

Lower global warming potential of cucumbers and lettuce from a greenhouse heated by waste heat

or

How to make cucumbers out of garbage

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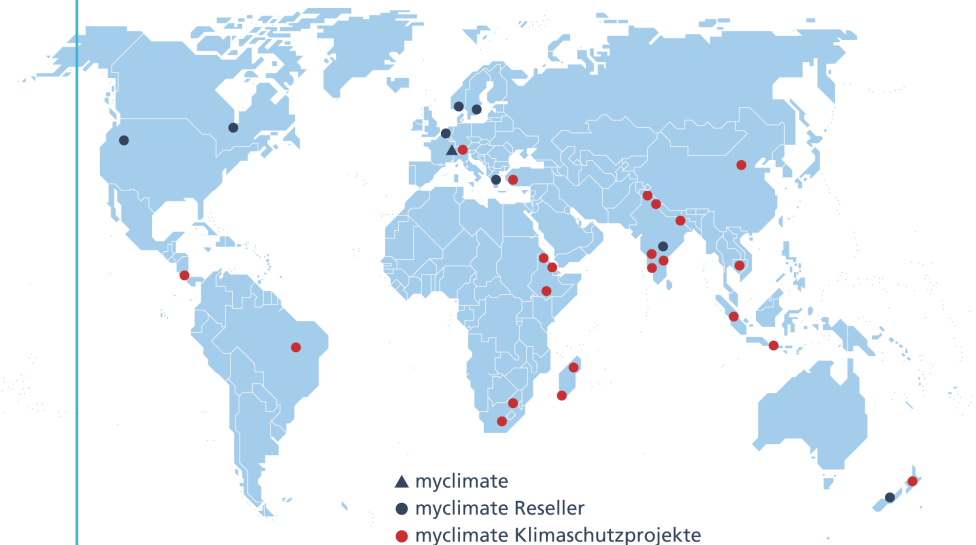
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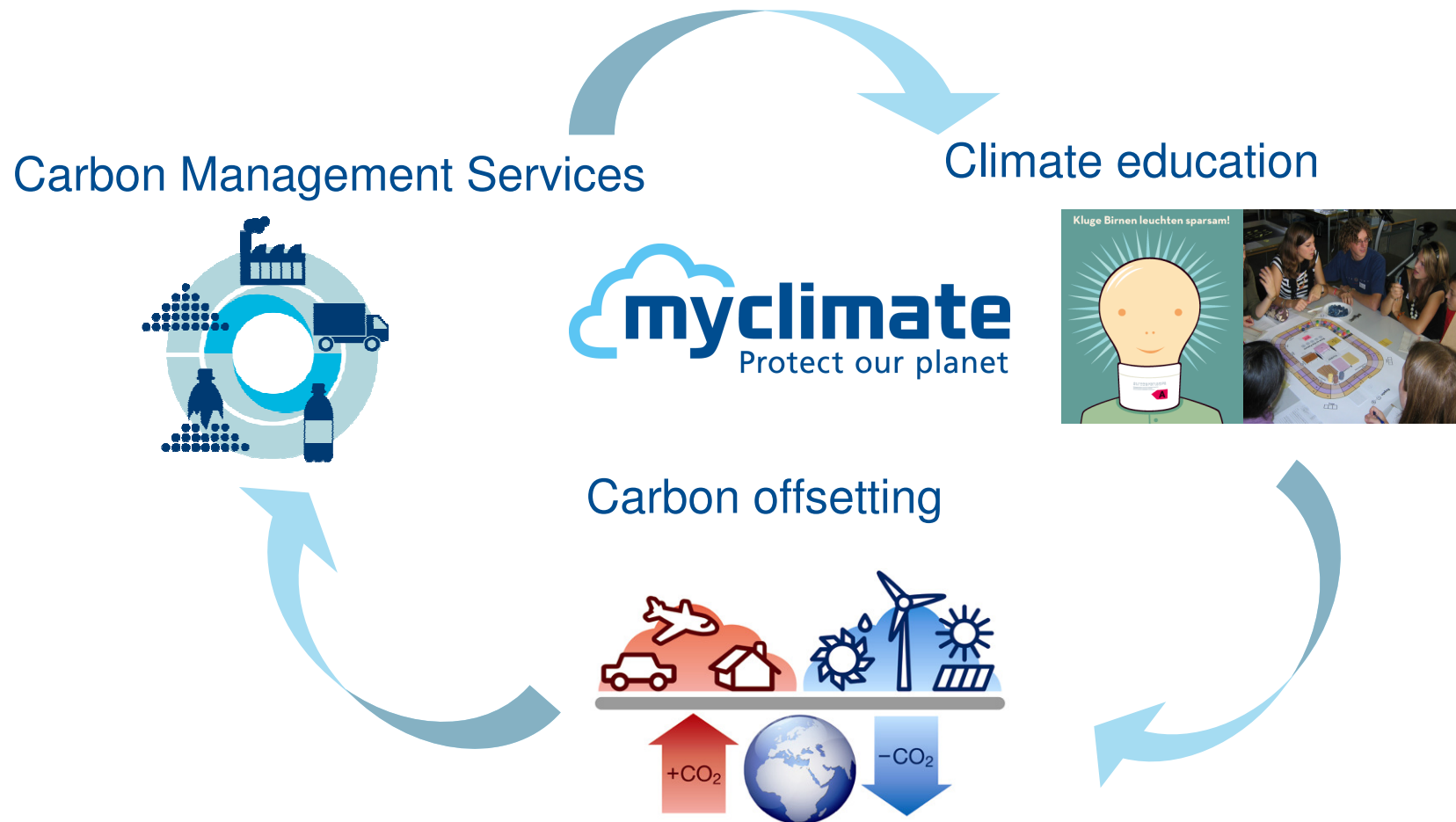
About myclimate

