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EVROPSKÁ UNIE

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

OP Vzdělávání pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

CLIMATE CHANGE AND CROP PRODUCTION ADAPTATION

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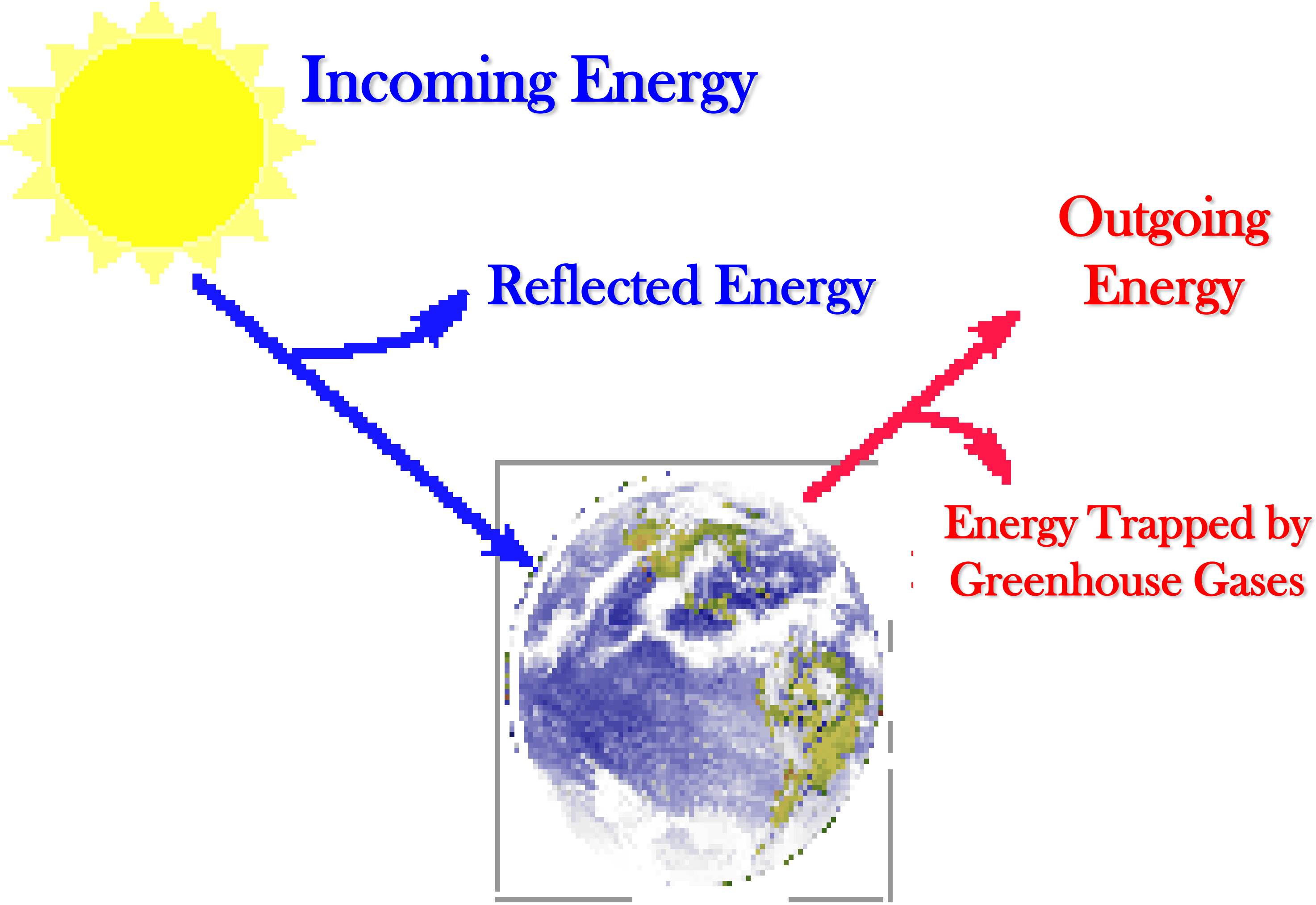
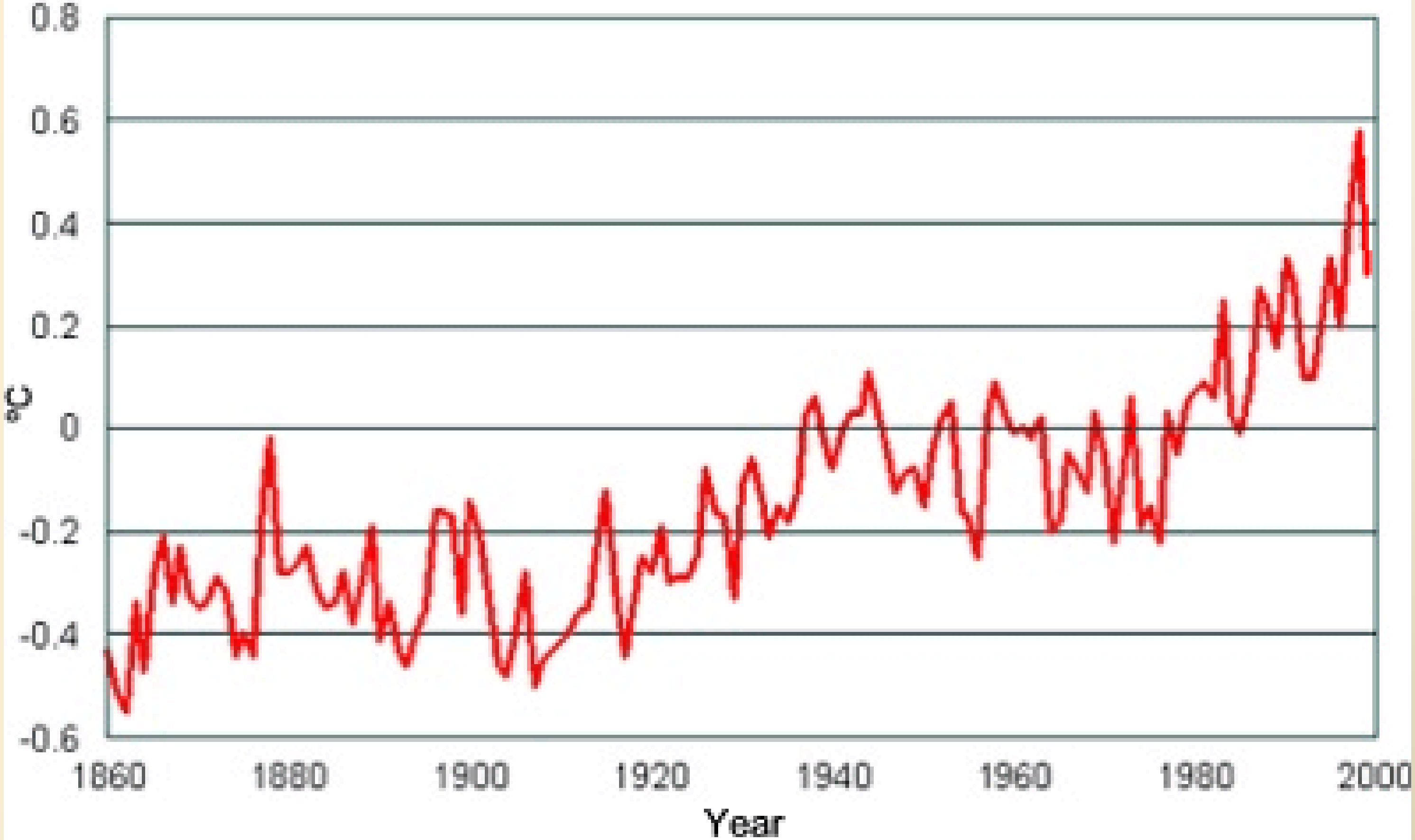
The World's climate has not been constant. We know, it has gone through dramatic past changes, but there is an increasing evidence that human activities are altering our climate at an unprecedented rate.

