Life cycle analysis of bread production

– a comparison of eight different options –

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Questions

- How to produce bread being most environmentally friendly ?
- Which of the process steps, including transports, do account for the highest or lowest environmental effects ?
- At which processes is it feasible to introduce ecological optimisations or to reduce environmental implications, and what are the corresponding recommendations ?

Goal definition

- **Functional unit:**

  1 kg bread ready for consumption at home.

- **System boundaries:**

  Production in Germany. Pre-chains: split worldwide.

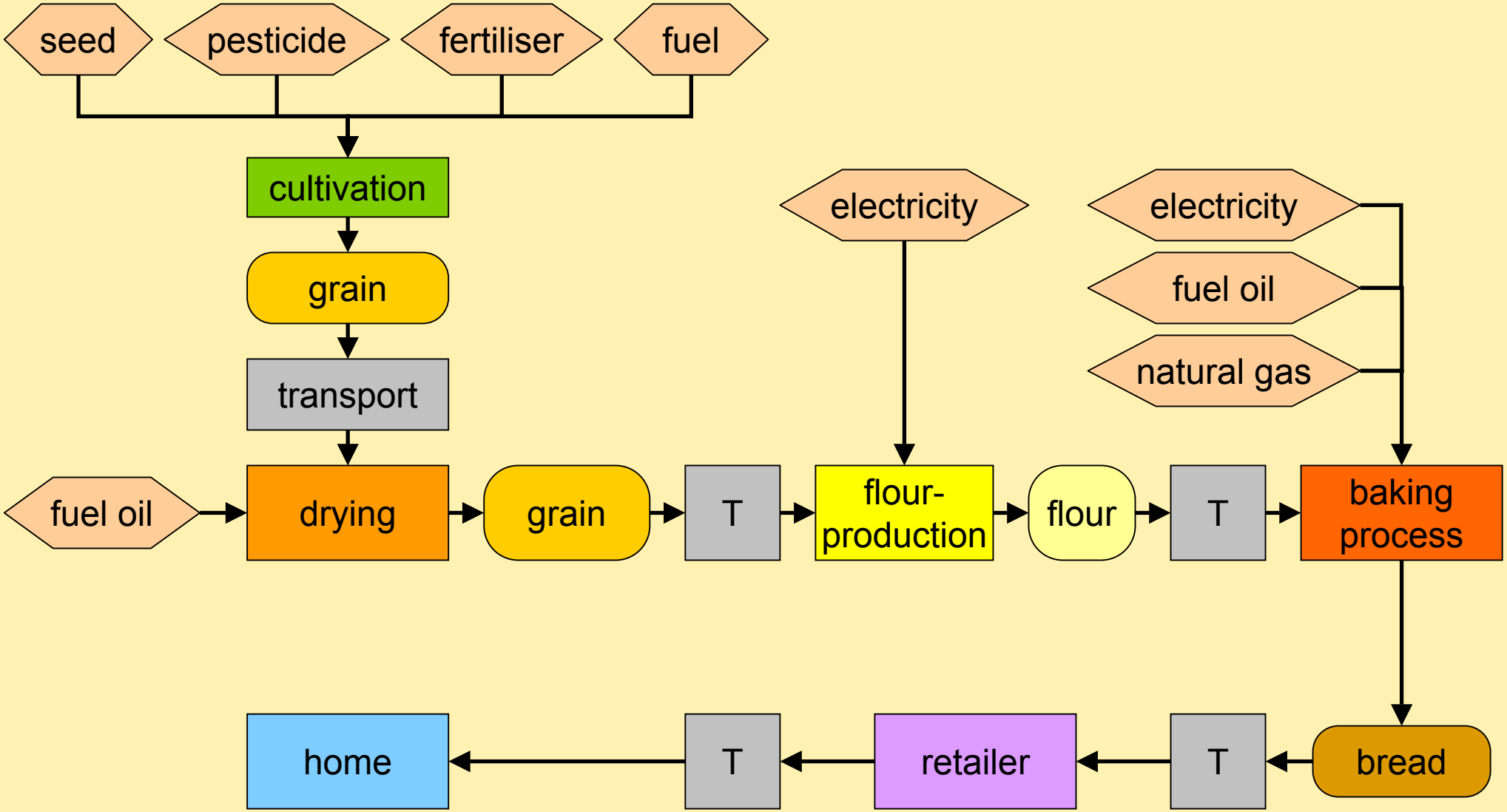
- **Others:**

  Basic data, assumptions, allocation issues et cetera: see paper.

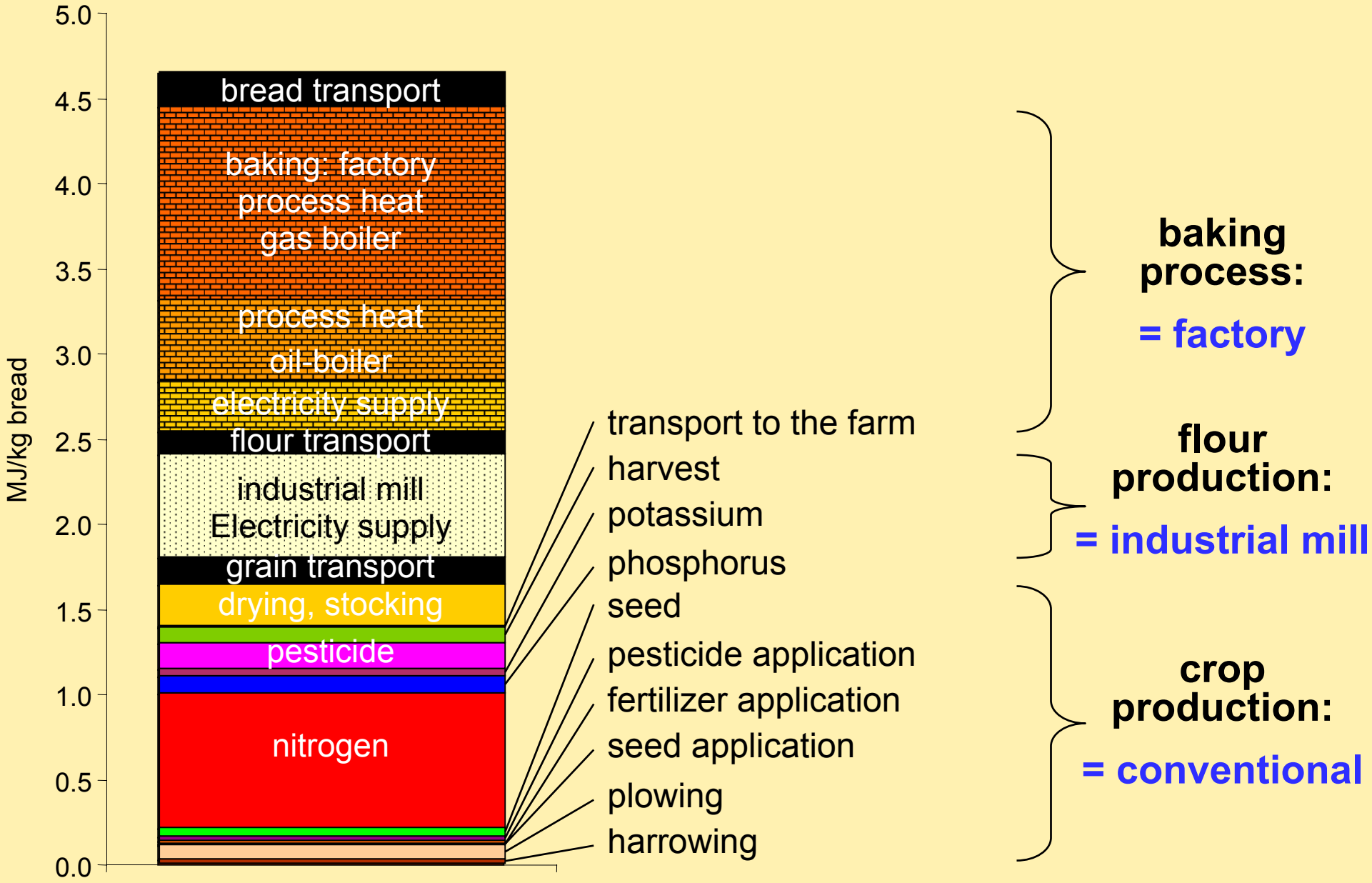
Impact Assessment

Environmental impact	Indicator	Parameter
Resource depletion	cumulated non-renewable primary energy	Crude oil, natural gas, mineral coal, lignite, uranium ore
Greenhouse effect	CO_2-equivalents	CO_2, N_2O, CH_4
Ozone depletion	N_2O	N_2O
Acidification	SO_2-equivalents	SO_2, NO_x, NH_3, HCl
Eutrophication	PO_4-equivalents	NO_x, NH_3
Photo smog	Ethene-equivalents	CH_4, NMHC
Land use	ha	ha

