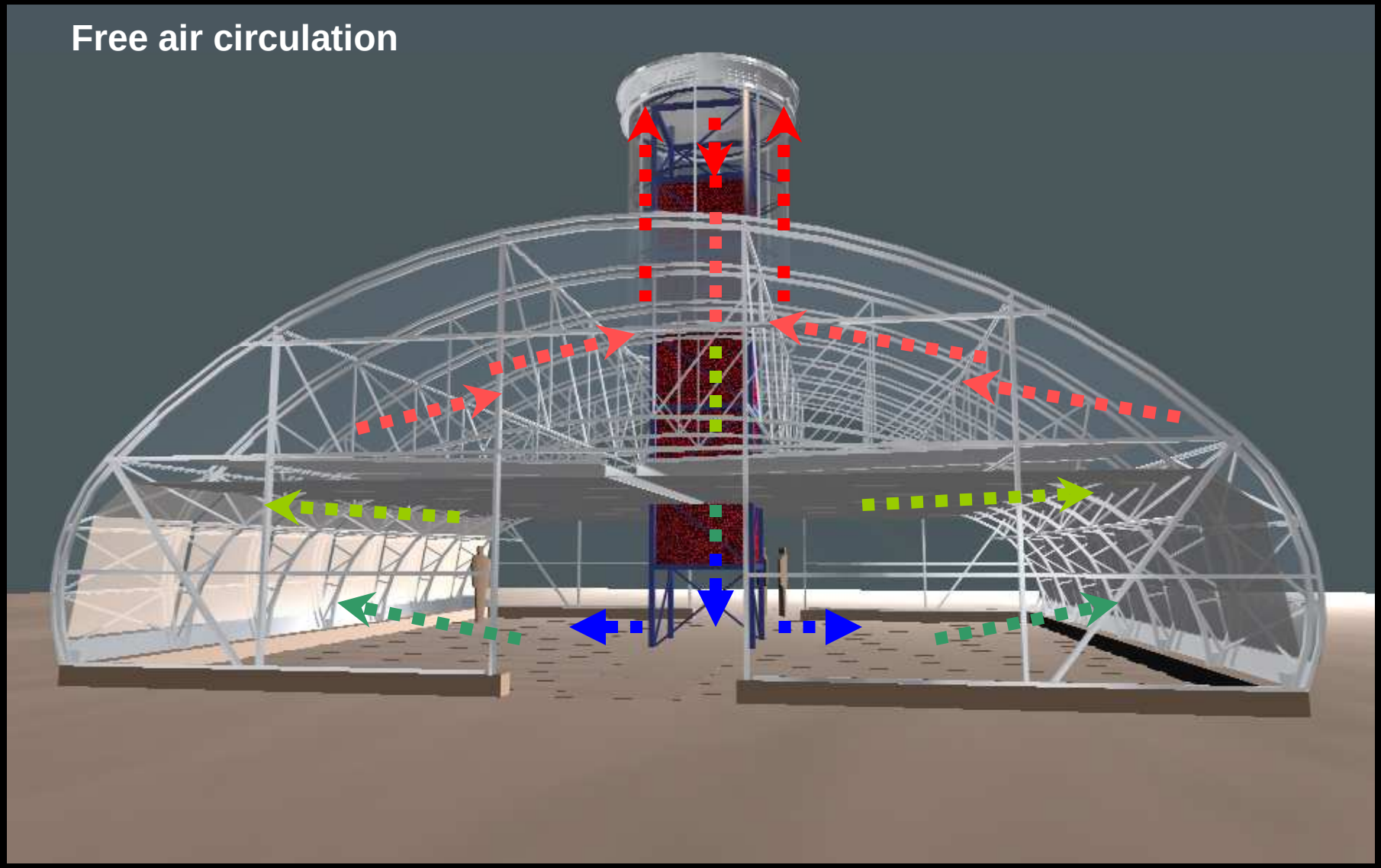
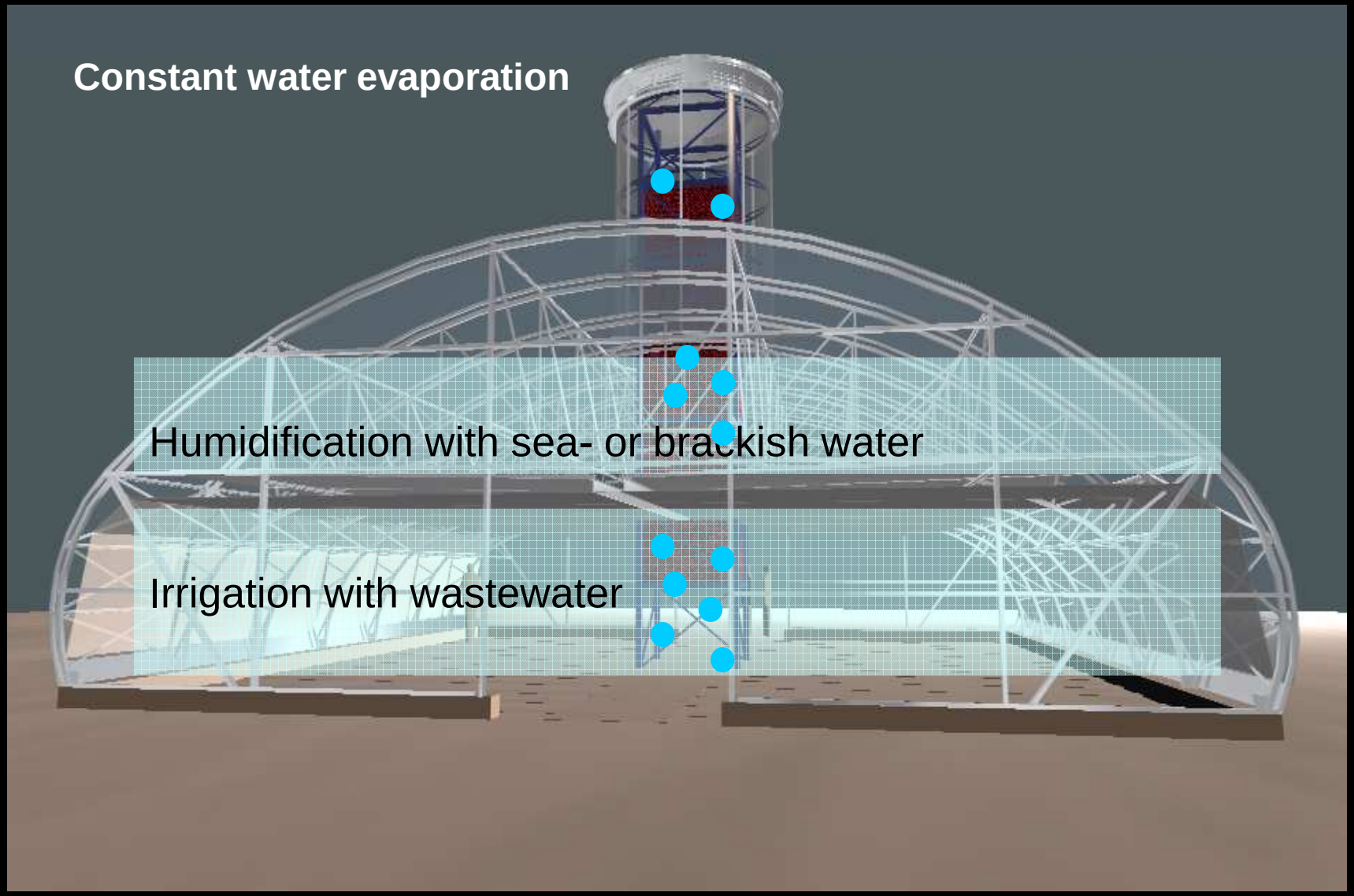
Closed greenhouses for emerging markets

