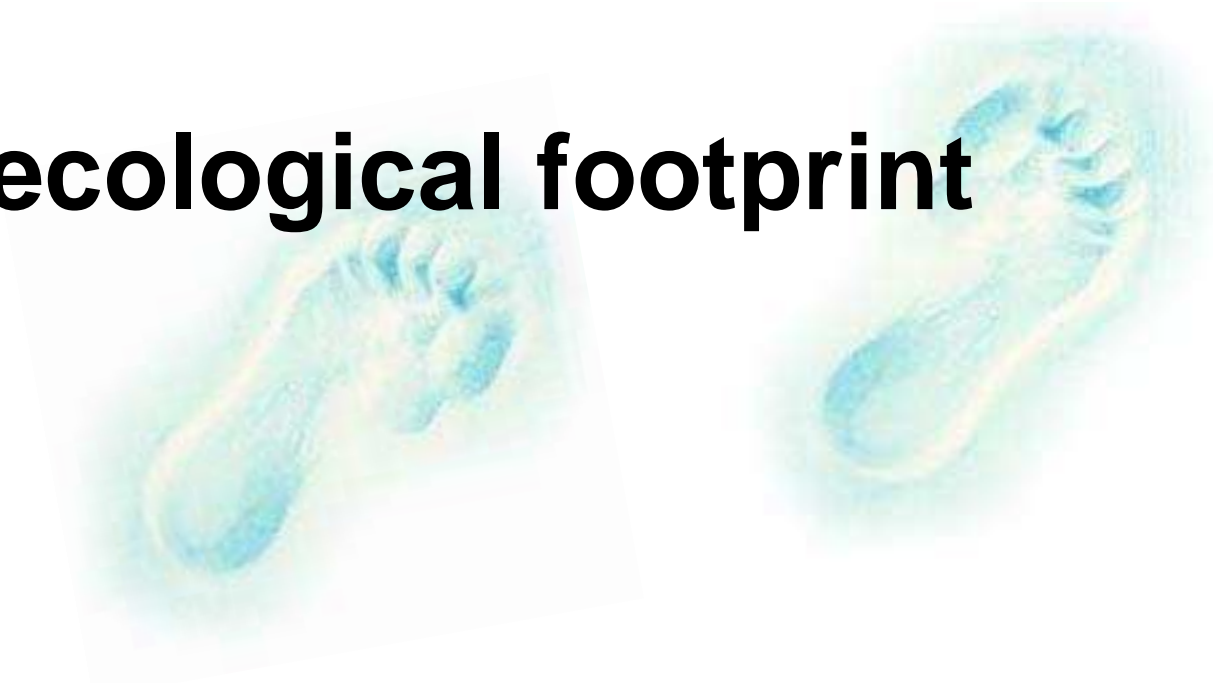




# BIOGAS REGIONS

„train the trainer“

## ecological footprint



## What is the ecological footprint?

- Tries to measure the human demand on the Earth's ecosystem and natural resources
- Area, which is needed, to regenerate (if possible) the resources, a human population consumes
- How many earth does it take, to support humanity if everybody lives his given lifestyle?



The Sustainable Process Index (SPI) has been developed: The Sustainable Process Index (SPI) is a measure developed to evaluate the viability of processes under sustainable economic conditions. Its advantages are its universal applicability, its scientific basis, the possibility of adoption in process analyses and syntheses, the high sensitivity for sustainable qualities, and the capability of aggregation to one measure. It has proved to be useful in industrial strategic planning. **The concept of the SPI is based on the assumption that in a truly sustainable society the basis of economy is the sustainable flow of solar energy.** The conversion of the solar energy to services needs area. Thus area becomes the limiting factor of a sustainable economy. The SPI evaluates the areas needed to provide the raw materials and energy demands and to accommodate by-product flows from a process in a sustainable way. It relates these areas to the area available to a citizen in a given geographical (from regional to global) context. The data necessary to calculate the SPI are usually known at an early stage in process development. The result of the computation is the ratio between the area needed to supply a citizen with a given service and the area needed to supply a citizen with all possible services. Thus it is a measure of the expense of this service in an economy oriented towards sustainability. Several case studies exist: pulp and paper industry, electronic industry, agriculture, biotechnology, traffic and transport, energy systems; moreover in regional and municipal planning, insulation of family houses, total pressure of life styles (on base of Austrian data).



