Calculating CO_2 footprint of greenhouse crops produced with CHP

Lisboa, 28st International Horticultural Congress
August 23th 2010

Peter Vermeulen, Wageningen UR Greenhouse Horticulture
Myrtille Danse, Wageningen UR LEI

WAGENINGEN UR
For quality of life

Ministry of Agriculture, Nature and Food Quality

Productschap Tuinbouw

Introduction

- Modern greenhouse horticulture developed fast
- Wholesalers, supermarkets, consumer organizations wants insight in GHG emissions of this development
- The Carbon Trust, DEFRA, British Standard Institute developed a standard for CO_2 footprint
  - Calculation protocol CO_2 footprint: PAS 2050
- the Dutch Horticultural Board and the ministry of Agriculture, Nature and Food Quality start a pilot to built a calculation model CO_2 footprint
- They saw a gap

CHP use Dutch Greenhouse Horticulture

- Surface: 10.500 ha
  - Organic: ± 100 ha
- Firms: 3.500
- Main fuel: 95 % natural gas
- Average gas use: 45 m^3/m^2/year
- Heating system:
  - gas boiler: 95% area
  - co generation: 3.000 MW_{el}: production: 10 TWh/year

CHP use greenhouse horticulture

- Use CHP:
- Produced electricity
  - partly used for artificial lighting (flowers)
  - the main part is delivered to the national grid
- Produced heat:
  - Used for heating of the greenhouse
- Produced CO_2:
  - Used for the crop

CO_2 footprint co generation CHP 1

- PAS 2050:
  1. System reduction,
  2. System expanding
  3. Economic allocation.

  - Production of crop, heat, electricity and CO_2 → System expanding

CO_2 footprint co generation 2

- System expanding: GHG emission
  - gas CHP ←→ avoided electricity production
- Avoided electricity production in NL
  - CHP runs at daytime → supply of CO_2
- Kind of electricity plant:
  - Weekdays → peak load: gas combustion
  - Weekend → base load: coal combustion
  - Avoided electricity: 2/7 coal 5/7 gas

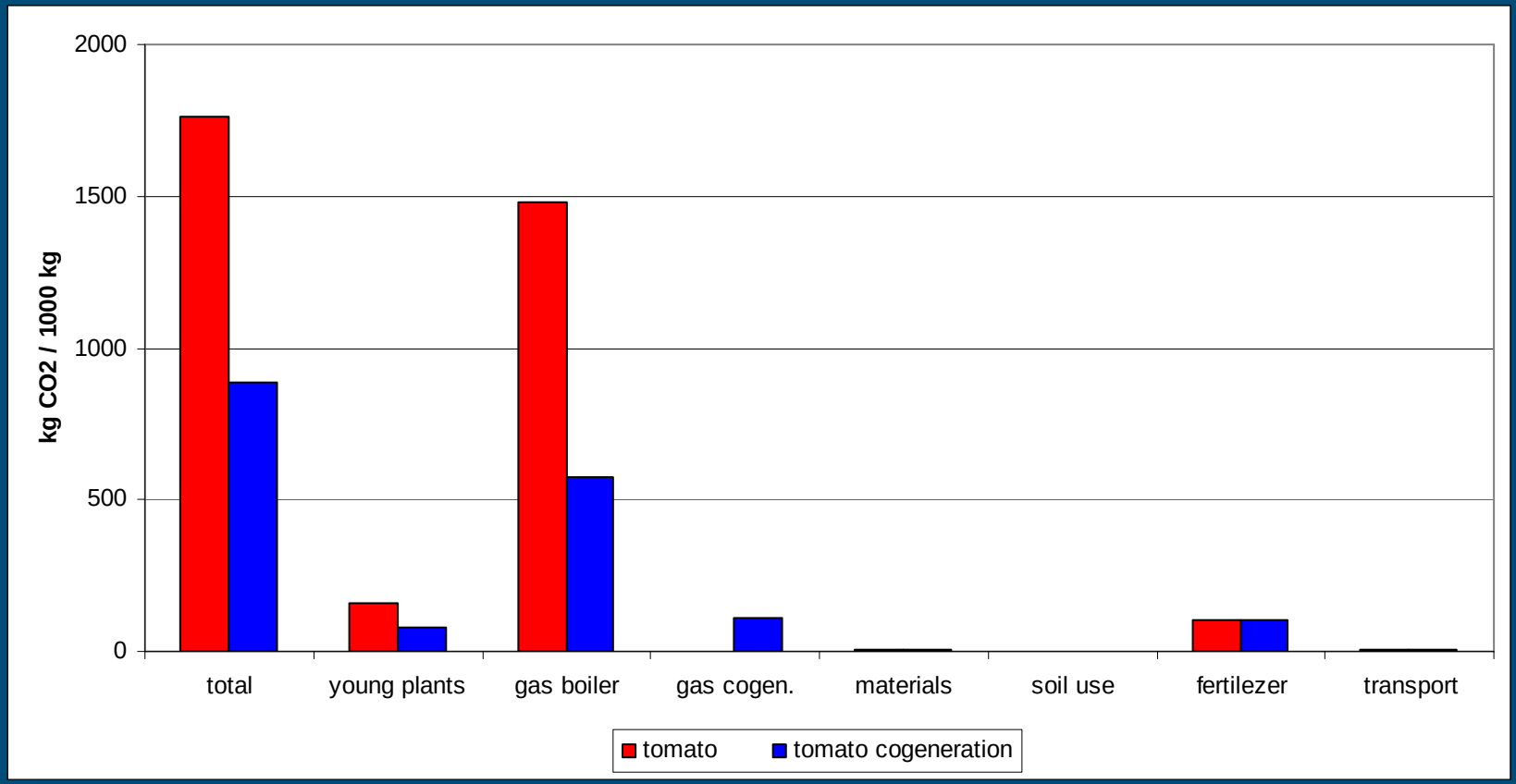
Tomato cases CO_2 footprint 1

- Tomato crop without CHP
- Tomato crop with CHP

Tomato case input data 2

		Regular [1)]	Regular [1)] with CHP
Production	kg/m^2/year	58.5	58.5
Electric power co generator	MW/ha		0.5
Cogeneration	hours/year		3565
Natural gas boiler	m^3/m^2/year	43.4	15.0
Natural gas co generator	m^3/m^2/year		49.7
Electricity	kWh/m^2/year	10	10
Electricity production	kWh/m^2/year		178
PE/PVC/PS	kg/ha/year	927	927
Pesticides	kg/ha/year	8	8

Tomato case CO_2 footprint 3



WAGENINGEN UR
For quality of life

Ministry of Agriculture, Nature and Food Quality

Productschap Tuinbouw

New developments grenhouse horticulture

- Innovations conventional growers
  - Heat delivery by greenhouse growers to
    - other companies,
    - other no greenhouse partners, such as schools, swimming pools, etc.
  - CO_2 delivery by electricity or industrial plants to greenhouses
  - Use of geothermal heat,
  - Bio energy
  - Fermentation
- These cases has to be described in PAS 2050

- Thanks for your attention

WAGENINGEN UR
For quality of life

Ministry of Agriculture, Nature and Food Quality

Productschap Tuinbouw

Wageningen UR Greenhouse horticulture

Innovations for and with the greenhouse horticulture

WAGENINGEN UR
For quality of life

Ministry of Agriculture, Nature and Food Quality

Productschap Tuinbouw