Energy saving in Belgian Greenhouses

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Overview

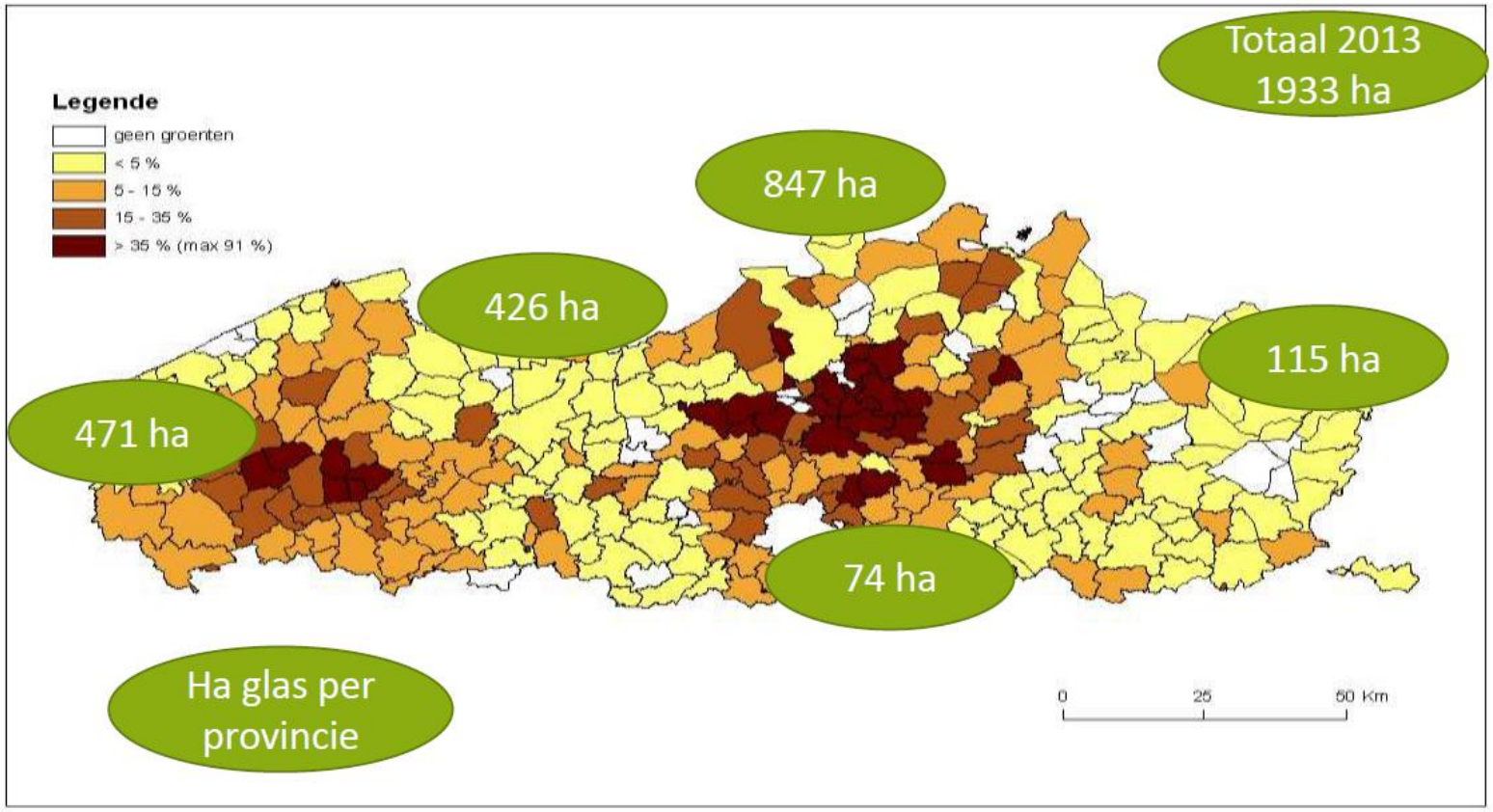
1. Overview greenhouses in Belgium
    1. Overview area
    2. Company size
    3. Energy sources
    4. Technologies