Climate change facts

The Greenhouse Effect

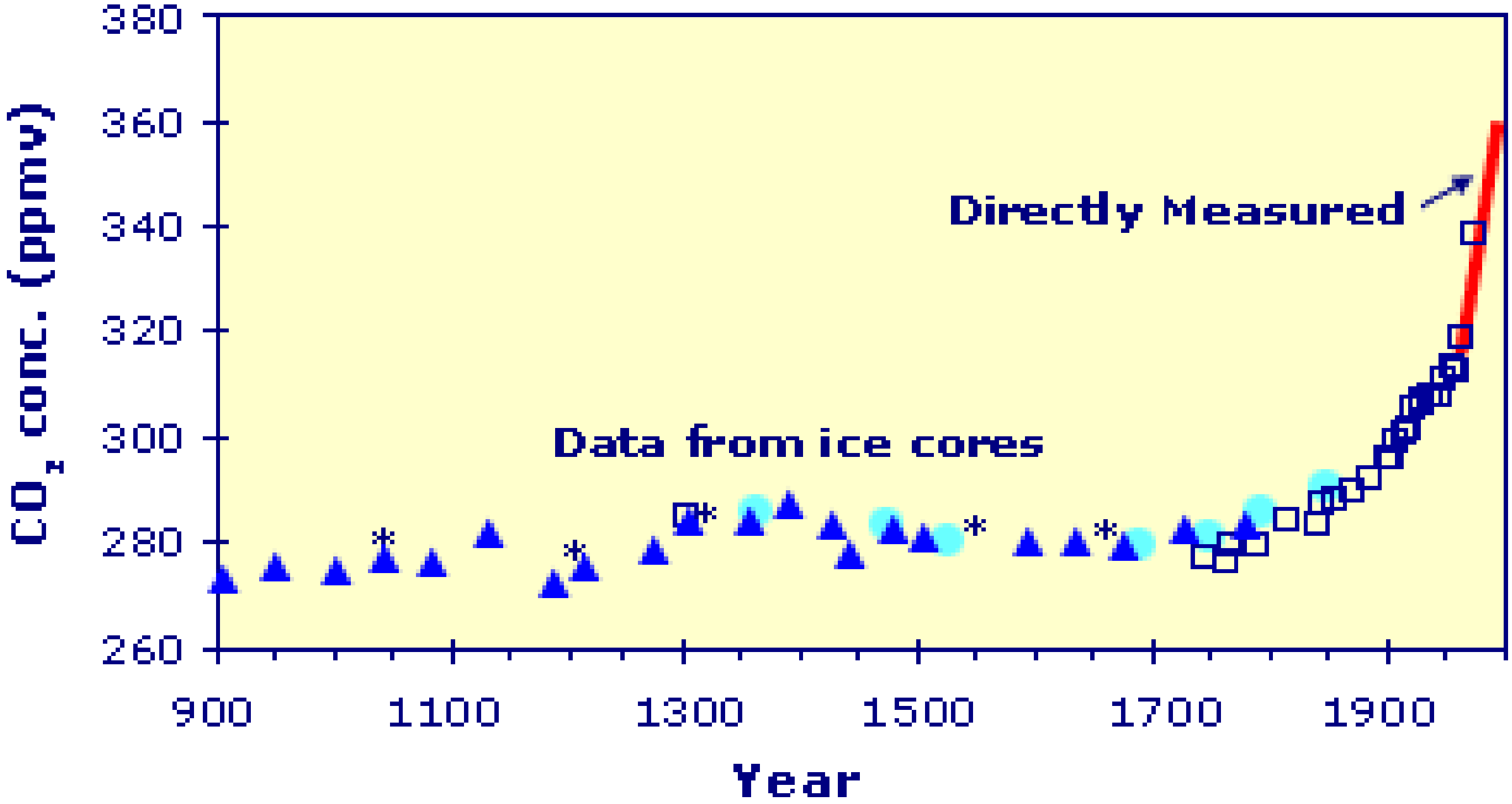


Global temperature change (1860-1999) relative to 1961-1990 average temperature



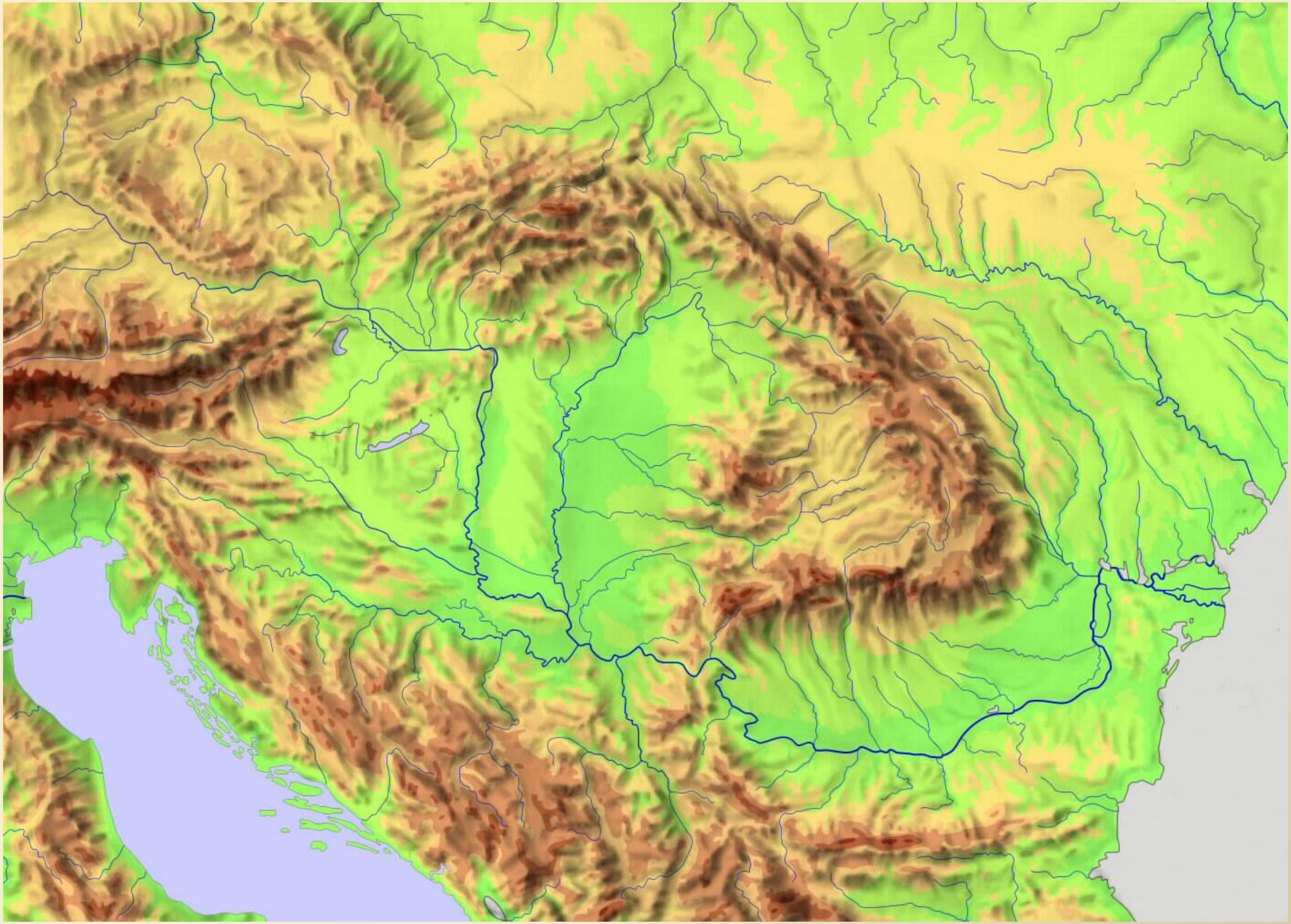
Source: Environment Canada, 2001.
(http://www.ec.gc.ca/climate/overview_trends-e.html)

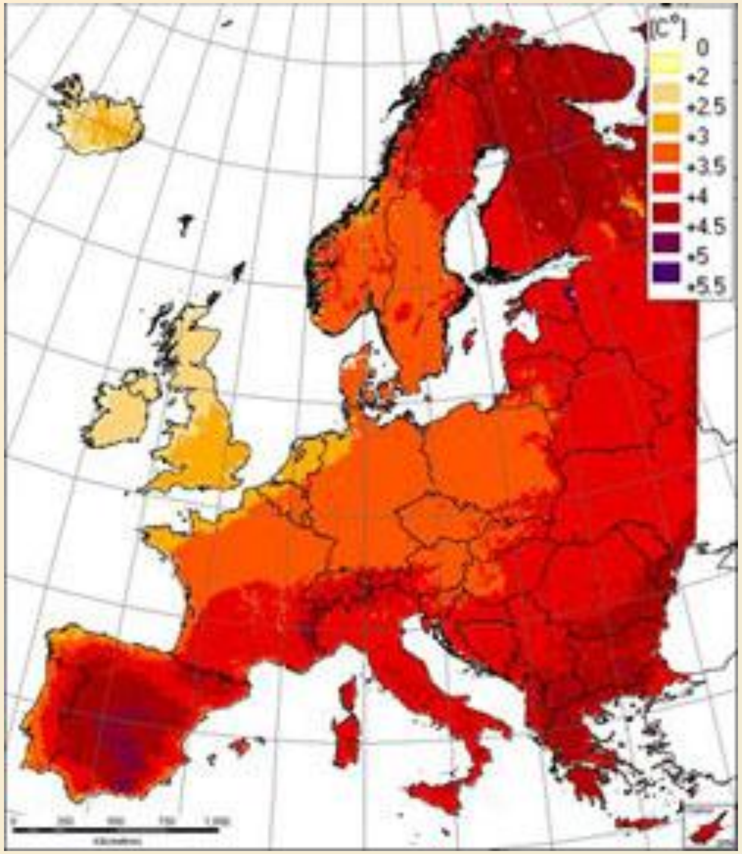
Trends in CO_2 concentrations for past 1000 years (parts per million by volume, ppmv)