Life Cycle of the bread production



Energy demand



Differentiation of important processes

- **Crop production:**

  conventional ⇔ organic

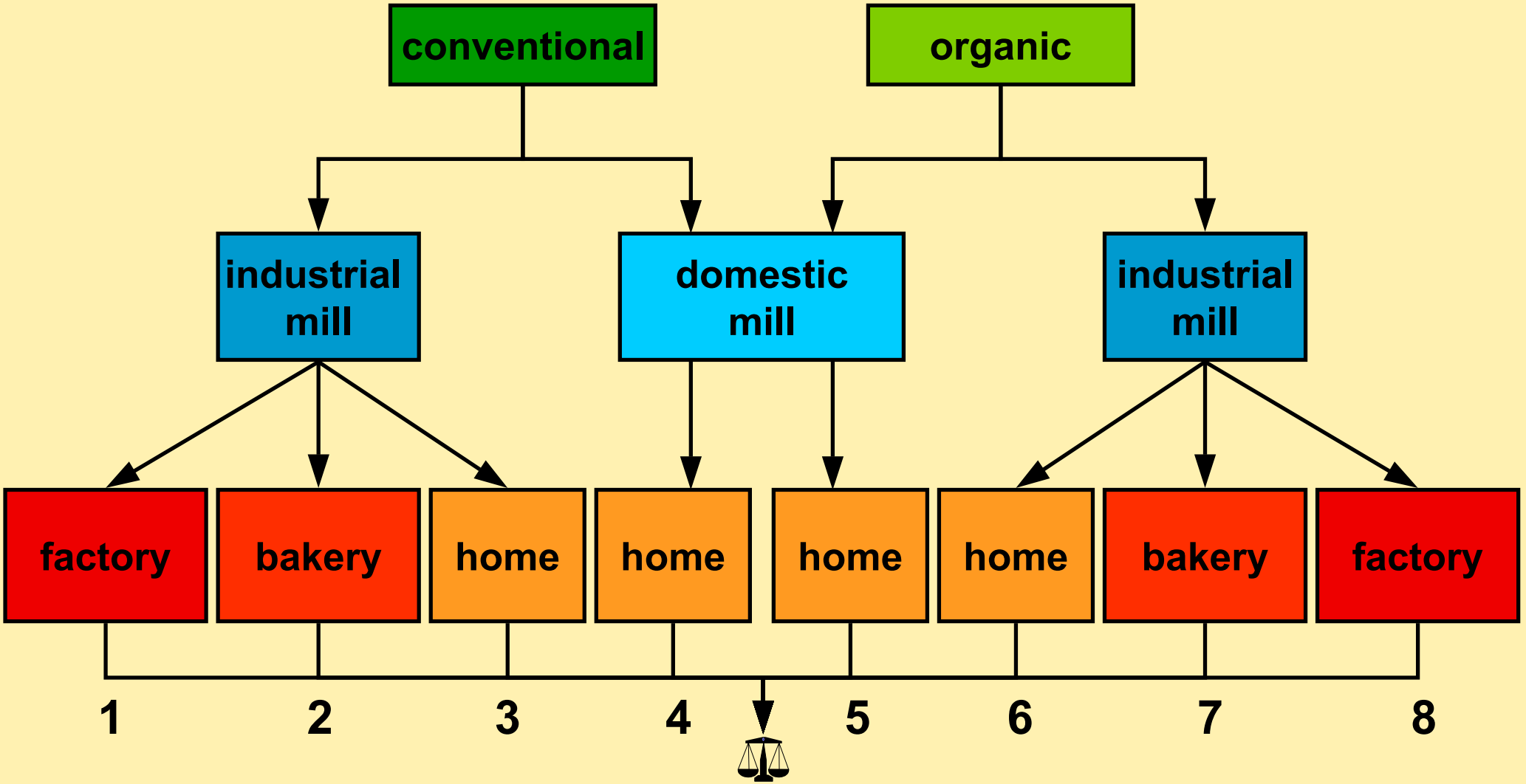
- **Flour production:**

  industrial mill ⇔ domestic mill

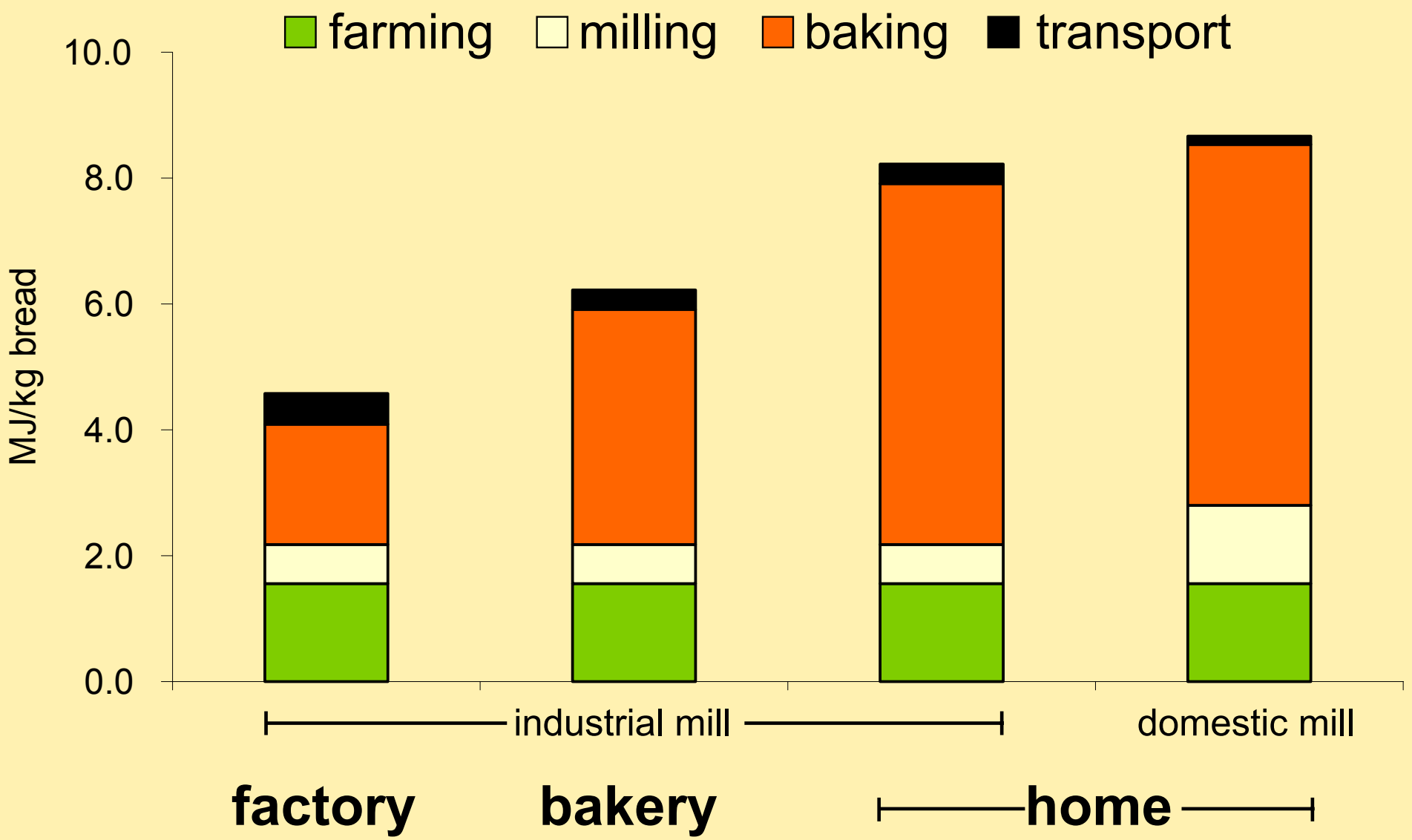
- **Baking technologies:**

