Energy-saving strategies for early-season strawberry production in North-West European greenhouses

International Soft Fruit Conference 2026

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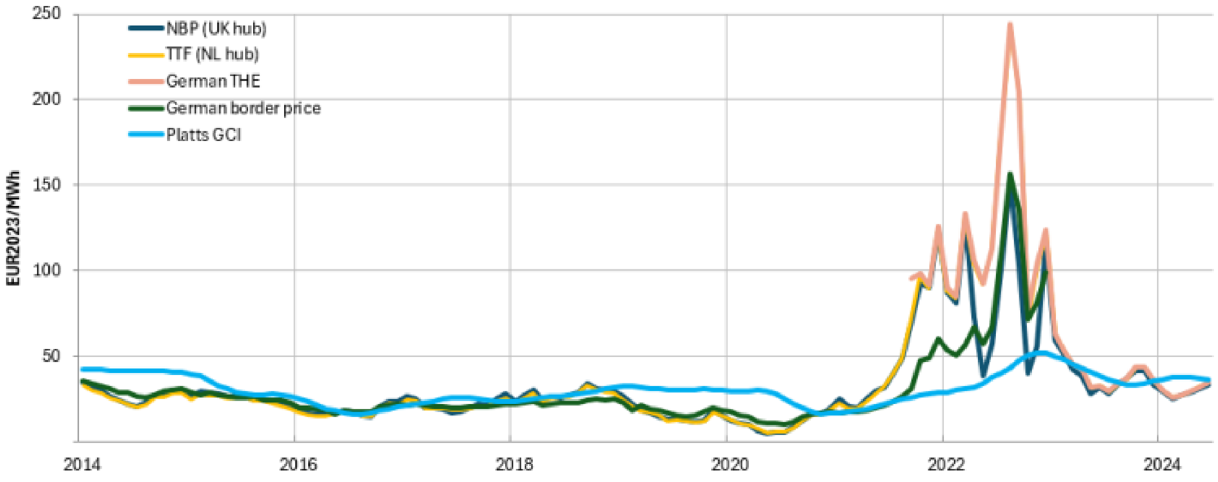
Context

- Europe: **sharp increase** in **gas prices**
  - Recession after COVID
  - Post-COVID global economy recovery
  - Unfavourable weather conditions for renewable energy production
  - Outages at nuclear installations
  - Disruption of gas supply (February 2022)

➔ August 2022: gas prices x10
➔ 2023-2025: normalisation of prices
But still higher than before 2022!!

- European Union: **Going climate-neutral by 2050**
  - Enhancing sustainability agricultural energy use

Selected wholesale day-ahead gas prices in European gas hubs



Source: Trinomics et al (2024), based on data from P Platts, Enerdata EnerMonthly

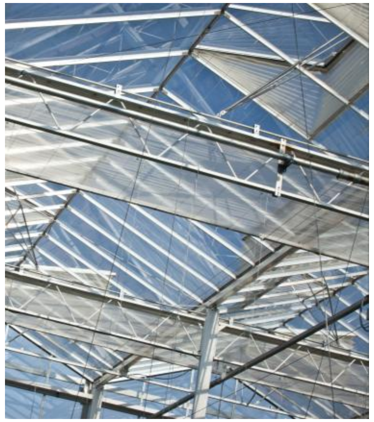
3 trials

- **Spring cultivation glasshouse**
  - Cultivar: Sonsation (standard propagation)
  - Planting date: beginning of January
  - Harvesting period: mid-March – May
  - Challenges
    - Early-season production
    - Low level of natural sunlight
    - Artificial heating (energy prices!)

➔ Maintain **profitability**

Trial 1: **Heating** strategy **connected with radiation** trajectory

Trial 2: Intensifying the use of a **single thermal screen**



Trial 3: **Combination** of **connected heating-radiation**, intensified use of **screen** and **vertical ventilation**

01

Trial 1

Heating strategy connected with radiation trajectory

Heating strategy connected with radiation trajectory (2024)

- **Minimize energy input** on cloudy days

	Control	**Heating-radiation**
Day/night temperature	16/8 + 3°C At harvest: 15/6°C	12/8 + 7°C At harvest: 14/6 + 1°C
Radiation trajectory	Start: W/m² at 1.00 pm at cloudy day End: W/m² at 11.00 am on sunny day	Start: 0 W/m² End: W/m² at 11.00 am on sunny day

