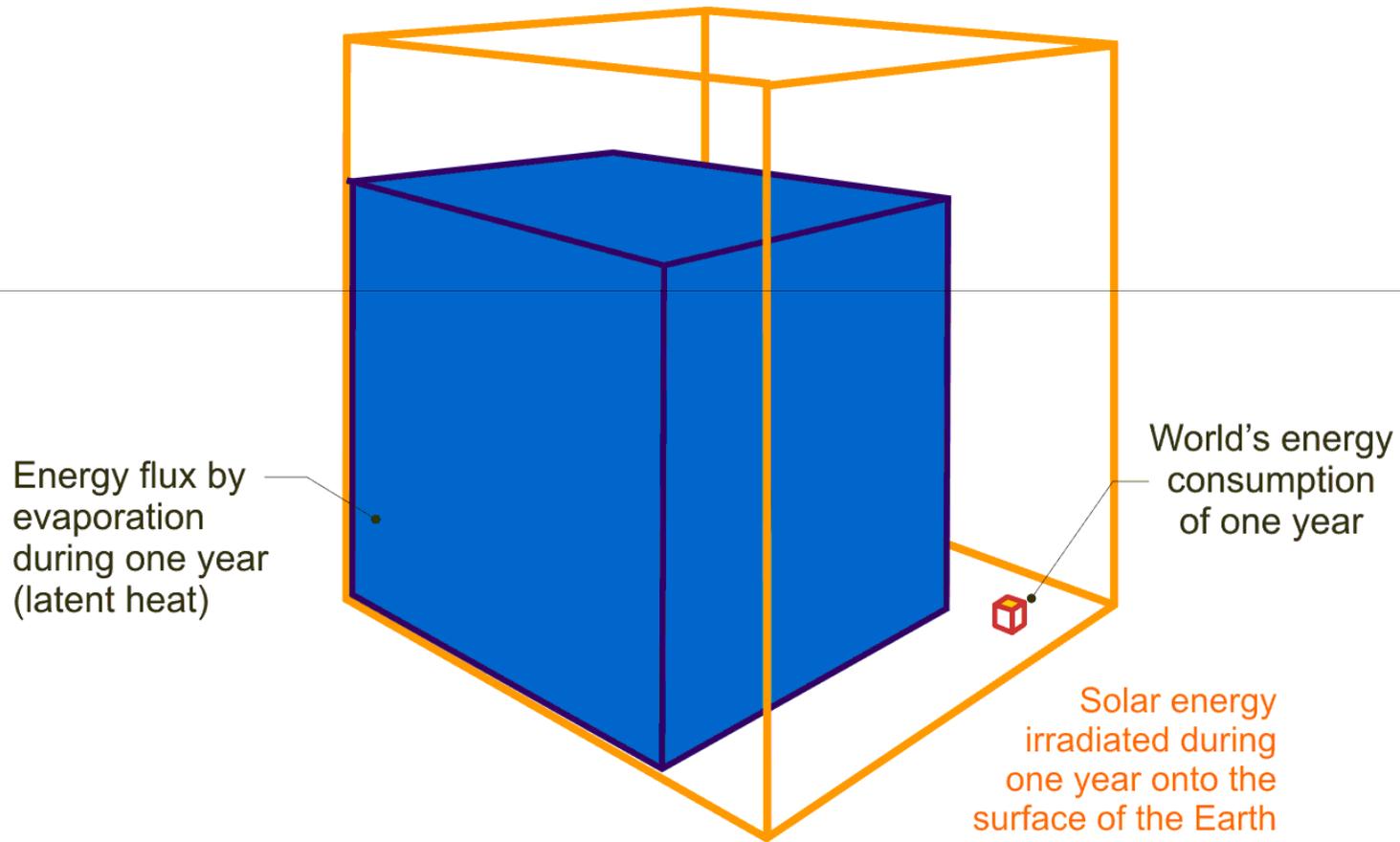


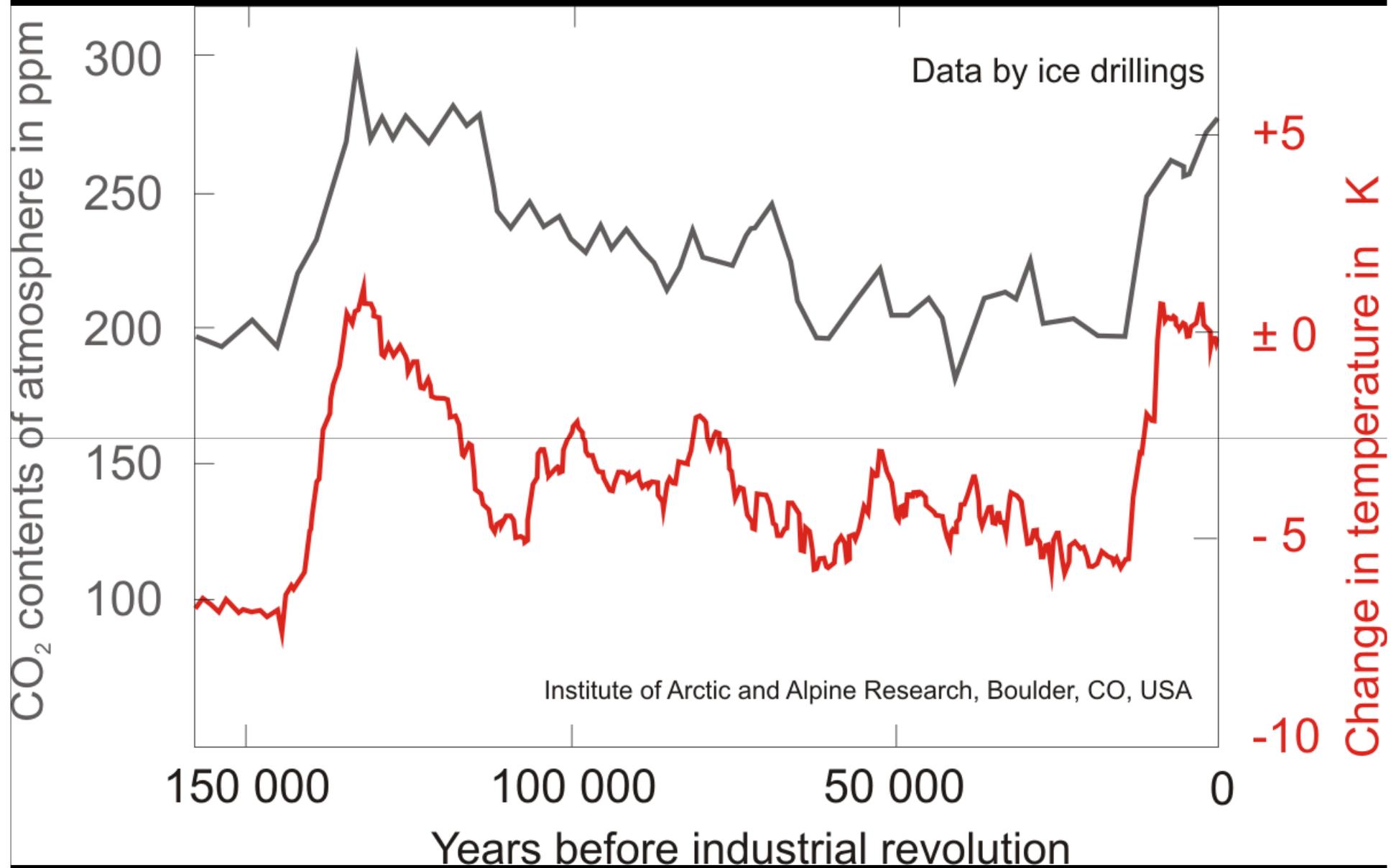
# Global Energy Consumption in Relation to Radiation