With the current consumption and lifestyle one person uses an area of **2.2 ha** – but only **1.8 ha** per capita would be available!

A global comparison shows the inequalities of resource use on this planet:

region/country	demand per capita
Europe (EU25 and Switzerland)	4.7 ha*
USA	9.7 ha
Great Britain	5.6 ha
Brazil	2.1 ha
China	1.6 ha
India	0.7 ha

\* possible demand with area of EU25 = 2.3 ha

data source: "State of the Planet", Beihefter New Scientist, 6. Januar 2007



## Ecological Footprint – Sustainable Process Index



One method for this ecological evaluation is the SPI (*Sustainable Process Index*).



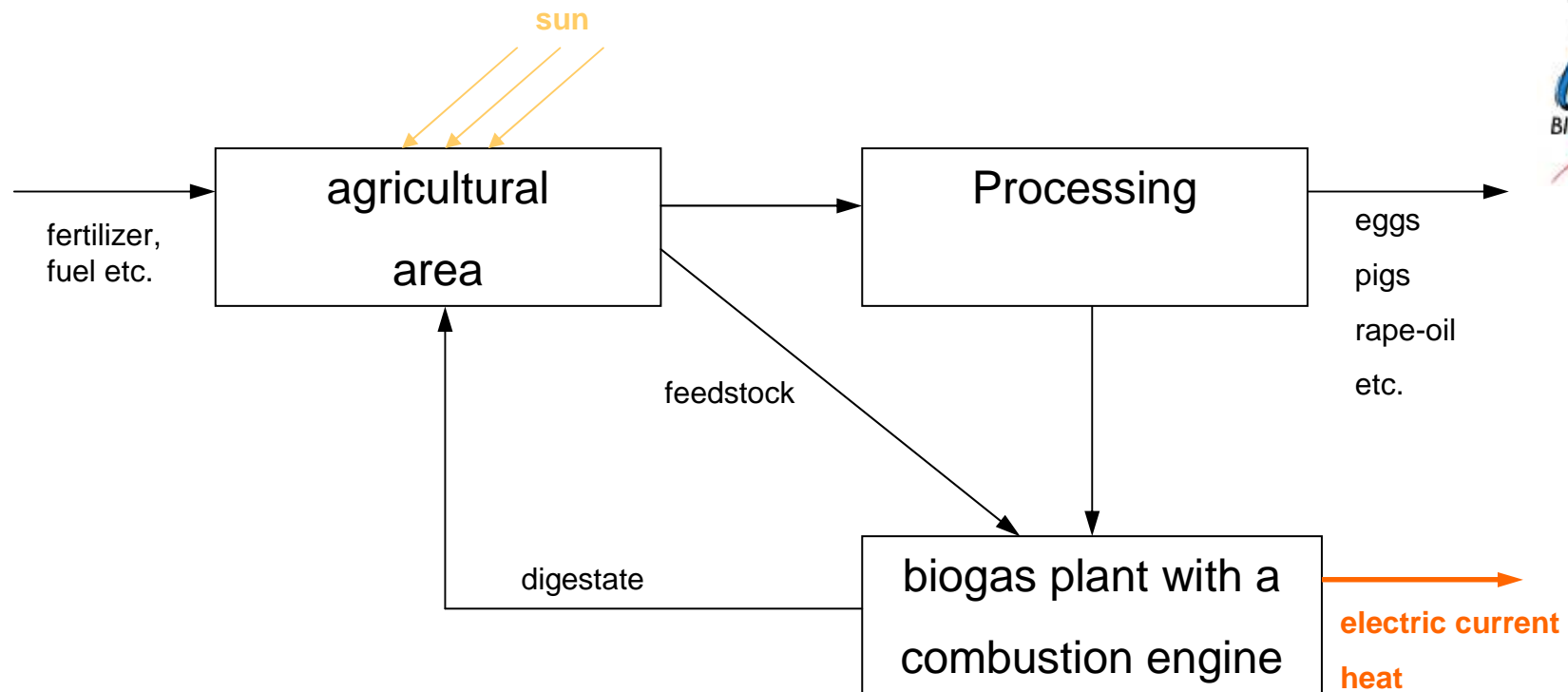
SPI is an indicator, which evaluates the utilization of resources, infrastructure and emissions in different domains on a mutual basis in terms of area. All sustainable economy builds on **solar energy** only.



