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Energy Positive Farm - ENPOS

Energy consumption in plant production,
specific figures, energy ratio

ENPOS Seminar - Energy use in plant production - Otepää 20 - 22 January 2010

Energy input for plant production:

- ▶ Direct energy input
 - ▶ Fuel for engines
 - ▶ Electricity for operations on the farm (conveyors, illumination, fans, ...)
 - ▶ Energy for grain drying
 - ▶ Radiant energy from the sun
- ▶ Indirect energy input
 - ▶ Seeds
 - ▶ Production of agrochemicals (fertilizers, lime, pesticides)
 - ▶ Manufacturing of machines
 - ▶ Construction of buildings
 - ▶ Human work
 - ▶ Infrastructure (roads, electricity and data networks, pipelines, ...)
 - ▶ Social services (health care, education, administration, ...)
 - ▶ Environmental services (wind, rain)

Some basic suggestions for the analysis

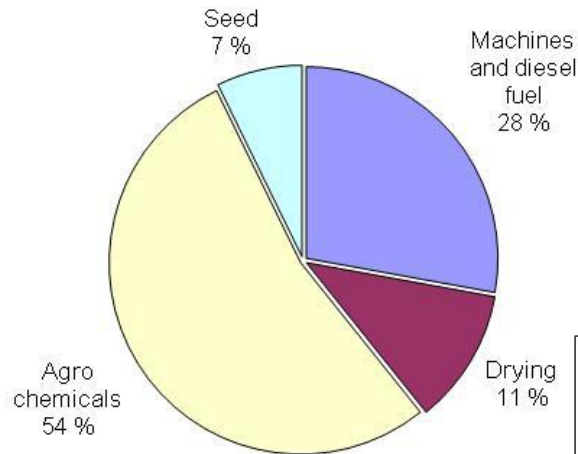
- ▶ Plant production system should be defined keeping in mind targets of the analysis – ENPOS →
 - ▶ Analysis of energy use on Finnish and Estonian farms
 - ▶ Suggestions for improving energy efficiency
- ▶ Energy consumption is considered transparently → a detailed description of assumptions and system definitions
- ▶ Secondary energy is converted to primary energy
- ▶ Results are presented versatily with appropriate key figures (GJ/ha, MJ/kg, energy ratio, net energy, ...)
- ▶ Simultaneous analysis of CO₂ emissions is advisable

Energy consumption of field operations

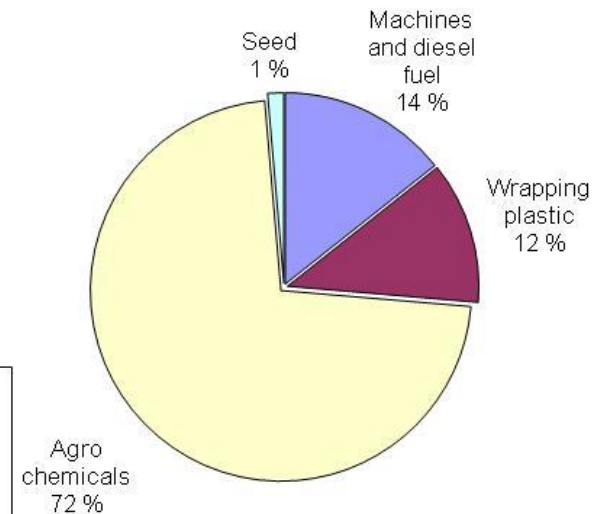
- ▶ Operations: soil tillage, seeding, fertilization, liming, plant protection, combine harvesting, moving, baling, ...
- ▶ Fuel consumption values l/ha are available in literature
- ▶ Range may be wide depending on conditions, e.g. for ploughing 21.6 – 31.0 l/ha
- ▶ If there are many references available, the mean could be used. However, consideration is needed if local conditions demand higher or lower consumption than the mean.