2. Research at Vegetable research centre

Overview greenhouses in Belgium

Overview greenhouse area

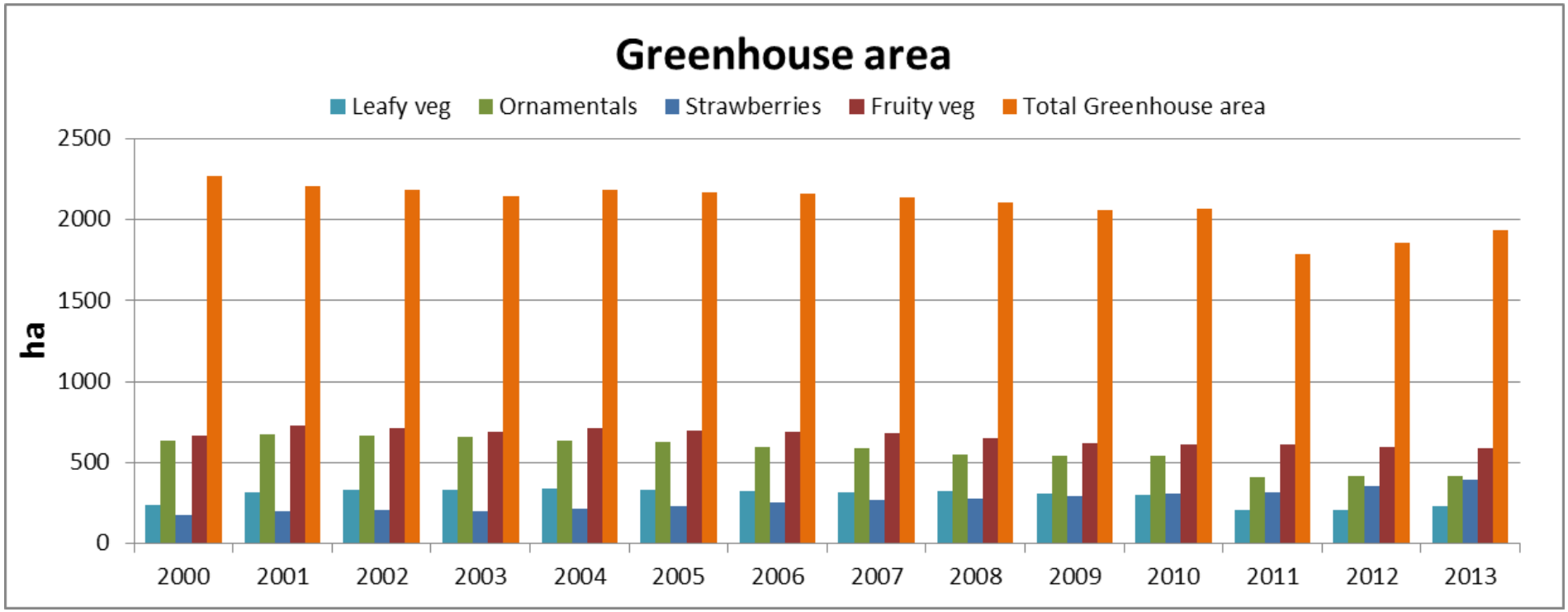
Greenhouse area flanders