About myclimate: Who we are

- non-profit foundation in Zurich
 - founded in 2002, ETH spin-off,
 - 38 employees
- objective: climate protection
 - climate protection: measurable, efficient
 - sustainable development
- broad base
 - foundation board
 - economics, science, politics, NGO
 - patronage committee



About myclimate: Solutions for climate protection



The project



Image source: LID

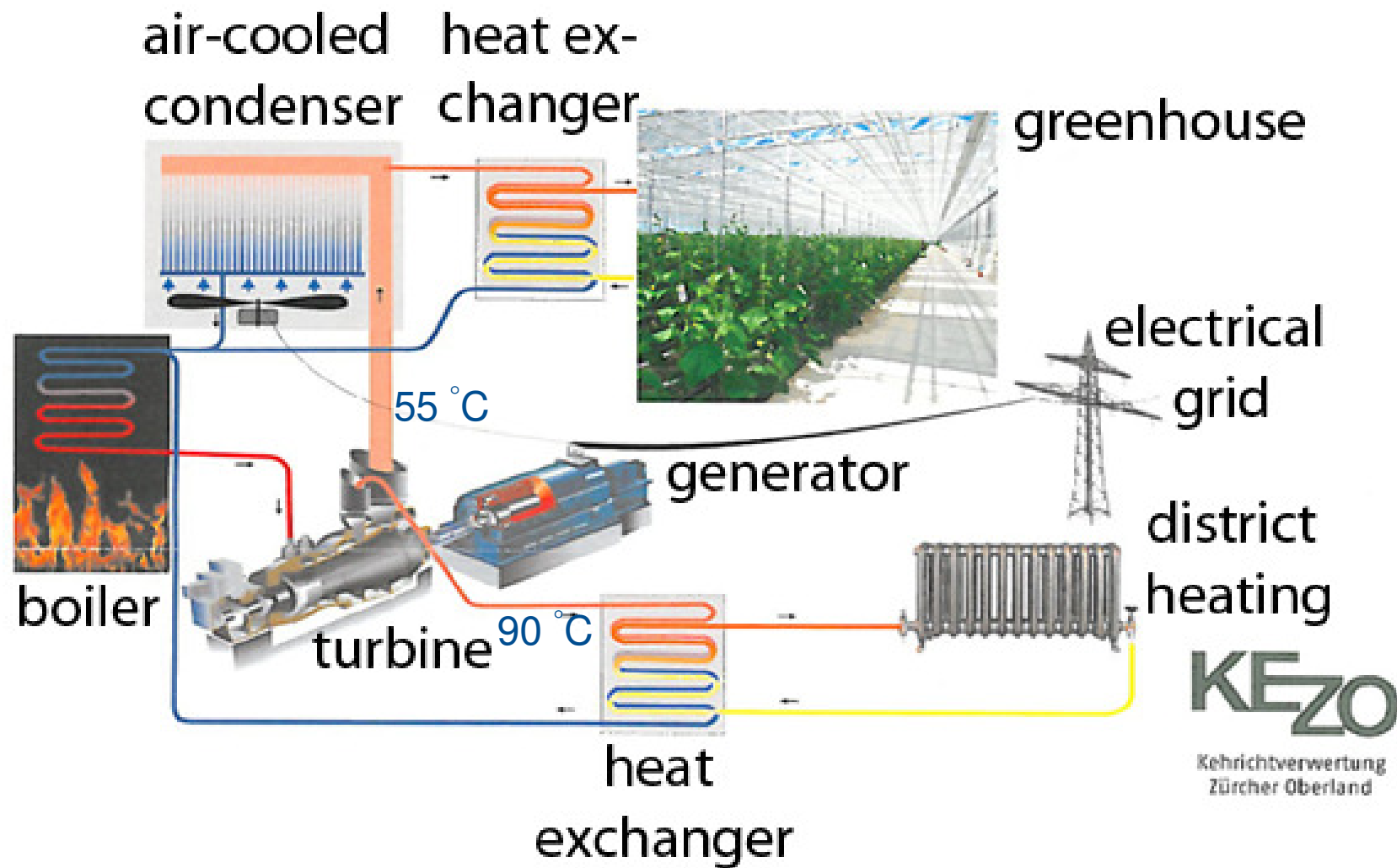
The waste incineration plant KEZO



Image source: http://en.wikipedia.org/wiki/File:Hinwil_-_KEZO_-_Ringwilerstrasse_IMG_8027.JPG

- Amount of waste: about 200 000 t
- Electric power generation: 116 704 MWh
- Heat production: 27 973 MWh