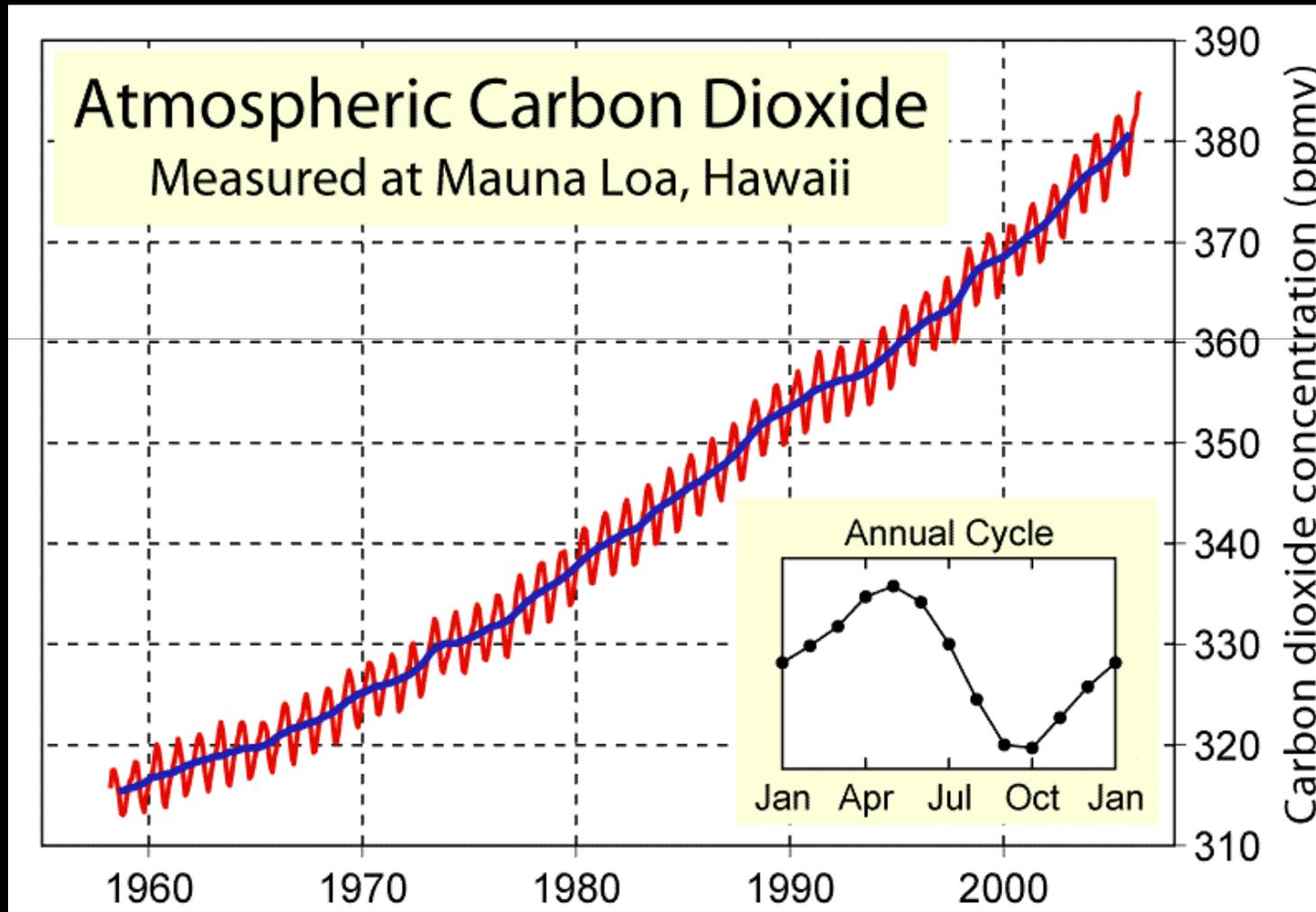
# Evaporation in Relation to Radiation

Global Radiation in Relation of Evaporation (Latent Heat Flux)