0,3 % of total agriculture area

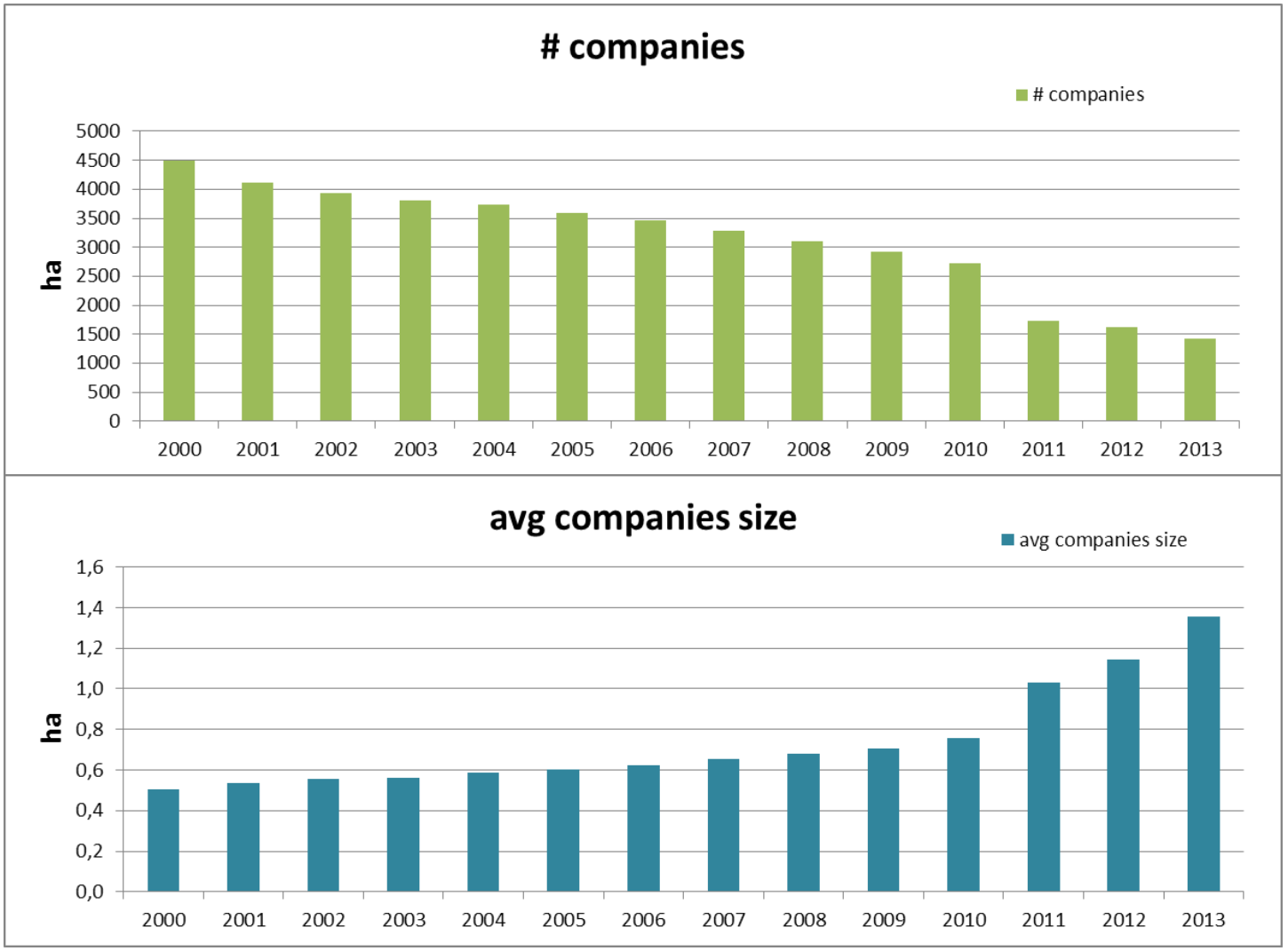
Source: Fod economie, 2013

Overview greenhouse area



Source: Fod economie, 2013

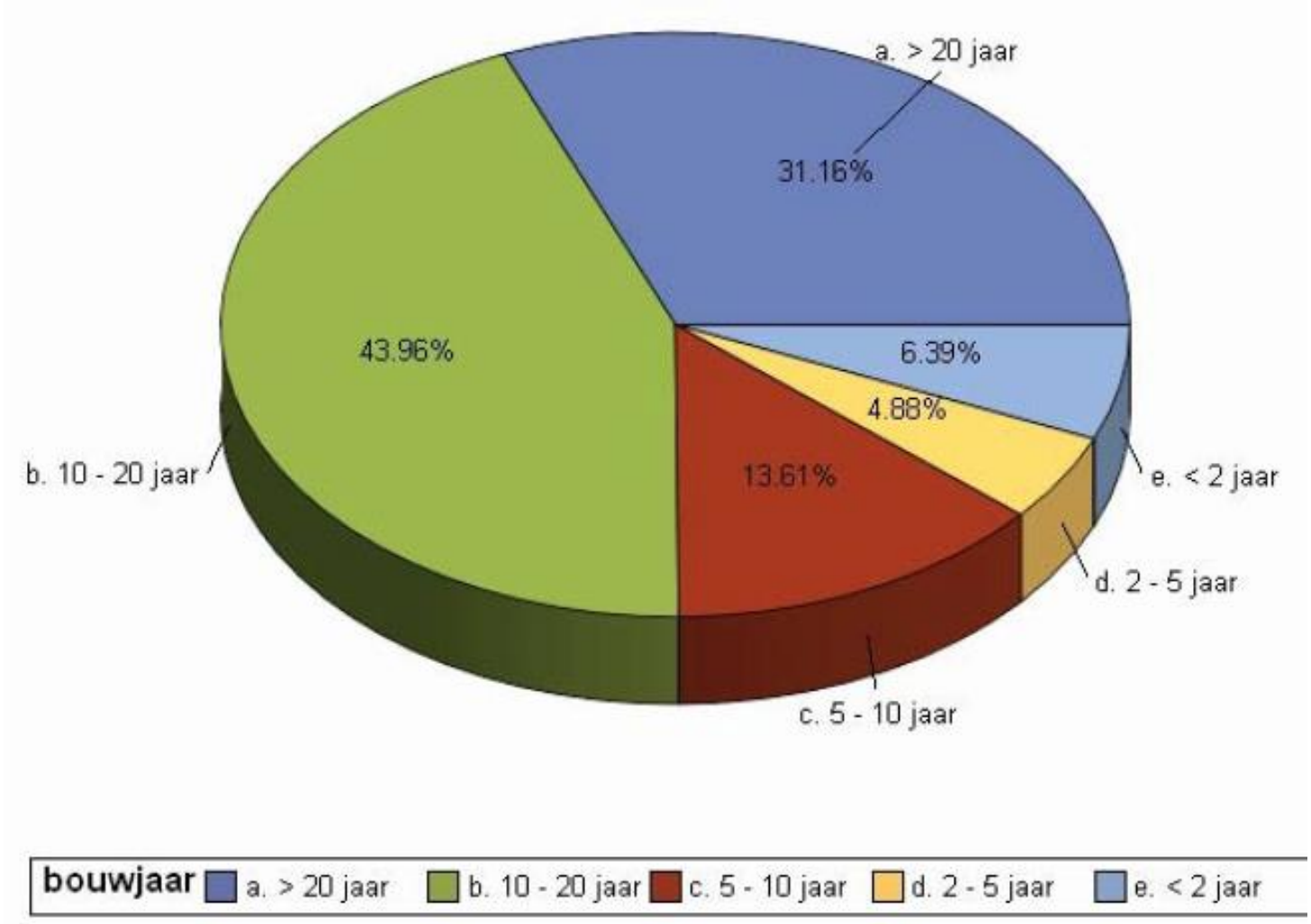