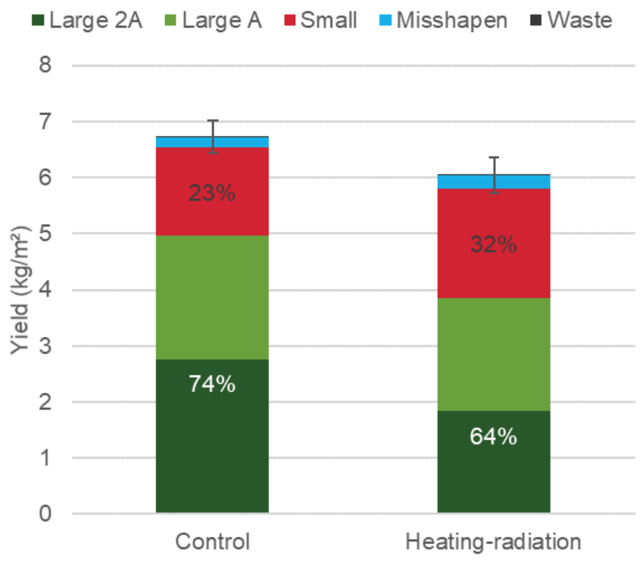
- Cloudy days: lower temperatures
- Differences in crop elongation, fruit quality and shelf-life are negligible

➔ **21% of energy saved**

➔ **8% increase energy-efficiency** (turnover/energy used)

BUT **production loss** due to lack of activation energy (**dark spring 2024**)

➔ New boundaries radiation trajectory



02

Trial 2

Intensifying the use of a single thermal screen

Intensifying the use of a single thermal screen (2025)

- **Reducing heat loss** through intensified use of thermal screen

	Control	Energy saving by extra screening
Day/night temperature	12/8 + 7°C At harvest: 14/6 + 1°C	12/8 + 7°C At harvest: 14/6 + 1°C
Radiation trajectory	Start: 0 W/m^2 End: W/m^2 at 11.00 am on sunny day	Start: 0 W/m^2 End: W/m^2 at 11.00 am on sunny day
Extra heating pipe temperature	35°C -20°C radiation increase +5°C relative humidity increase	35°C -20°C radiation increase +5°C relative humidity increase
Thermal screen closed if	Outside temperature < 5°C Radiation < 30 W/m^2 + 50 W/m^2 with outside temperature between 5°C and -5°C	Outside temperature < 10°C Radiation < 50 W/m^2 + 30 W/m^2 with outside temperature between 5°C and -5°C
Ventilation fans	Vertical	Vertical

Intensifying the use of a single thermal screen (2025)

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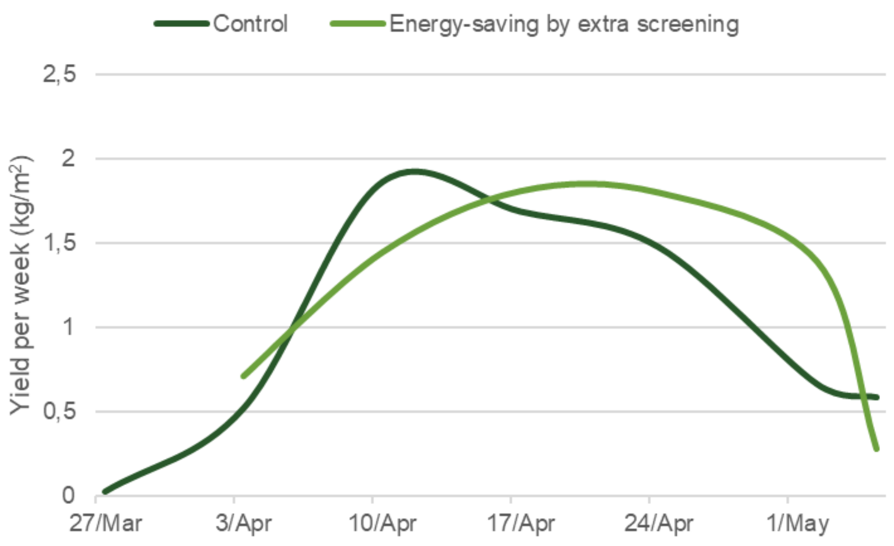
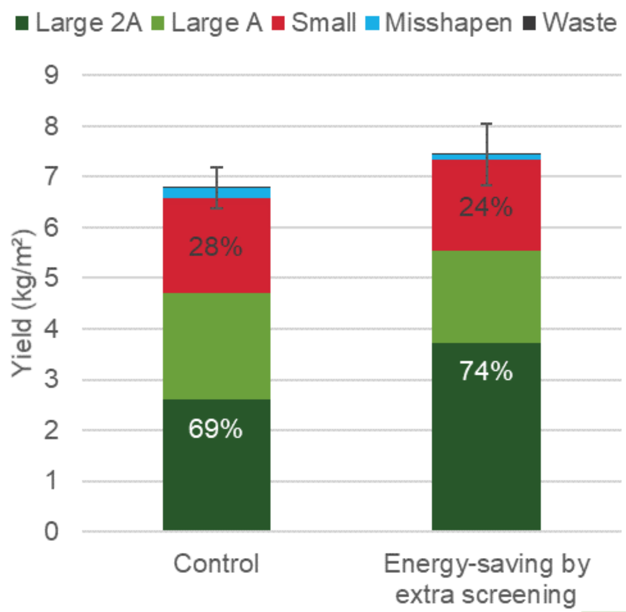
- Average daily temperature and relative humidity levels were similar in both compartments
- Differences in crop elongation, fruit quality and shelf-life are negligible
- **Thermal screen**: **+11% hours closed**