Heating system



Methodology

Goal and Scope

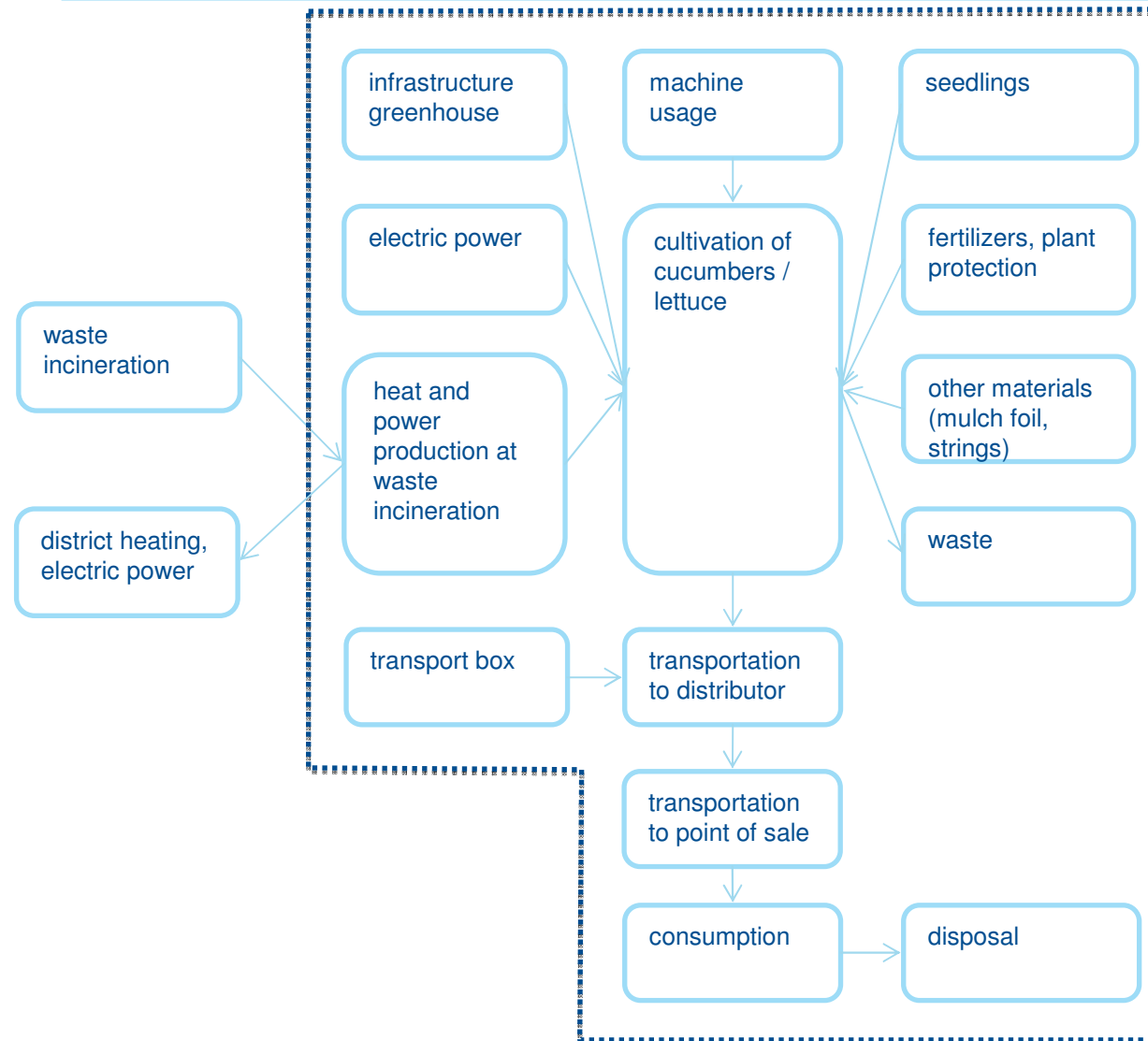
■ Goal

- General: Comparison of products from a waste heat heated and a fuel oil heated greenhouse
- Specific: Are there significant differences between the carbon footprints?

■ Functional unit:

- 1kg cucumber
- 1kg lettuce

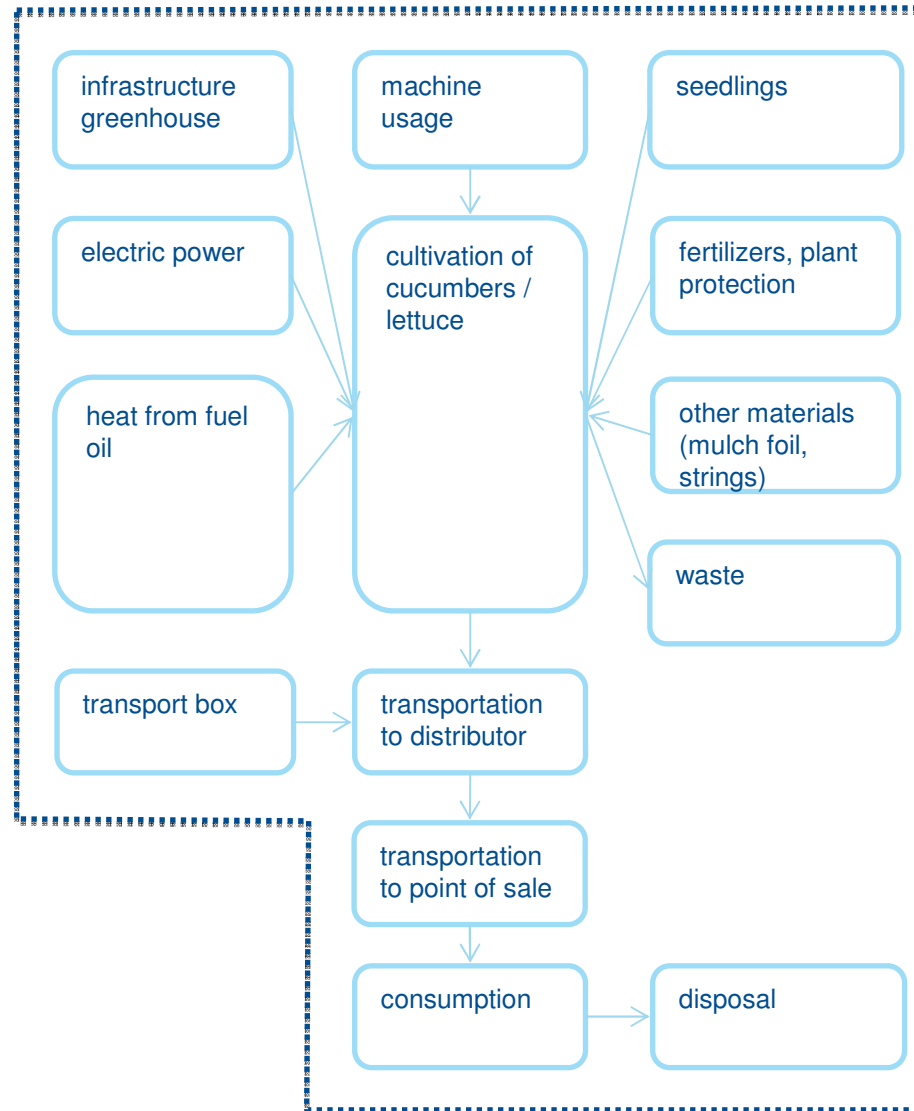
System boundaries I



System boundaries
of the Primanatura
greenhouse

Data source:
Primanatura AG,
KEZO,
ecoinvent 2.1