Overview greenhouse area



Source: Fod economie, 2013

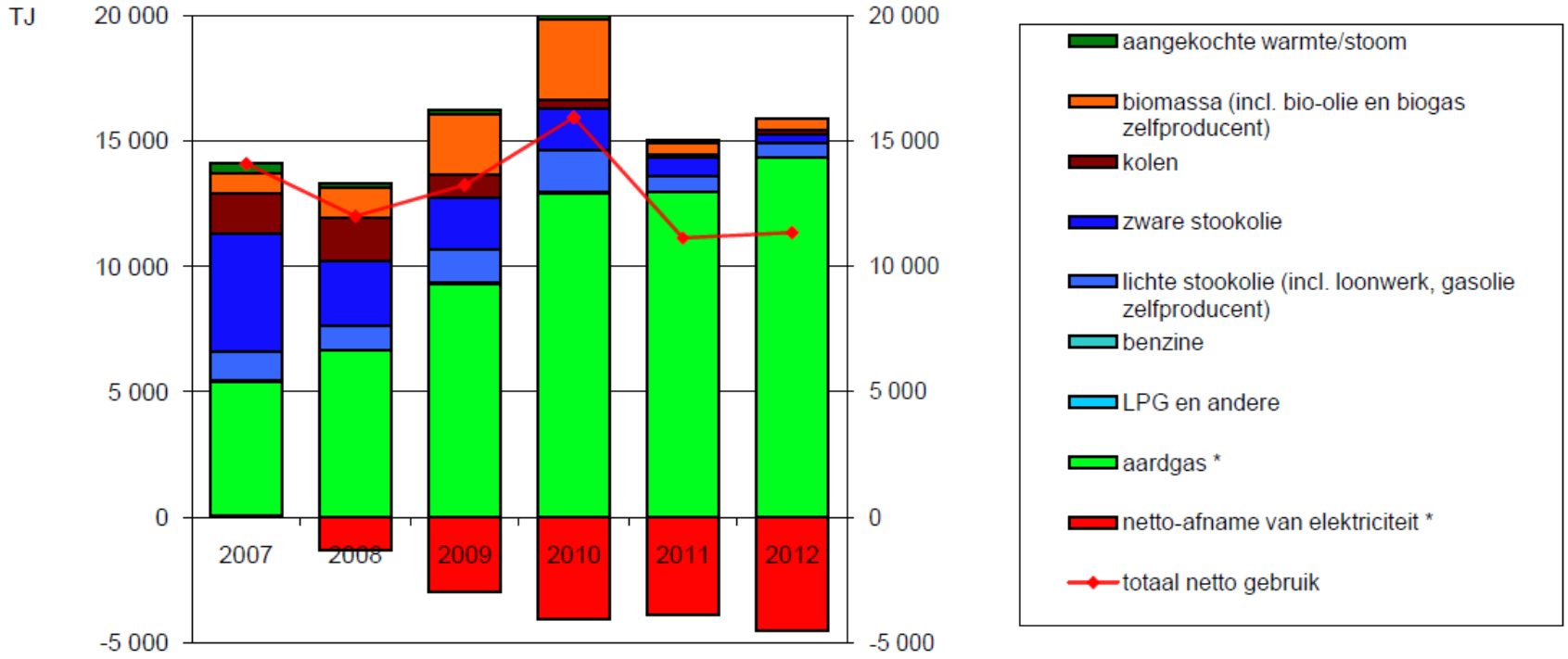
Overview greenhouse area

Survey Flemish gouvernement (971 compagnies (2006))



