Energy Saving Research WUR

Exkursion Deutscher Gärtner, Berater und Wissenschaftler 17. Februar 2011

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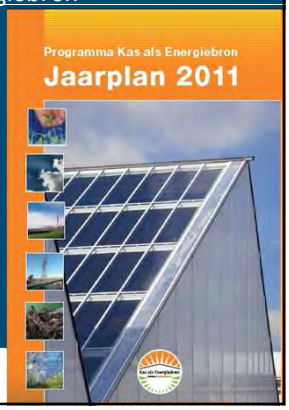
Ambition of "Kas als energiebron"

Goals for 2020

- Climate neutral, economically feasible (newly build) greenhouses
- Greenhouse sector as supplier of sustainable heat and energy
- Reduce of fossil fuel consumption



Transition paths

- Energy saving
  Crop management Light
- Sustainable energy resources
  Solar energy Geothermal heat Biofuel
- Efficient application of fossil fuel
  Sustainable electricity
- Remaining
  Sustainable carbon dioxide

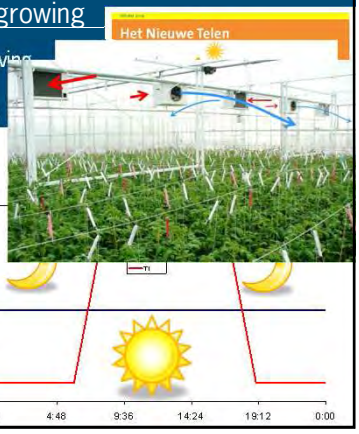
Projects in the program in 2010

- In total more than 50 projects
- Total budget 7 MEURO
- Financed by ministry of Economic Affairs, Agriculture and Innovation and the Dutch Product board

Next generation of growing

7 steps to 50% energy saving

1. Controlled dehumidification
2. More use of ther
3. Temperature inte
4. Co
5. Ap
6. Ac
7. Se



The next generation of growing

60 kg tomato with 27 m^3 gas

Gewächshausausstattung:

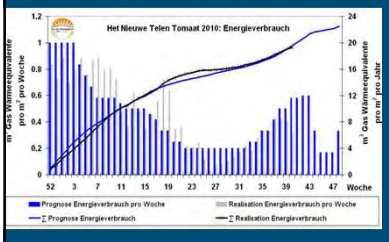
- drei Energieschirme (Folie, transparent, Energie)
- Heizung mit maximal 48°C
- Entfeuchtung durch Einblasen von trockener Außenluft
- Erhöhung Feuchte Setpoint >85%

Die Energie der Sonne wurde bei der Klimaregelung maximal zum Aufwärmen des Gewächshauses genutzt.

Step 1, 2 and 3 are used

De Gelder, 2009

The next generation of growing



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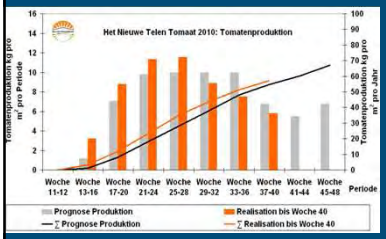
The next generation of growing



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The next generation of growing

Gerbera: 27m³ Gas pro m² Kulturfläche statt 52m³/m²/Jahr

Gewächshausausstattung:
- Verdunklung und Energieschirm
- Verzögerte Temperaturregelung
- DIF Temperaturregelung
- Entfeuchtung durch Einblasen von trockener Außenluft, Luftzirkulation
- Befeuchtung durch Fogging
- CO_2 Dosierung 800ppm

Step 1, 2 and 3 are used

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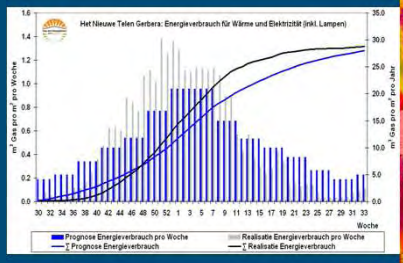
The next generation of growing



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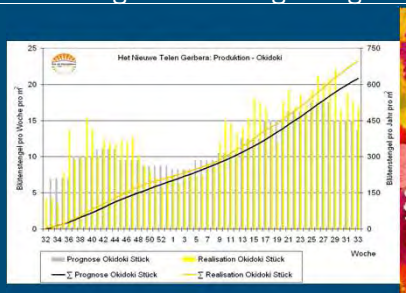
Ministerie van Economische Zaken, Landbouw en Innovatie

Uw sector investeert in dit onderzoek via het Productschap Tuinbouw

The next generation of growing



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Uw sector investeert in dit onderzoek via het Productschap Tuinbouw

Innovation and Demonstration Centre

- Greenhouses
  - Sunergy Greenhouse
  - FlowDeck Greenhouse
  - Sun Wind Greenhouse
- Ca. 500m² each greenhouse