System boundaries II



System boundaries
of a conventional
greenhouse

Data source:
Agridea (2008),
Jungbluth (2000),
ecoinvent 2.1

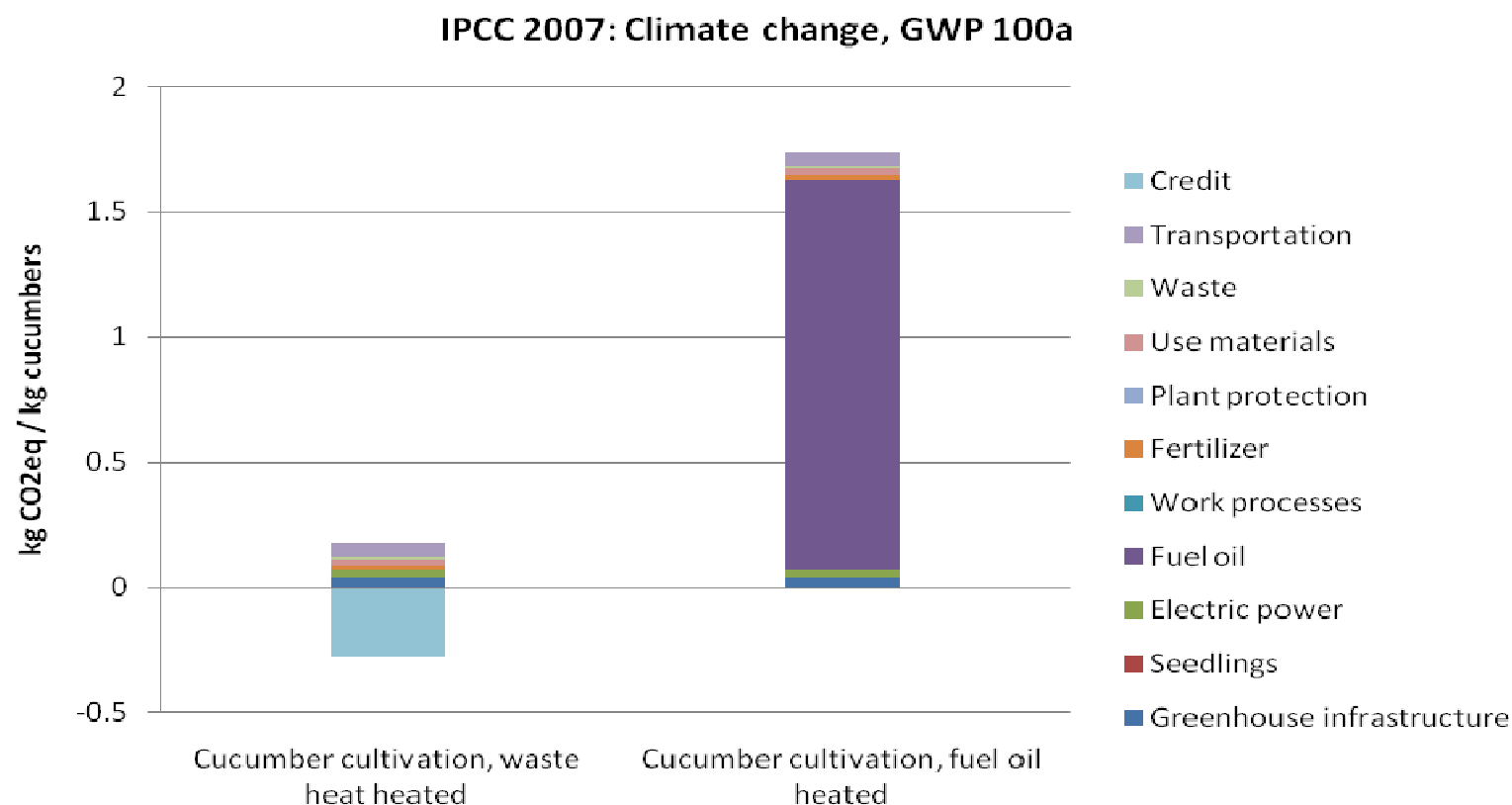
Credits ?!?