  ➔ **Energy saving of 7%**

- Delay in harvest but increased yield and better grading of fruits





- **Turnover**: 34,59 €/m^2 (**+17%**) ➔ **Energy-efficiency**: 0,46 €/kWh (**+26%**)

03

Trial 3

Combination of connected heating-radiation, intensified use of screen and vertical ventilation

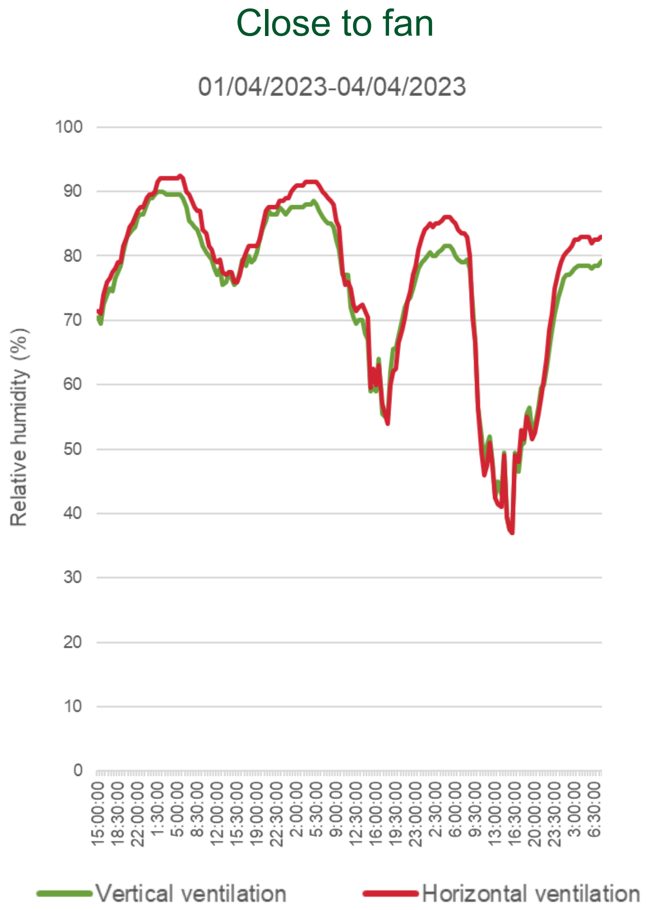
Combination of connected heating-radiation, intensified use of screen and vertical ventilation (2025)