Cutting Costs - Improving Performance

Free air circulation



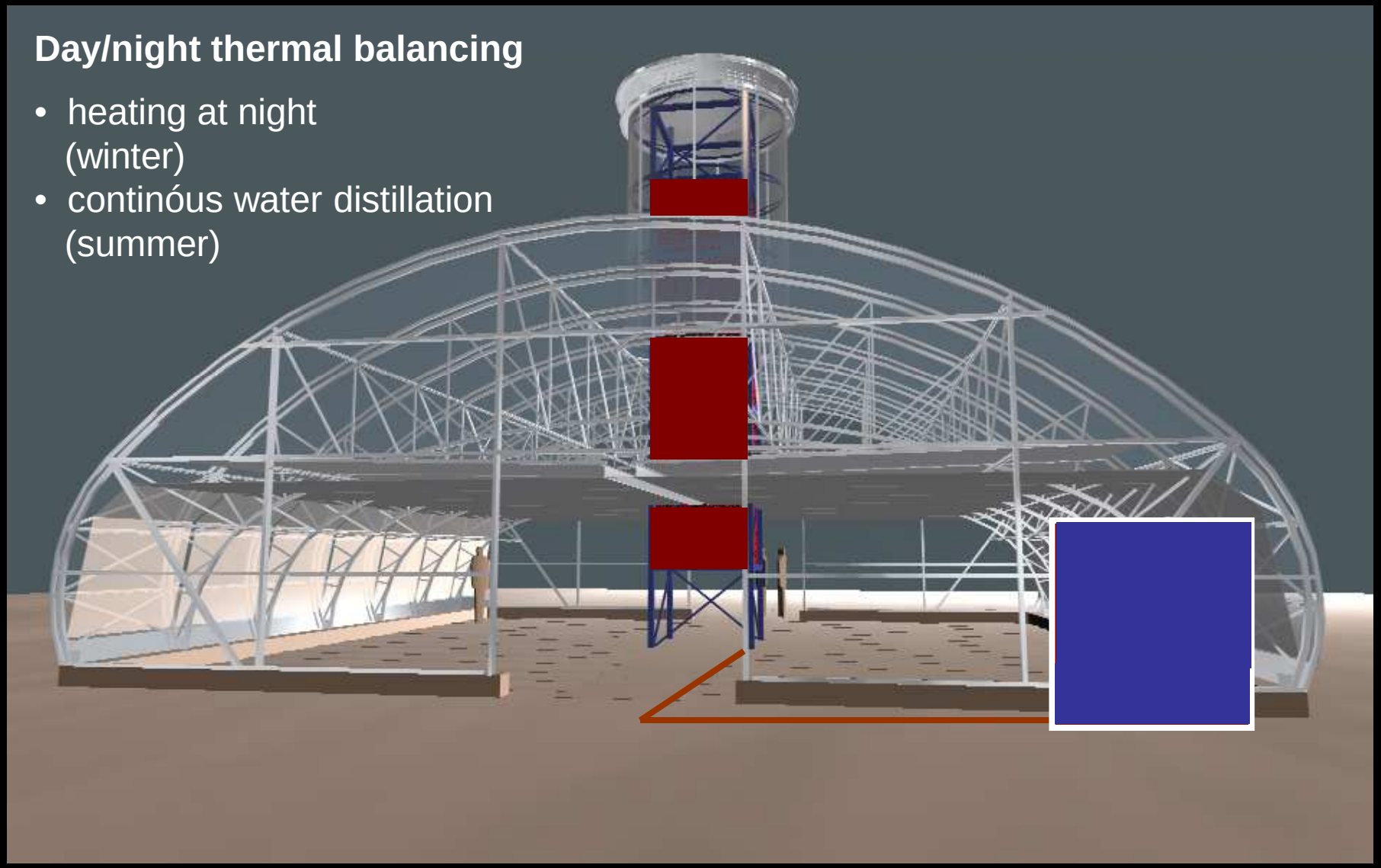

Constant water evaporation
Humidification with sea- or brackish water
Irrigation with wastewater