- Waste heat was formerly unused, too cold for district heating (55 °C vs. 95 °C)
- Increase of efficiency, more electric power generated
 - air-cooled condenser
 - load reduced, economisation of electric power
 - increase in productivity of the turbine
 - optimisation of negative pressure, additional production of electric power
 - heat pumps to provide heat for the greenhouse
 - energy consumption
 - net increase of 110 kW electric power

Results

Cucumbers

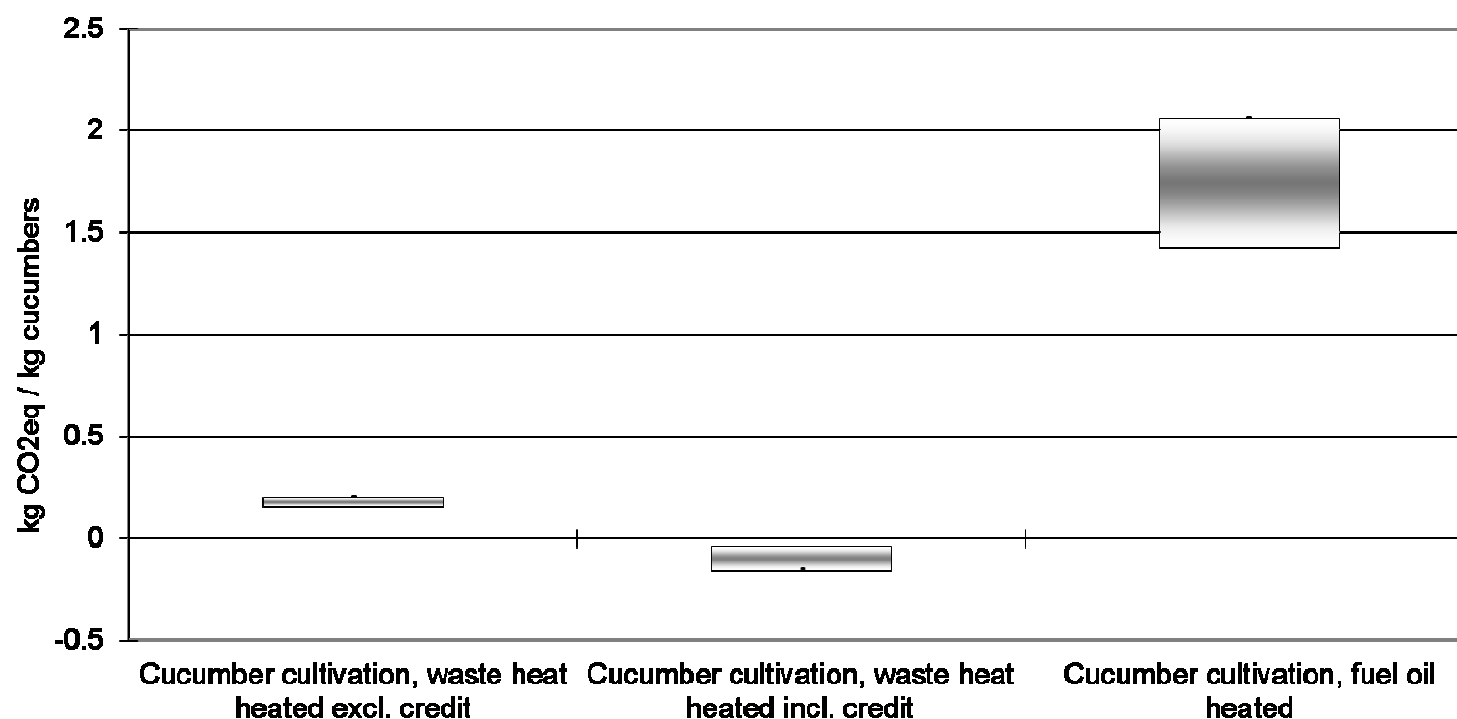
- without credits: 0.178 kg CO₂e vs. 1.741 kg CO₂e per kg of cucumbers
- credit from power generation: 0.574 kWh resp. 0.276 kgCO₂e per kg of cucumbers