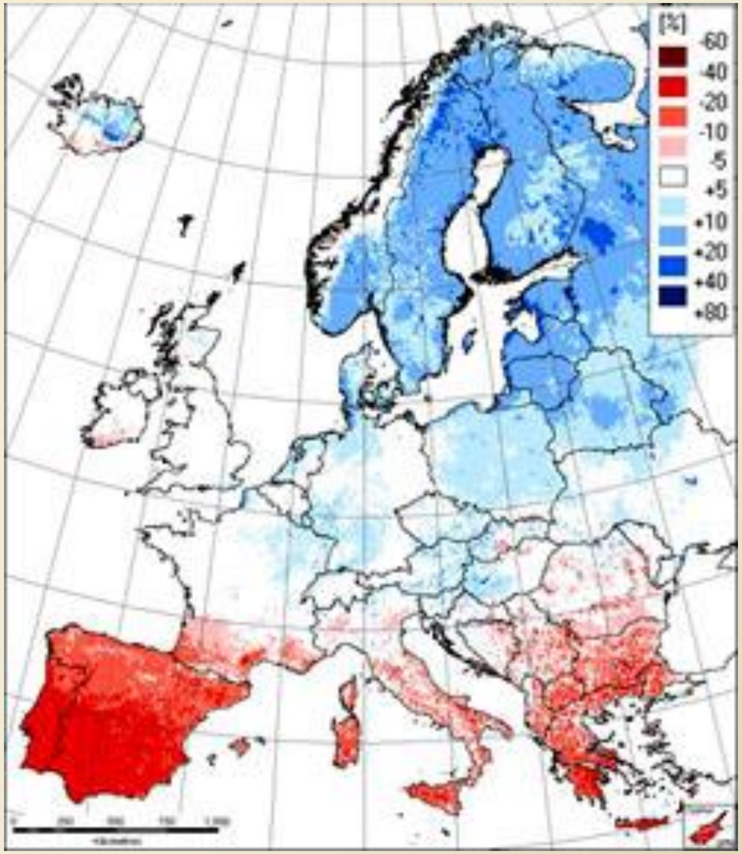


Source: Carbon Dioxide Information Analysis Center (CDIAC) (http://cdiac.esd.ornl.gov/)

The Carpathian Basin

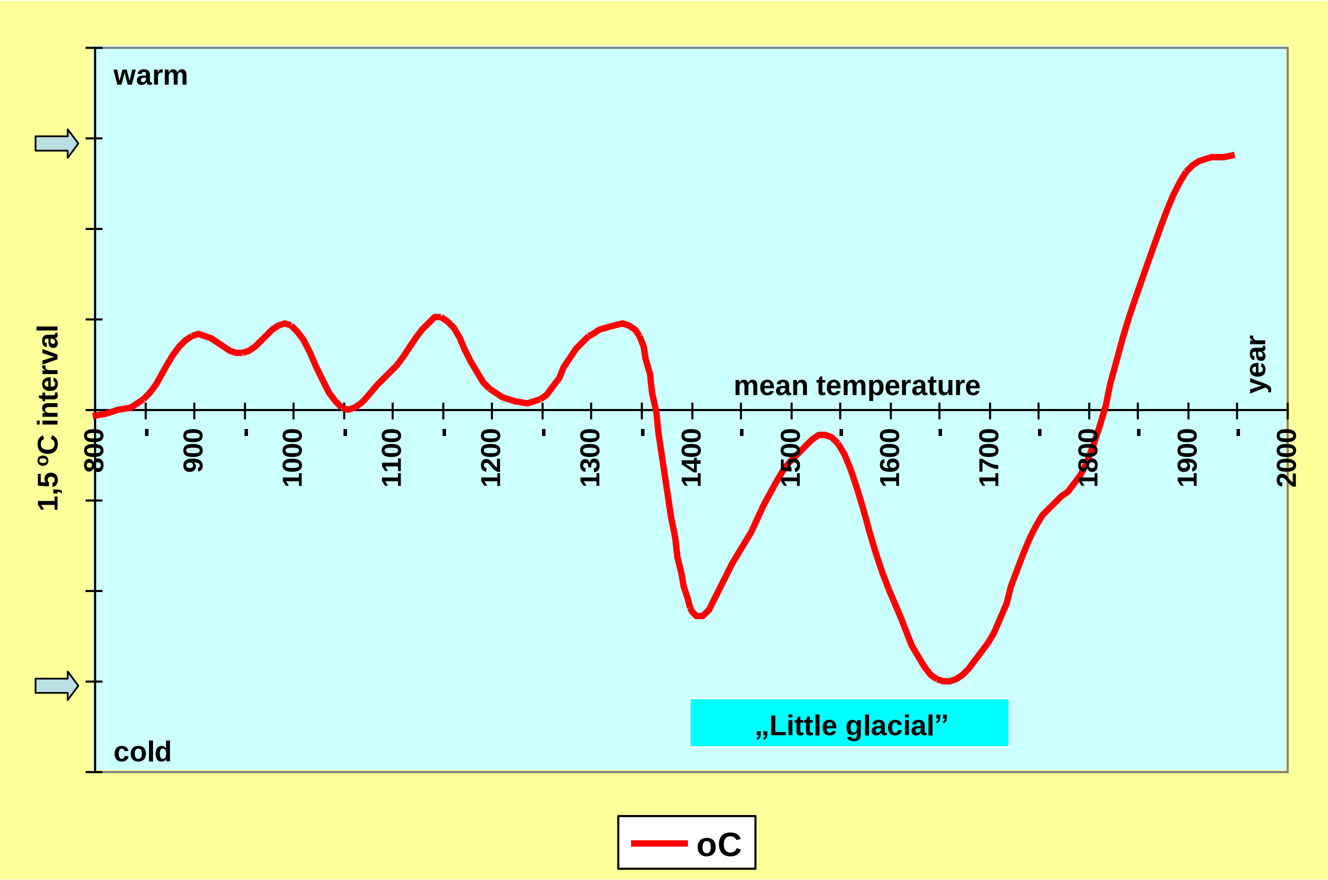






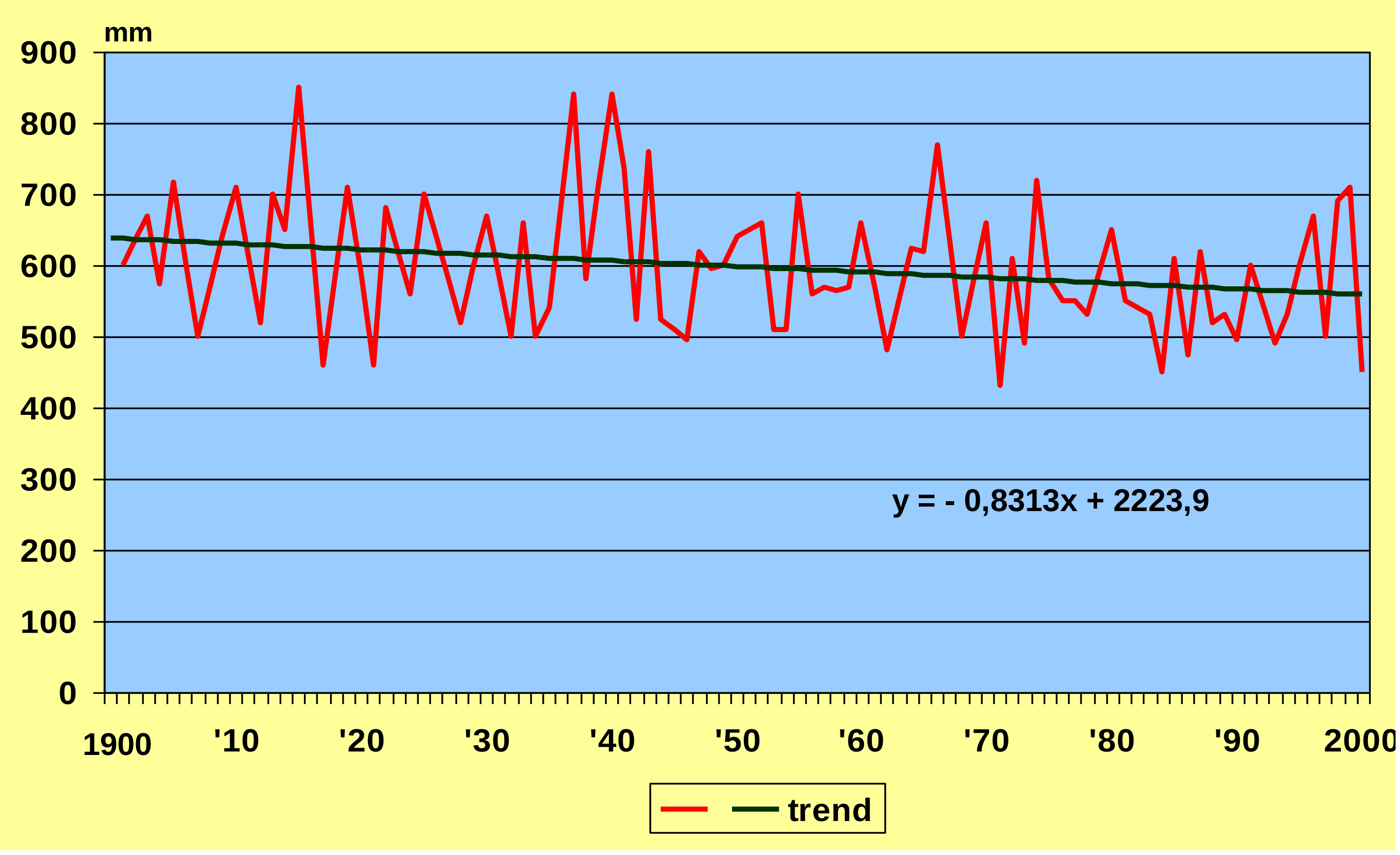
According to IPCC A2 scenario Hungary may face 3-3,5 ^{o}C temperature rise, and -5 - +5 %-os precipitation changes by the end of the 21st century in comparison with 1961-1990 period.