  large bread factory ⇔ bakery ⇔ domestic bread maker

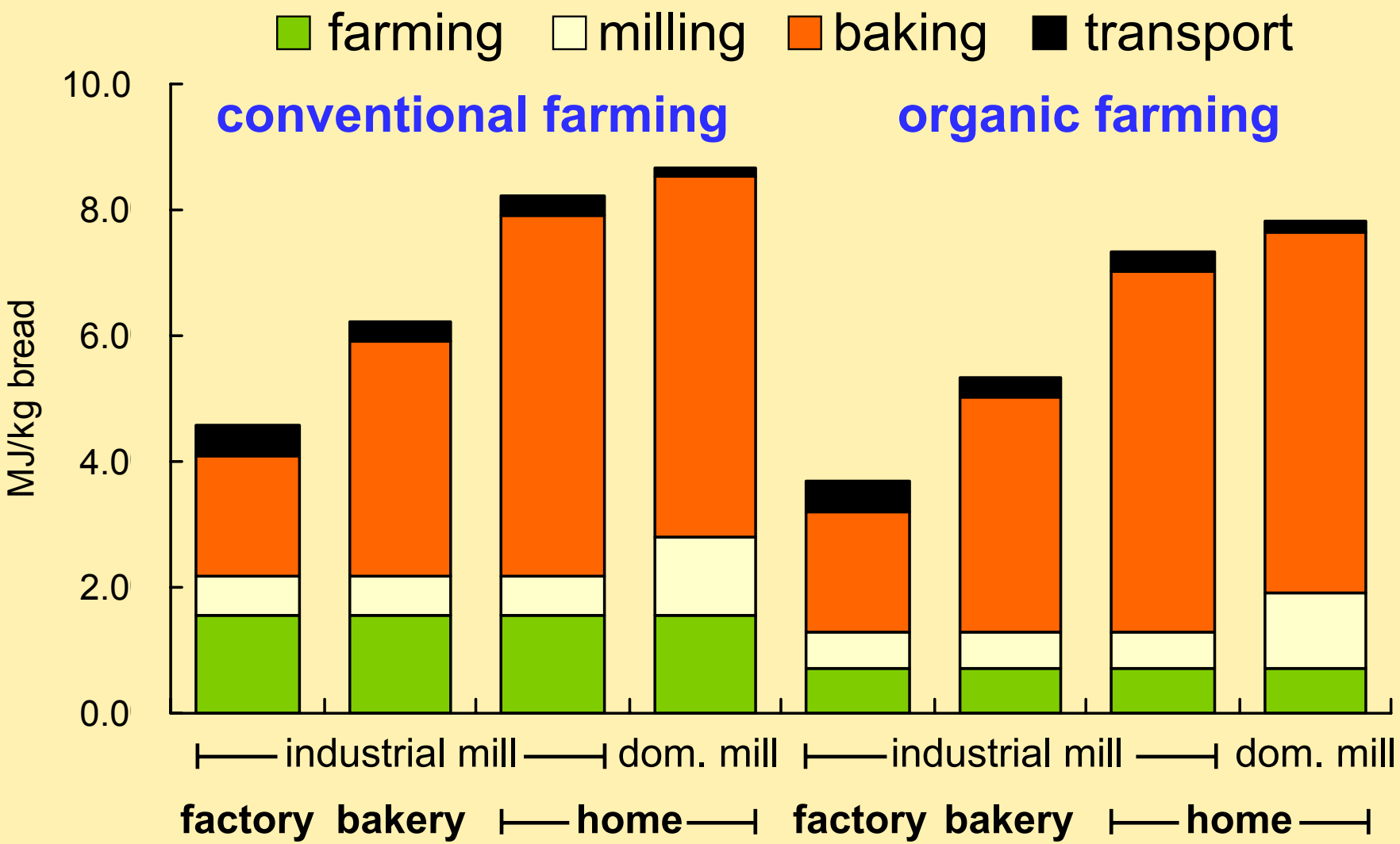
8 scenarios to produce bread



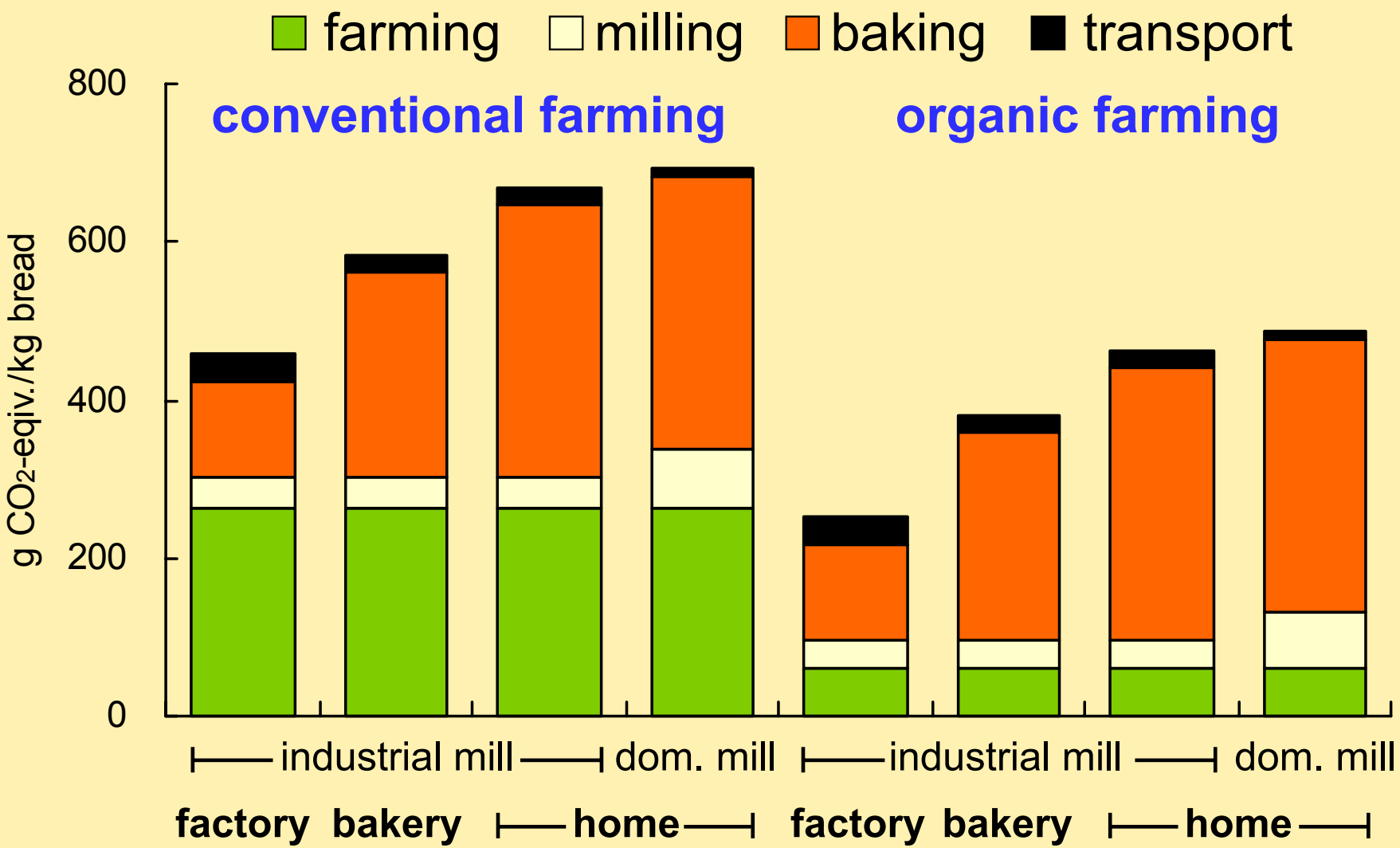
Energy demand



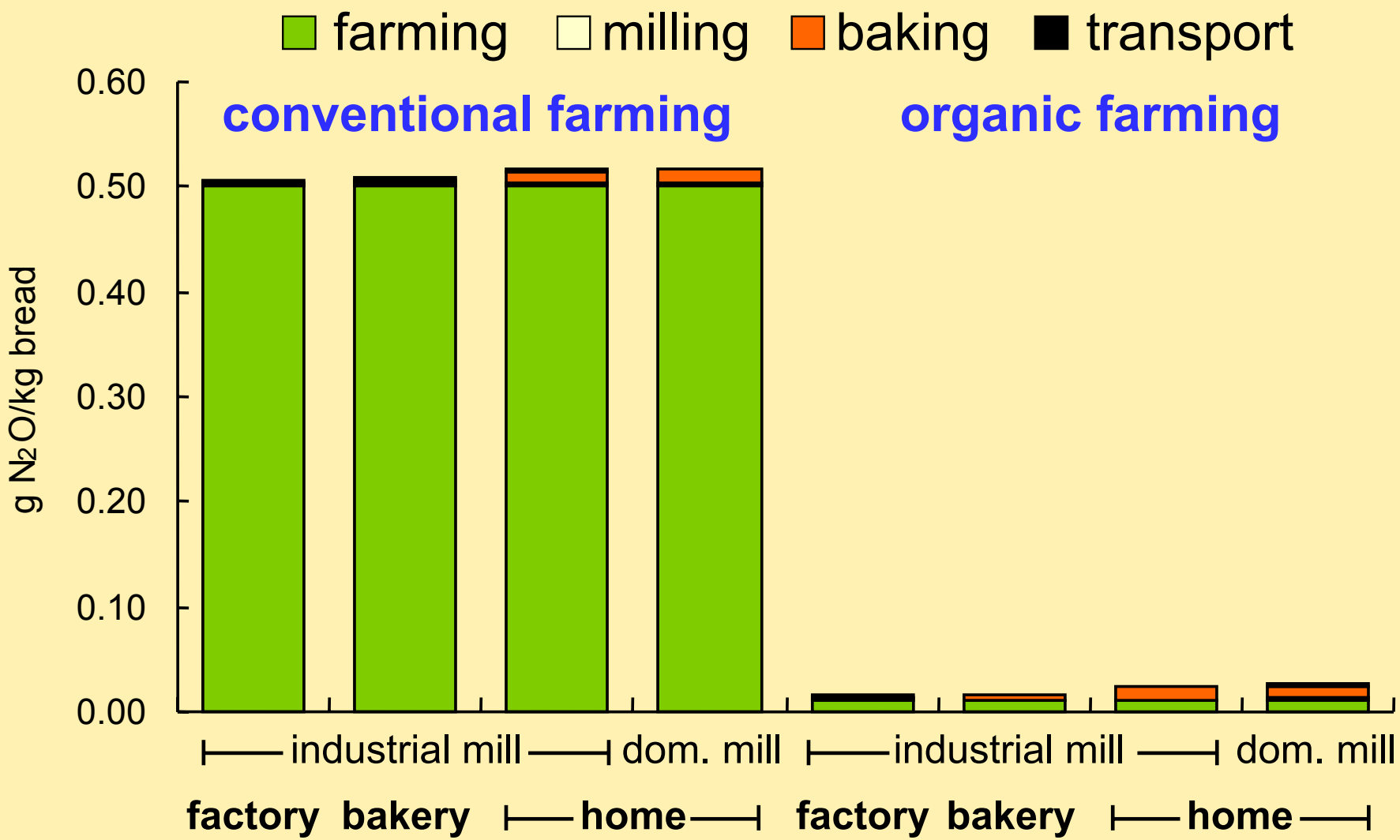
Energy demand



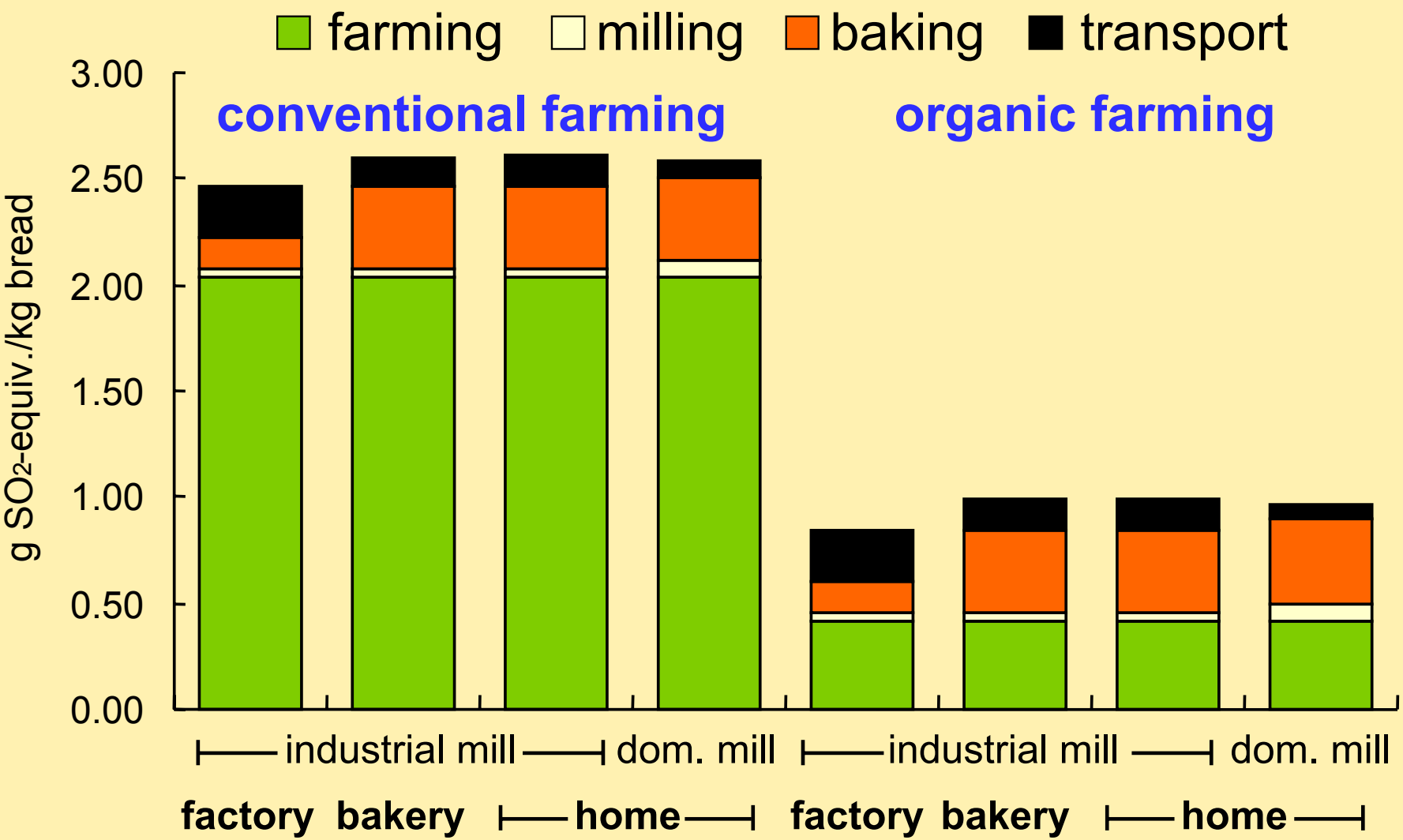
Greenhouse effect



