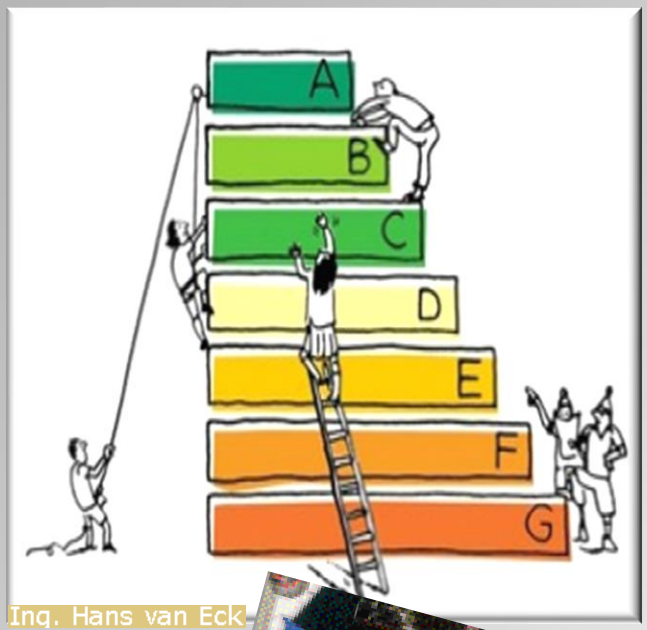
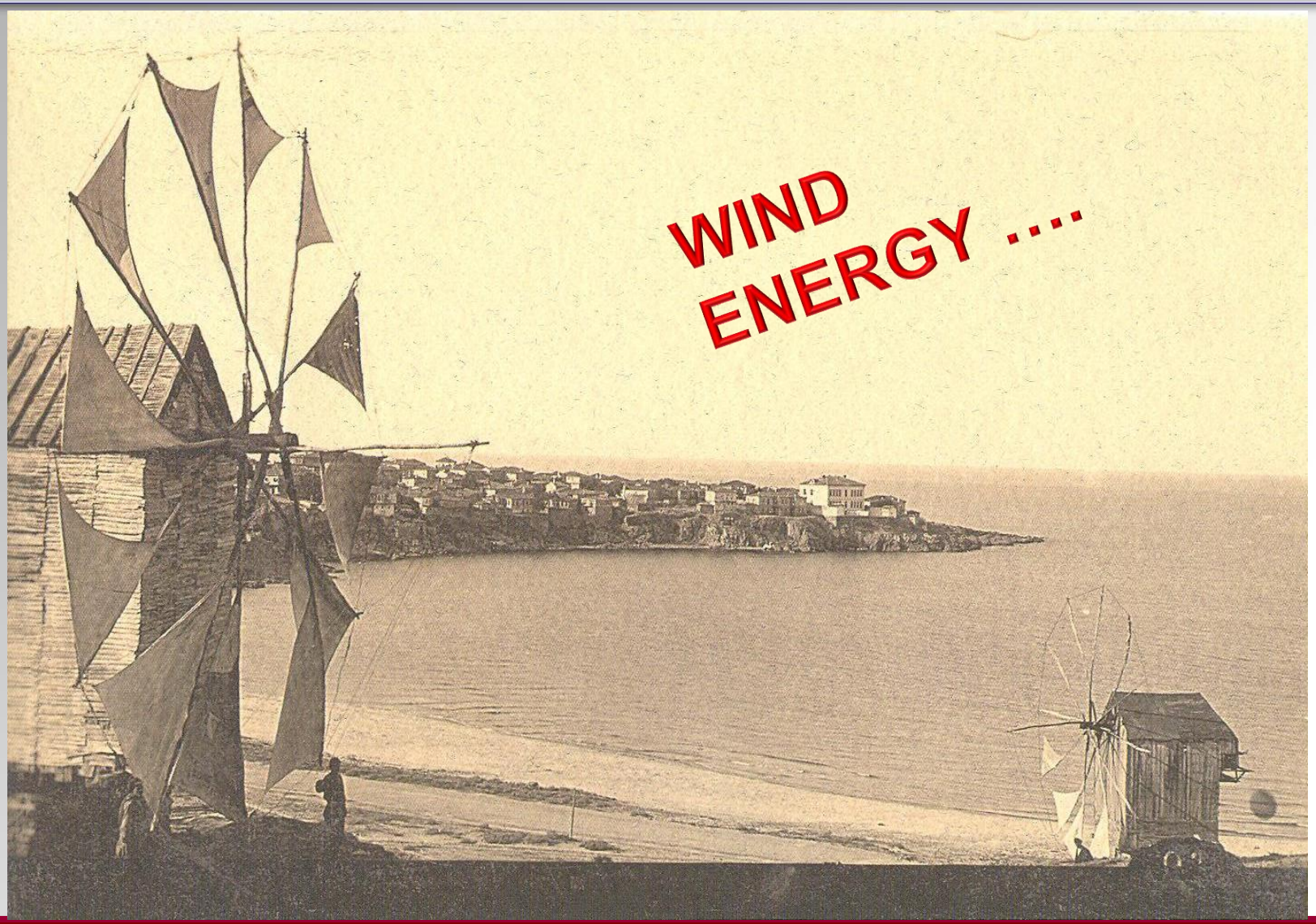
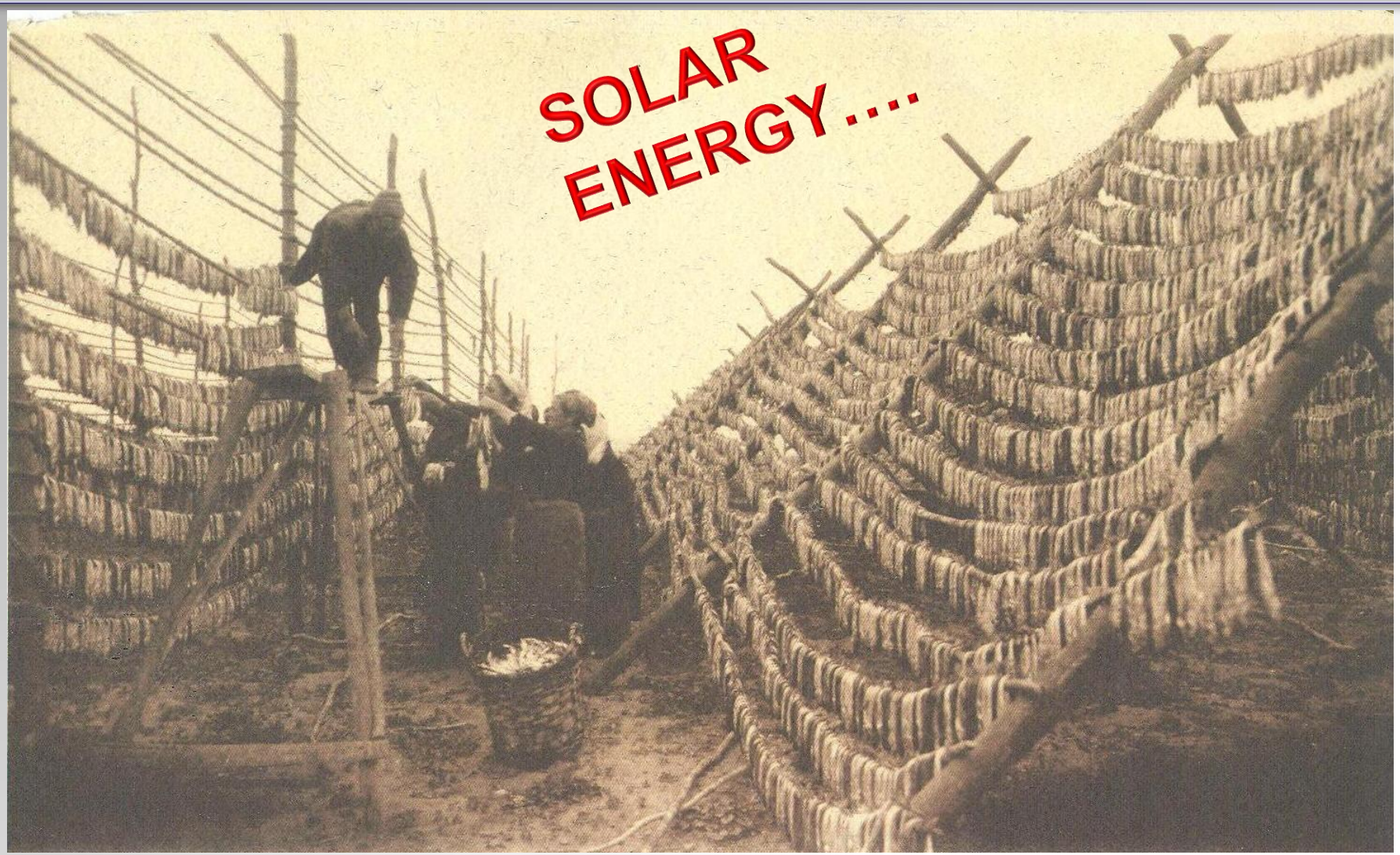