Energy use

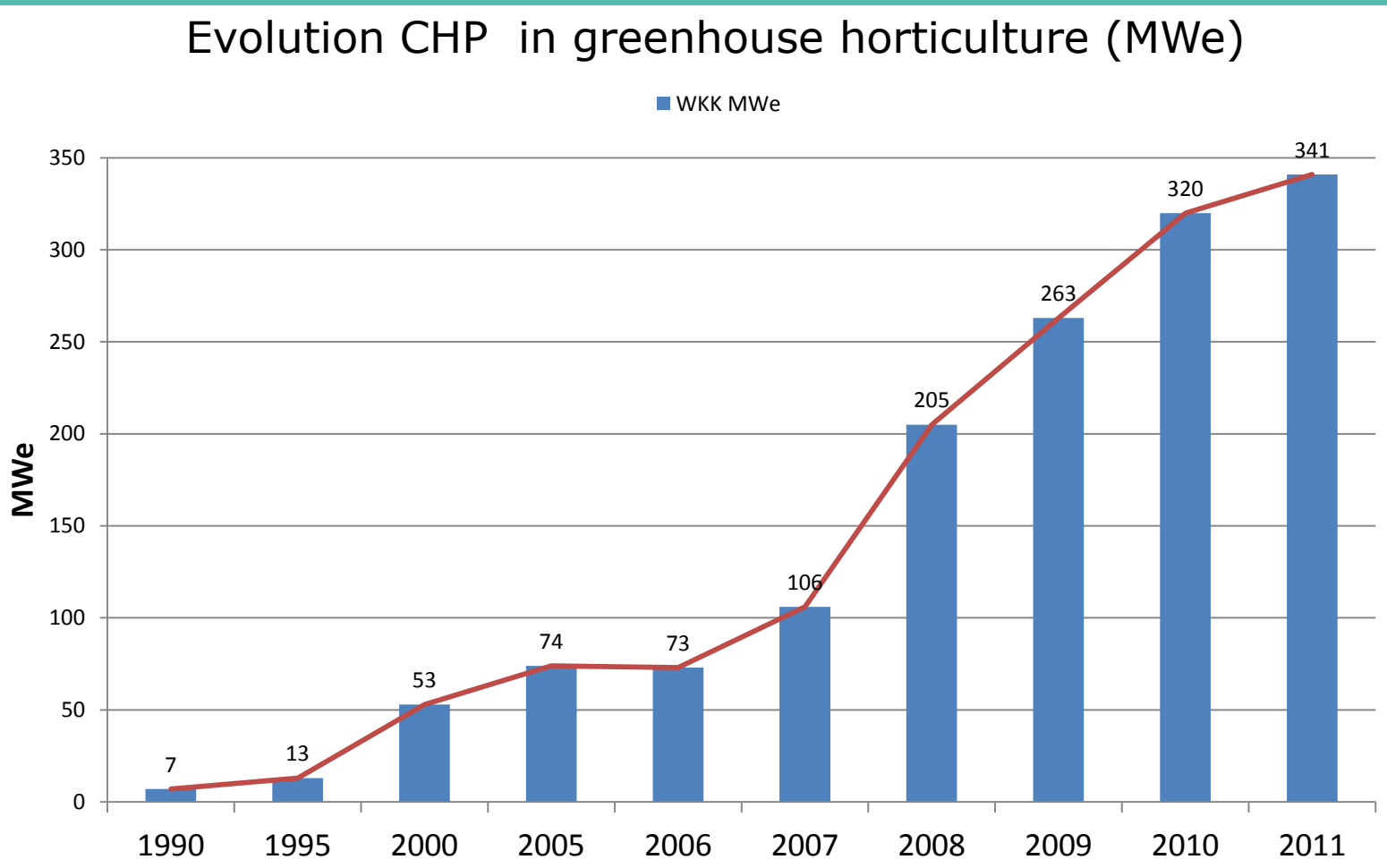
Energy use greenhouse horticulture



46 % (11,461 TJ) of the total primary energy use (24,916 TJ) in argriculture with only 0,3 % of the total area

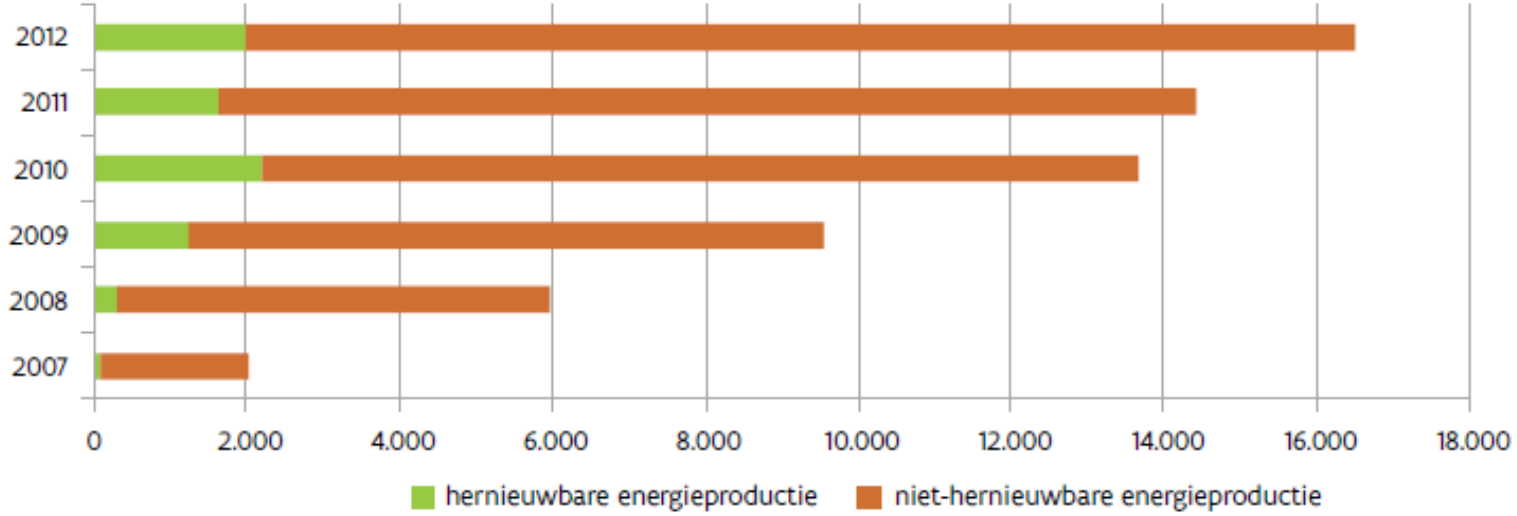
Source: AMS, L&V Vlaamse Overheid

Technologies



Technologies

Figuur 7. Energieproductie door WKK's in de Vlaamse landbouw, TJ, 2007-2012



Bron: Departement Landbouw en Visserij op basis van VITO

Technologies

- Use of cogeneration or CHP
  - 351 MWe
- Energy screens
  - Single or double moveable screen
  - Anti condensation screen
- Clustering
  - 2 or more companies on one site with shared CHP
- Waste heat
- Heat pumps
- Air treatment
- Humidity control

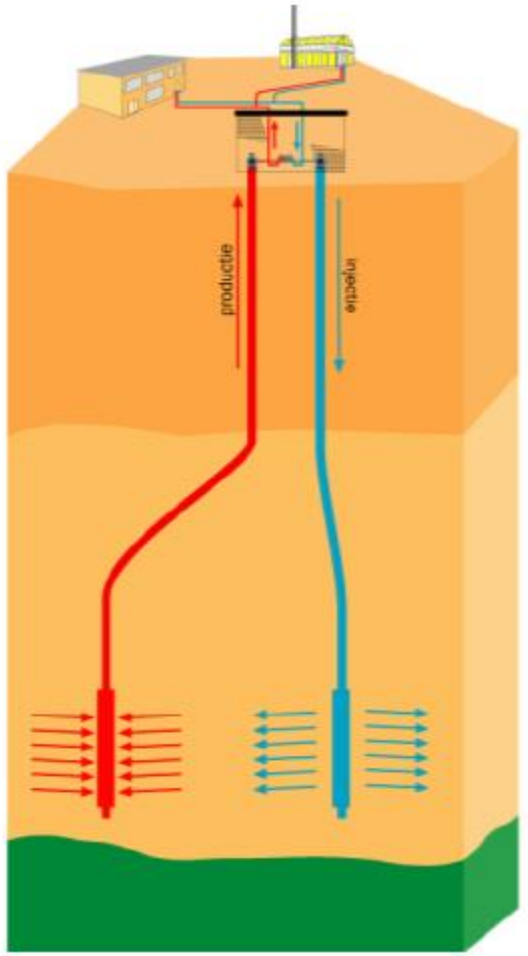
Technologies

Technologies

Technologies

Future?