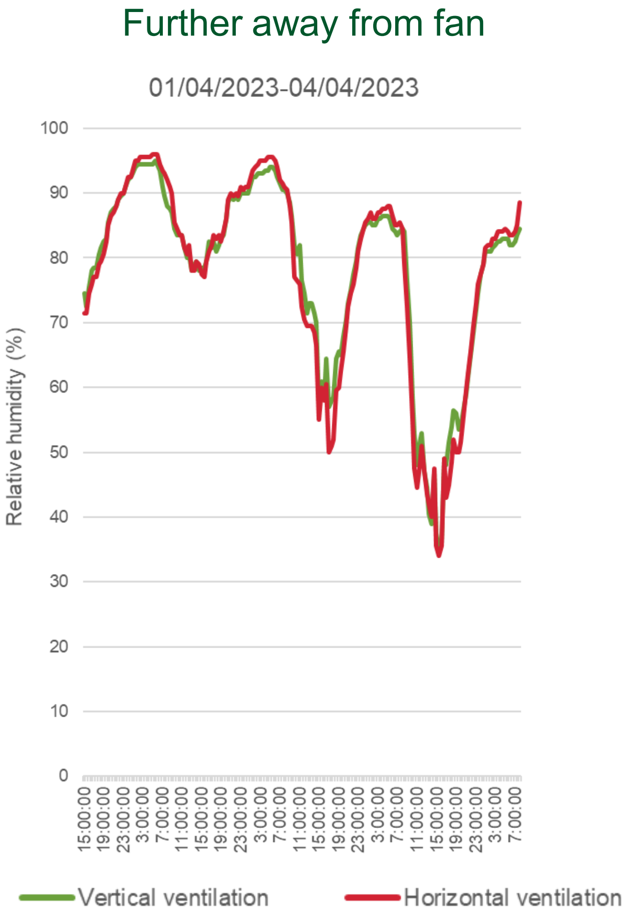
- **Reducing energy consumption** by the use of **multiple strategies**

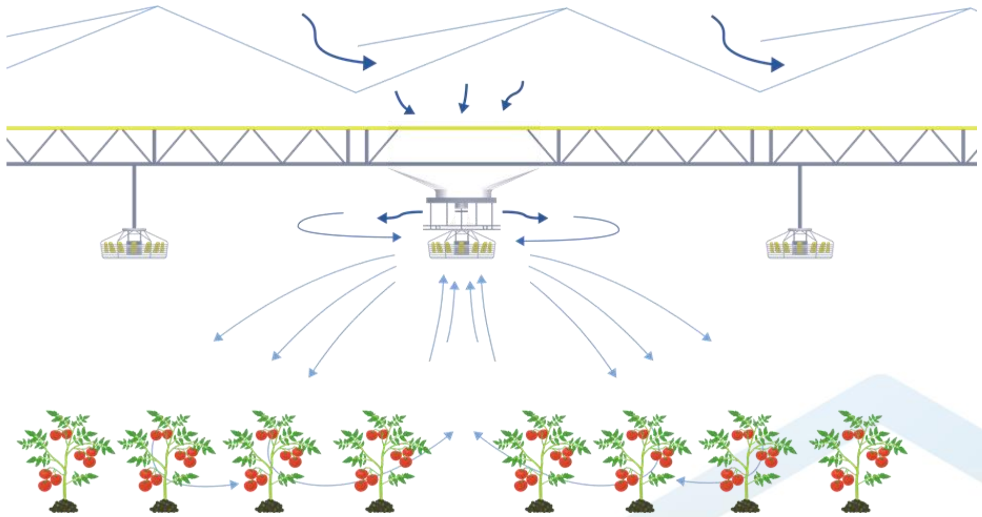
	Standard	Energy-efficient
Day/night temperature	16/8 + 3°C At harvest: 15/6°C	12/8 + 7°C At harvest: 14/6 + 1°C
Radiation trajectory	Start: W/m² at 1.00 pm at cloudy day End: W/m² at 11.00 am on sunny day	Start: 0 W/m² End: W/m² at 11.00 am on sunny day
Extra heating pipe temperature	35°C -20°C radiation increase +5°C relative humidity increase	No extra heating pipe
Thermal screen closed if	Outside temperature < 5°C Radiation < 30 W/m² + 50 W/m² with outside temperature between 5°C and -5°C	Outside temperature < 10°C Radiation < 50 W/m² + 30 W/m² with outside temperature between 5°C and -5°C
Ventilation fans	Horizontal	Vertical

Combination of connected heating-radiation, intensified use of screen and vertical ventilation (2025)

- **Vertical ventilation**
  - Relative humidity at crop level (measurements in 2023)