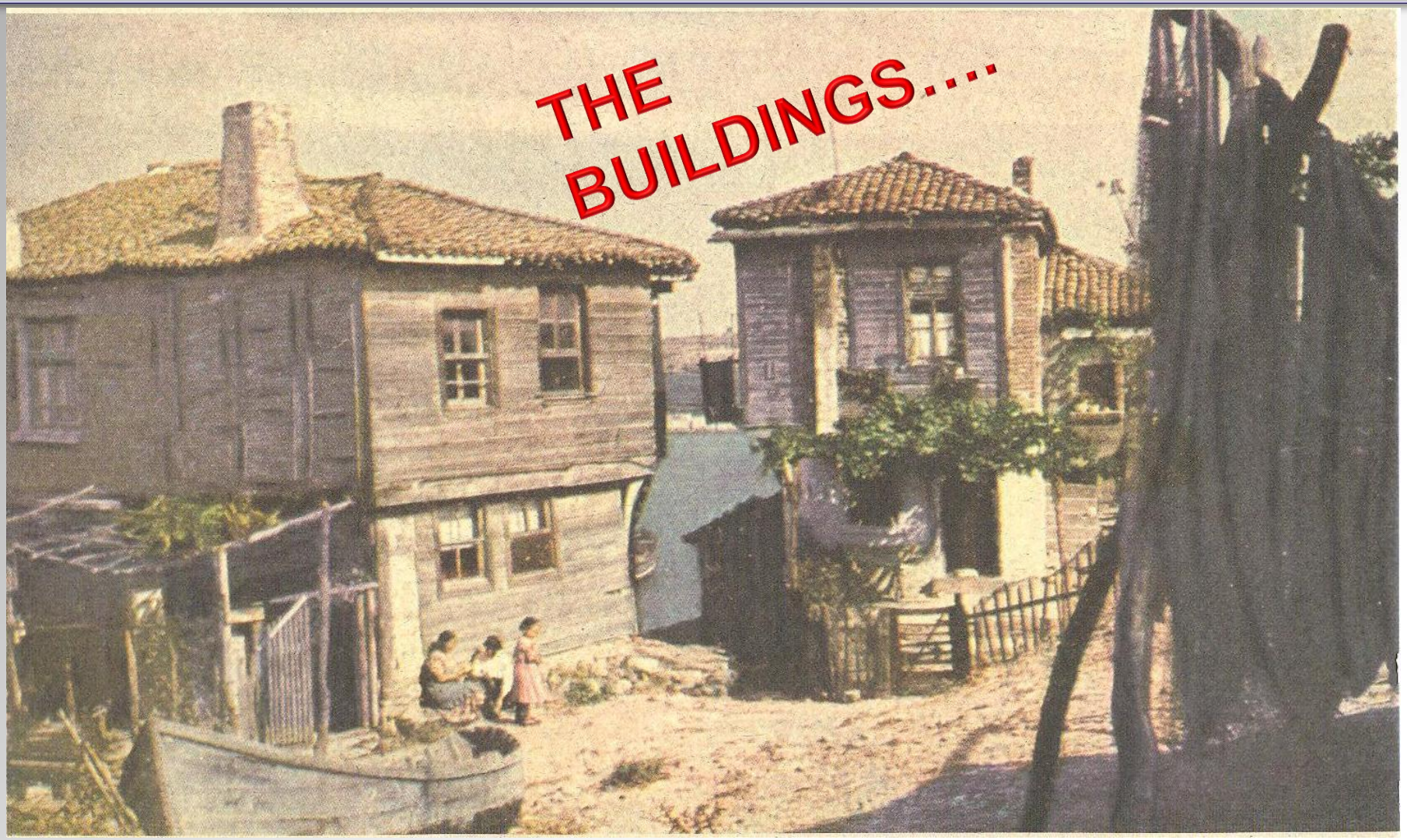
TOWARDS THE POTENTIAL CONTRIBUTION OF THE PASSIVE SOLAR SYSTEMS IN A BALKAN CLIMATE REGION

Prof.Dr. Nikola Kaloyanov


WIND
ENERGY ....

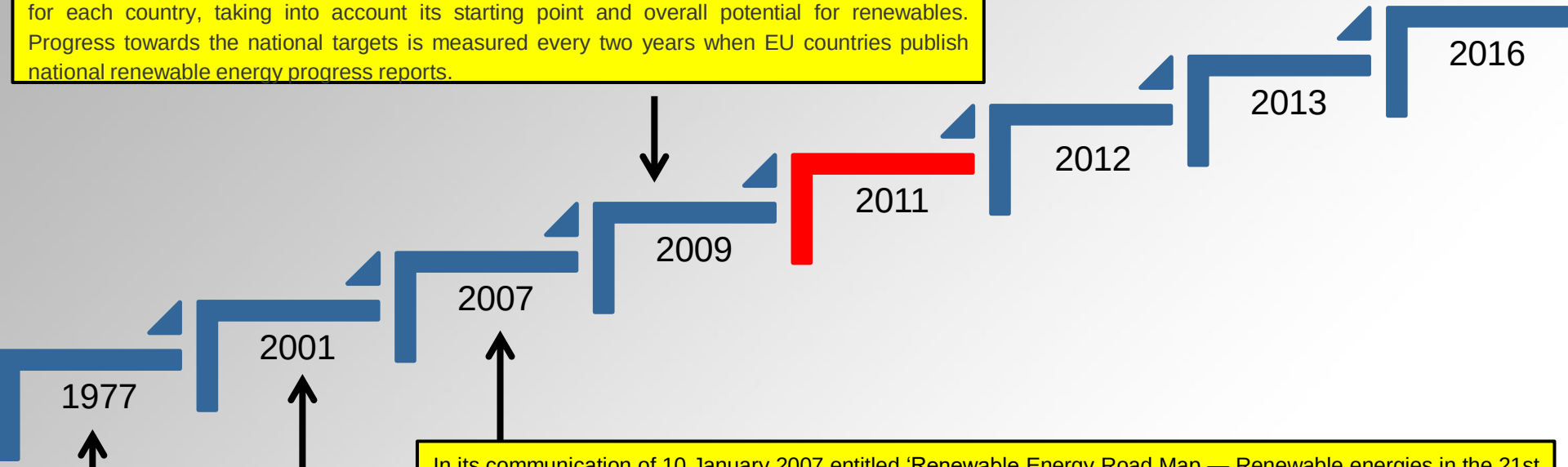

91. Созополъ плажа
Sosopol la pla


SOLAR
ENERGY ....


THE
BUILDINGS....

…the history of the RES requirements in EC

Renewable Energy Directive, adopted by codecision on 23 April 2009 (Directive 2009/28/EC, repealing Directives 2001/77/EC and 2003/30/EC). All Member States are required to obtain 10% of their transport fuels from renewable sources by 2020. The directive also mapped out various mechanisms that Member States can apply in order to reach their targets (support schemes, guarantees of origin, joint projects, cooperation between Member States and third countries), as well as sustainability criteria for biofuels.The directive specifies national renewable energy targets for each country, taking into account its starting point and overall potential for renewables. Progress towards the national targets is measured every two years when EU countries publish national renewable energy progress reports.