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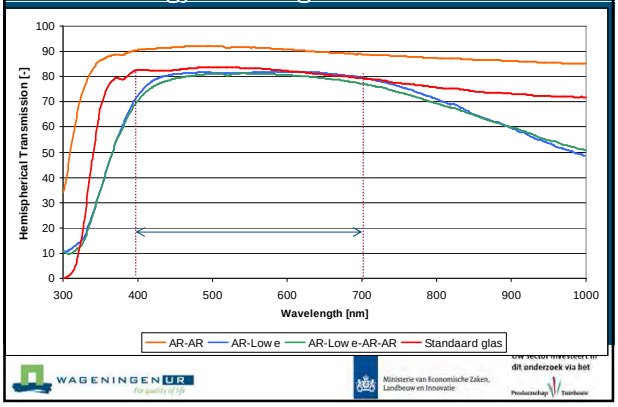
VenlowEnergyGreenhouse

VenlowEnergy - covering



Idea KASPRO Venlow Energy concept

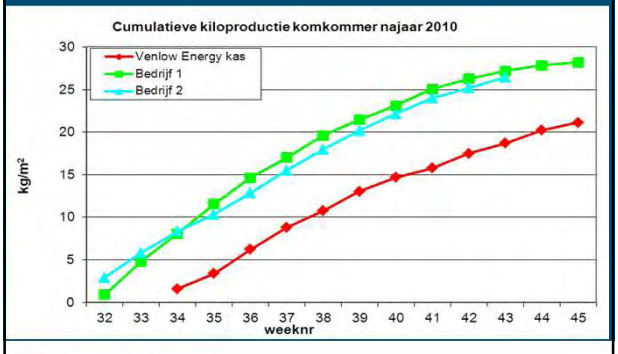
Nieuwe Telen in Scheuten glas kas

Scheuten glas dubbel	KASPRO	23 m^3
+ energiescherm	-15%	19.5 m^3
+ ontvochtigen Climeco systeem	-10%	17.5 m^3
+ minimum buis eruit	-10%	**16 m^3**

VenlowEnergy - cucumber

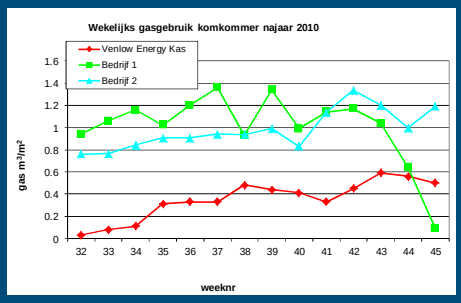
- Crop period : 6 Aug – 15 Nov
- Crop system : High wire
- Variety : Ranomi (Monsanto)
- Crop density : ca. 2.2 plants/m^2
- Fruit treatment : 1 of 2 taken out

VenlowEnergy - cucumber production



21 kg per m^2

Venlow Energy - energy consumption



5m^3gas per m^2

Result Cucumber Autumn crop

- Energy consumption heat 5 m^3 g.e./m^2 (goal16 m^2/m^3/year would have been realised)
  - No cooling, no minimum pipe, fogging, no screen, dehumidification with heat regain
- Humidity
  - Week 40 high need of dehumidification
  - System worked well
- Crop
  - no problems related to covering material
  - Production 21 kg with 53 fruits per m^2
  - Growers were satisfied

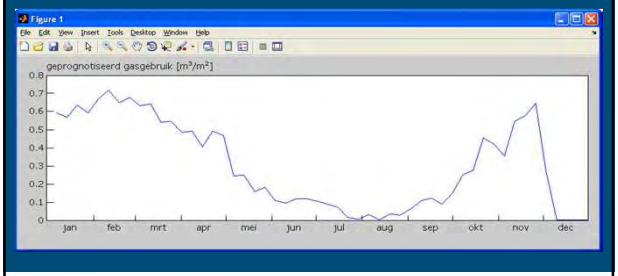
Snow on roof

VenlowEnergy - Tomato

- Plant date : 23 December 2010
- Variety : Komeett (tros)
- Plant density : 2.55 → 1st wk Feb 3.8 st/m^2
- Weekly visit by growers / advisors

VenlowEnergy – tomato

- Prognosis energy consumption by climate models based on reference climate year (SEL year)



VenlowEnergy – tomato

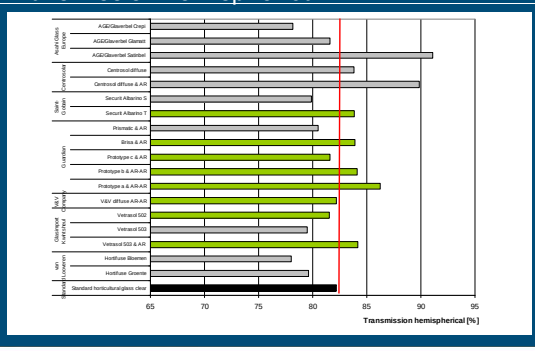
Venlow Energykas IDC Wageningen UR Glastuinbouw tomatenteelt 2011
Plantdatum 23 december 2010, plantdichtheid 2.5 st/m2, ras Komeett