Day/night thermal balancing

- Daytime cooling

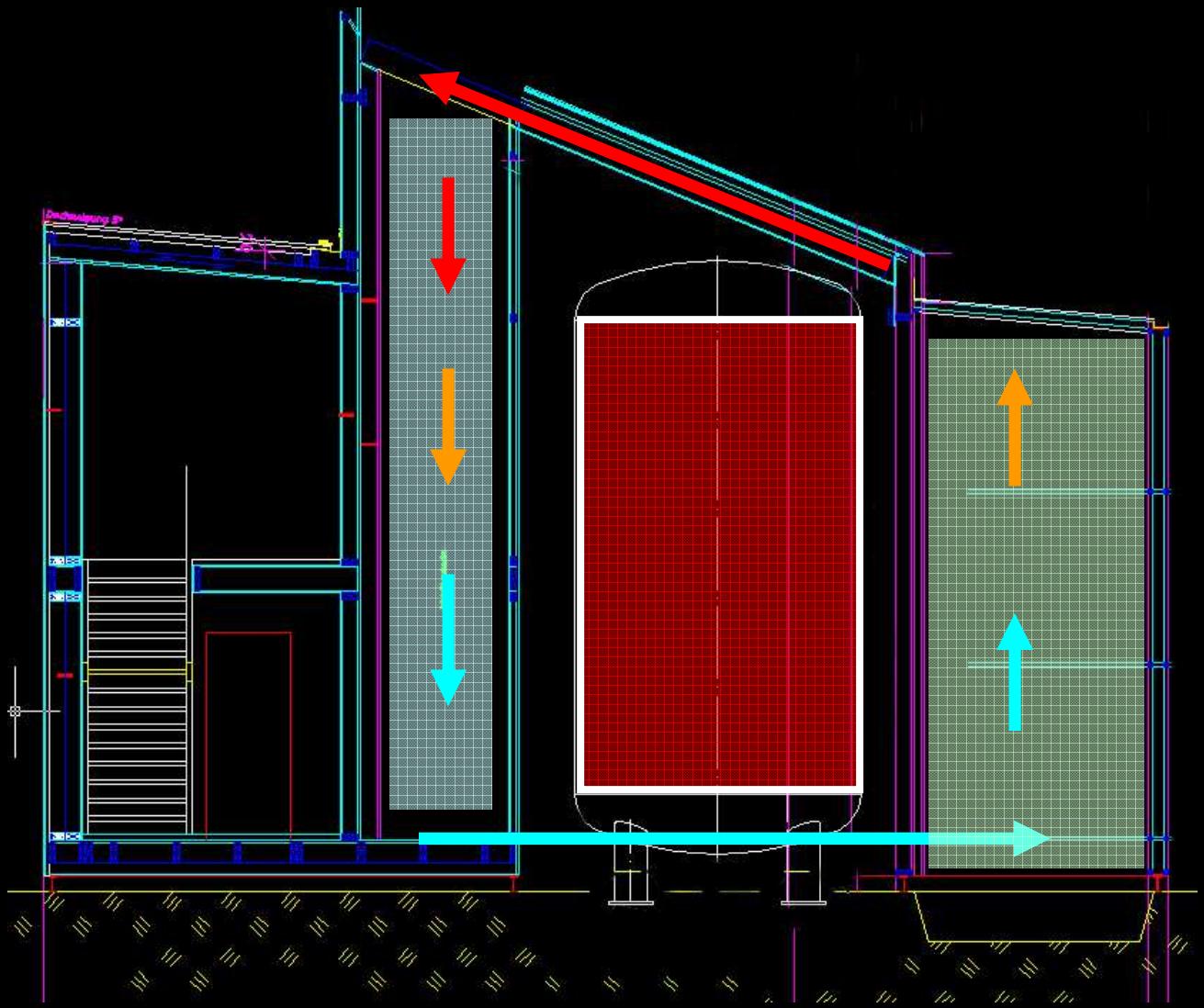
Day/night thermal balancing

- heating at night (winter)
- continóus water distillation (summer)