- Geothermal heat
- Hygroscopic dehumidifying
- Plant sensors
- LED
- Waste heat
- PCM
- Biogas
- …



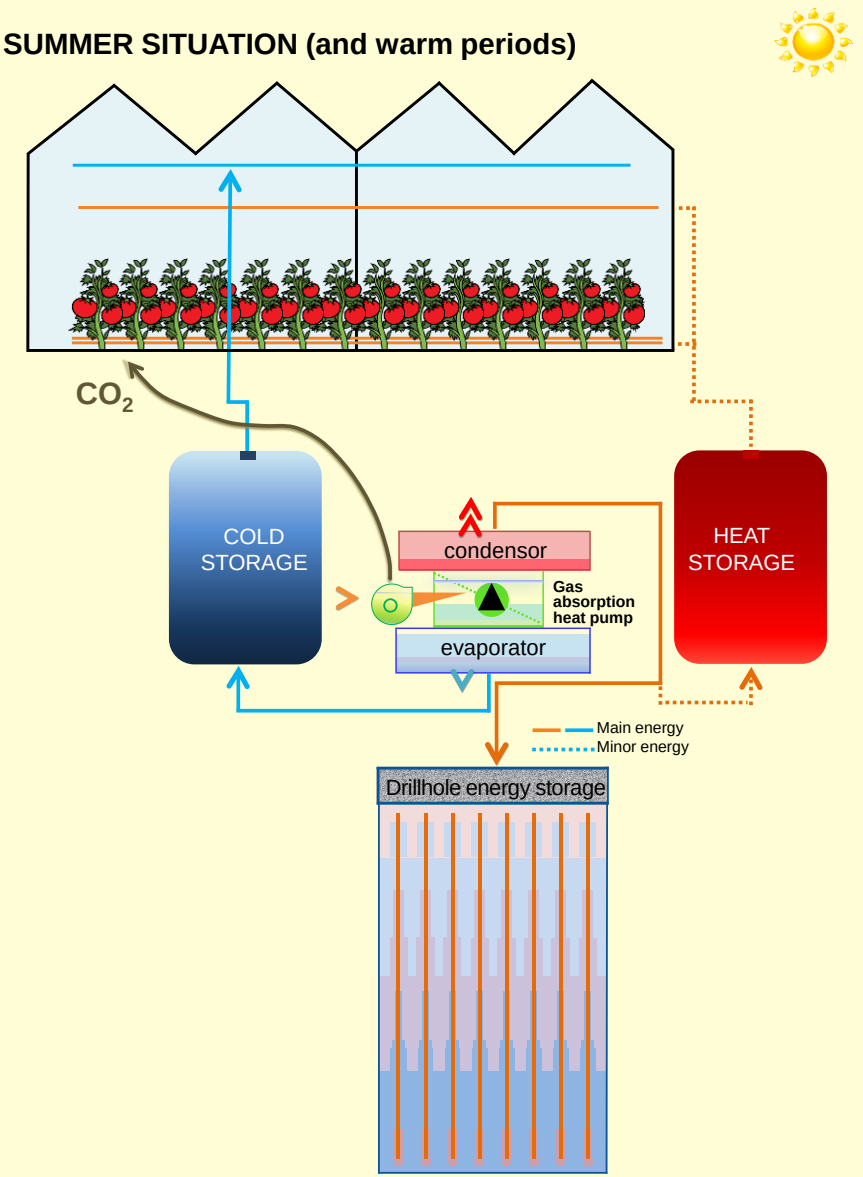
Technologies

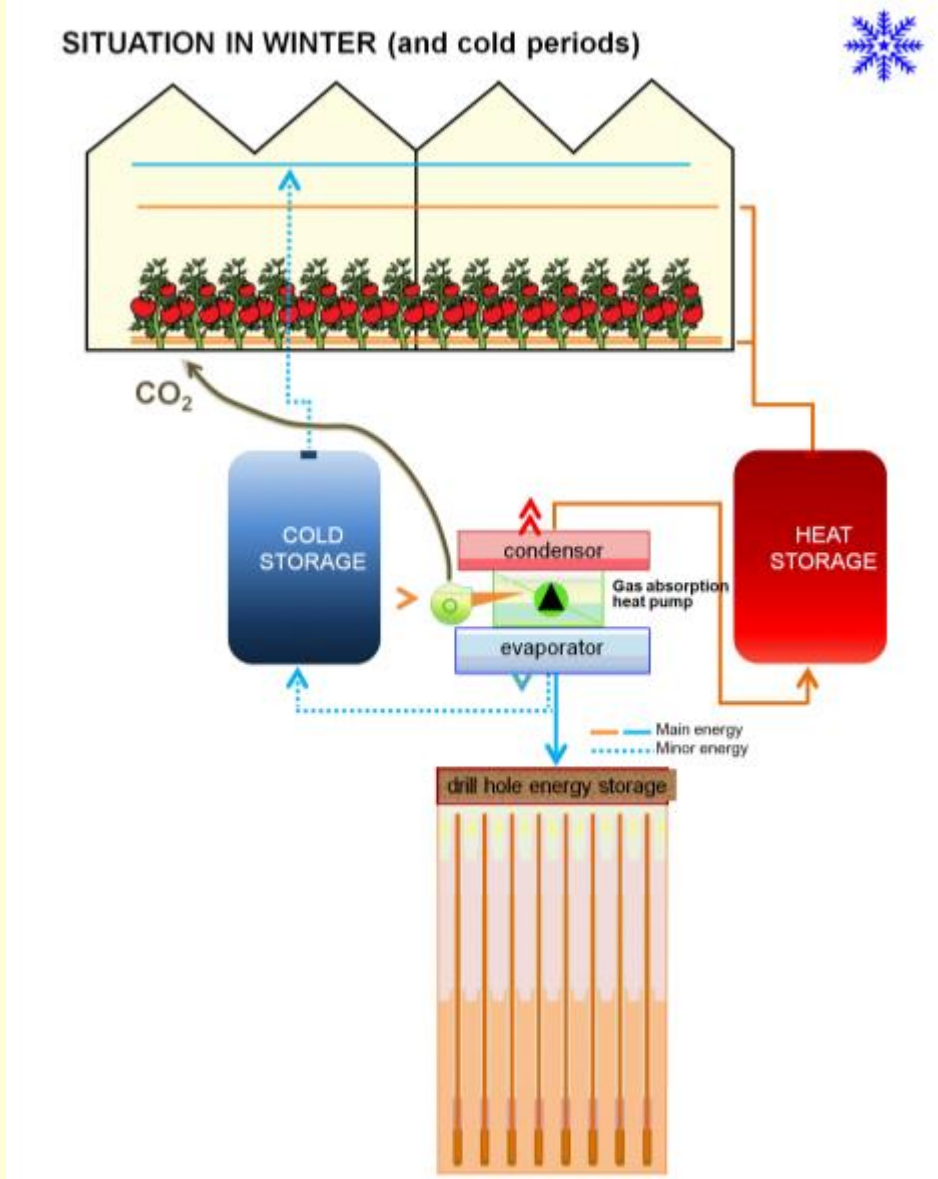
Research at vegetable research center

Research at PCG

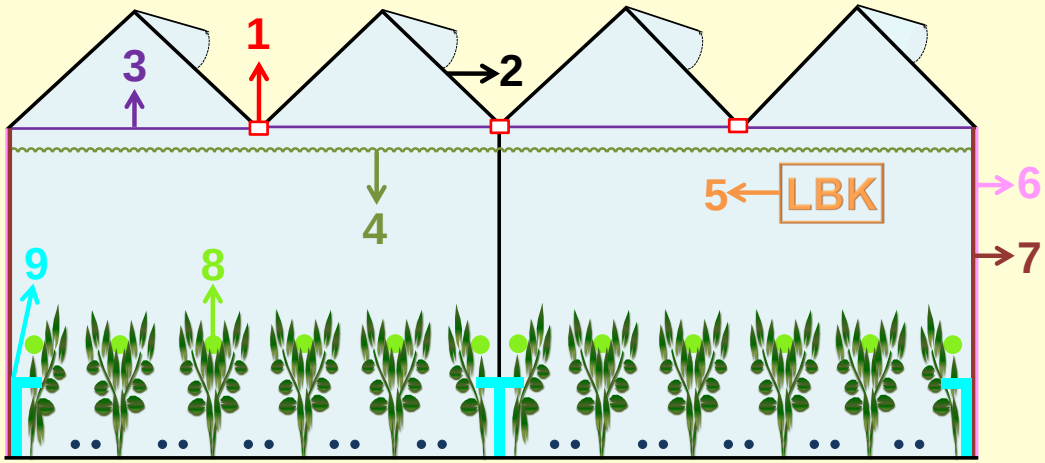
- Insulated greenhouse (U-value **2,75 W/m² K**) with low temperature tubes (< 55 °C)
- Use of **dehumification**
- Efficient heating with 3 gasabsorption **heat pumps** (120 kW and COP of 130 – 170 %)
- Larger **heating surface** in greenhouse
- **Short term heat** and **cold** storage (2 water tanks of 45 m³)
- **Long term heat** in ground (Borehole thermal energy storage or BTES)
- Use of **CO2** in greenhouse from heat pump