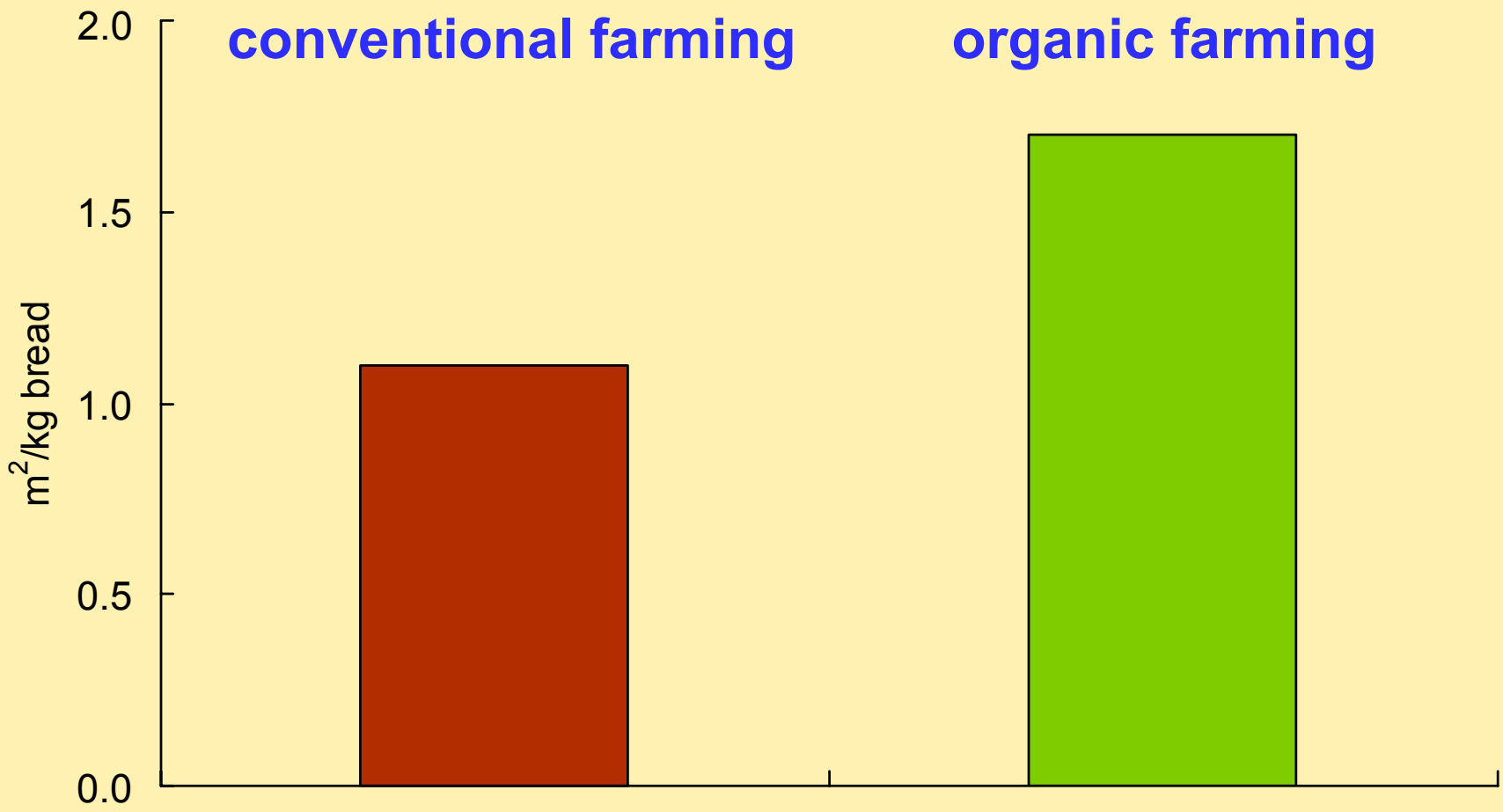
Ozone depletion



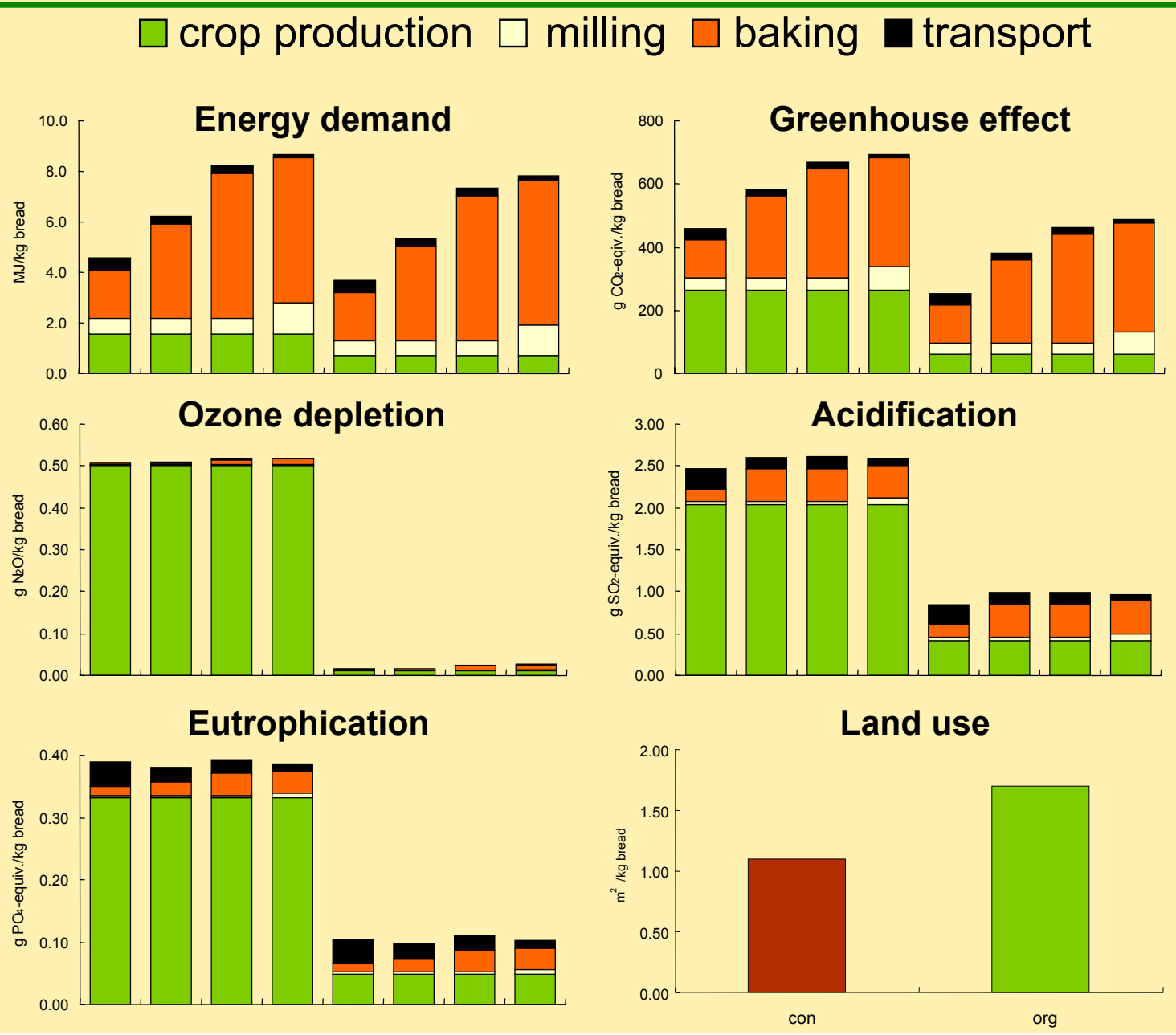
Acidification



Land use


conventional farming
organic farming
2.0
1.5
1.0
0.5
0.0
m²/kg bread

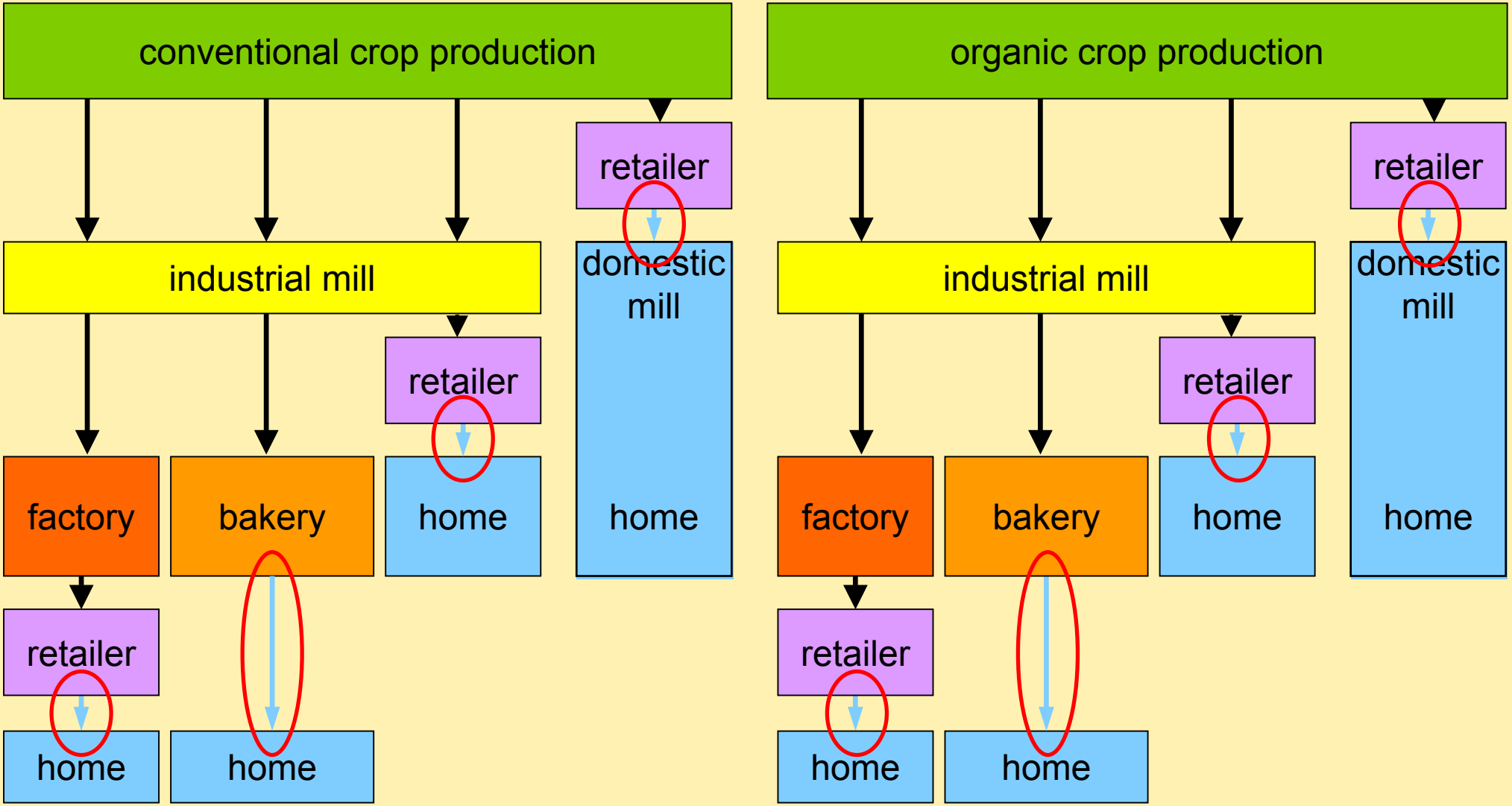
LCIA results



Results

- Organically produced grain has to be preferred to grain that was