Distribution of input energy in Finnish plant production

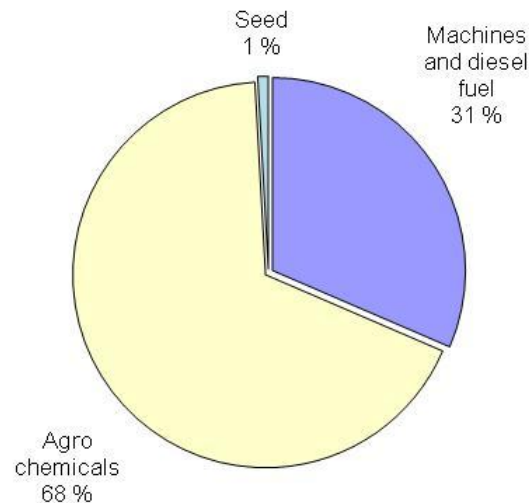
Barley, 11.6 GJ/ha total



Lay for silage, 15.5 GJ/ha total



Sugar beet, 18.1 GJ/ha total

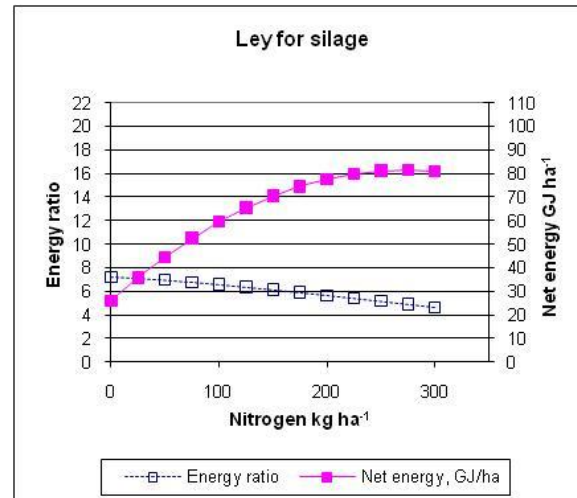
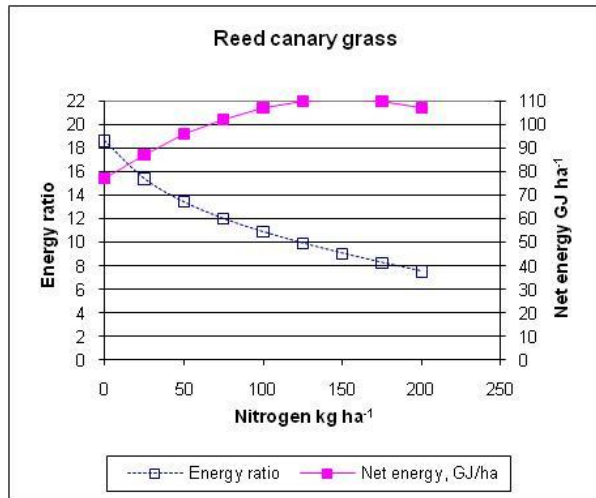
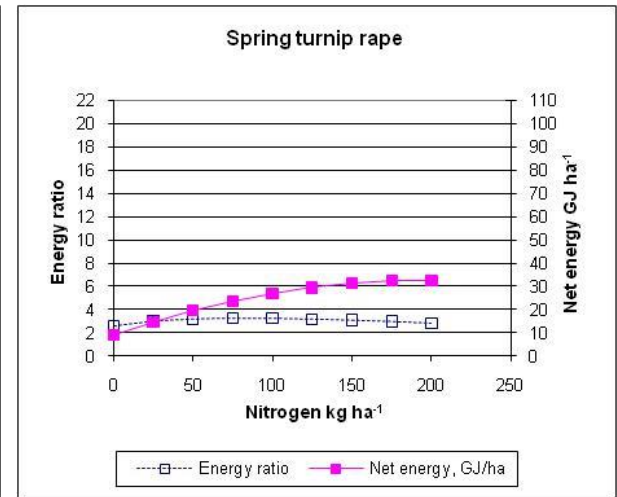
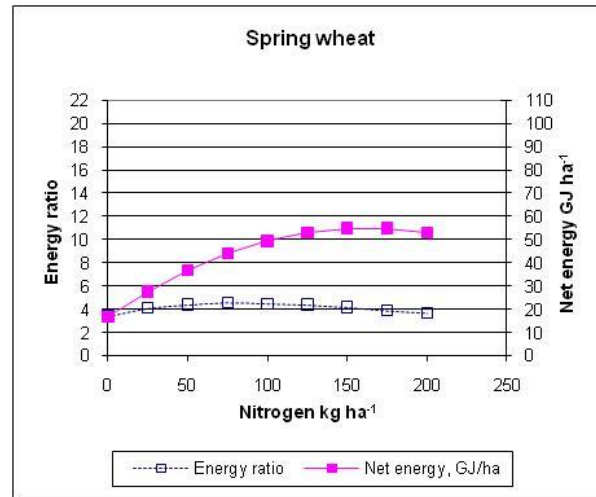
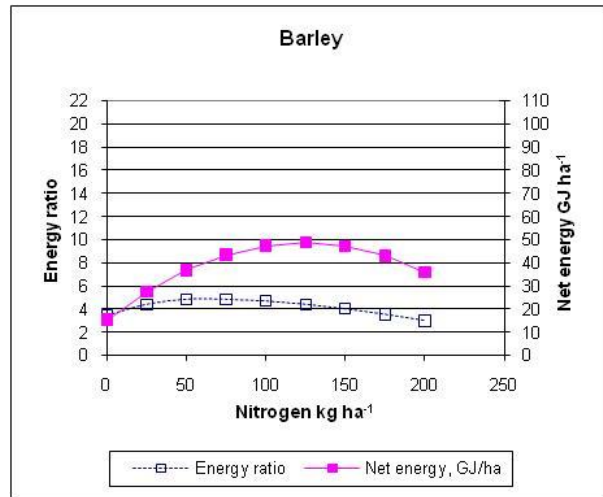