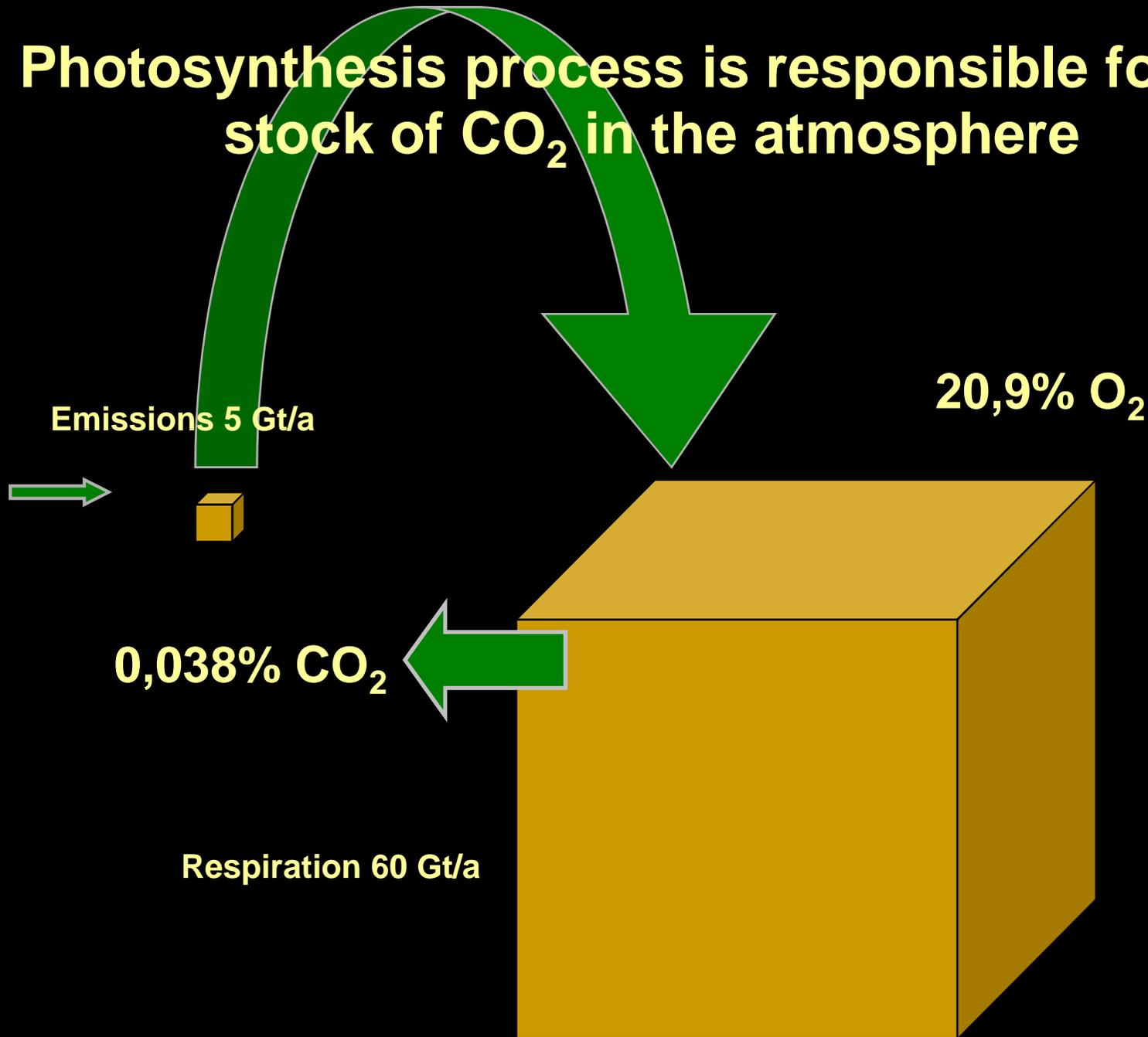




## Why does CO<sub>2</sub> correlate with the global temperature ?



# Photosynthesis process is responsible for the stock of CO<sub>2</sub> in the atmosphere



# renewable biomass ?



***Agadir, Morocco 5/2008***



## Agadir, Morocco 5/2008

Agadir, Morocco today compared to descriptions by ancient Greek geographer Strabo:

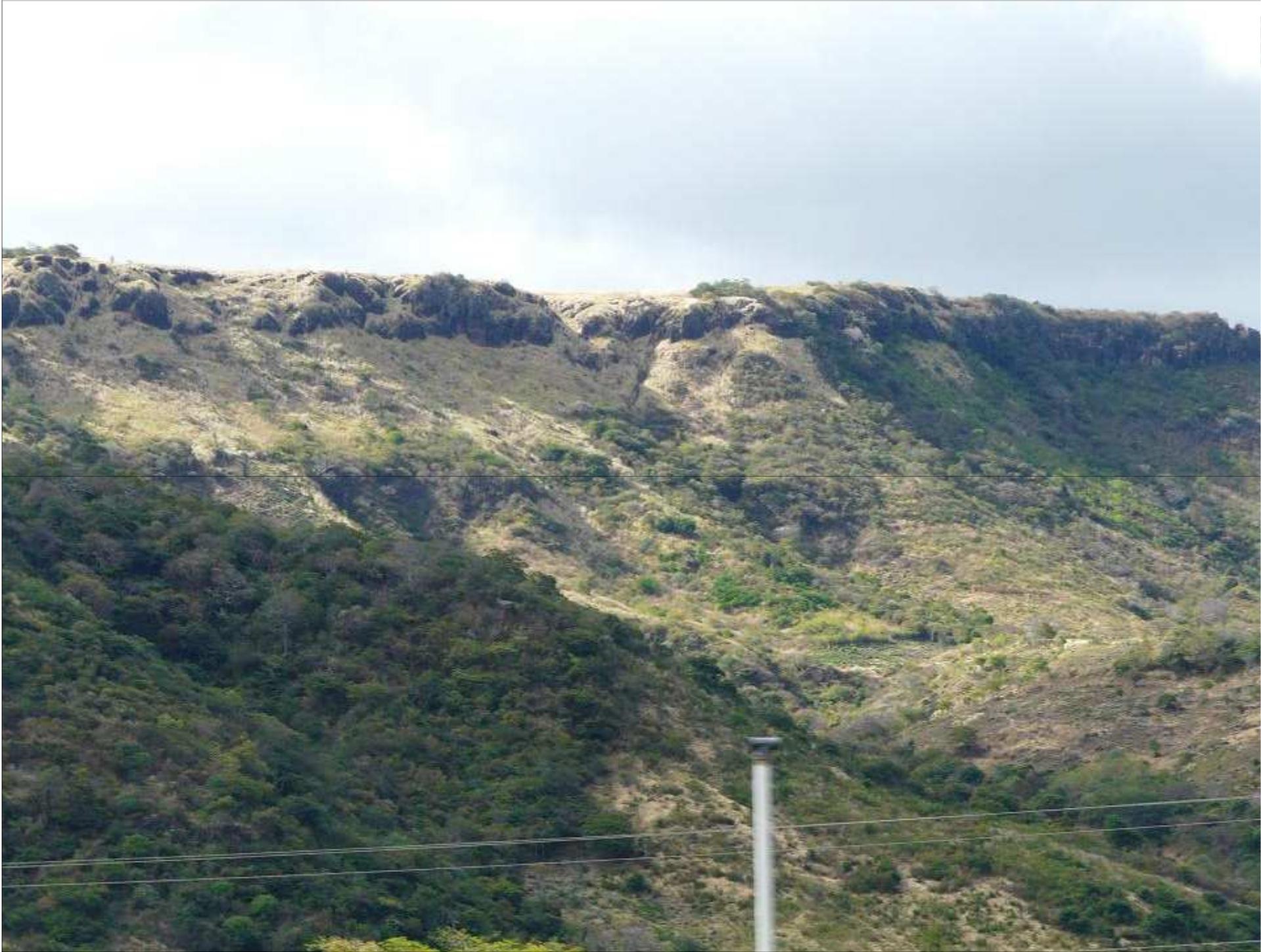
*"all of the [land] between Carthage and the Pillars of Hercules [from Tunis to the Atlantic ocean] is of an extreme fertility."*

Morocco was often singled out as *"one of the most beautiful and fertile countries of the earth"* and was frequently described as *"one of the granaries of Rome"*

A satellite view of Earth showing the continents of Africa, Europe, and parts of Asia and South America. The image is overlaid with the text "We dry out the planet!".

***We dry out the planet !***





arXiv:0707.1161v3 [physics.ao-ph] 11 Sep 2007

**Falsification Of  
The Atmospheric CO<sub>2</sub> Greenhouse Effects  
Within The Frame Of Physics**

**Version 3.0 (September 9, 2007)**  
*replaces Version 1.0 (July 7, 2007) and later*

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**Water for the Recovery of  
the Climate - A New Water  
Paradigm**



M. Kravčík, J. Pokorný, J. Kohutiar,  
M. Kováč, E. Tóth

- Reduction in Evaporation causes local and global warming
- Don't believe computer models which are based on poorly understood processes



<http://www.gebaeudekuehlung.de>  
<http://www.watergy.de>  
<http://www.waterparadigm.org>