Prototype 2

Integrated building system




Eurasol Eurasol Eurasol
FLOAT

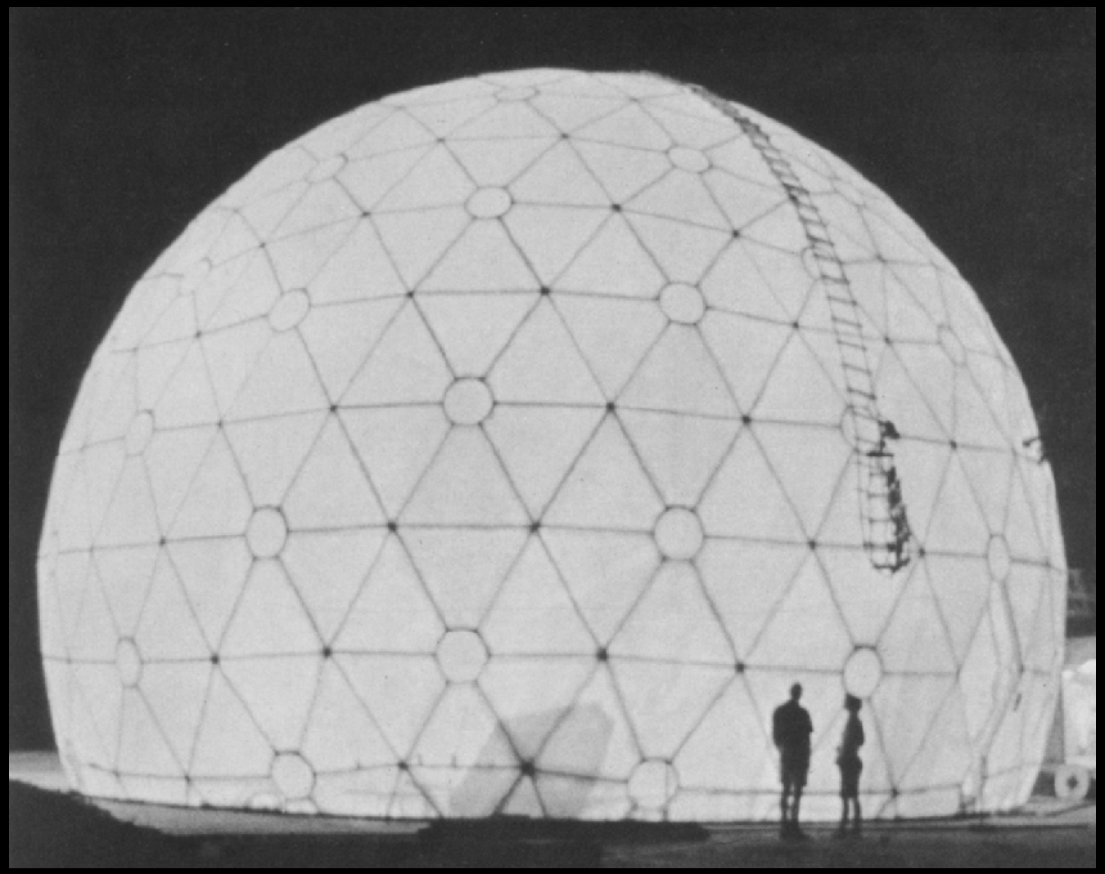
Towards a low cost watergy greenhouse

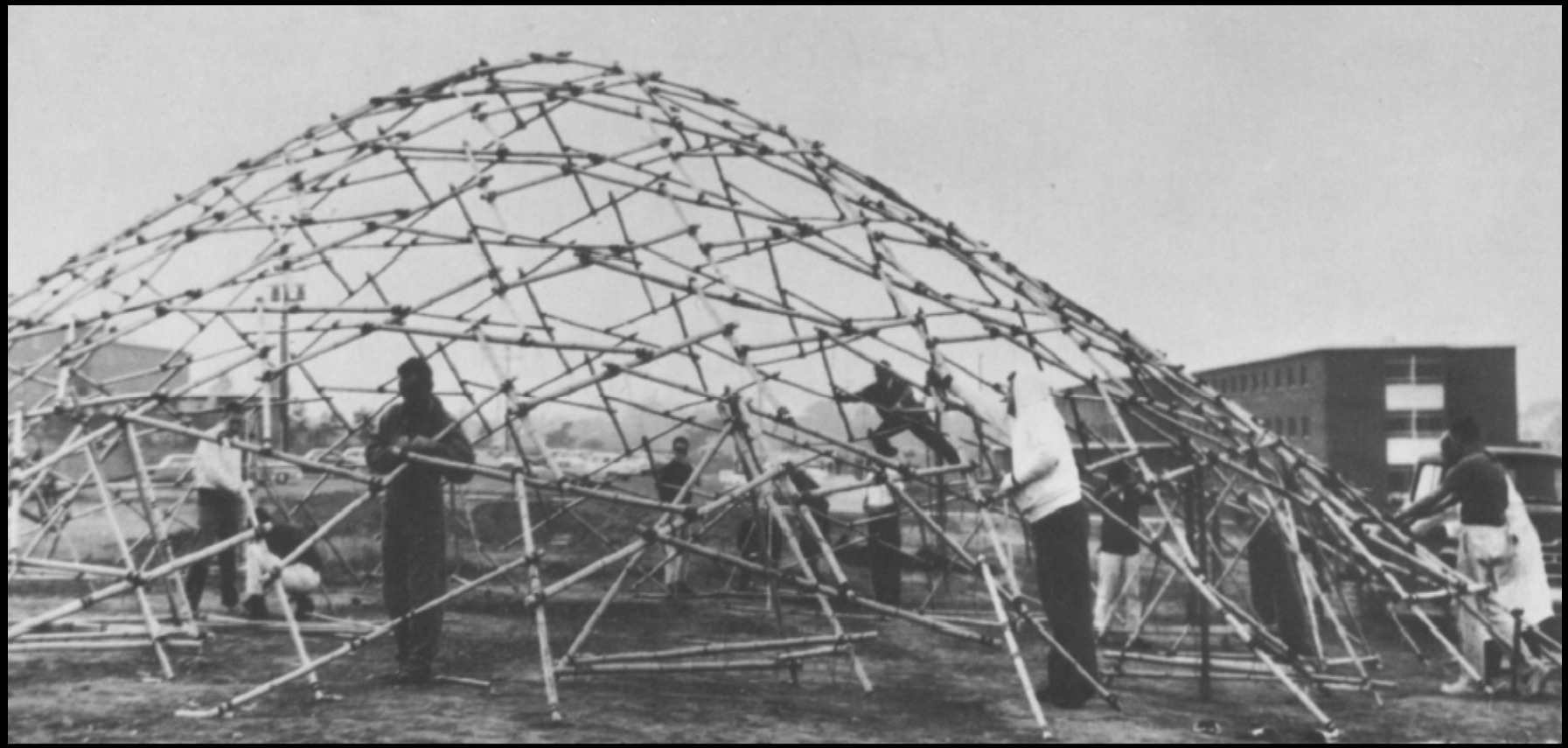
Cost reduction
1. Construction

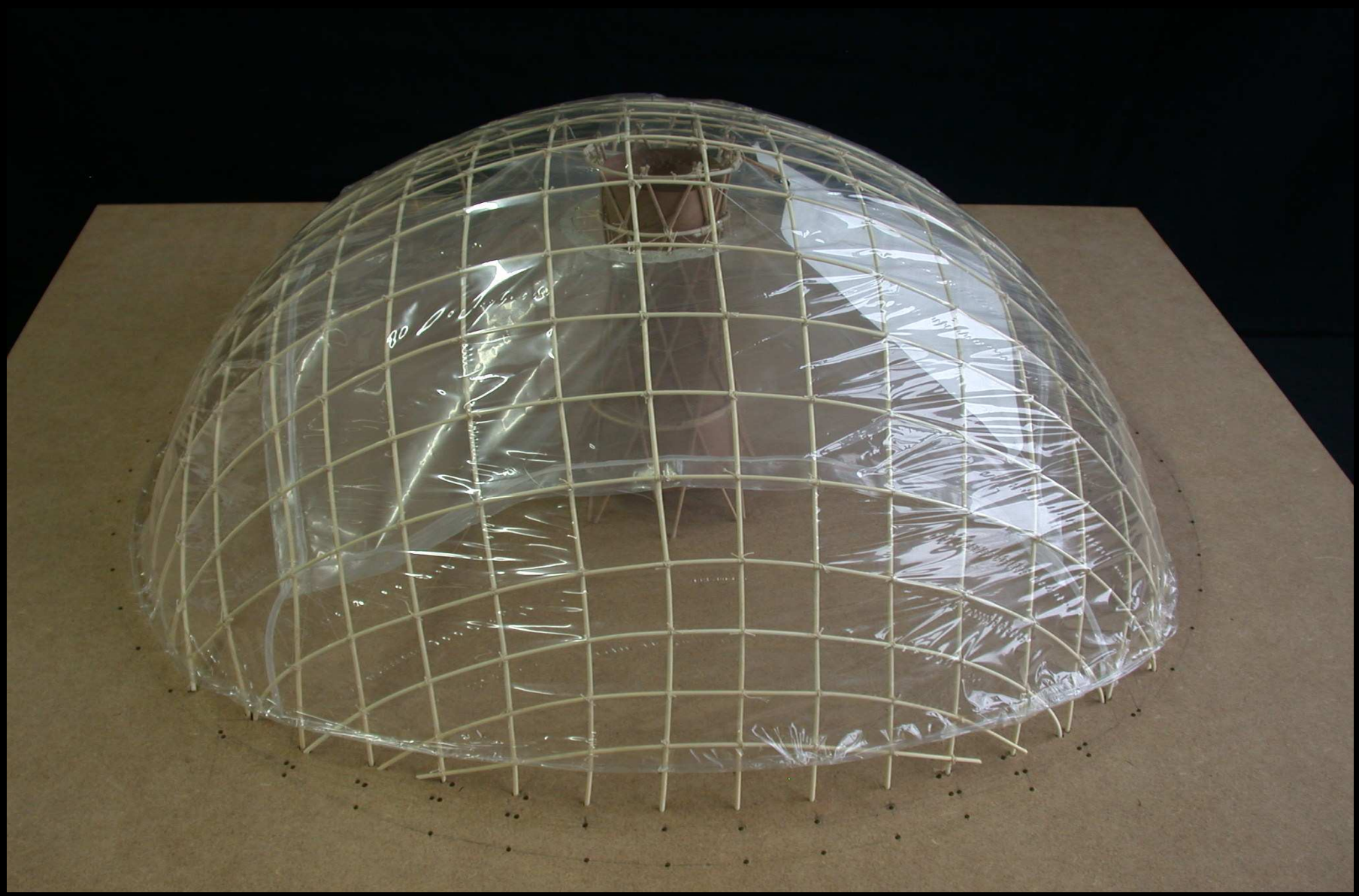
- General reduction of material
- Reduction of steel components
- Use of renewable material
- Optimisation of anti – drip properties for improved collection of condensed water