Energy ratio

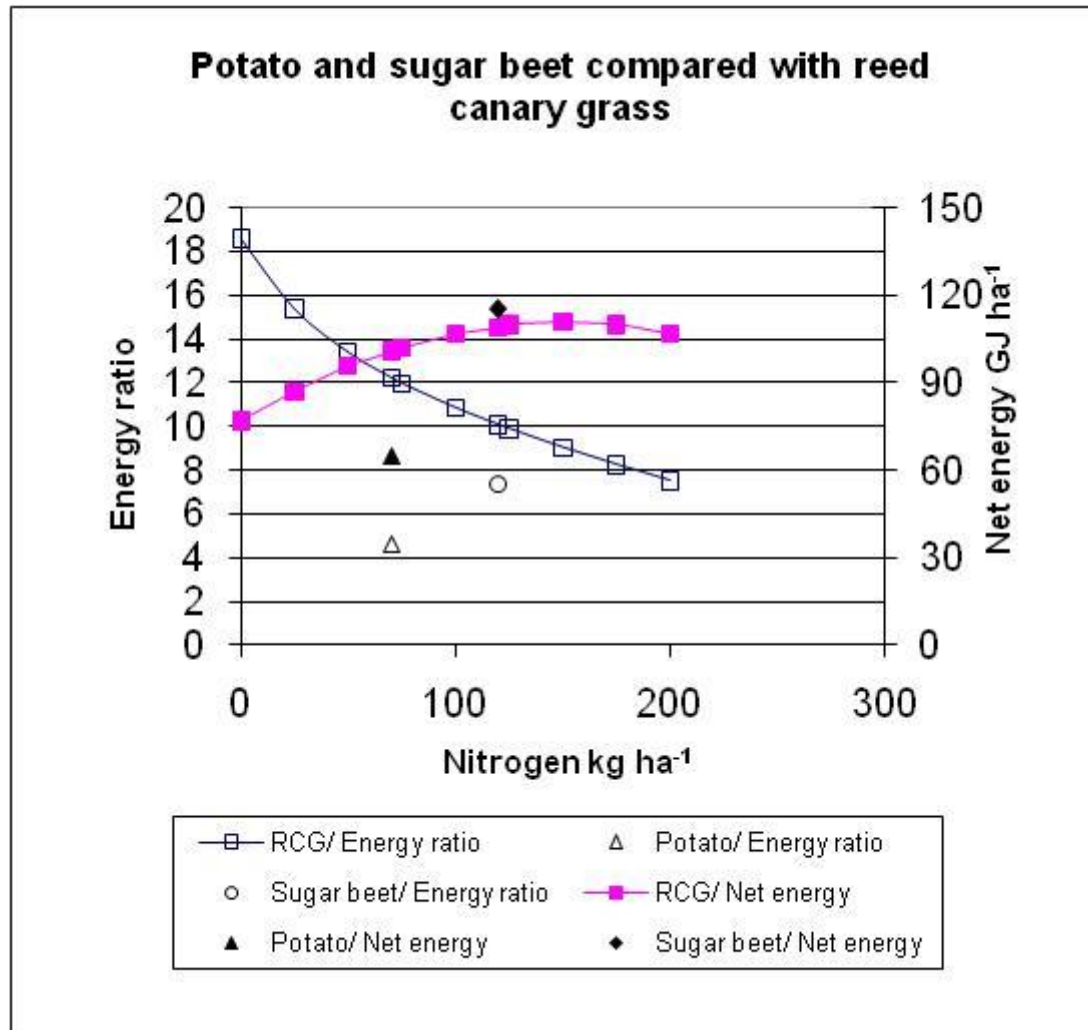
- ▶ Energy ratio = Output/Input
- ▶ There is no exact target value, but should be $\gg 1$
- ▶ For further reading:

Mikkola, H. J. and Ahokas, J. 2009. Energy ratios in Finnish agricultural production. *Agriculture and Food Science*, Vol. 18 (2009): 332 – 346.

Energy ratio and net energy in Finnish plant production 1 (2)



Energy ratio and net energy in Finnish plant production 2 (2)



Conclusions

- ▶ The energy ratio of Finnish field crops varied from 2 to 18
- ▶ The energy ratio of reed canary grass was the highest and reed canary produced as high net energy yield as sugar beet
- ▶ Low fertilization intensity favours high energy ratio and high intensity high net energy
- ▶ Energy ratio and net energy are useful key figures for ranking potential bioenergy crops