produced conventionally regarding all impact categories except land use.
- Flour may be produced preferably in an industrial mill rather than in a domestic mill.
- Ranking the bread baking process from the most to least advantageous option results in the order: factory, local bakery and domestic bread maker.
- **Sensitivity analysis for transportation**

Transport by the consumer



Assumptions

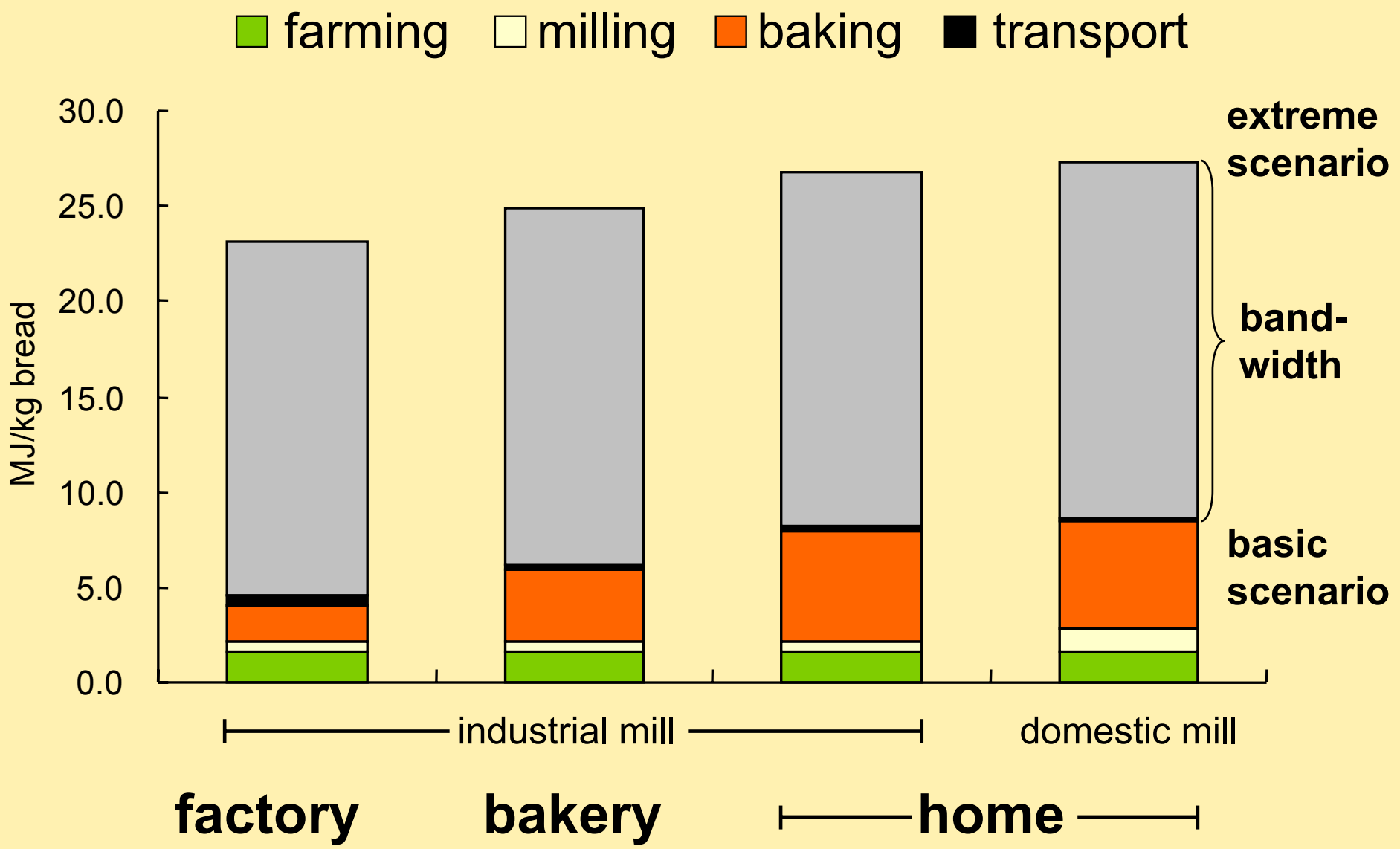
Basic scenario

- Transport of bread from the bakery: by bicycle.
- Transport of grain, flour or bread from the supermarket:
  by car without driving detours (on the way from / to work etc.).