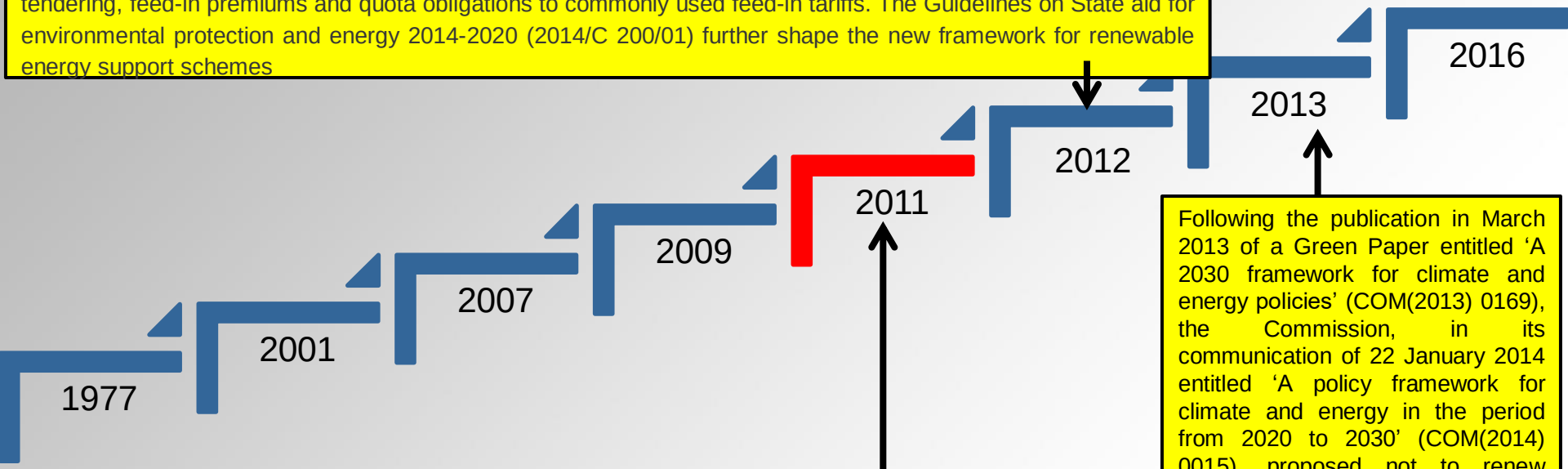
In its communication of 10 January 2007 entitled 'Renewable Energy Road Map — Renewable energies in the 21st century: building a more sustainable future' the Commission proposed a mandatory target of using renewable energy sources to meet 20% of EU energy consumption needs by 2020, a mandatory target of 10% of transport fuel consumption coming from biofuels by 2020, and the creation of a new legislative framework.

Indicative targets for each Member State set out in Directive 2001/77/EC. The lack of progress towards achieving the 2010 targets led to the adoption of a more comprehensive legislative framework.

Following the 1997 White Paper on renewable energy sources (COM(1997) 0599), the EU set itself targets of using renewable energy sources to meet 12% of energy consumption and 22.1% of electricity consumption needs by 2010.

…the history of the RES requirements in EC

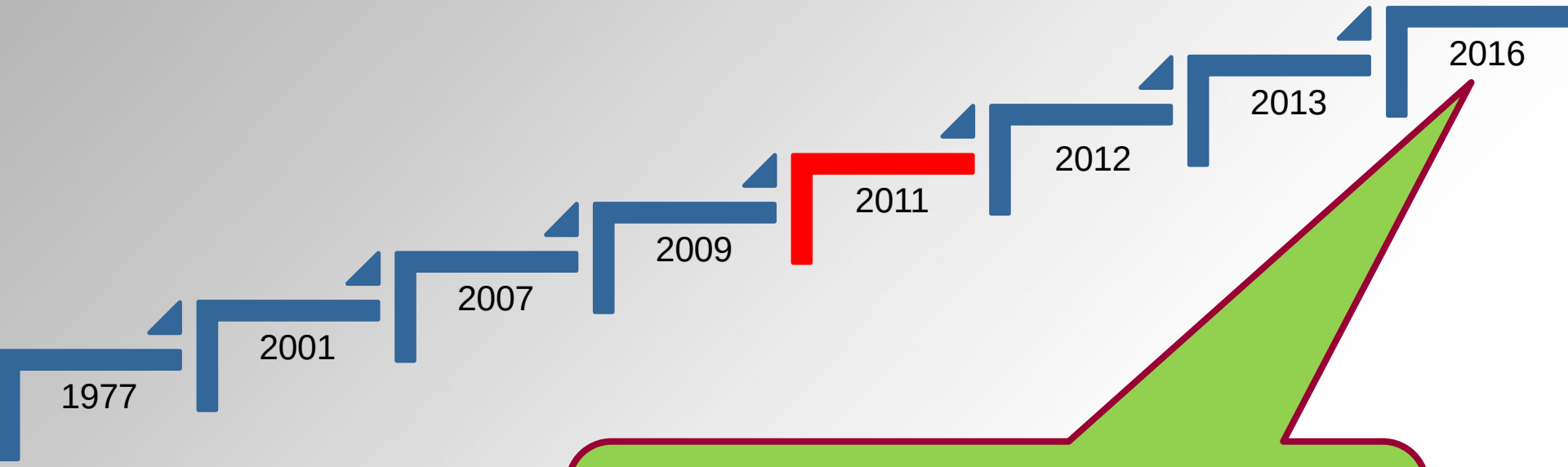
The Commission, in its communication of 6 June 2012 entitled 'Renewable energy: a major player in the European energy market' (COM(2012) 0271), identified the areas in which efforts should be stepped up between now and 2020 for the EU's renewable energy production to continue to increase up to 2030 and beyond. In November 2013, the Commission provided further guidance on renewable energy support schemes as well as on the use of cooperation mechanisms to achieve renewable energy targets at a lower cost (COM(2013) 7243). It announced a complete overhaul of the subsidies that Member States are allowed to offer the renewable energy sector, preferring tendering, feed-in premiums and quota obligations to commonly used feed-in tariffs. The Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01) further shape the new framework for renewable energy support schemes



The EU has started preparing for the period beyond 2020, in order to provide early policy clarity on the post-2020 regime for investors. Renewable energy plays a key part in the Commission's long-term strategy as outlined in its 'Energy Roadmap 2050' (COM(2011) 0885). The decarbonisation scenarios for the energy sector proposed in the roadmap point to a renewable energy share of at least 30% by 2030. However, the roadmap also suggests that the growth of renewable energy will slacken after 2020 unless there is further intervention.

Following the publication in March 2013 of a Green Paper entitled 'A 2030 framework for climate and energy policies' (COM(2013) 0169), the Commission, in its communication of 22 January 2014 entitled 'A policy framework for climate and energy in the period from 2020 to 2030' (COM(2014) 0015), proposed not to renew binding national targets for renewable energy after 2020. A mandatory target — 27% of energy consumption to come from renewable sources — is provided for only at EU level.

…the history of the RES requirements in EC



On 30 November 2016, the Commission published a legislative package entitled ‘Clean energy for all Europeans’ (COM(2016) 0860) as part of the broader Energy Union strategy (COM(2015) 0080). It includes a proposal for a revised Renewable Energy Directive to make the EU a global leader in renewable energy and to ensure that the target of at least a 27% share of renewables in the total amount of energy consumed in the EU by 2030 is met.

The legislative proposals cover energy efficiency, renewable energy, the design of the electricity market, security of supply and governance rules for the Energy Union.

The tabled package pursues three main goals:

- Putting energy efficiency first
- Achieving global leadership in renewable energies
- Providing a fair deal for consumers

PUTTING ENERGY EFFICIENCY FIRST

Putting energy efficiency first reflects the fact that the cheapest and cleanest source of energy is the energy that does not need to be produced or used.

The Commission has reviewed the EU's energy efficiency target, in line with the request by the European Council of October 2014, and considers that the EU should set a target binding at the EU level of 30% by 2030.