Source: ClimaFlow System (Svensson)

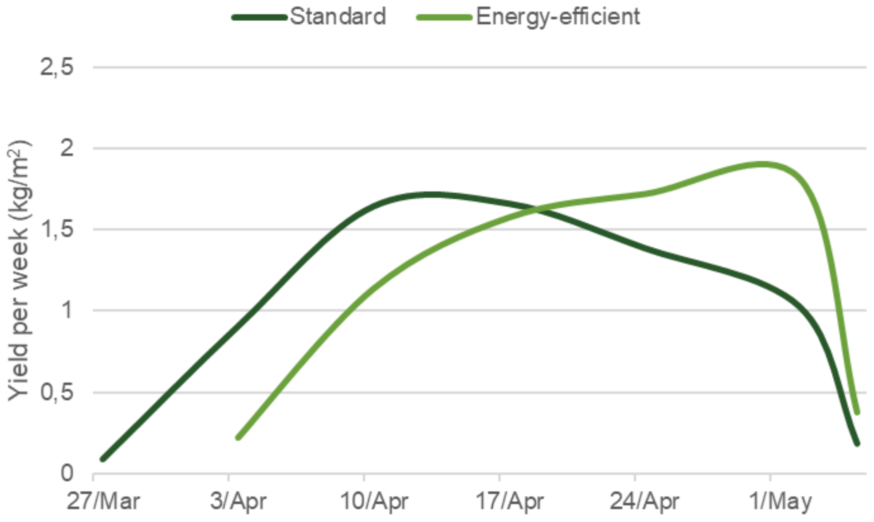
- Active air flow
  - Location-specific effect
  - Lower relative humidity
    - ➔ Activation of crop
    - ➔ **Less or no need for extra heating pipe**

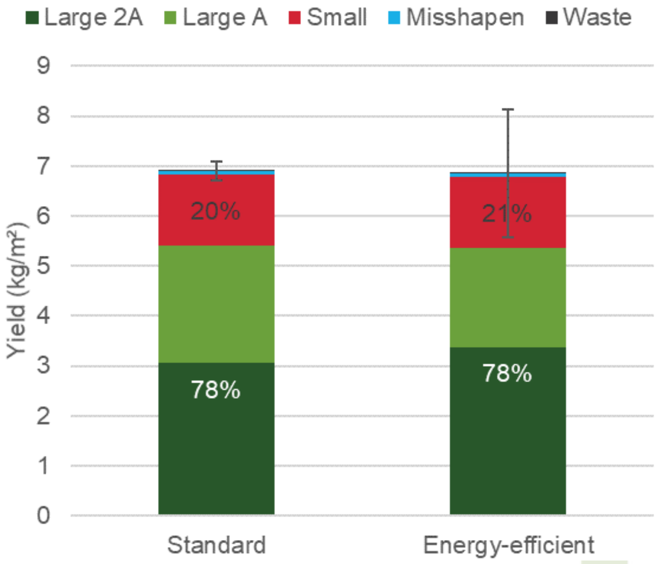
Combination of connected heating-radiation, intensified use of screen and vertical ventilation (2025)

- Cloudy days: average daily temperature -1°C and relative humidity +5%
- Differences in crop elongation, fruit quality and shelf-life are negligible
- Thermal screen: +8% hours closed

➔ **Energy saving of 54%**

- Delay in flower appearance was compensated in March (very sunny): still delayed peak production period
- Same yield and grading of fruits





- **Turnover**: 30,34 €/m^2 (**-8%**) ➔ Energy-efficiency: 0,91 €/kWh (**+100%**)

Conclusion

- Natural activation by sunlight

Conclusion

- Combination of energy saving strategies increases energy-efficiency
  - Strong **connection heating-radiation**
  - Intensive **thermal screen** use
  - Activation of crop without increase in heating (**vertical ventilation**)!!

- Spring 2024: 2th darkest spring of the last 30 years
  ➔ Yield loss (-10%) and decrease in grading of fruits (+14% small fruits)

↕

- Spring 2025: 3rd most sunniest spring ever measured in Belgium
  ➔ No yield loss or decrease in grading of fruits

➔ **Natural activation by sunlight**!!

- Next steps
  - 2 thermal screens
  - Active dehumidification

Thanks for your attention

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