Regarding a biogas plant, the SPI evaluates the total process chain (taking the raw material/resource – utilization – return of used resources in eco-sphere)

The dimension of the ecological footprint is  $m^2/a$ . That means, that a specific activity uses one square meter of the Earth's surface for one year.

# process of a biogas plant



# The ecological footprint of a biogas process:

example:

Input	amount	unit	SPI <sub>total</sub>
silage maize	1000	kg	4200
liquid manure	661	kg	0
water	177	kg	9
air	6,01	kg	0
combustion air	2296	kg	2
diesel	0,58	kg	67
lubricating oil	0,15	kg	86
activated-carbon/filter	0,002	kg	2
membrane for silage	0,24	kg	174
electric current	40	kWh	0
delivery of substrate	1,27	km	436
output of digestate	2,11	km	724

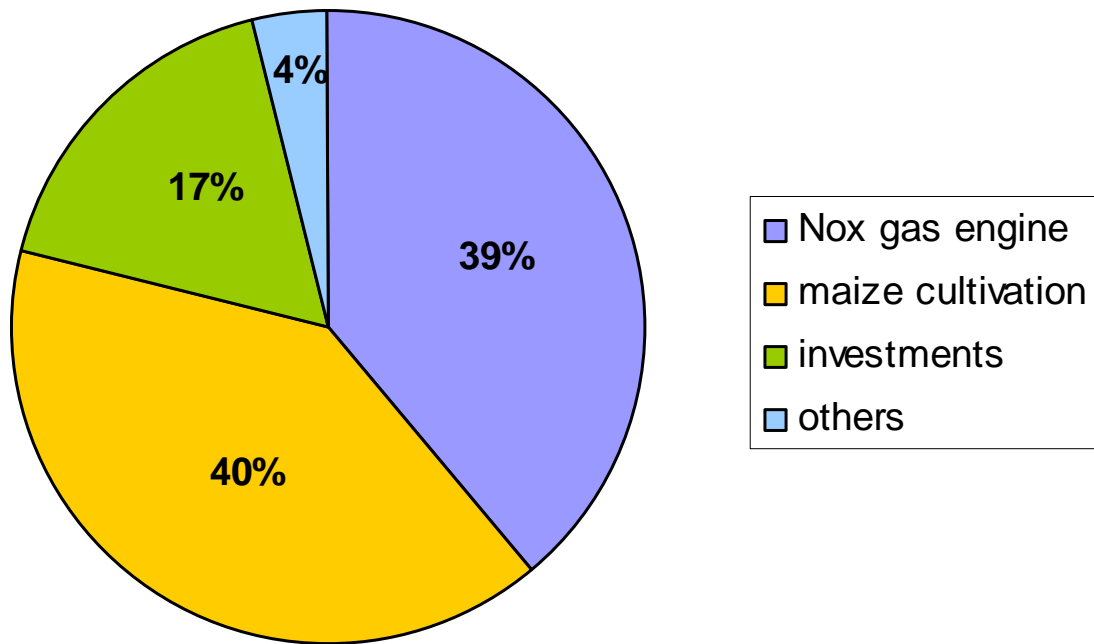
...and others

	Output	amount	unit	SPI <sub>total</sub>
emission gas engine	CO <sub>2</sub>	472	kg	0
	H <sub>2</sub> O	222	kg	1
	CO	0,8327	kg	85
	So <sub>x</sub>	0,1203	kg	472
	No <sub>x</sub>	0,7133	kg	5445
	HCl	0,004	kg	0
	C <sub>x</sub> H <sub>y</sub>	0,3955	kg	61
emission wheel-loader	CO <sub>2</sub>	1,8267	kg	299
	CO	0,001	kg	0
	HC	0,001	kg	0
	No <sub>x</sub>	0,0032	kg	25
	sooty particle	0,005	kg	3
products	electric current	460	kWh	12838
	heat	66	kWh	1254
	sale total	532	kWh	14092