Cucumbers

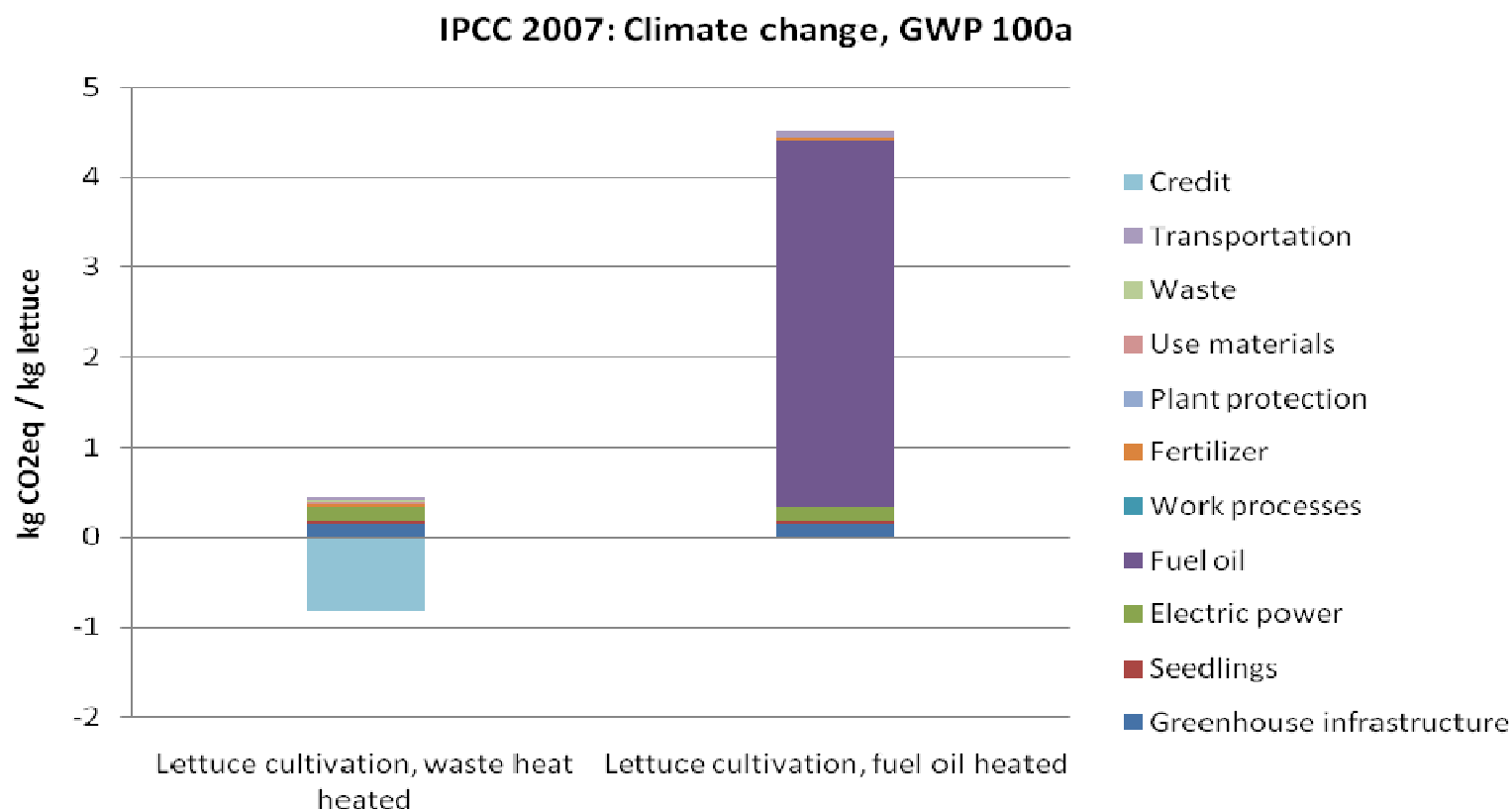
- cucumbers, waste heat heated excl. credit: 0.178 kg CO₂e / kg cucumber +/- 11.4 %
- cucumbers, waste heat heated incl. credit: -0.098 kg CO₂e / kg cucumber +/- 61.1 %
- cucumbers, fuel oil heated: 1.741 kg CO₂e / kg cucumber +/- 18.3 %