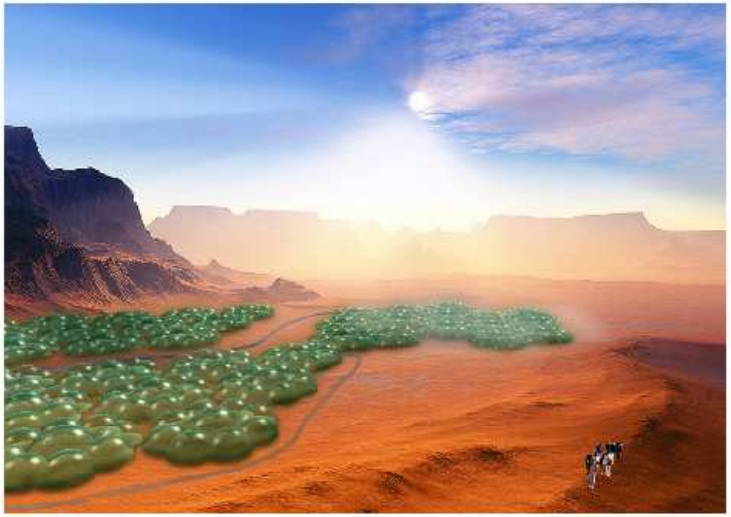
Cost reduction
1 - Construction
- bamboo dome

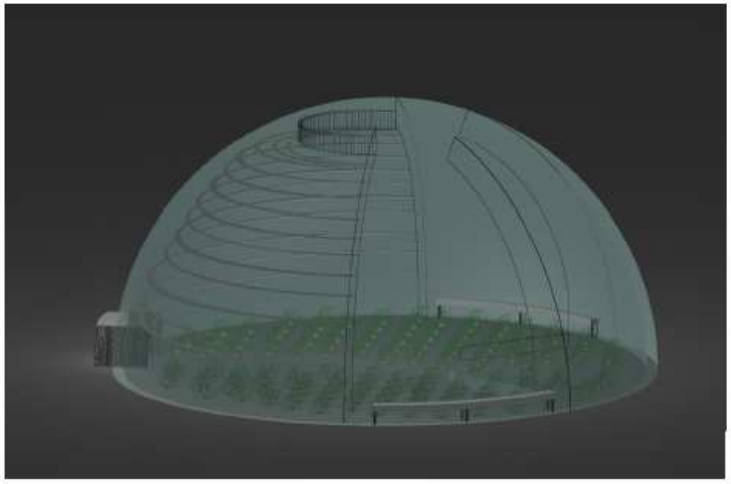
Compression force on rods of 2.5m, euler c. 2	Wood EC5 S10/MS10	Bamboo EC5 *Guadua angustifolia kunth*	Steel EC3 S235
Density kg / m³	550	700	7800
M.of Elasticity N/mm²	7400	6000	210000
f_c N/mm²	21	30	235
cross-section	 D=9cm	 D=12cm d=9cm	 D=5.1cm d=4.5cm
Area A cm²	63.6	49.5	4.4
Inertia I cm⁴	322.1	695.8	12.7
Slenderness λ	111.1	66.7	147.2
Weight kg	**8.7**	**8.7**	**8.7**
Force, allowable KN	**15.1**	**25.6**	**27.6**
BIC $\frac{g}{N*m}$	0.23	0.14	0.13
Prize per meter € Colombia / Germany	2 | 5	1 | 3	4 | 8
ECOCOSTO $\frac{MJ/m^3}{N/mm^2}$ [JAN00]	80	30	1500

