Hortinergy

Energy and climate analysis for greenhouse project

HORTINERGY SPECIFICATION

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Input parameters

Weather file:

- GPS position
- Altitude
- Time zone
- Site situation (open, depression, near to sea/lake, city…)
- Albedo
- Climate scenario:
    - Contemporary
    - IPCC forecast scenarios
    - RCP 2.6, RCP 4.5 and RCP 8.5 in 2030, 2040,2050 and 290

Greenhouse envelop

- Greenhouse type: venlo, large span, gothic, flat arch
- Length and width: number of chapel/ span
- Orientation
- For each wall
    - Cover (cf. library)
    - Frame percentage
    - Climate screen number for roof: 0-1-2; for wall: 0-1
    - Climate screen type (thermal, white strips, aluminium, blackout)
    - Shading percentage
- Light transmission loss due to dust
- Air leakage: defined by user, calculated by Hortinergy

Crop production

- Type of crop (cf.library)
- Cultivation period
- Production technique: suspended crop/gutter, benches, above plastic mulch, asphalt, soil
- Type of soil
- Central pathway: type, percentage

Climate management

- Heating temperature settings
    - 6 periods during one year
    - Day/night or Day/pre-night/post-night or constant

- Ventilation opening temperature
- Humidity settings
    - Relative humidity or humidity deficit
    - Maximum / minimum during day and night
- Day / Night switch - Thermal screen management strategy
    - Minimum solar radiation
    - Delta Temperature inside/outside maximum
- Morning revival
    - Solar radiation to reach day temperature
    - Temperature increase per hour

Climate control equipment

- Semi-closed greenhouse
    - Number of air tubes per chapel
    - Air renewal maximum rate
    - Air internal recirculation rate
    - Fan specification
        - Max air flow for a fan
        - Electrical power at 100%, 75%, 50% and 25% air flow
    - Cooling temperature
    - Humidification and cooling system
        - Pad
        - Fog
- Closed greenhouse
    - Maximum day temperature
    - Maximum night temperature
- Pad and Fan in classic greenhouse
    - Air renewal maximum rate
    - Pad specification: thickness, height, length, length, flush rate
    - Maximum water flow for the whole greenhouse
    - Fan specification
        - Max air flow for a fan
        - Electrical power at 100%, 75%, 50% and 25% air flow
    - Distance between pad and fan
    - Cooling temperature
- Fog in classic greenhouse
    - Maximum water flow for the whole greenhouse
    - Cooling temperature
- Assimilation lighting
    - Type: LED, HPS or both
    - Specification: maximum power, efficiencty
    - Settings:
        - Monthly hour o monlhy hour schedule
        - Minimum number of "dark hour"
        - Lights switch off above outside light level

Heating production

- 2 heat sources and 2 heating systems
- Energy cost and currency
- Maximum power calculation by Hortinergy
- Primary production and auxiliary:
    - Running period
    - Maximum power
    - Condenser
- Distribution efficiency
- Buffer tank
    - Volume
    - Temperature variation load/unload
    - Height
    - Insulation

Results

PDF report for a scenario

- Weather data summary
- Energy: demand, total, main and auxiliary systems
    - Annual and monthly
    - Average hourly for each month
- Energy cost: total, main and auxiliary systems
    - Annual
    - Monthly
- PAR reaching canopy: monthly summary
    - External solar radiation
    - Solar radiation reaching canopy
    - PAR reaching canopy
    - Assimilation lighting
- Semi closed greenhouse: electricity and water consumption
- Closed greenhouse: sensible and latent needs
- Inner climate during 24h
    - Temperature, humidity
    - Crop transpiration
    - Air flow
    - Water flow to cool
- Dehumidification needs: monthly summary

Excel report (hourly, monthly summary)

- Weather data file
- Inner climate: temperature, humidity, crop transpiration
- Radiation reaching canopy: solar, PAR, assimilation lighting
- Energy: demand, total, main and auxiliary systems
- Energy cost: total, main and auxiliary systems
- Electricity consumption: fan, lighting
- Closed greenhouse: sensible and latent needs
- Semi closed greenhouse: electricity and water consumption
- Closed greenhouse: sensible and latent needs

On line comparison between scenarios

- Monthly
- Hourly
- Economic analysis

Library:

Transparent cover library:

- 4mm clear glass
- 4mm clear glass 1AR coating
- 4mm clear glass 2AR coating
- 4mm diffuse glass
- 4mm diffuse glass 1AR coating
- 4mm diffuse glass 2AR coating
- 6mm clear glass
- Double glazing
- Double glazing with thermal break
- Low-E double glazing
- Low-E 4mm clear glass
- Double inflated plastic film 1 clear and 1 diffuse
- Double inflated plastic film 2 diffuse
- Double inflated plastic film 2 clear
- Single plastic film clear
- Single plastic film diffuse
- ETFE
- Double inflated ETFE
- Glass and ETFE
- Polycarbonate 8mm
- Polycarbonate 10mm
- Polycarbonate 16mm
- Polycarbonate 32mm
- PMMA 16mm
- Corrugated transparent PVC
- Waved polycarbonate
- Retractable plastic cover
- Opaque (5cm insulation)
- Opaque (10cm insulation)
- Opaque 50% (5 cm insul)- Polycarbonate 16mm (50%)
- Opaque 50% (5 cm insul)- Polycarbonate 16mm (50%)
- Opaque 50% (10 cm insul)- Polycarbonate 16mm (50%)

Crop library:

- Tomato
- Cucumber
- Strawberry
- Lettuce
- Cannabis (mother)

- Cannabis (flowering)
- Cut flower
- Pot plant
- Pepper
- None