IPCC 2007: Climate change, GWP 100a



Lettuce

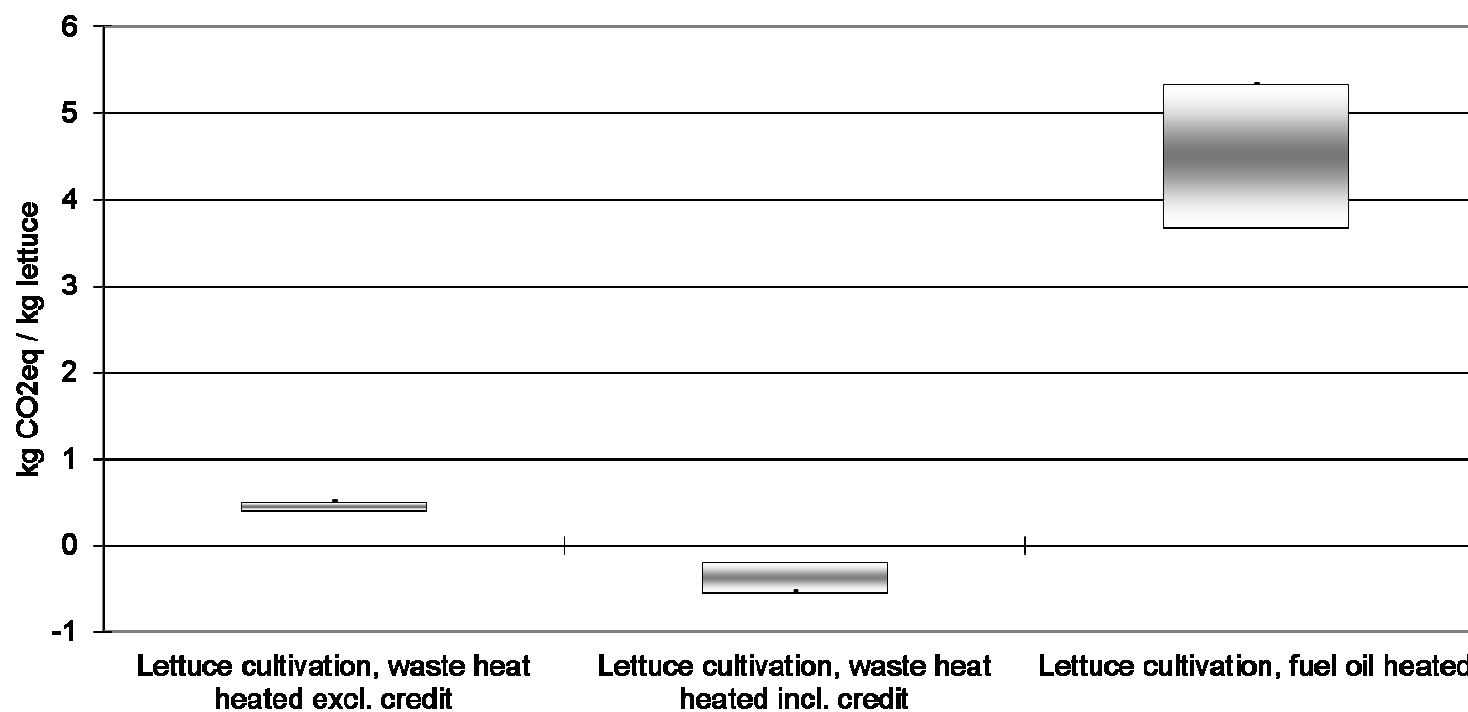
- without credits: 0.453 kg CO₂e vs. 4.507 kg CO₂e per kg of lettuce
- credit from power generation: 1.568 kWh resp. 0.820 kgCO₂e per kg of lettuce



Lettuce

- lettuce, waste heat heated excl. credit: 0.453 kg CO₂e / kg cucumber +/- 10.7 %
- cucumbers, waste heat heated incl. credit: -0.368 kg CO₂e / kg cucumber +/- 47.4 %
- cucumbers, fuel oil heated: 4.507 kg CO₂e / kg cucumber +/- 18.4 %

IPCC 2007: Climate change, GWP 100a



Conclusion

Conclusion and prospects

For greenhouses:

- Great potential to lower GWP of greenhouse production

For the waste incineration plant:

- Usage of waste heat (approx. 50-60 °C) improves efficiency of generators
- Still room for further improvements
 - aiming at a net additional power generation of over 200 kW
 - yearly generation of 1.72 GWh, satisfying the needs of over 300 Swiss households!

**Thank you very much
for your attention!**

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