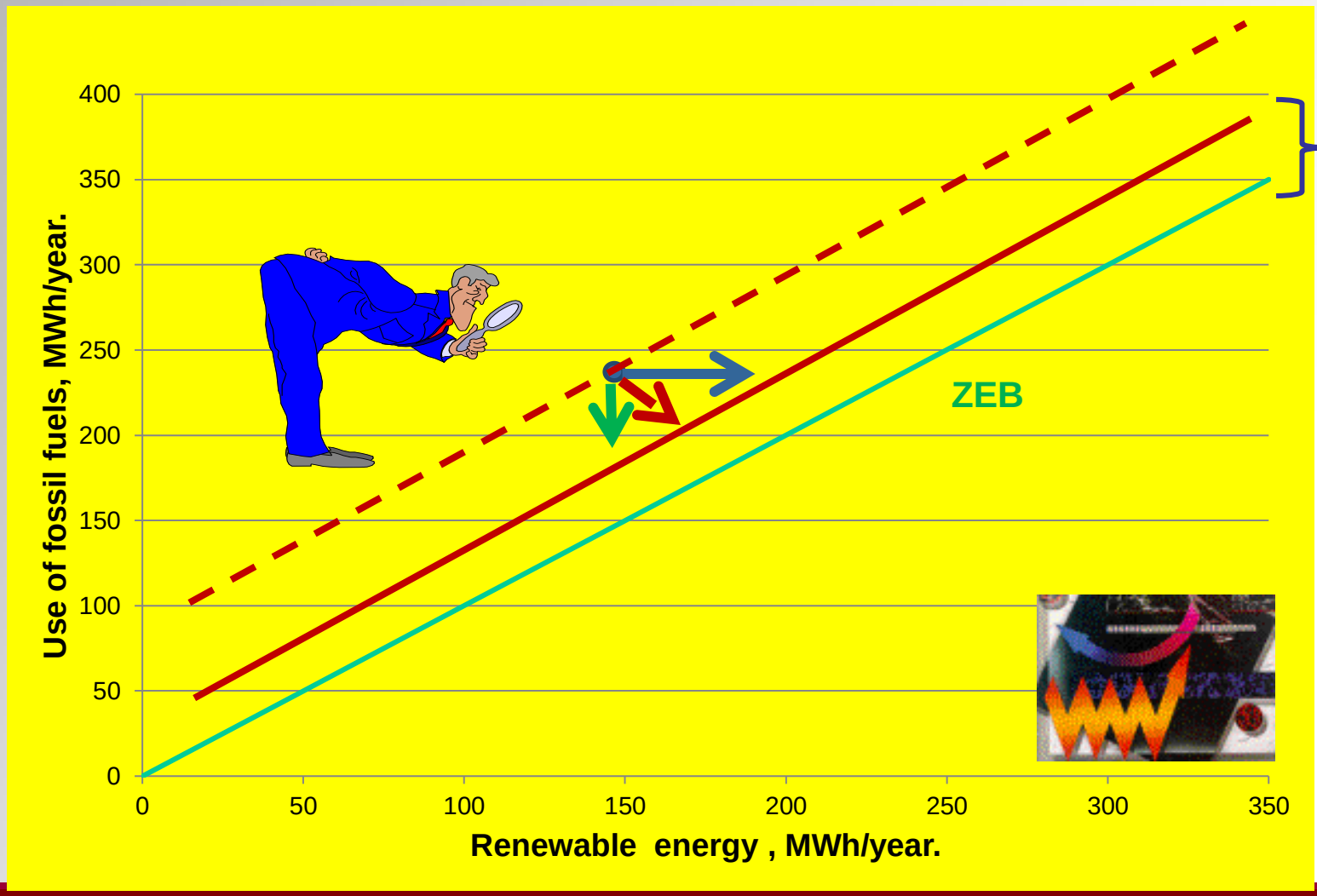
Buildings account for 40% of total energy consumption and around 75% of them are energy inefficient. Energy efficiency in buildings suffers from underinvestment and numerous barriers. Whereas buildings are regularly maintained or improved, energy saving investments are often disregarded because they face a competition for scarce capital, a lack of trustworthy information, lack of skilled workers or doubts on the possible benefits.

REDUCING THE BUILDING ENERGY CONSUMPTION ?.....

....TO WHAT EXTENT ?

DIRECTIVE 2010/31/EC (EPBD):
Nearly Zero Energy Buildings !!!

"ZEB" → „nZEB"


Use of fossil fuels, MWh/year.
400
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
Renewable energy , MWh/year.
ZEB

The THREE MAIN PRINCIPLES FOR nearly Zero-Energy Buildings

- **Energy demand**

Clearly defined boundary in the energy flow related to the operation of the building that defines the energy quality of the energy demand with clear guidance on how to assess corresponding values.

- **Renewable energy share**

Clearly defined boundary in the energy flow related to the operation of the building where the share of renewable energy is calculated or measured with clear guidance on how to assess this share.

- **Primary energy and CO_2 emissions**

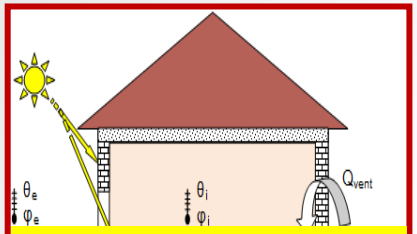
Clearly defined boundary in the energy flow related to the operation of the building where the overarching primary energy demand and CO_2 emissions are calculated with clear guidance on how to assess these values.

The BG "nearly Zero-Energy Buildings" DEFINITION:

nZEB is a building with:

- **Primary energy consumption (including appliances) – class A.** (The national requirement for new buildings is energy class B)

- **At least 55% of the final energy (without appliances) covered by RES.**



ENERGY NEED:
Heating
Cooling
Ventilation
DHW
Lighting
~~Appliances~~

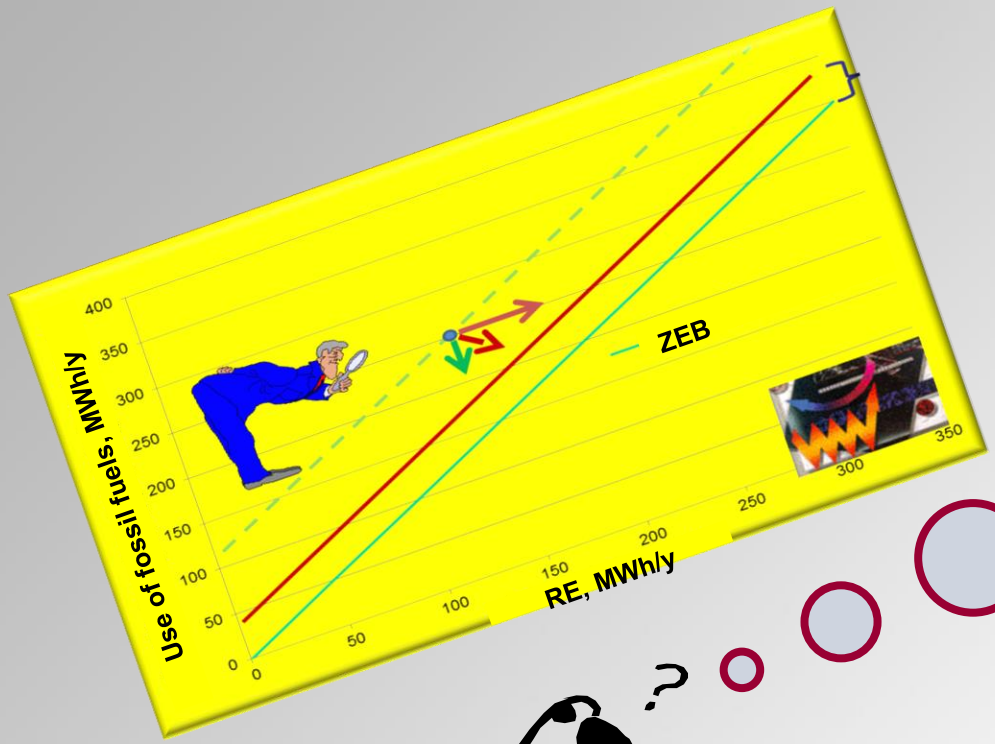
Heating energy

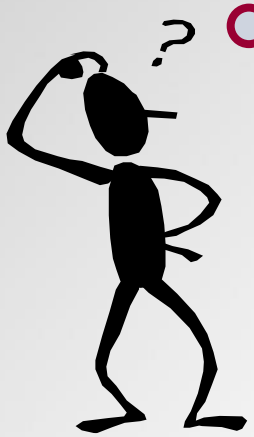
Cooling energy

Electricity for lighting

~~**Electricity for appliances**~~

…the BUILDING ENVELOPE …or the BUILDING SYSTEMS…?

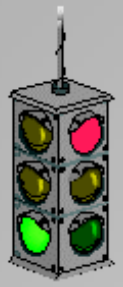




More than 100 CEN standards for implementation of the EPBD
/ more than 50 of them are in a process of updating/

The analysis of the globally evolving regulatory framework shows that the rules and standards are oriented only on active systems for RES utilization.

Although they have long been known, the PASSIVE SYSTEMS fall outside the scope of the framework of standards, most likely due to insufficient research and knowledge of their capabilities.