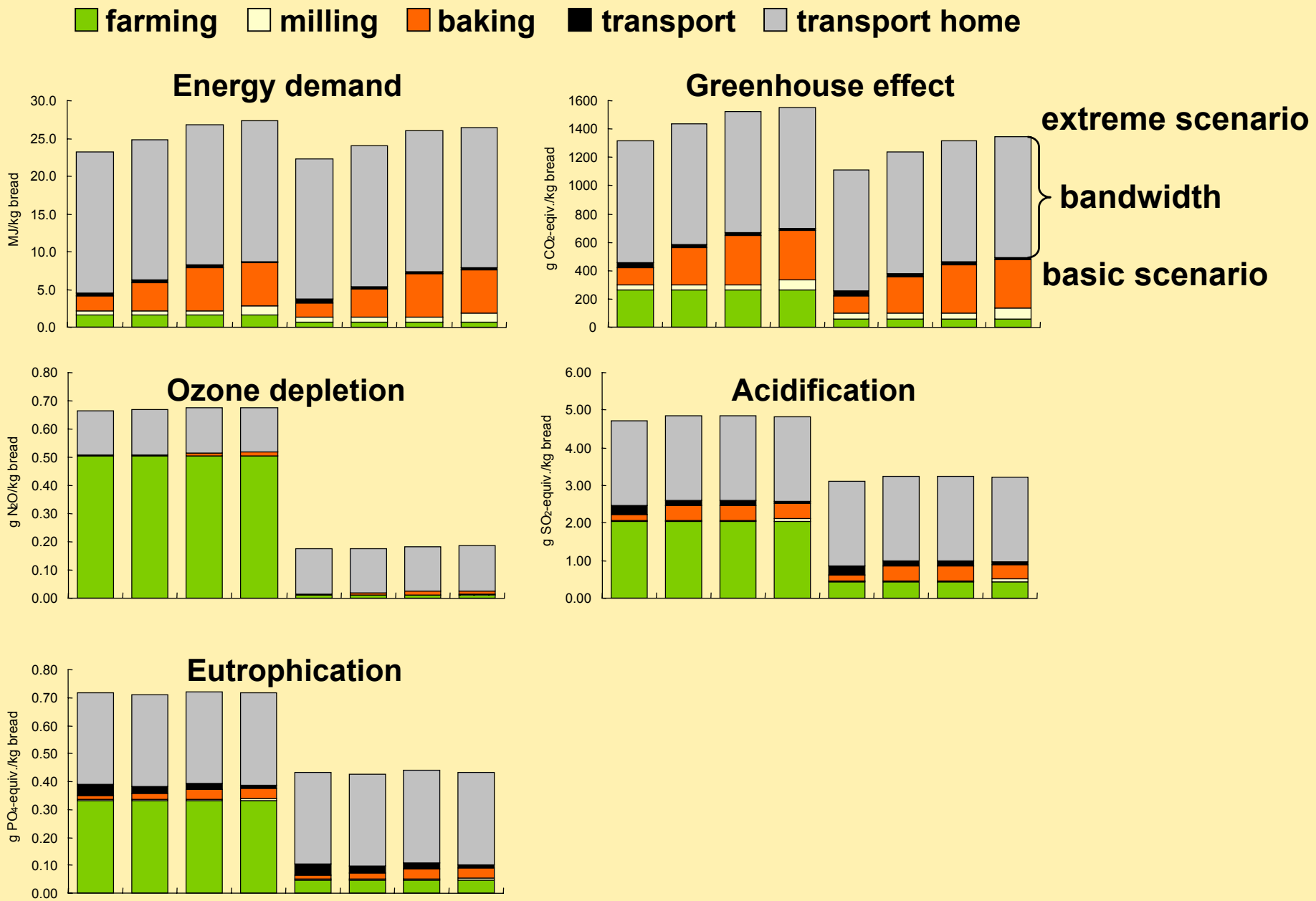
Extreme scenario

- Transport of 1 kg of bread, flour or grain by car (4 km round trip).