...and others



## SPI of the biogas process:



maize cultivation = inputs

NO<sub>x</sub> gas engine = outputs

investments = planning/construction and equipment/machines

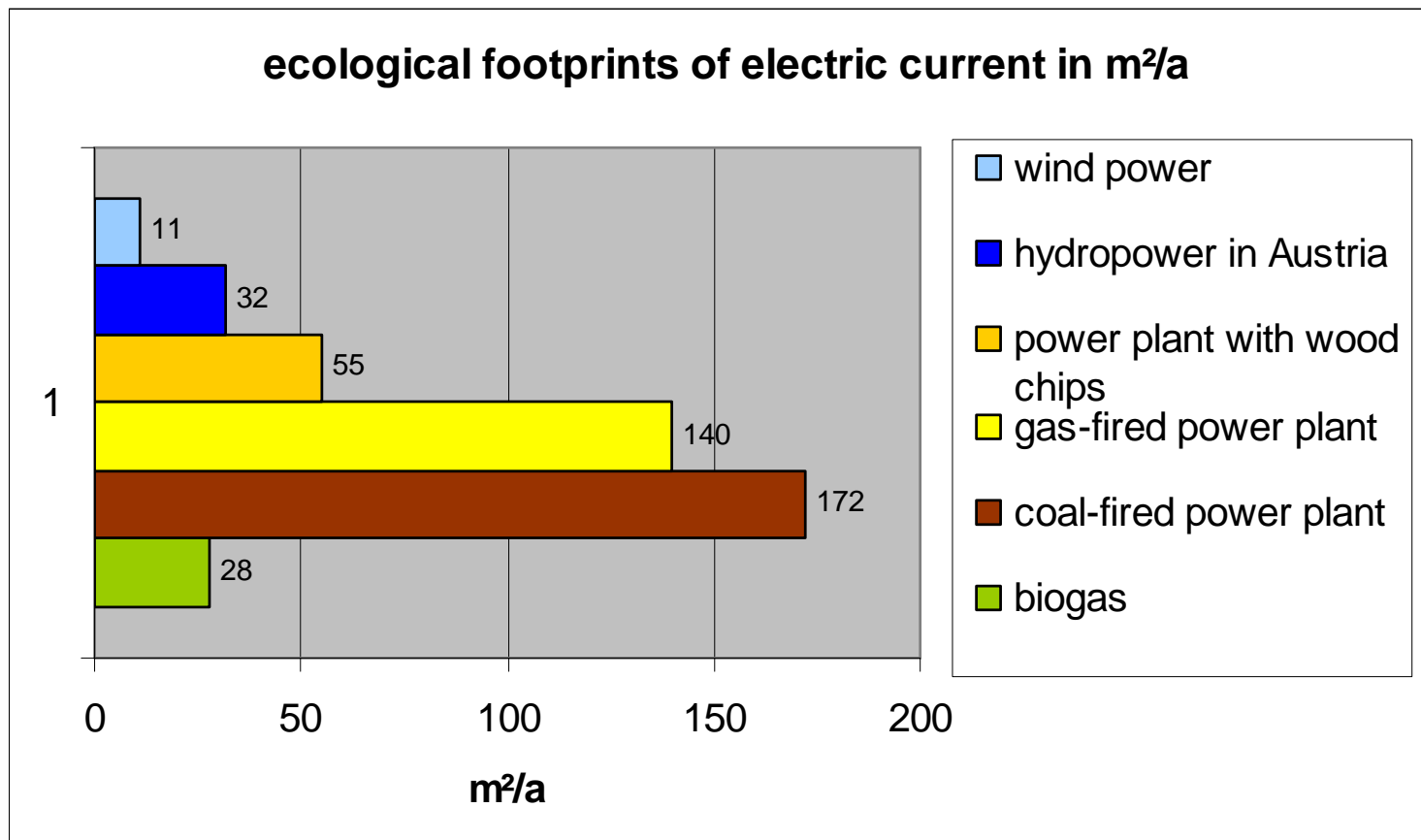
others = maintenance, gas processing and human labour



# SPI of the biogas process per electric energy

28 m<sup>2</sup>/a / kWh

28 m<sup>2</sup> (raw material-, emission-, cultivation area) for one kWh electric current are used for one year.





Thank you  
for your  
attention!