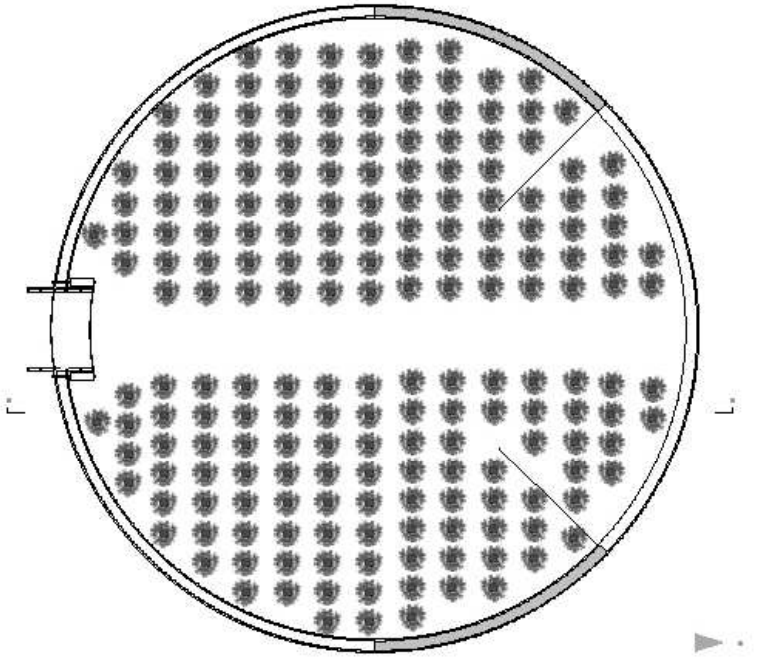


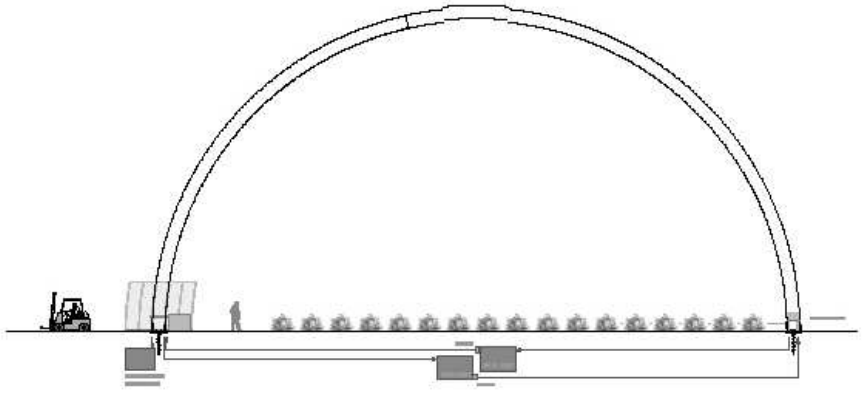






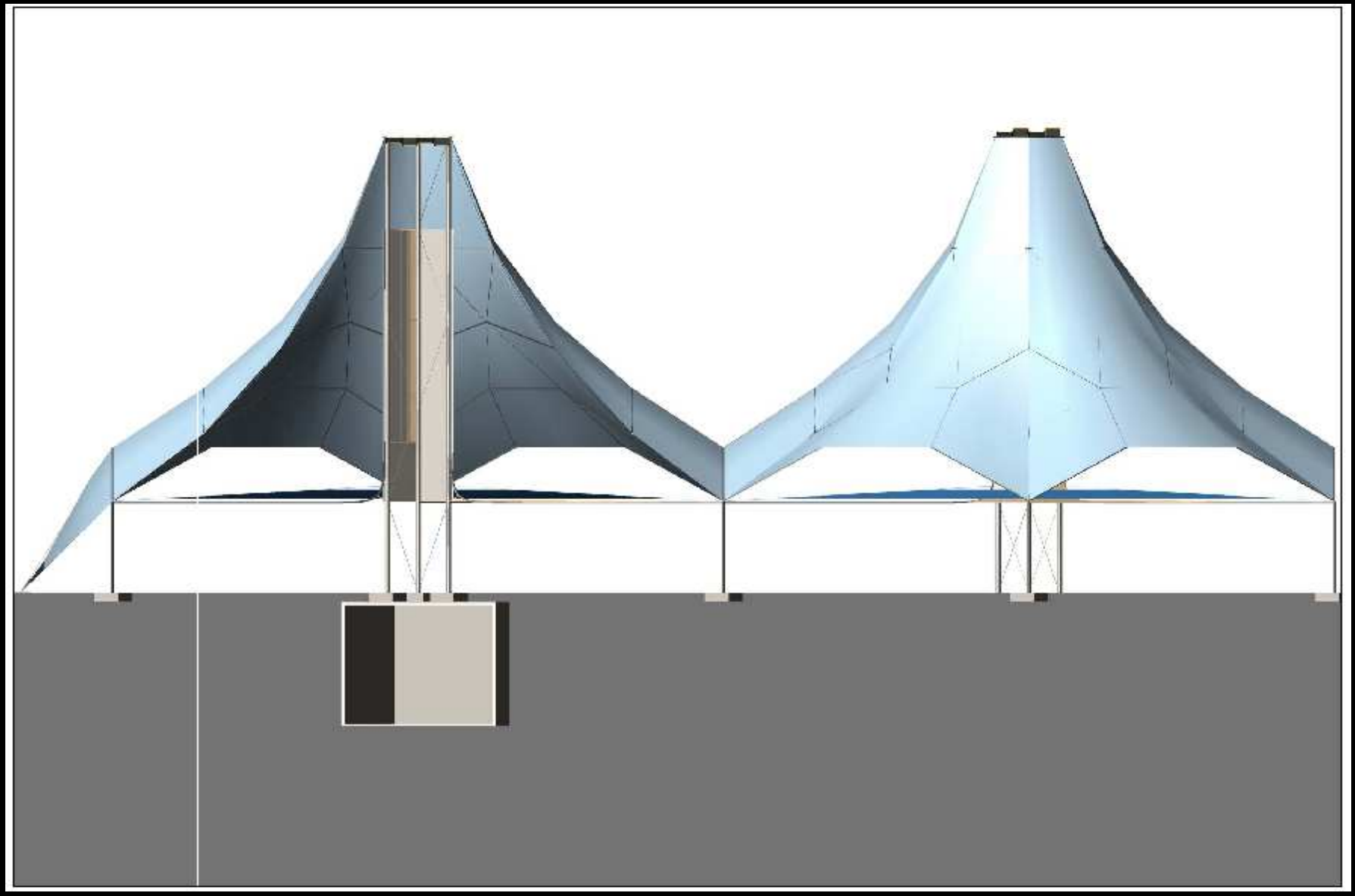




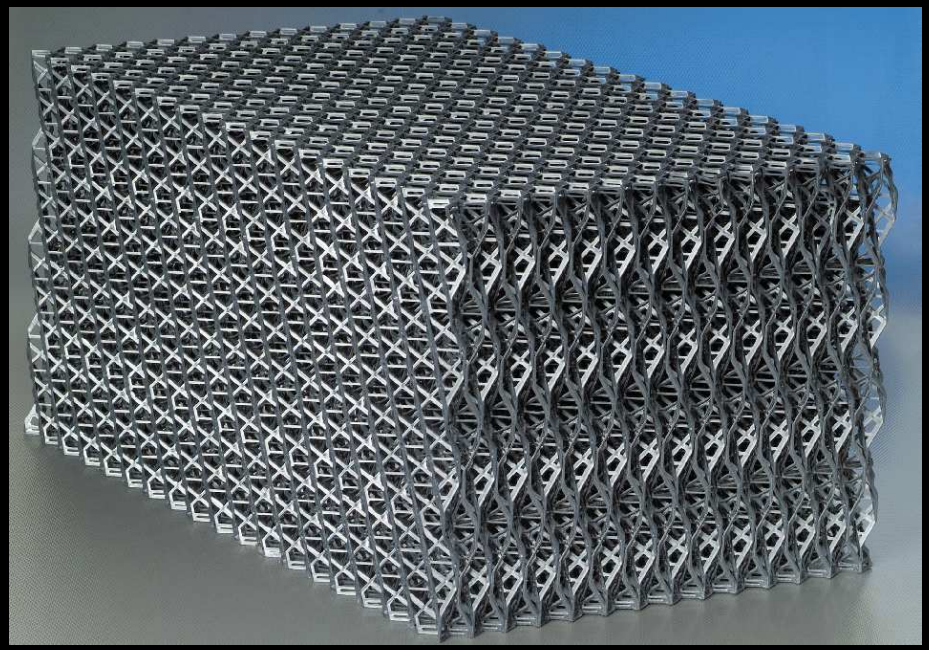


Cost reduction
Construction
- wooden tent

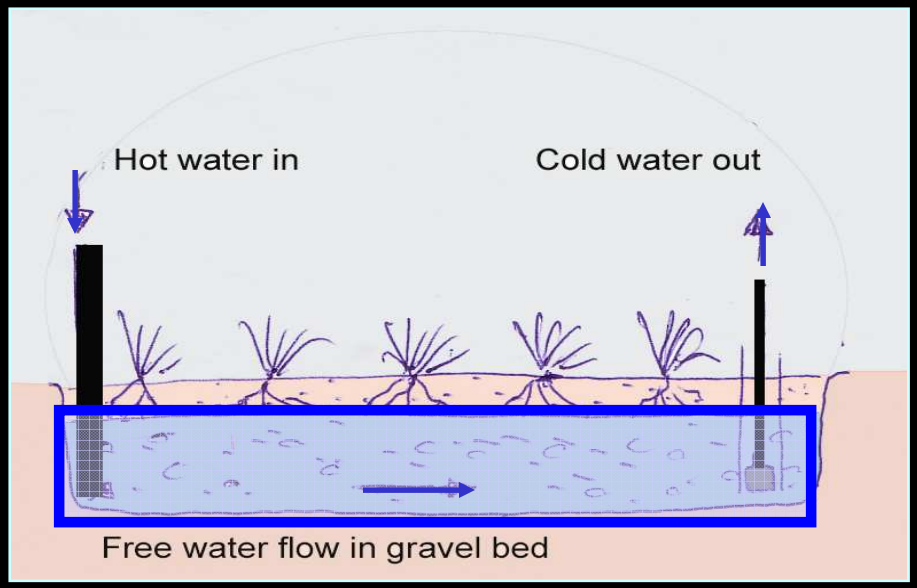

1:288

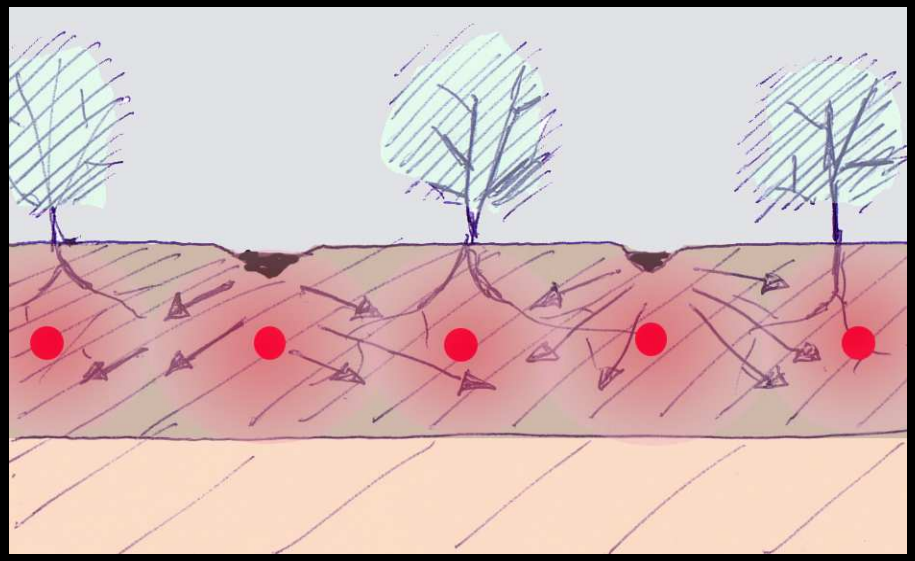


Cost reduction 1
Greenhouse cooling
- heat exchanger



Cost reduction 1
Greenhouse cooling
- thermal storage


Hot water in
Cold water out
Free water flow in gravel bed