Average temperature changes in East Europe



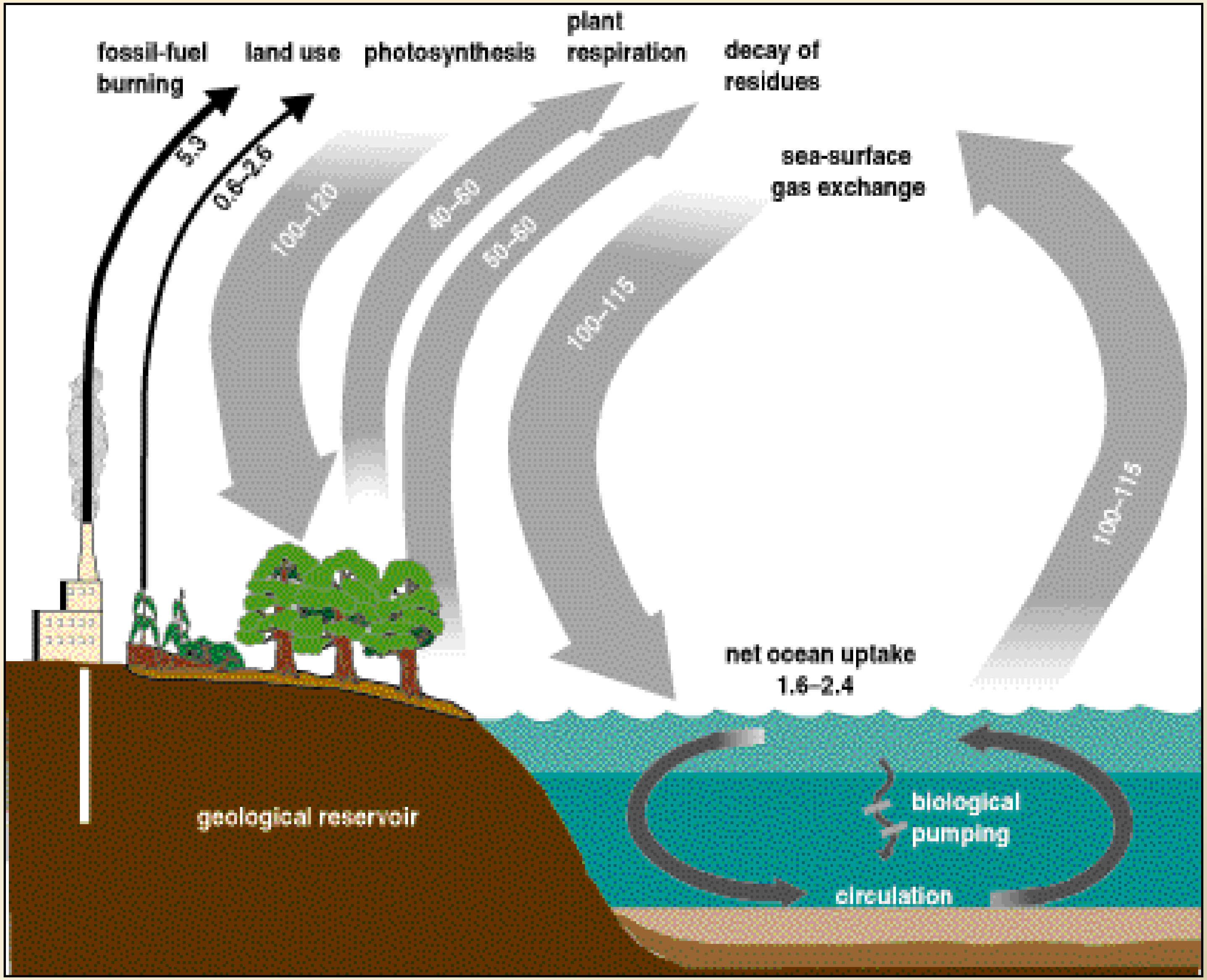
Varga-Haszonits, 2003. www.vahava.hu

Changes in the annual precipitation of Hungary



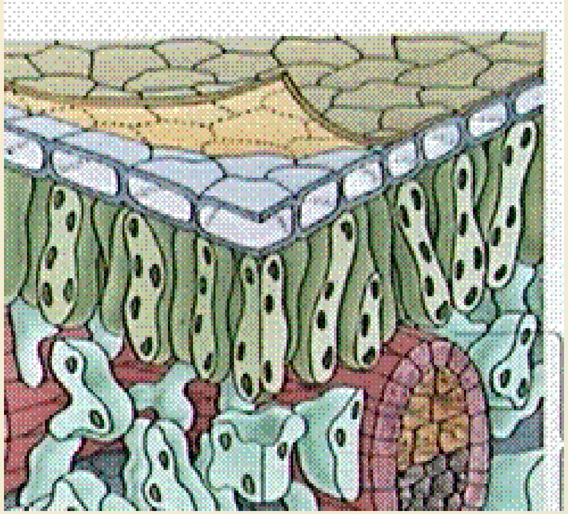
Varga-Haszonits, 2003, klima.vahava@office.mta.hu