Weeknr	51	52	1	2	3
Datum	20-dec	27-dec	3-jan	10-jan	17-jan
Ingestelde temperatuur dag (oC)	18.9	18.9	18.7	18.6	19.0
Ingestelde temperatuur voornacht (oC)	18.0	18.0	17.4	15.6	15.0
Ingestelde temperatuur nacht (oC)	18.0	18.0	17.5	16.2	16.1
Temperatuur dag (oC) zonop	21.1	20.5	20.1	18.9	19.9
Temperatuur voornacht (oC) zononder	18.6	18.5	17.6	16.3	16.1
Temperatuur nacht (oC) 3 uur na zononder	18.2	18.2	17.6	16.4	16.3
Temp etmaal (oC)	19.0	18.9	18.3	17.2	17.5
Vochtdeficiet dag (g/m3)	8.1	6.5	6.5	5.7	4.7
Vochtdeficiet nacht (g/m3)	7.1	5.5	5.2	4.7	3.8
Vochtdeficiet etmaal (g/m3)	7.4	5.8	5.6	5.0	4.1
Instralingssom/dag (J/cm2)	247	229	205	141	210
buitentemperatuur (oC)	0.0	1.9	3.8	7.0	4.5
Cumulatief aantal schermuren	82	210	275	296	394
Gasverbruik per week	0.42	0.64	0.65	0.46	0.73
Cumulatief gasverbruik tot eind van week	0.4	1.1	1.7	2.2	2.9
Geschat gasgebruik per week (SEL2000)	0.59	0.57	0.63	0.59	0.67
Cumulatief geschat gasgebruik (SEL2000)	0.6	1.2	1.8	2.4	3.1

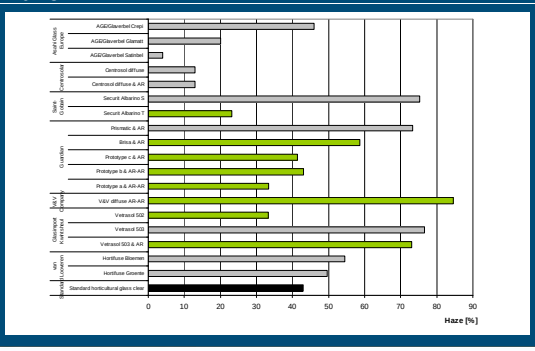
Effect of diffuse light

- Diffuse light is positive because…
  - Changed light penetration in crop
  - Diffuse light is absorbed more by middle leaf layers of cucumber
  - Higher photosynthesis in those leaf layers
  - Higher yield
  - Milder greenhouse climate on sunny days
  - Lower head temperature during high irradiation
- 1% light = 1% growth rule has to be re-defined
- Optimum diffusing properties have to be found (haze and hemispherical transmission important)

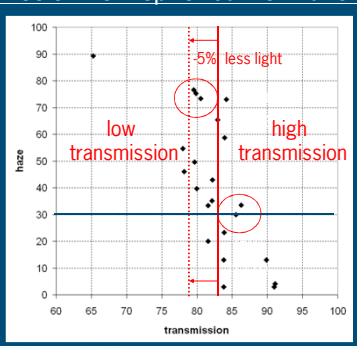
Transmission hemispherical



Haze



Transmission hemispherical vs. Haze



Still tolerable?

What is better?

Price?

Diffuse light tomato

- Experiment
  - Tomato 20 Dec – End of Nov
  - Reference glass
  - 3 Glasses with different haze and/or transmission factors
  - External summer coating
- Model calculations

Diffuse tomato

Material	Code	Haze %	Transmission Hemispherical	Transmission Perpendicular
Reference glass, 808		0	82.7	89.8
Velglas, AR, 807	GN11C	45	82.6	92.4
Prismatic, AR, 805	GN11B	71	82.9	93.6
Brisa, AR, 806	GN11A	62	85.4	93.9
Mardenkro coating, 809	MA11B	75	75.7	90.1

Wage re
Innova
green

Thanks to all my colleagues contributing to this research

Thanks to our financers:
Ministry of Agriculture, Nature and Food quality
Product board of Horticulture

Which cove

3 screens
other setpoints
dehumidification outside air

1 screen
other setpoints
dehumidification outside air
heat regain unit

	cucumber			
	grower	HNT	diffuse	double
Energy consumption				
Heat [m^3/m^2]	40	25	25	
Electricity [kWh]		6	6	
Total energy [m^3 a.e./m^2]	40	26	26	
Crop yield [kg/m^2]	75	75	79	
Energy efficiency [m^3 a.e./kg]	0.53 *100%*	0.35 *66%*	0.33 *62%*	

Demo autumn 2010 in IDC, Bleiswijk

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