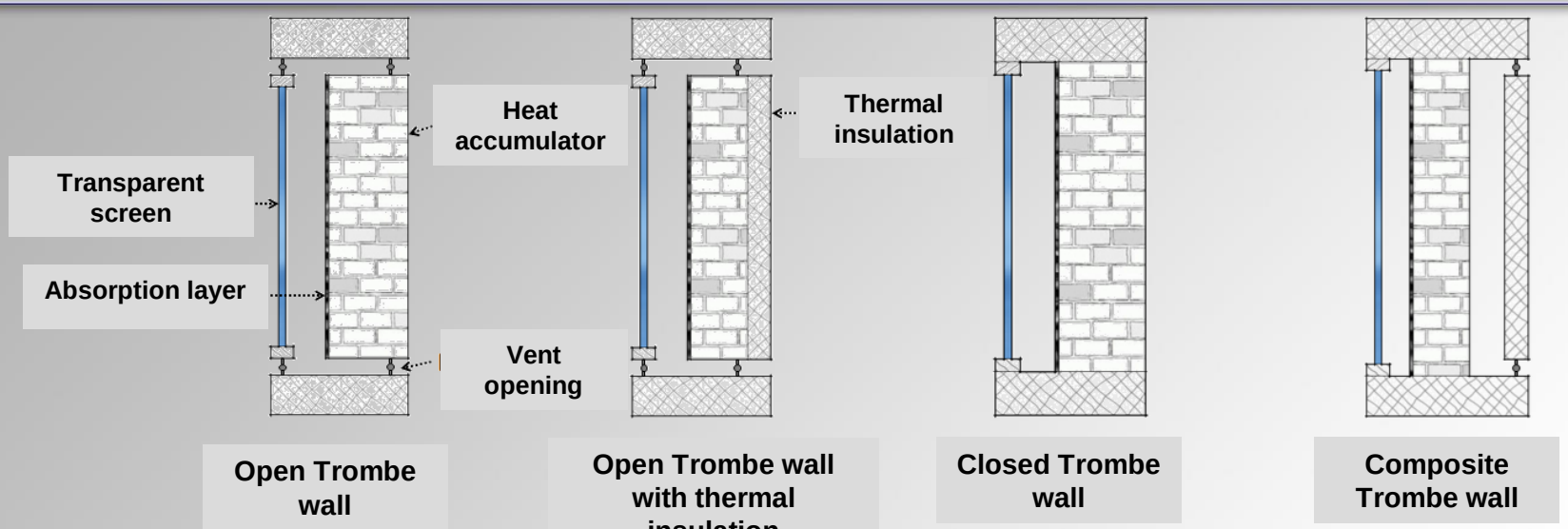
THE PASSIVE ENVELOPE ELEMENTS AND THEIR APPLICATION

/some results from our studies and analyses/

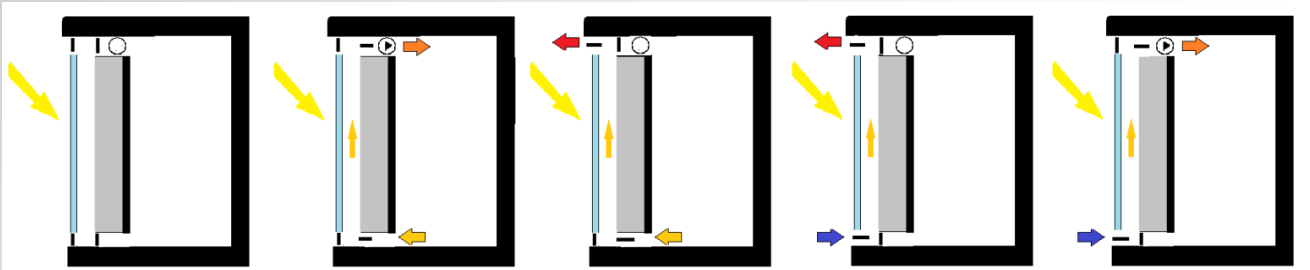
- ✓ 5-10% of building costs=HVAC (residential buildings)
- ✓ 30-50% of building costs= HVAC (public buildings)

- ✓ 15% of the HVAC costs are during the building process, 85% - during the life cycle of the building.

The Trombe wall

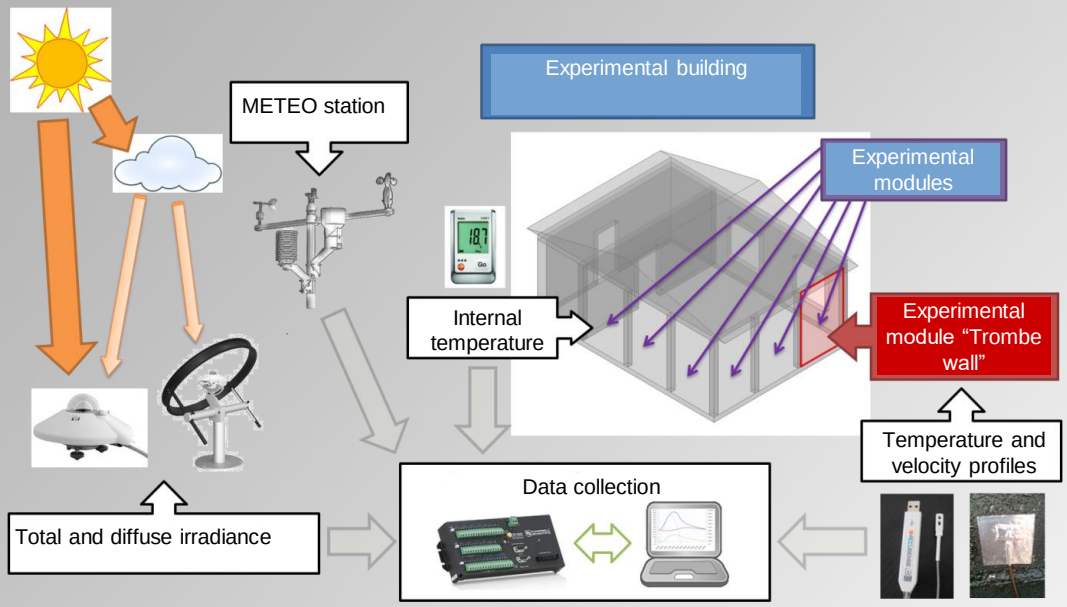


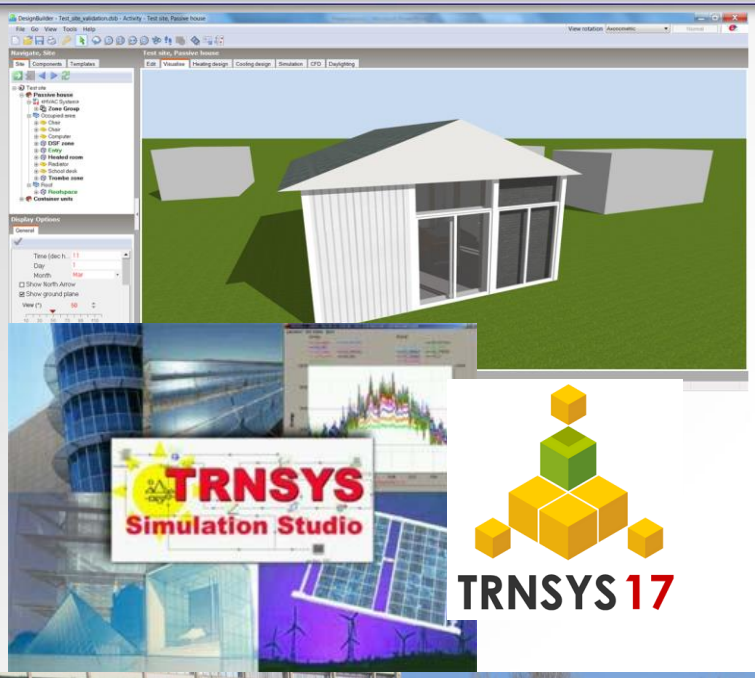
Modes of operation

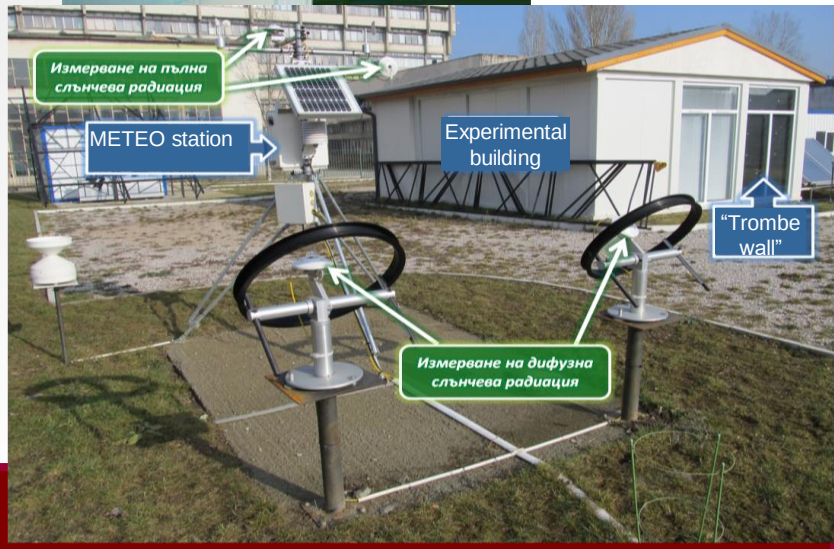


Accumulation of heat	Heating of internal air	Exhaust ventilation	Cooling of the facade	Ventilation of the internal space