Biological carbon fluxes



Photosynthesis

chlorophyll

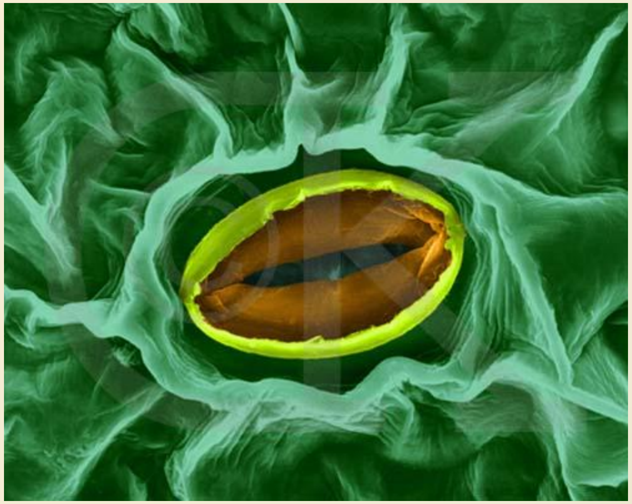


carbondioxide + water + energy = carbohydrate + oxigen

nCO_2 nH_2O light → $(CH_2O)n$ nO_2

Respiration

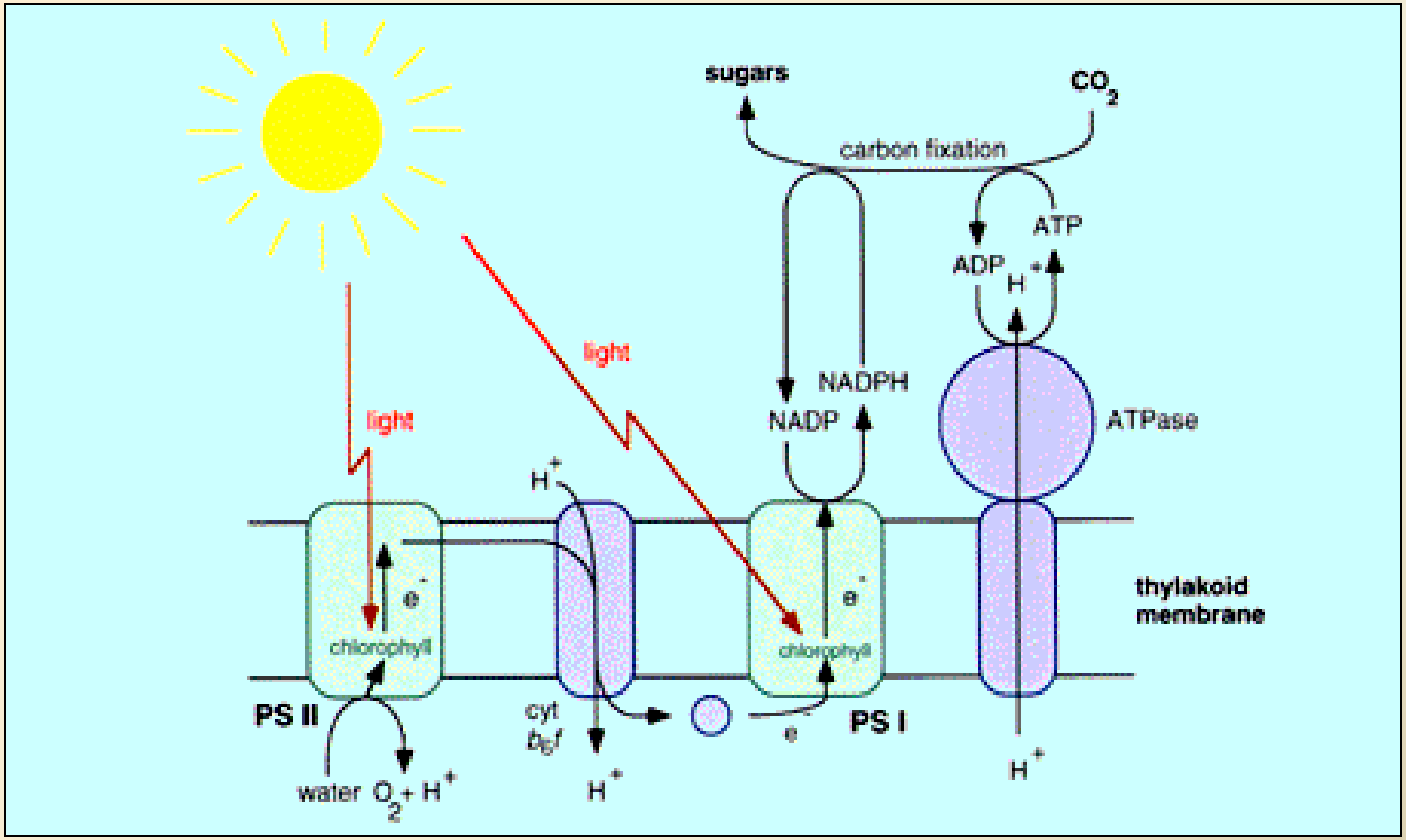
stomata



organic matter + oxigen = carbondioxide + water + energy

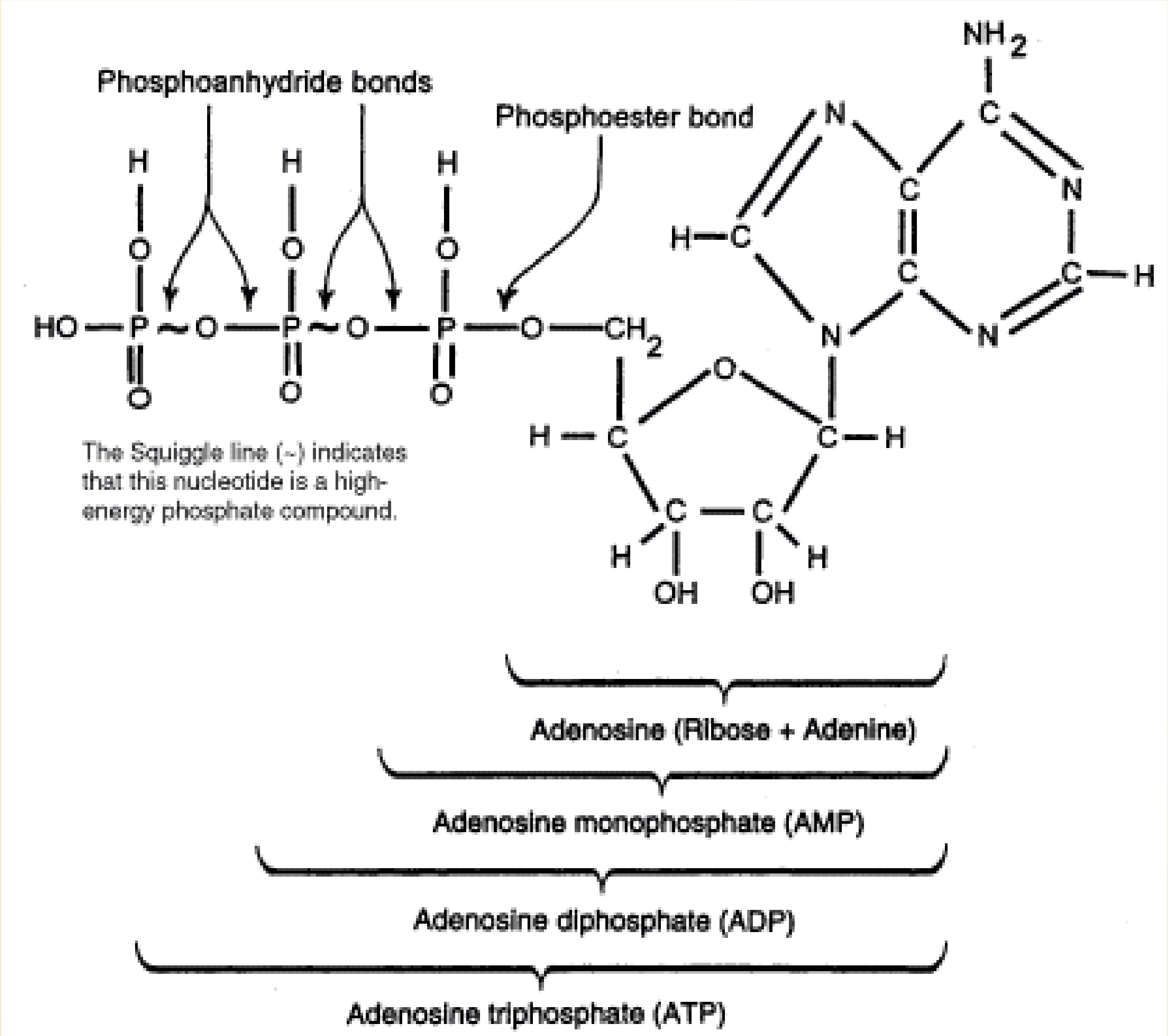
$(CH_2O)n$ nO_2 → nCO_2 nH_2O energy

The system



sugars
CO2
carbon fixation
ATP
ADP
H+
light
NADPH
NADP
ATPase
light
H+
e-
e-
chlorophyll
chlorophyll
thylakoid membrane
PS II
cyt b6f
PS I
e-
H+
water O2 + H+
H+

A key to the system



A sink-source budget

CO_2 fluxes	GtC	Sink	Source
Fossil fuel burning	5.6		x
Land use	0.6-2.6		x
Photosynthesis	100-120	x	
Respiration	40-60		x
Organic decomposition	50-60		x
Ocean net uptake	1.6-2.4	x	

Approx. 1.8-5.2 GtC CO_2 surplus yearly

Options for adaptation and mitigation

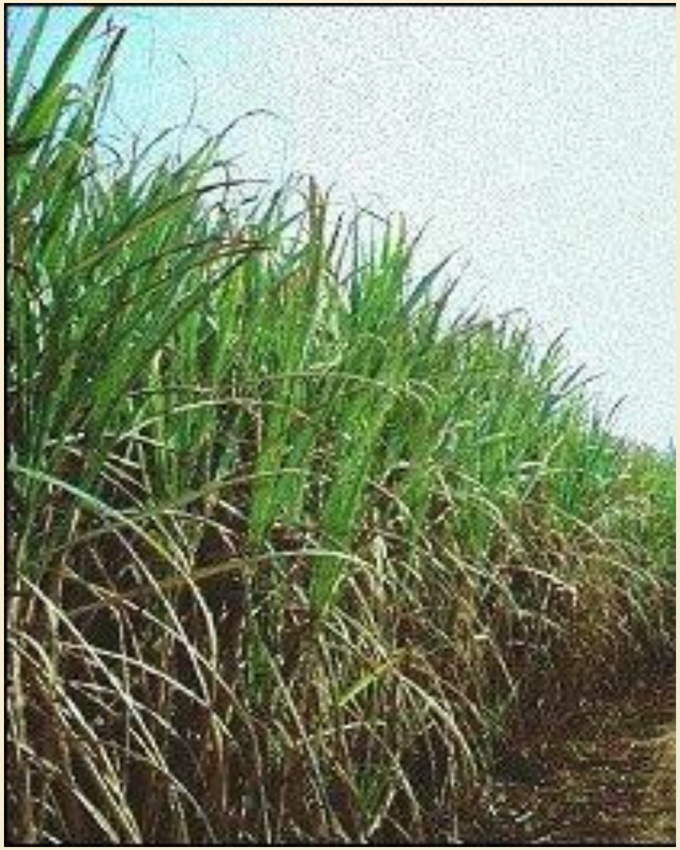
Reduce CO_2 emissions; means limit <u>sources</u>

Increase CO_2 uptake; means improve <u>sinks</u>

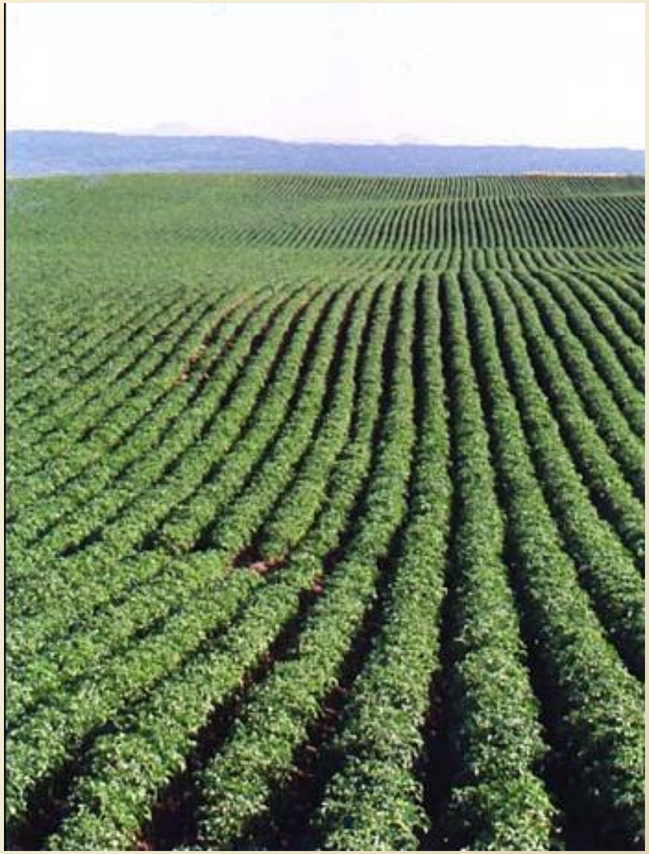
The negative effects of climate change can be limited by changes in crops and crop varieties, improved water-management and irrigation systems, adapted planting schedules and tillage practices, and better watershed management and land-use planning. Deforestation processes should be stopped, and deforested areas be converted into vegetation complexes or arable systems of CO_2 sink pattern.