Generating additional Income

Closed Greenhouse

Increased Productivity by CO2 Enrichment
100

Production without pesticides
50 + 50

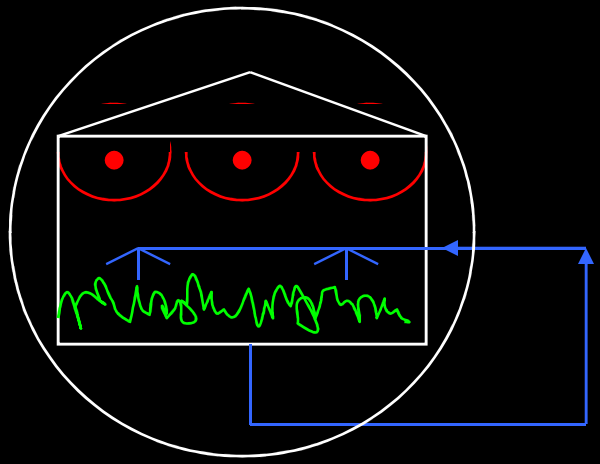
Solid State Fermentation

-Protein enrichment of crops (meat/fish substitute)
- Delignification of Biomass (Cotton substitute, Celluslosis)

100

Greenhouse Integrated Solar Power

100



Water Recycling
5 (**20** ?)

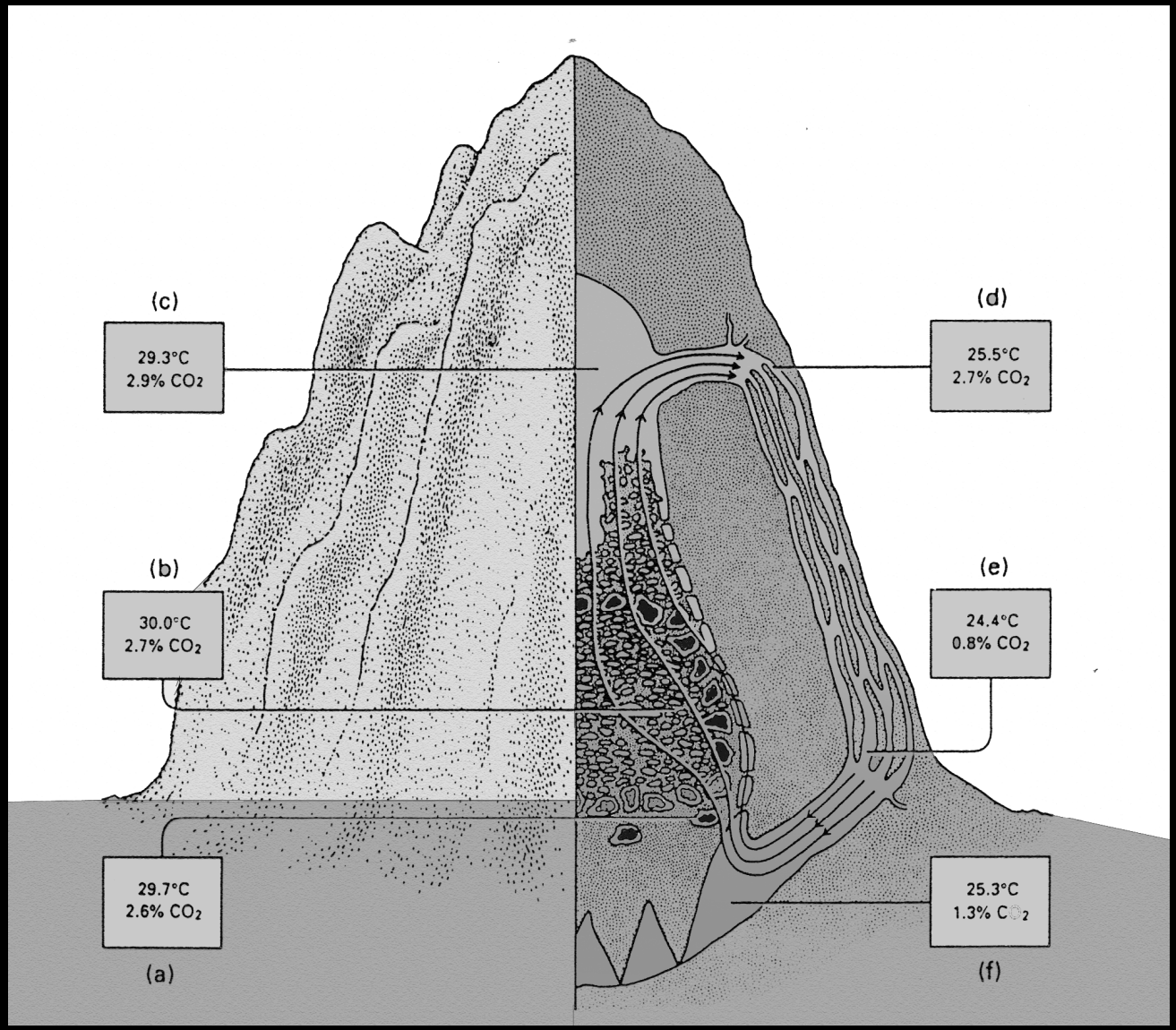
Urban Water Supply
20 (**80** ?)