TECHNICAL UNIVERSITY - SOFIA

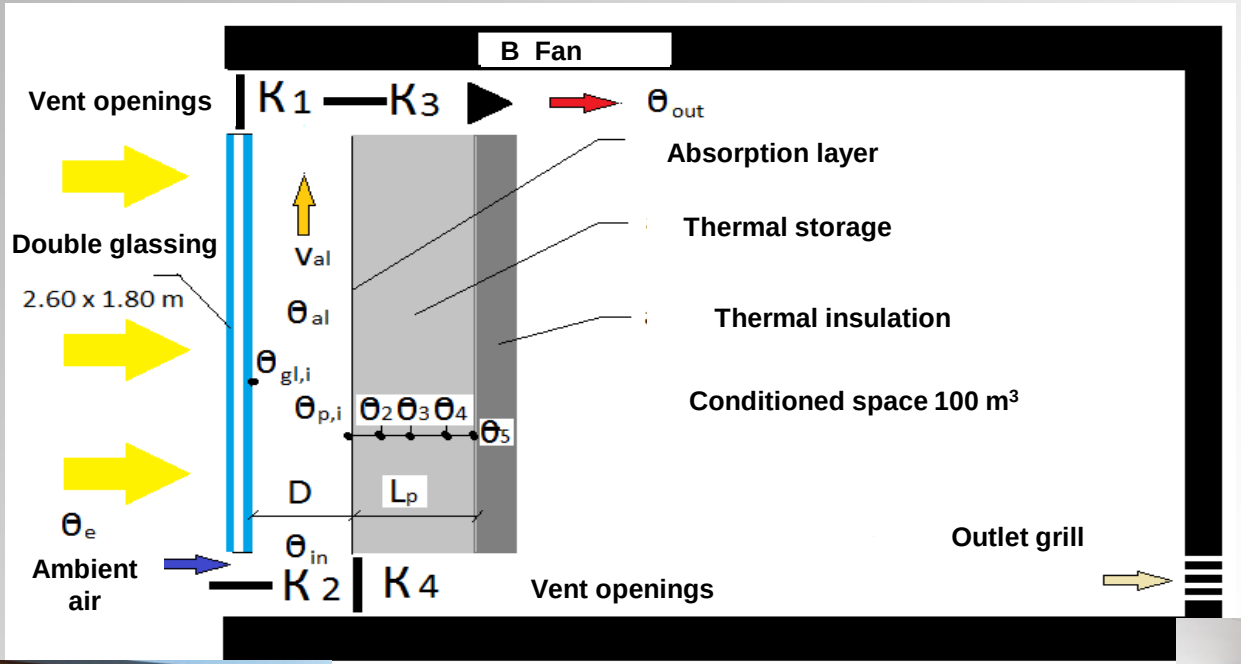




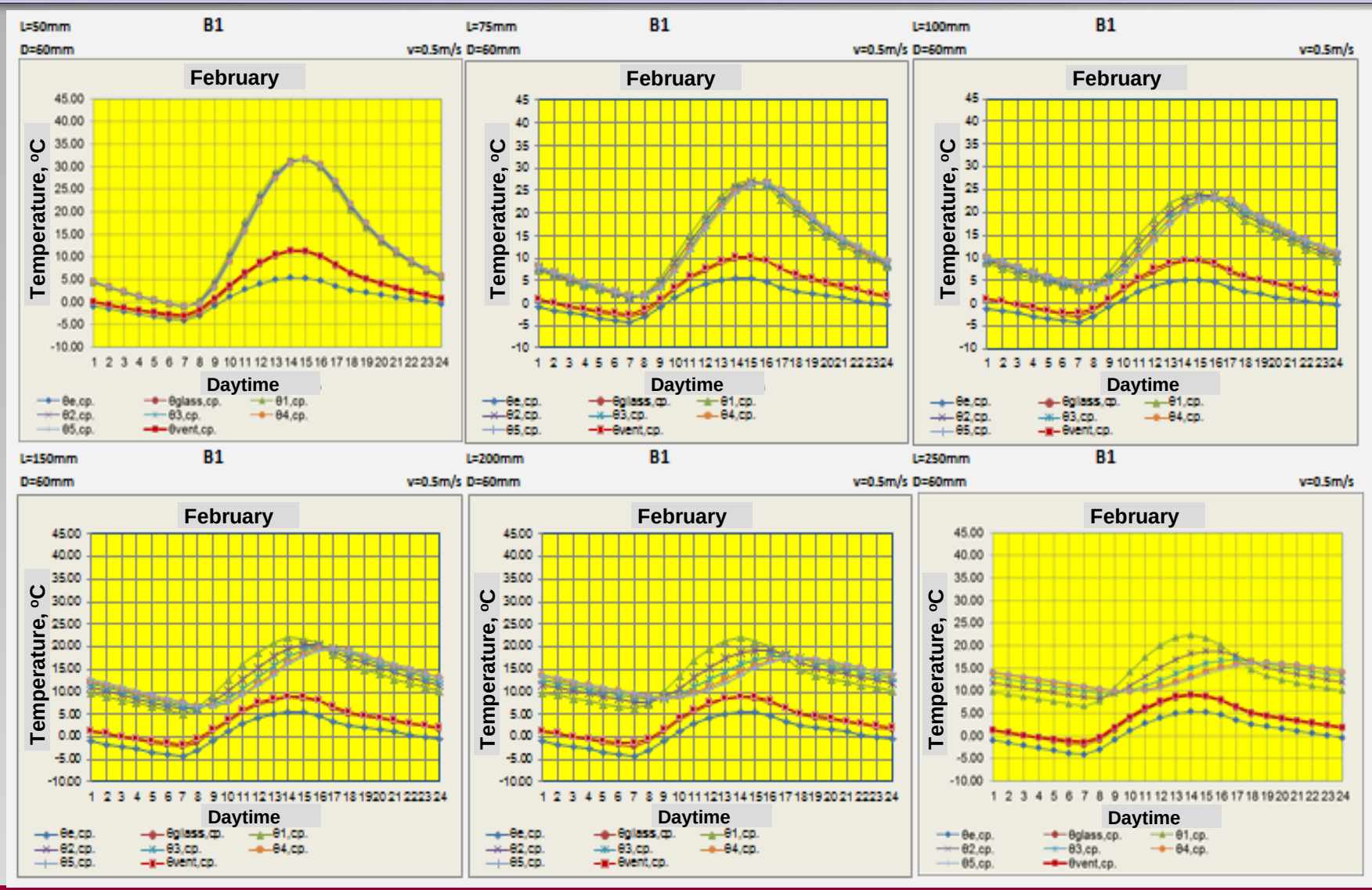


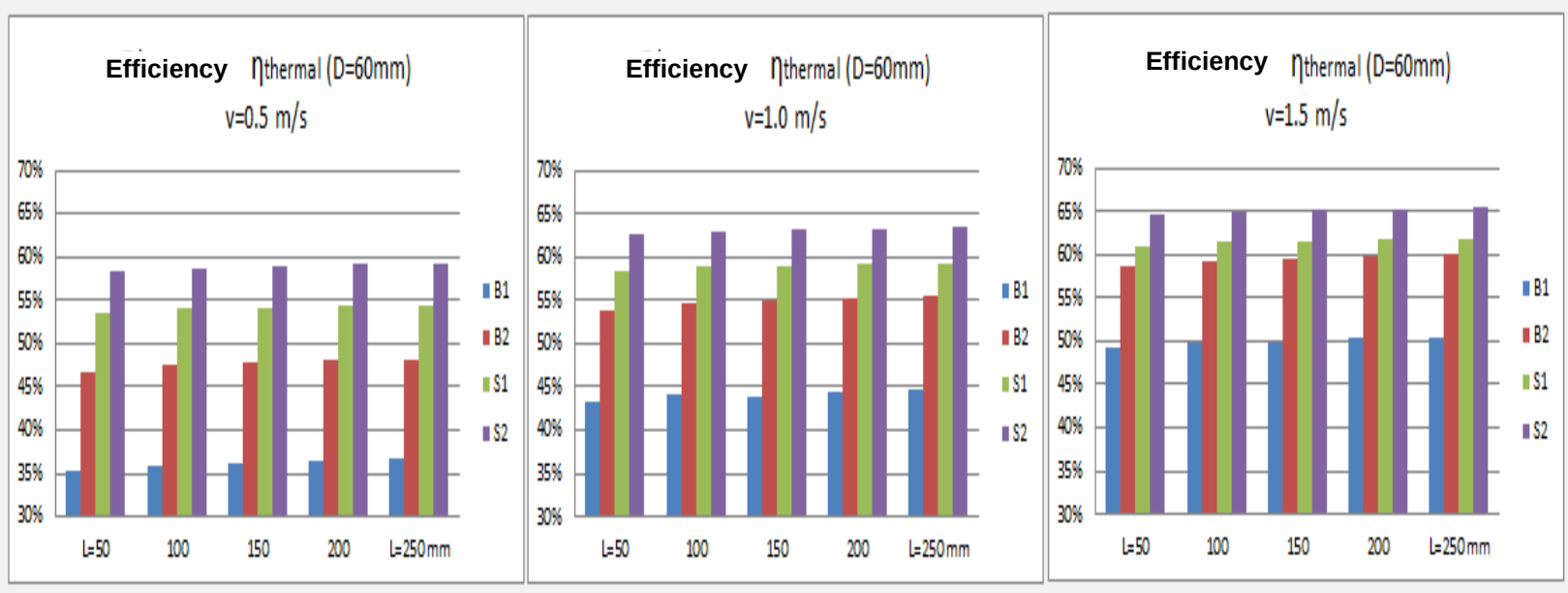
What is the efficiency of the passive elements for the climatic conditions of Bulgaria ???