Carbon sequestration by soil management and land use

Production of high CO_2 sink pattern crop species



Sugar cane



Potato

The Earth's lungs


2

Tropical rainforest (Ashanti, West Africa)

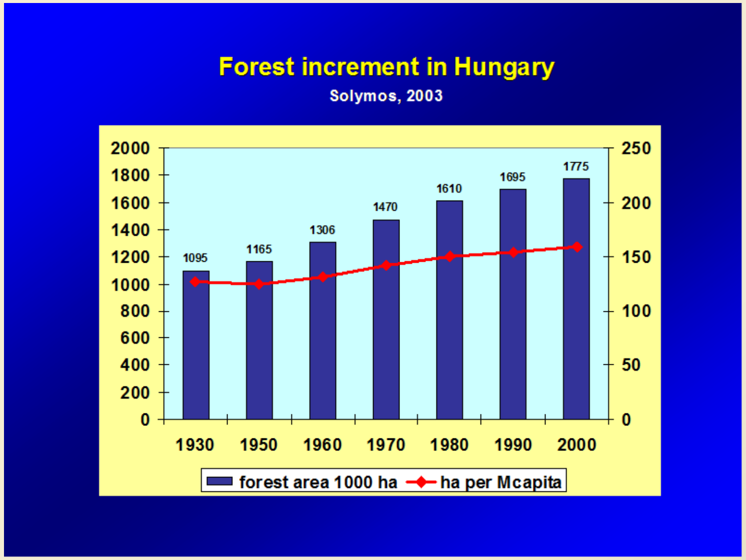
Deforestation

Rainforest remediation

Olive palm intercropping in banana plantation

Some promising facts offered by science

Plant breeding



Afforestation

Advanced monitoring

Biodiversity

Conclusion

The Global carbon cycle results in a positive budget annually. Increase in atmospheric CO_2 concentration can only be mitigated by reducing C sources and increasing C sinks at the same time.

Improved management techniques and practices may offset 1/3-1/4th of annual CO_2 increase.

On the other hand, energy based on fossil fuel combustion should be controlled Globally.

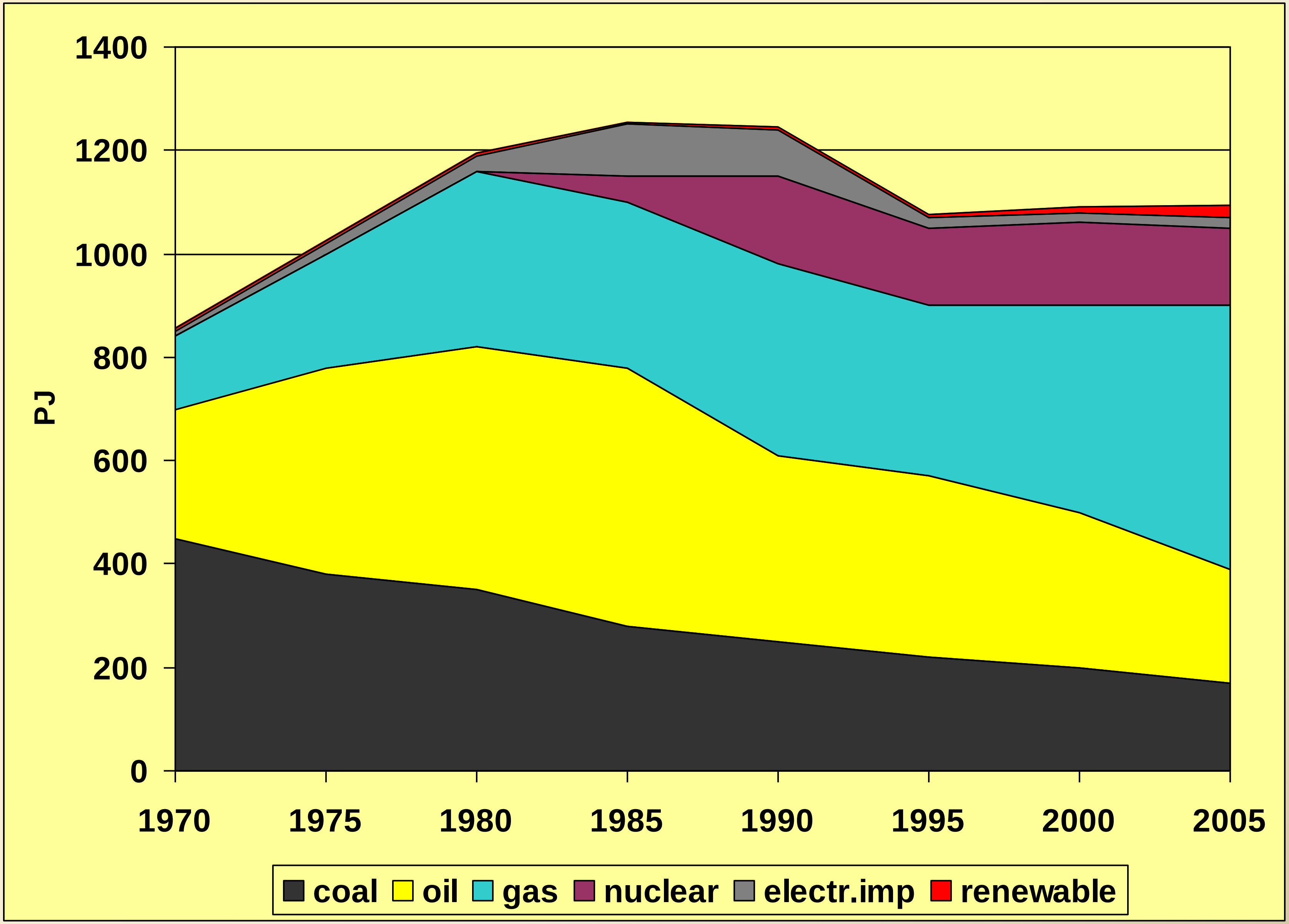
Green ecoanarchism obstructing the use of nuclear-, water- and wind energy should be prosecuted internationally.

Energy cropping

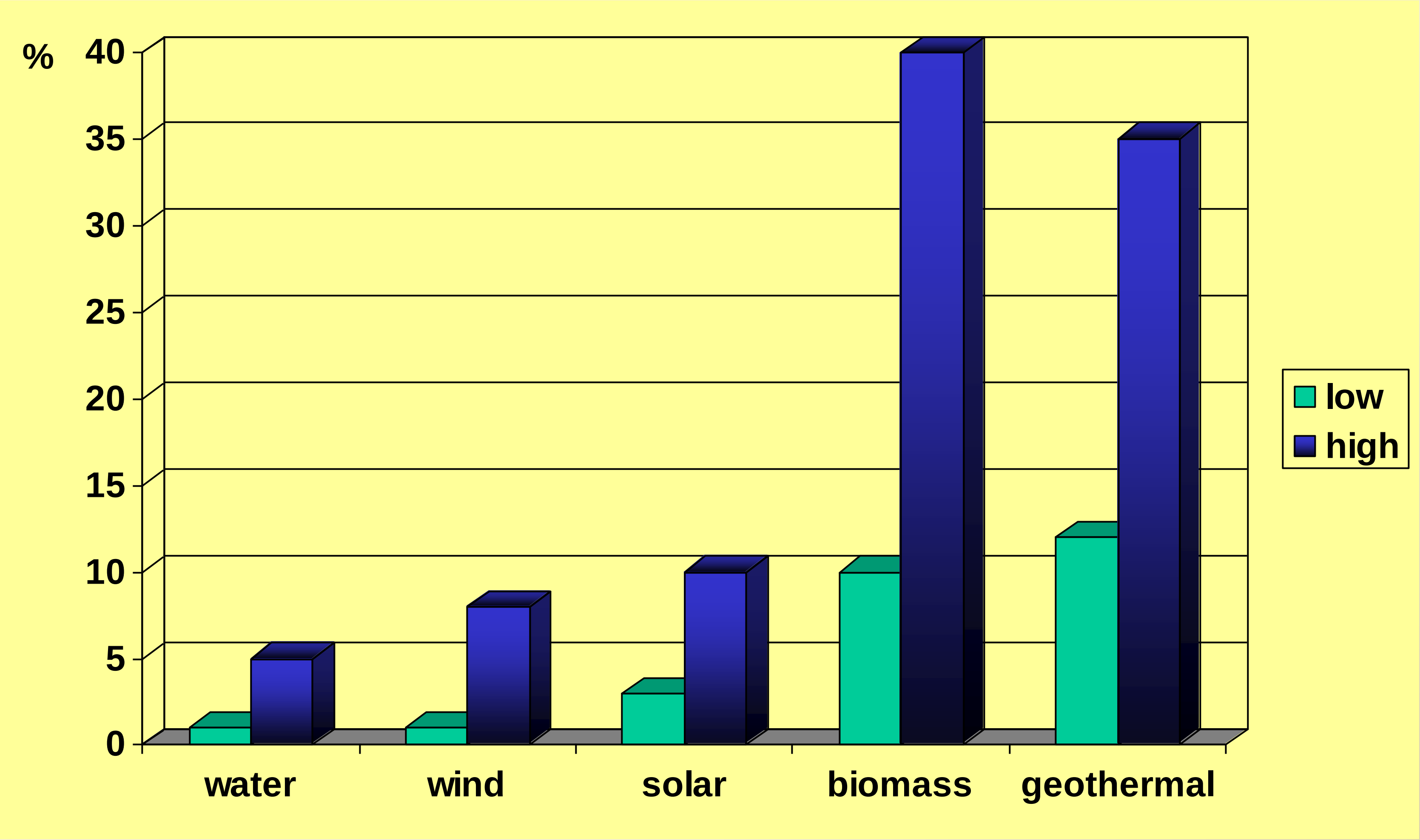
EU obligations

- The „Green Book” predicts 12 % renewable energy use for 2010.
- The 2001/77/EC directive predicts 22.1 % renewable energy input in electricity.
- The 2003/30/EC directive presents attempts in the field of alternative motor fuels.