Research at PCG





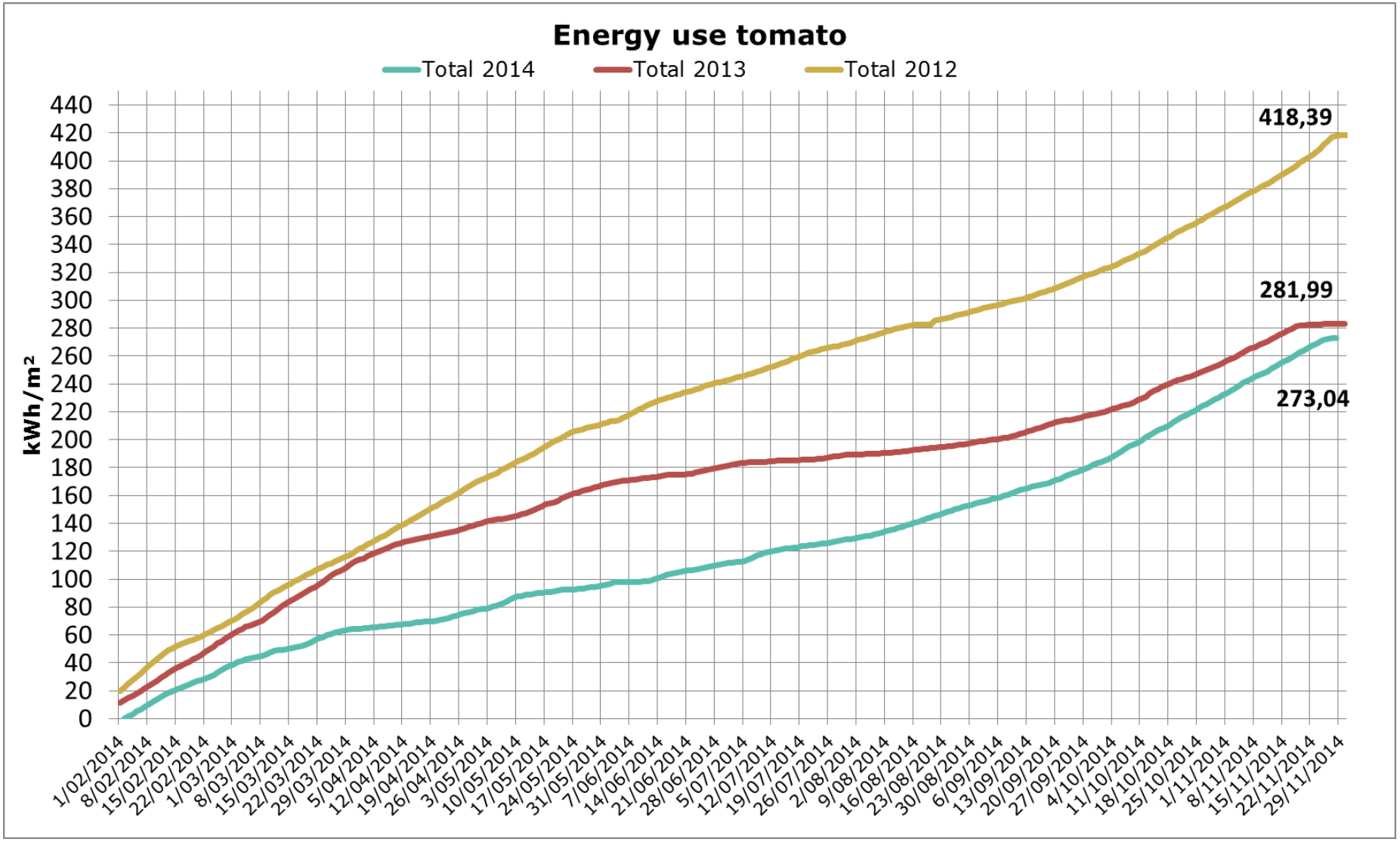
MAXIMUM ISOLATING GREENHOUSE



1. Aluminium gutter
   - ✓ Better isolation
2. Anti reflection glass
   - ✓6% more transmission
   - ✓Less reflection
3. Climate screen
   - ✓63% energy saving
   - ✓65% light screening
4. Energy screen
   - ✓45% energy saving
   - ✓14% light screening
5. Air treatment equipment
   - ✓Thanks to dehumidification more closed culture
   - ✓Better use of CO2 and heat
6. White coating
   - ✓More light reflection on the infrastructure
7. Polycarbonaat in the outdoor walls (two chambers 16 mm)
   - ✓Better isolation
   - ✓U = 2,3 W/m².K
8. Low temperature network, growpipes Ø 51 mm
   - ✓Better use of low temperature
9. CO_2 coming from the GAHP

U-value = 2,75 W/m².K

Research PCG – energy



Research PCG – energy

Energy use tomato 2012 – 2013

Tomato 400 m²/ 1m³ gas = 11,52 kWh	2012 (312 days)	2013 (300 days)
Heat demand greenhouse	**418,28 kWh/m²**	**291,8 kWh/m²**
COP heat pump	**1,4**	**1,41**
Total energy use (kWh/m²)	**297,1 kWh/m²**	**206,7 kWh/m²**
Gas use per m²	**25,8 m³/m²**	**17,9 m³/m²**

- Conventional energy use for tomatoes 450 kWh/m²:
  35 % - 55 % energy saving
- Paybacktime of **+- 7 years** for greenhouse of 2 ha with
  Heat pumps and drilhole energy storage (DES)

Research PCG – energy

Energy efficient humidity control

1. Keep the climate **homogeneous** in the greenhouse through the use of **a light airflow** (by ventilators). Do not encourage unnecessary evaporation by an heavy airflow.
2. Get rid of the humidity through **air treatment or active dehumidification**
   a. By mixing **dry outside air**, if possible with heat recovery
   b. **active dehumidification** with condensation of the humidity (with heat pump)
3. If an **energy screen** is used, you can apply a **humidity gap** of 1 or 2 %.
4. If these steps don't help, humidity can be disposed through **window ventilation**
5. **Raise tube or greenhouse temperature** to lower relative humidity.

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