THE EXPERIMENTAL MODEL



OPEN TROMBE WALL IN MODE OF 24 hour FAN DRIVEN (forced) VENTILATION



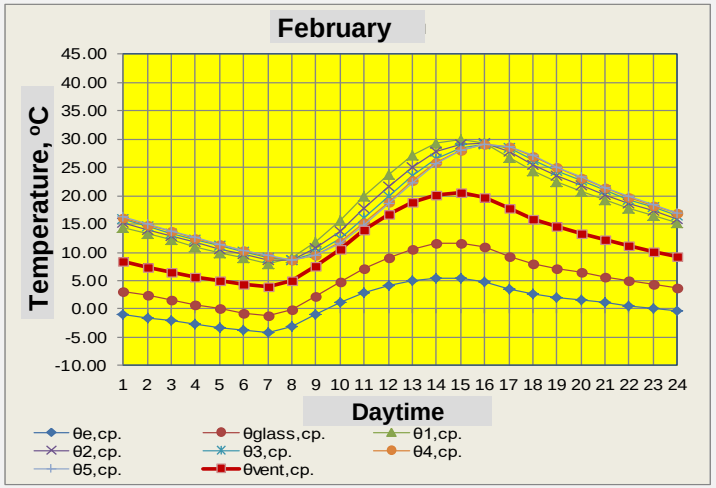


In continuous (24 hours) forced ventilation with fresh air mode:

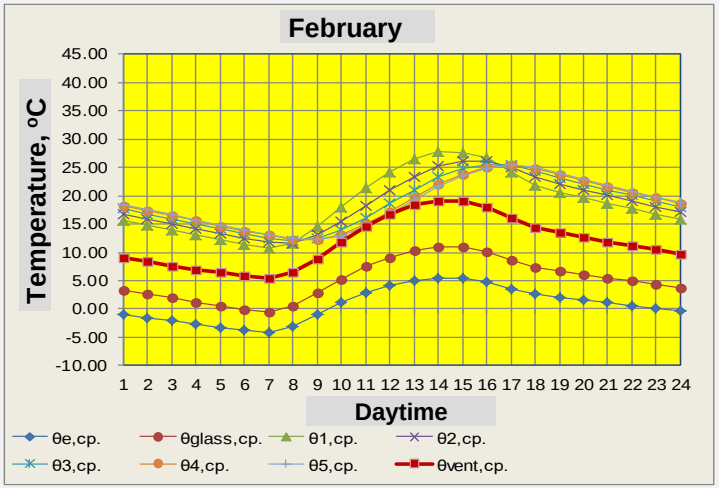
- **efficiency is most affected by the type and optical characteristics of the coating, followed by the number of transparent elements and air velocity.**
- **the thickness of the storage wall has virtually no effect.**
- **the optimal distance between the accumulating wall and the glass screen is 60 mm.**