Structure of primenergy consumption in Hungary



Contribution forecast estimates of renewable energy



Biomass energy potential in Hungary

	Total available biomass PJ	Energy potential PJ
Forestry	**160**	**62**
Main products	140	56
Byproducts	20	6
Energy plantations		**75**
Crop production	**780**	**132-265**
Main products	410	40-80
byproducts	370	92-185
Total	**940**	**269-402**

Photosynthetic carbon sequestration

Energy crops

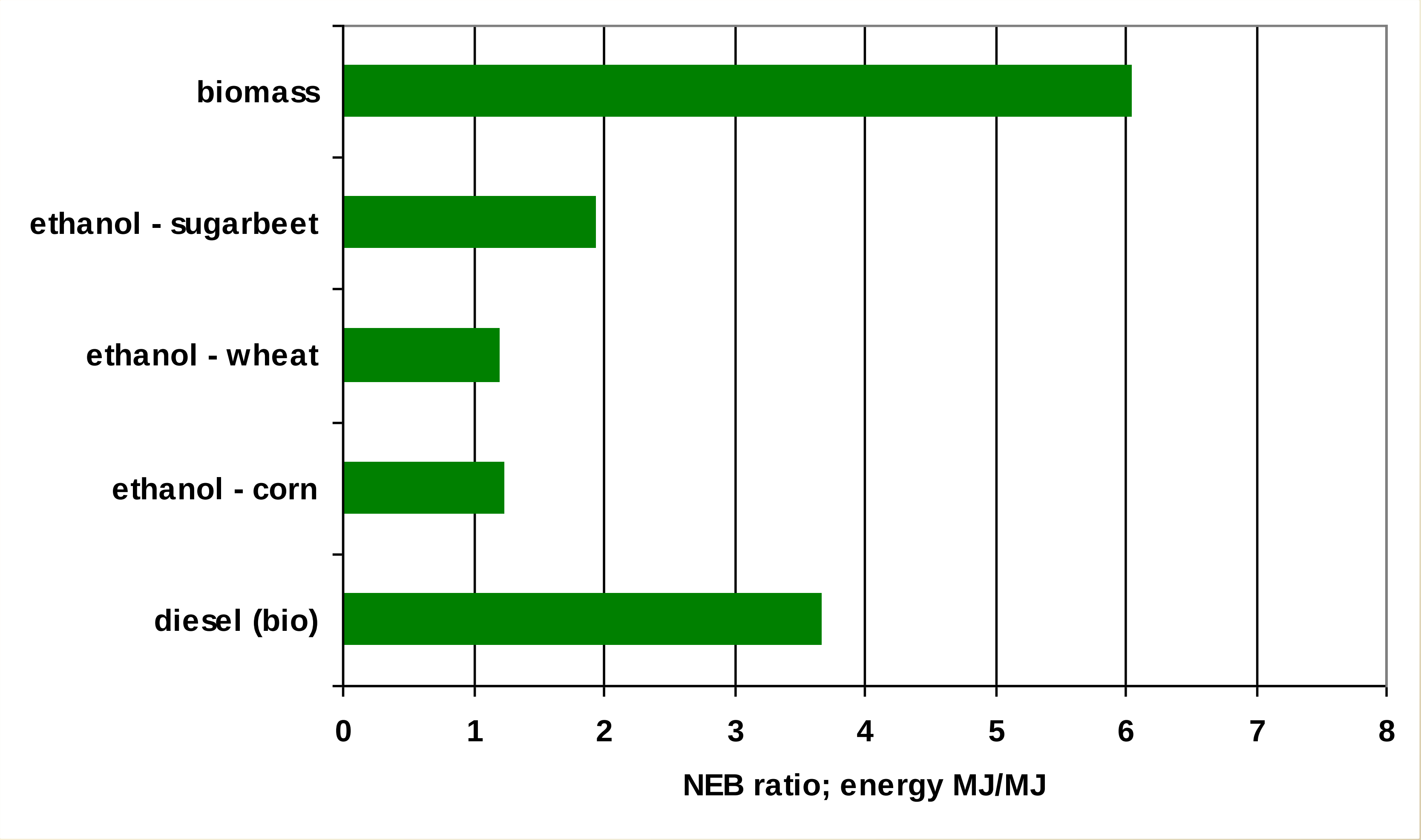
Biomass
- Forestry
- Grass
- byproducts

Ethanol
- Root/tuber crops
- Grain crops
- byproducts

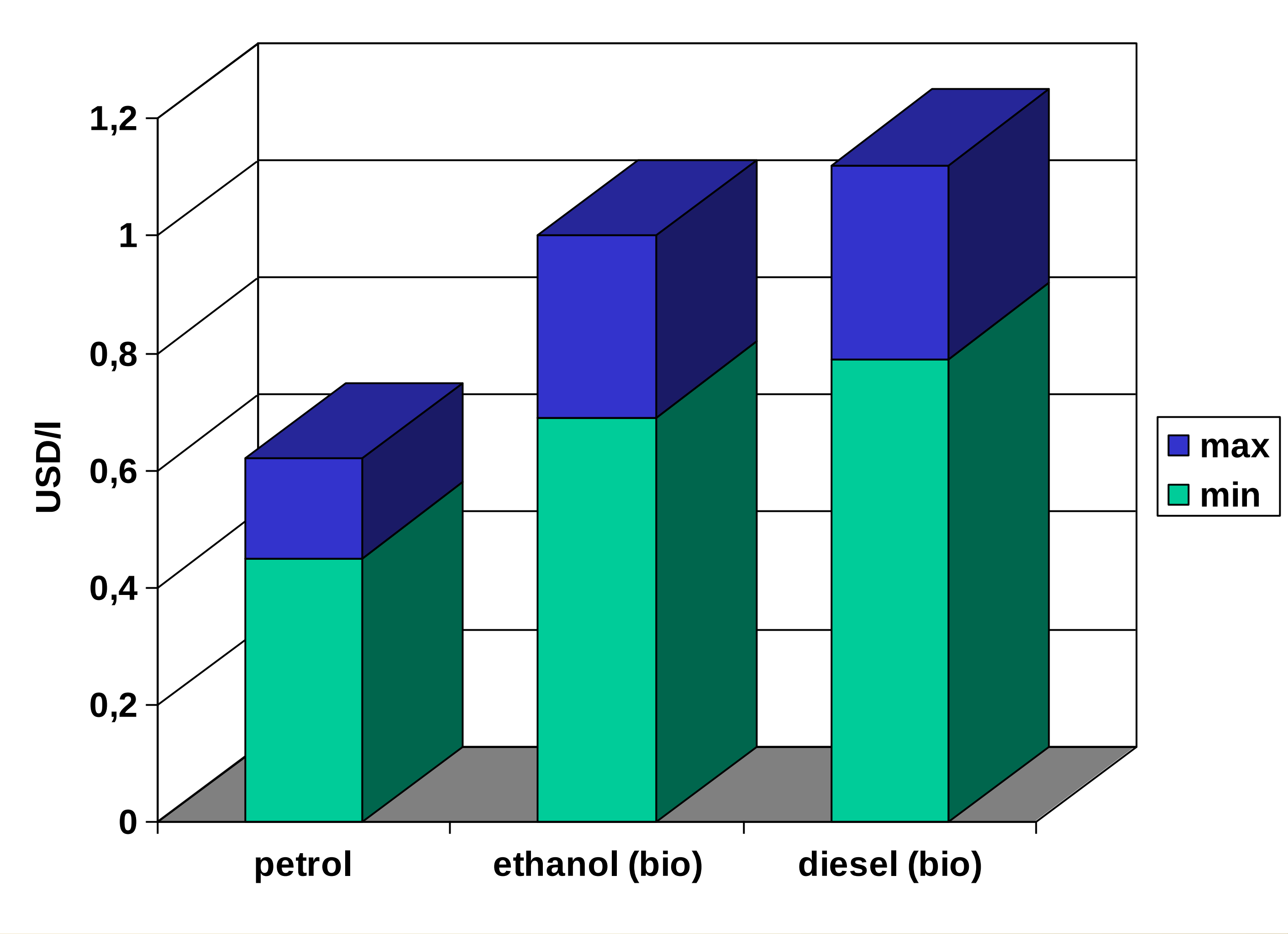
Diesel
- Oilseed rape
- Sunflower

Net energy balance of biofuels,

Source: PNAS 2006



Net production costs of oil based and biofuels*, 2012



* 50-60 USD/barrel price; energy equivalent = 0,66 ethanol, 0,91 diesel

Mv 454 maize hybrid

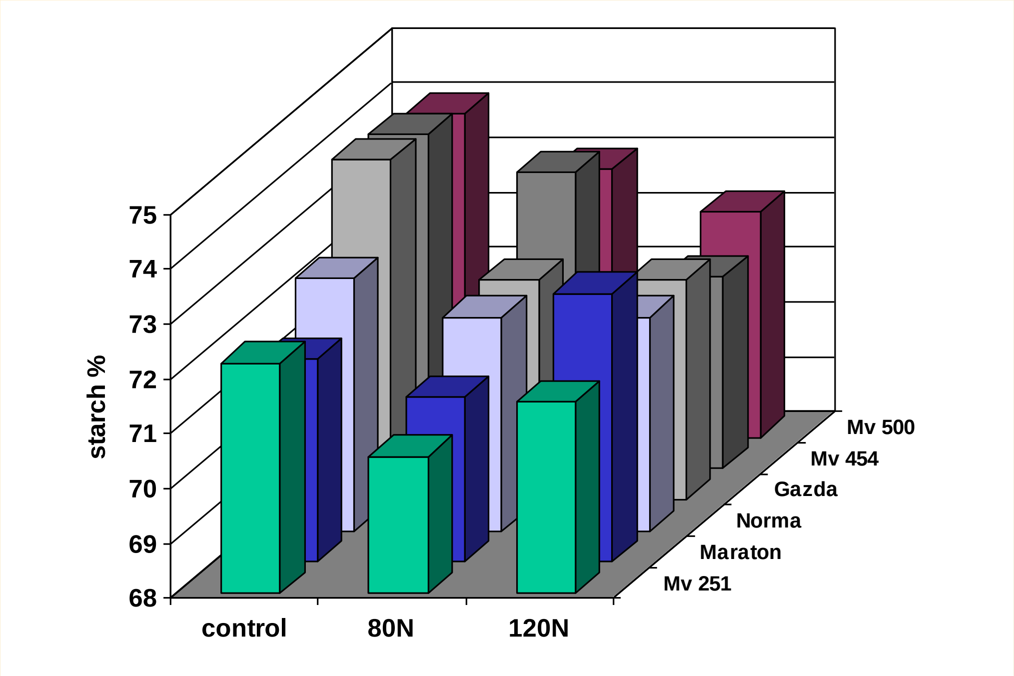
a high starch yielding crop variety for efficient ETBE production