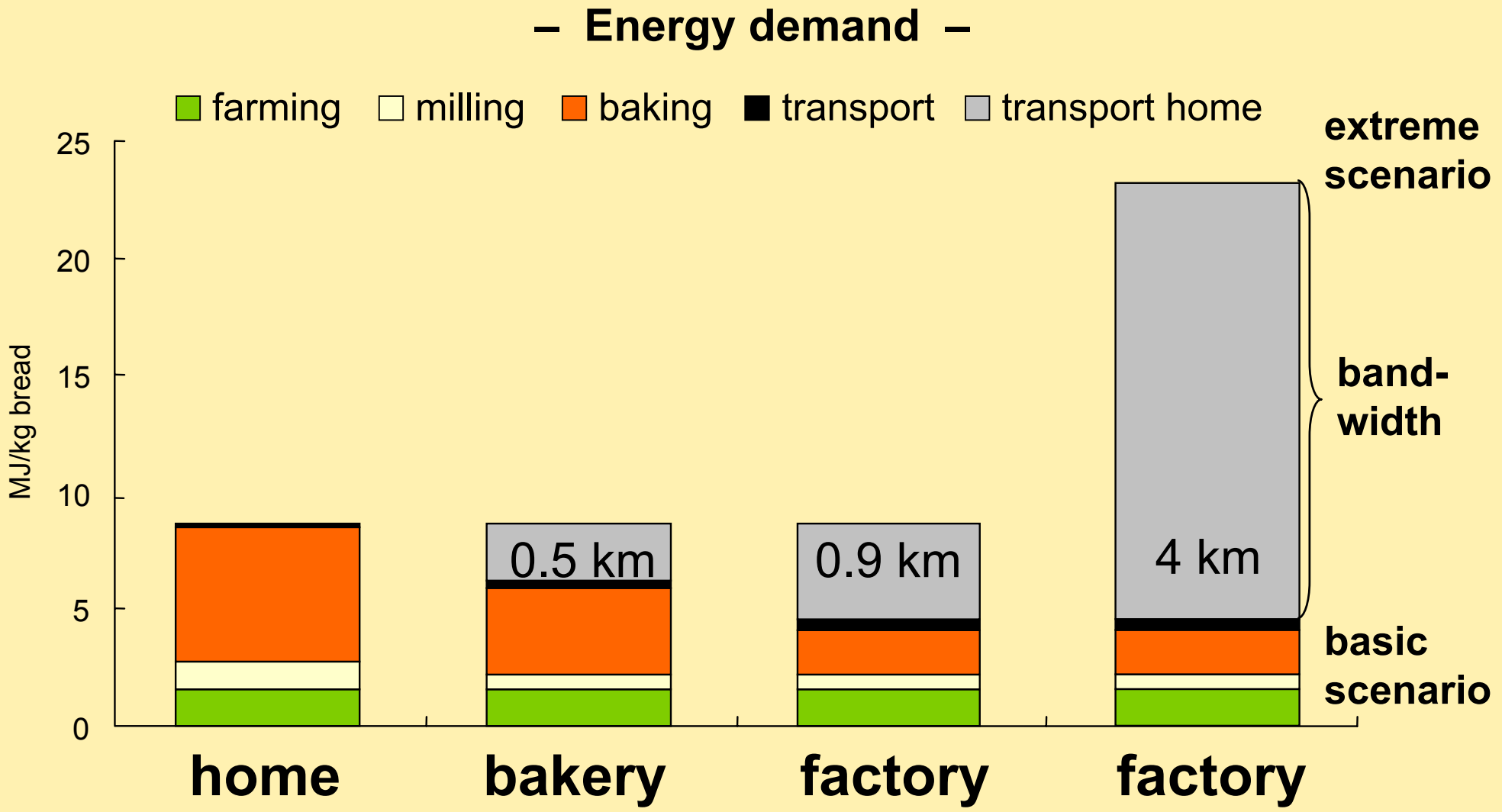
Sensitivity analysis: transport



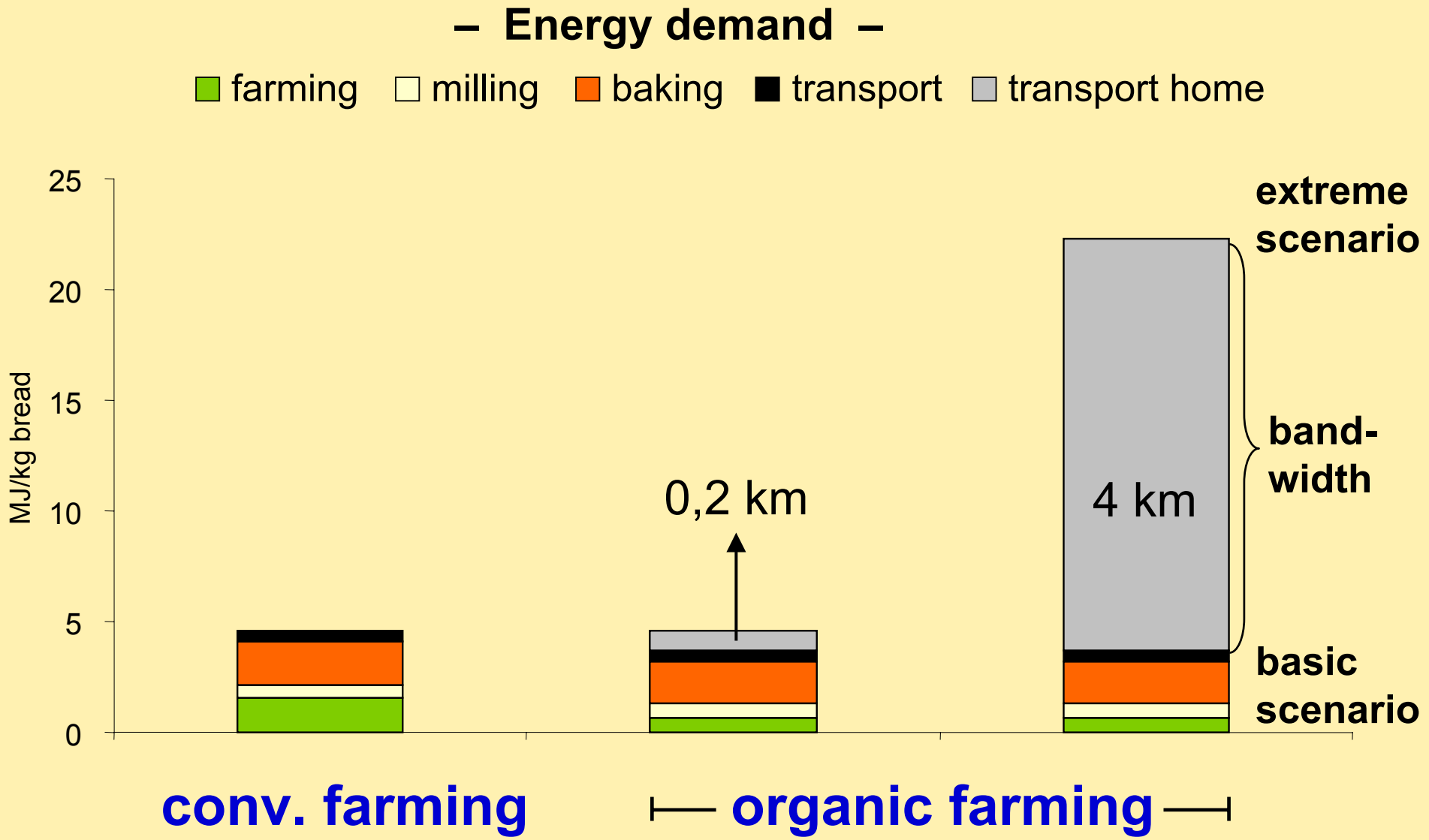
Sensitivity analysis: transport



Transportation: Break even points

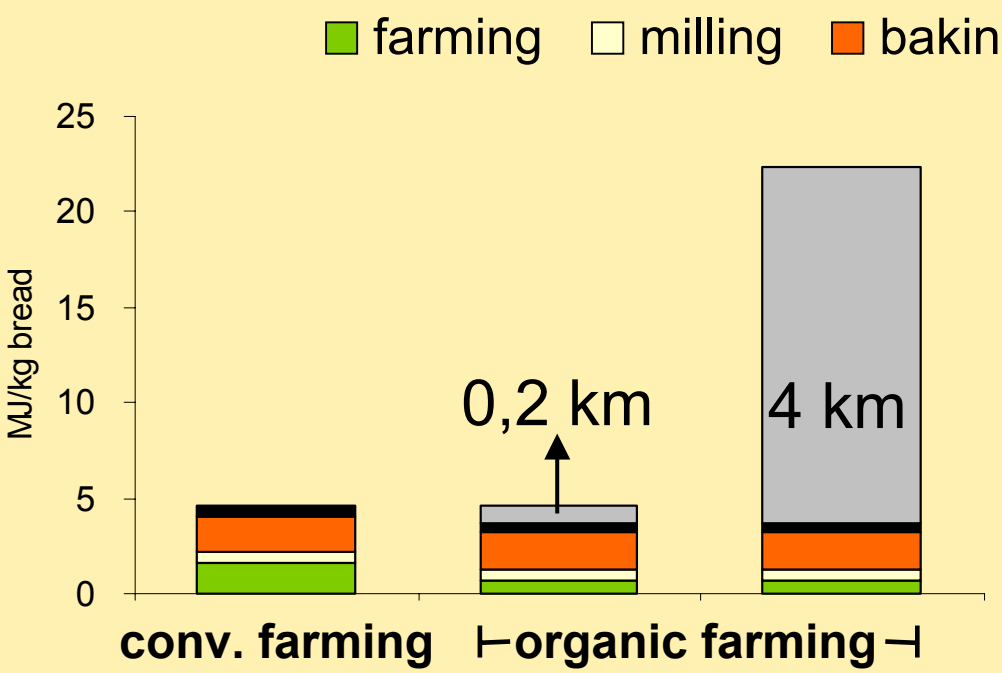


Transportation: Break even points

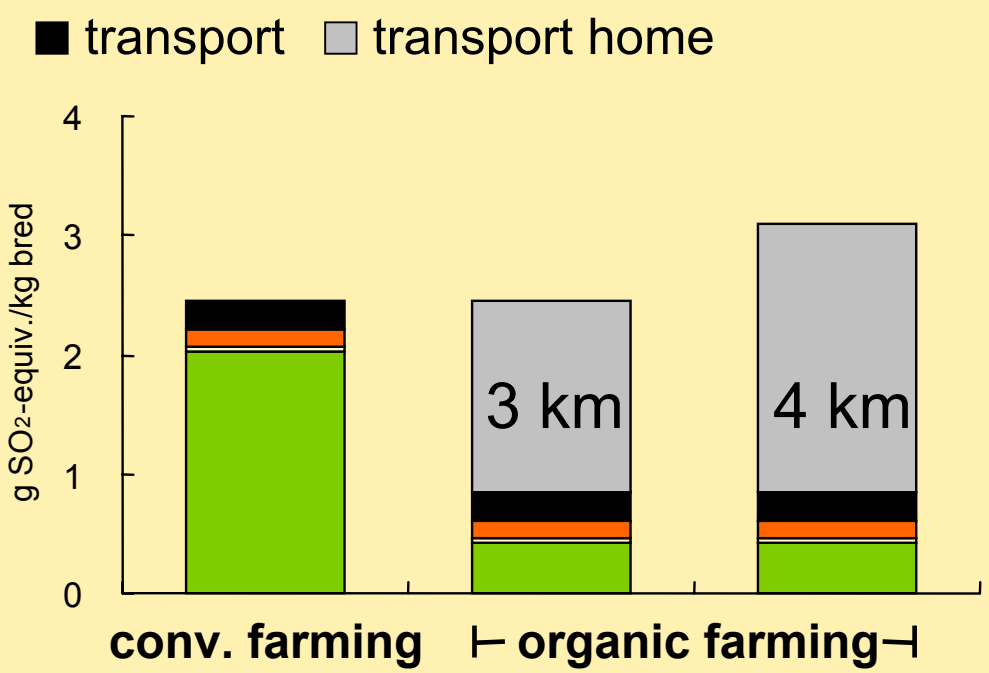


Transportation: Break even points

– Energy demand –



– Acidification –



Results

Advantages and Disadvantages of each processing step:

Farming:	**Organic**	⇔		**Conventional**
Milling:	**Industrial mill**	⇔		**Domestic mill**
Baking:	**Bread factory**	⇔ **bakery**	⇔	**Domest. bread maker**

➡ For the ultimate appraisal the **transport** of grains, flour or bread respectively, by the consumer is of evident importance.

Recommendations

If land use is more important than all the other environmental impact categories:

⇨ **grain from conventional farming has to be preferred to grain that was produced organically**

If land use is of minor relevance compared to saving of resources, greenhouse effect, ozone depletion, acidification and eutrophication:

⇨ **grain from organic farming has to be preferred to grain that was produced conventionally**

Recommendations

Bread factories / Supermarkets

- Use cereals from organic production.
- Mount campaigns, that customers buy as much as possible at once and if possible without driving detours (buy on the way from / to work etc.).

Bakeries

- Use cereals from organic production.
- Optimise the energy demand.
- Mount campaigns, that customers don`t use the car to buy bread.

Recommendations

Consumer

- Buy bread from organically grown cereals in a supermarket.
  - If bread from organic grain is not available in the supermarket, customers have to ask for it to increase the demand and ...
  - ... buy it in a bakery.

- If baking at home, cereals from organic production and flour from industrial mills have least environmental implications.
  - Use a domestic bread maker instead of an oven.
  - If an oven is used, increase the degree of utilisation.

- Don’t use a car to transport bakery products. If a car is used, buy also other groceries and without driving detours (on the way from/to work etc.).

Thank you – mange tak !

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