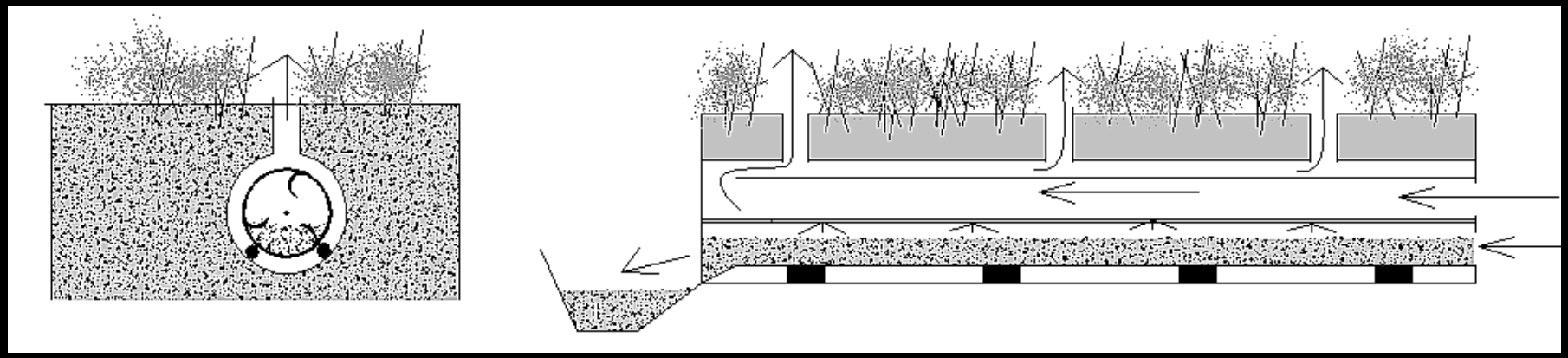
Greywater Disposal
5

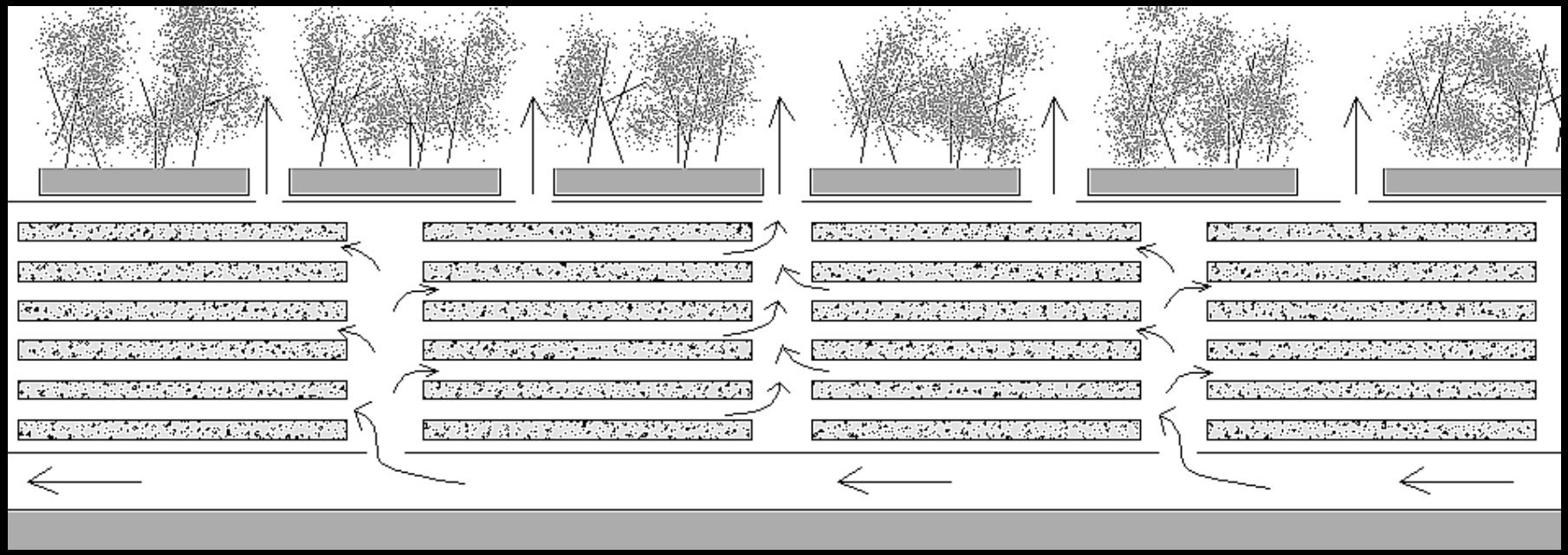
Organic Nutrients
5 (**20** ?)

Horticulture
100

Solid State Fermentation


(c)
29.3°C
2.9% CO_2
(d)
25.5°C
2.7% CO_2
(b)
30.0°C
2.7% CO_2
(e)
24.4°C
0.8% CO_2
29.7°C
2.6% CO_2
25.3°C
1.3% CO_2
(a)
(f)





Integration of Solid State Fermentation (Closed Ecosysem)

- Implemented CO_2 and heat production and oxygen sink by fungus metabolism
- Growth of Hemp, Linen or Kenaf and biotechnological further processing towards higher valued bulk products (cellulosis, upgraded textiles) as a substitute for cotton
- Production of high value proteine enriched food (Tempeh) as substitute for meat or fish
- Use of conventional wastewater as using non-food crops

Cost reduction

Intelligent light construction
Minimation of steel
Use of Regenerative raw material
Use of ETFE
Modified Heat exchanger
Thermal activation of soil

Income

Water recycling / Urban water and nutrient cycle
Greenhouse inntegrated solar concentrating power
CO_2 accumulation
New methods of pest control
Solid State Fermentation