Nagygombos experimental site 2006

Maize crop with an average 65 % starch content is highly suitable for bioethanol production. Starch content of some cultivars have been slightly increased by recent plant breeding projects. The Szent István University Crop Production Institute has recently started a new research on exploring the most characteristic agronomic impacts (biological bases, production sites, plant nutrition and crop year effects) influencing the efficiency of maize starch based bioethananol and so ethyl-tertiary-butyl-ether (ETBE) production. The aim of the research is to observe, identify and quantify agronomic impacts and their interactions that may have an influence on production efficiency and stability.

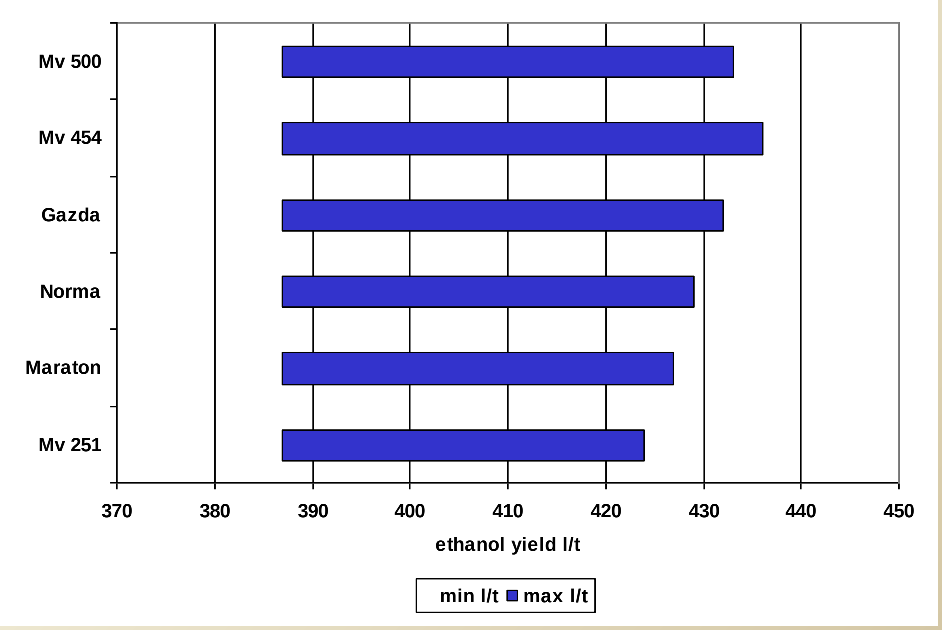
Starch content of maize hybrids

Nagygombos, 2006



Ethanol yield of maize hybrids

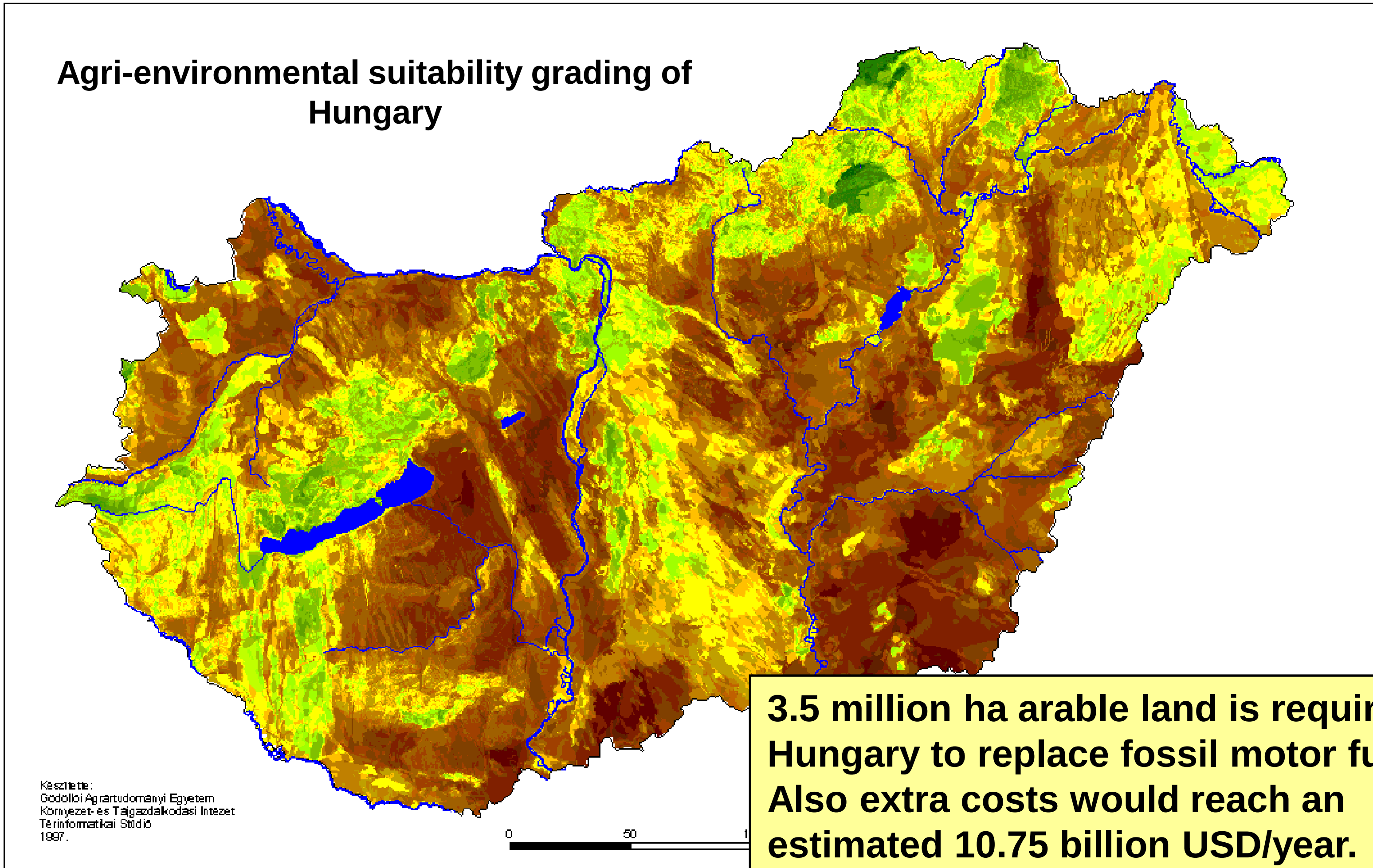
Nagygombos, 2006



Energy crops

Potential energy crops for Hungary (Source: Fogarassy 2000)

Grain crops
Barley - (Hordeum vulgare L.)
Maize - (*Zea mays* L.)
Oat - (*Avena sativa* L.)
Rye - (*Secale cereale* L.)
Sorghum - (*Sorghum bicolor* L.)
Sudan grass - (*Sorghum vulgare P.v. sudanense*)
Triticale - (*x Triticosecale*)
Wheat - (*Triticum aestivum* L.)
Legumes
Lupine - (*Lupinus* spp.)
Soybean - (*Glycine max* L.)
Oilseed crops
Hemp - (*Cannabis sativa L.*)
Oil seed rape - (*Brassica napus* L.)
Sunflower - (*Helianthus annus* L.)
Root and tuber crops
Artichoke - (*Heliantus tuberosum* L.)
Chicory - (*Cichorium intybus* L.)
Potato - (*Solanum tuberosum* L.)
Sugar beet - (*Beta vulgaris* L.)
Energy grasses
Chinese reed (-silver grass)- (*Miscanthus spp.*)
Fescue grass - (*Festuca arundinacea* L.)
Polygonum - (*Polygonum sachalinensis* F. Schmidt)
Reed grass - (*Phalaris arundinacea* L.)
Rye grass - (*Lolium perenne* L.)



3.5 million ha arable land is required in Hungary to replace fossil motor fuels. Also extra costs would reach an estimated 10.75 billion USD/year.

(in case of 58 USD/barrel oil prices).

Don’t forget

1 l petrol equivalent ethanol requires cca 3,1 kg maize grain.

That amount of corn would provide 1 week alimentation for an average Dagomba family.

To impair any impacts of climate change regarding food security, carbon sequestration and energy cropping, thorough training of stakeholders is scheduled

Research

Education

Extension

Thanks for your audience