OPEN TROMBE WALL IN MODE OF 24 hour NATURAL VENTILATION

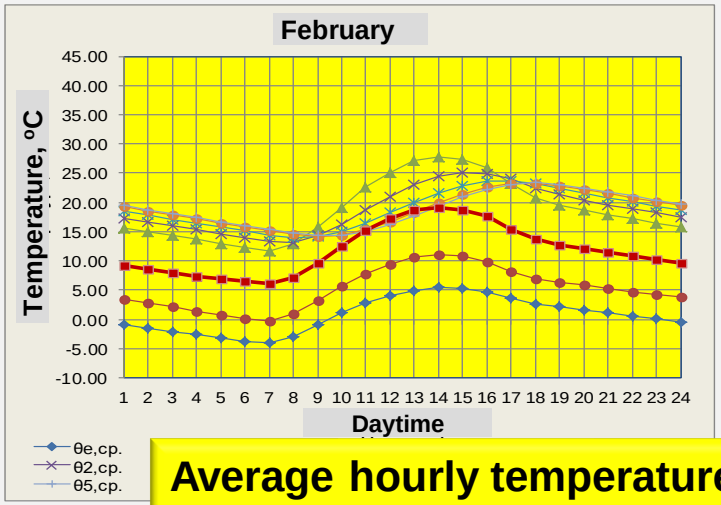
L=100mm B1
D=60mm Av=0.00785 m2



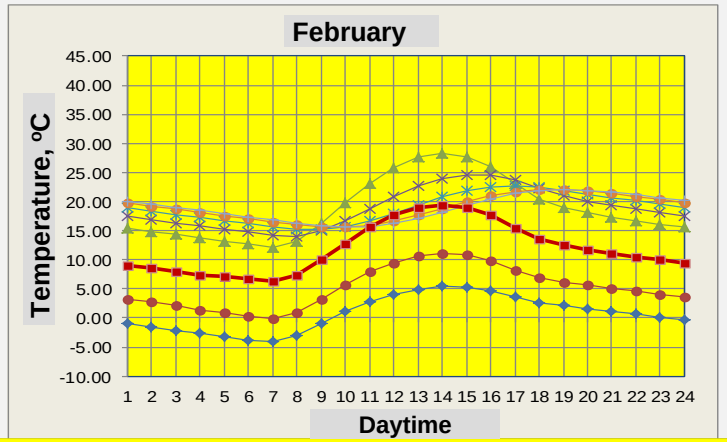
L=150mm B1
D=60mm Av=0.00785 m2



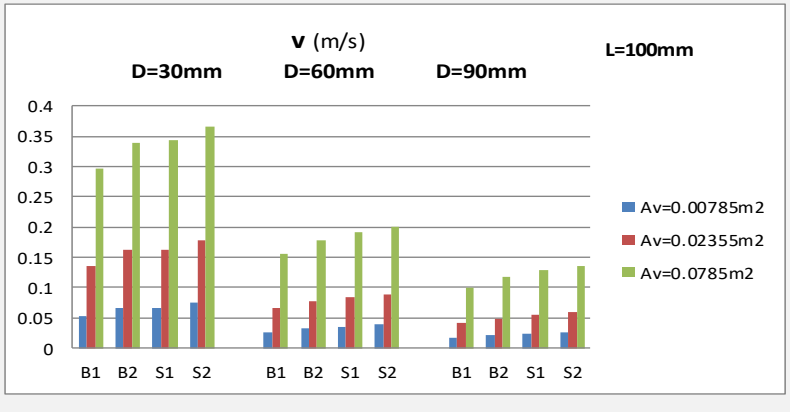
L=200mm B1
D=60mm Av=0.00785 m2

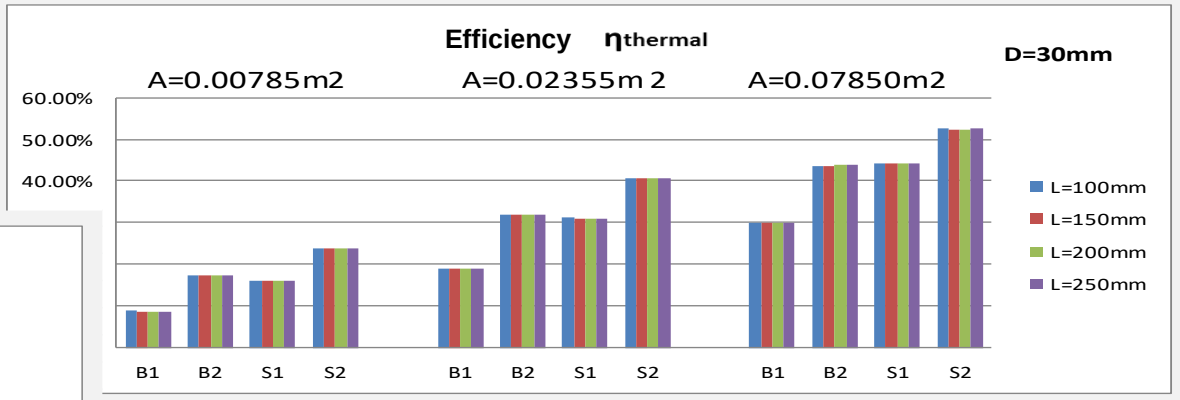


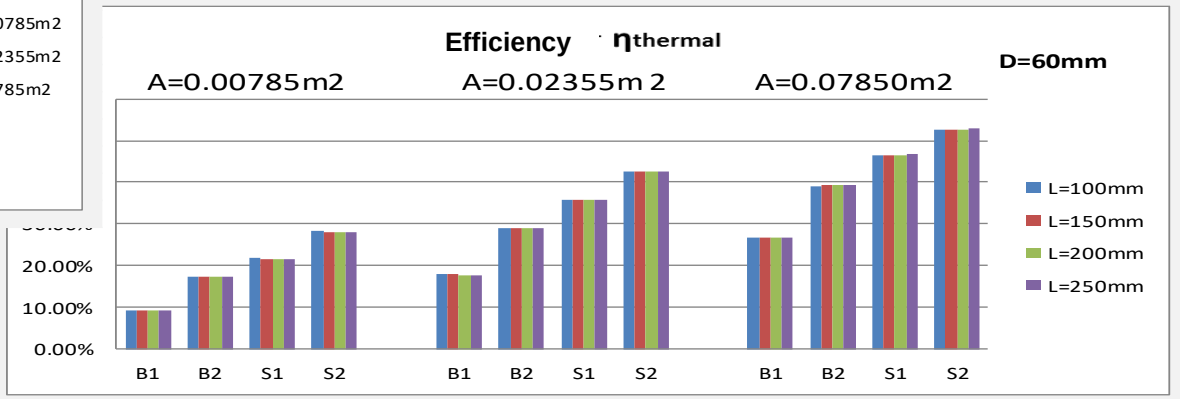
L=250mm B1
D=60mm Av=0.00785 m2

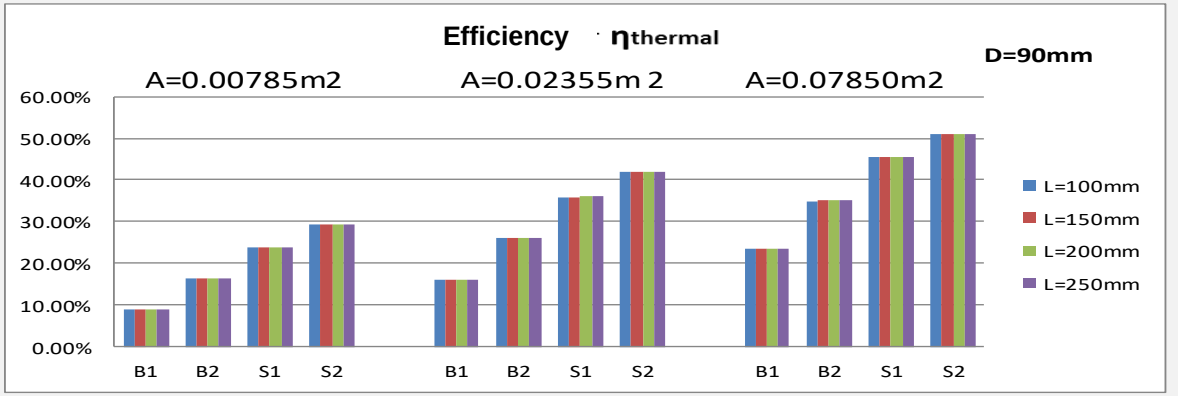


Average hourly temperatures for February for L = 100; 150; 200; 250mm (B1; D = 60mm; Av = 0.00785m^2)


v (m/s)
L=100mm
D=30mm
D=60mm
D=90mm
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
B1 B2 S1 S2 B1 B2 S1 S2 B1 B2 S1 S2
Av=0.00785m2
Av=0.02355m2
Av=0.0785m2


Efficiency ηthermal
D=30mm
A=0.00785m2
A=0.02355m 2
A=0.07850m2
60.00%
50.00%
40.00%
B1 B2 S1 S2 B1 B2 S1 S2 B1 B2 S1 S2
L=100mm
L=150mm
L=200mm
L=250mm


Efficiency · ηthermal
D=60mm
A=0.00785m2
A=0.02355m 2
A=0.07850m2
20.00%
10.00%
0.00%
B1 B2 S1 S2 B1 B2 S1 S2 B1 B2 S1 S2
L=100mm
L=150mm
L=200mm
L=250mm

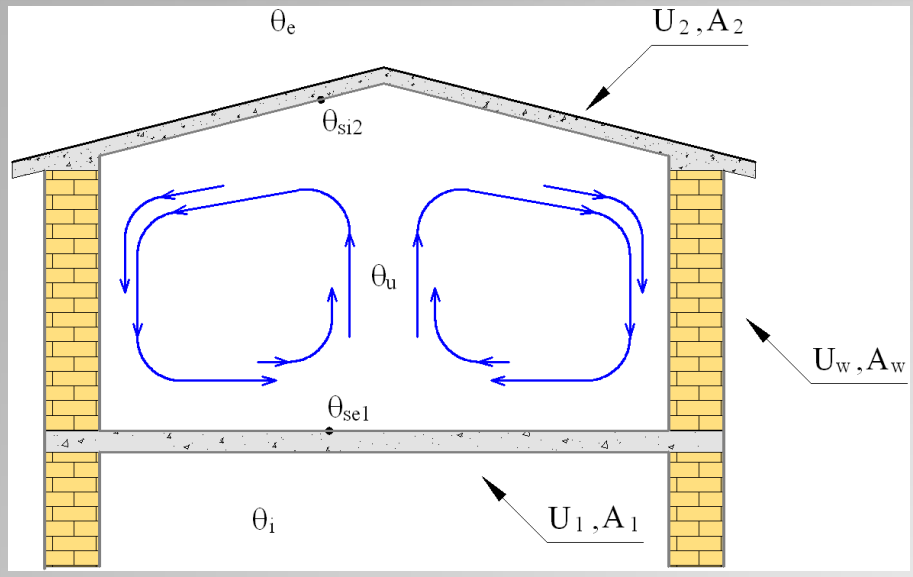

Efficiency · ηthermal
D=90mm
A=0.00785m2
A=0.02355m 2
A=0.07850m2
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
B1 B2 S1 S2 B1 B2 S1 S2 B1 B2 S1 S2
L=100mm
L=150mm
L=200mm
L=250mm

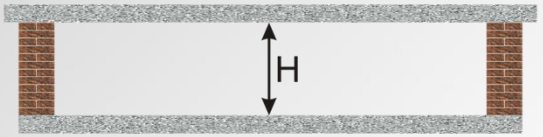
The analysis of the results of the study of the thermal efficiency of an open Trombe wall in intermittent forced air supply mode show the following:

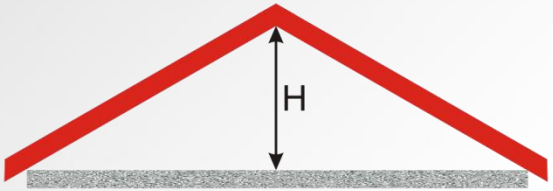
- **The thickness of the storage wall has virtually no influence (as in the 24-hour mode) on the thermal efficiency.**
- **The material of the storage wall has practically no influence (as in the 24-hour mode) on the thermal efficiency.**
- **The main factors affecting the thermal efficiency are (as in 24-hour mode) the number of transparent elements, the type of coating and air velocity.**
- **The modes: AM (7: 00-13.00h); PM (13: 00-19: 00h); WT (8: 00-17: 00h) have different efficiency, highest at WT (due to longer working hours - 9 hours). At 6-hour modes (AM and PM), the efficiency of PM is higher due to heat accumulated by the wall in the preceding morning hours.**
- **Intermittent modes are less effective than continuous mode of 24 hours.**

SOME NEGATIVE EFFECTS OF THE PASSIVE ENVELOPE ELEMENTS DUE TO THEIR UNKNOWN PERFORMACE

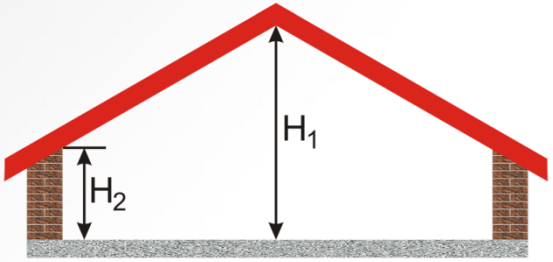
Heat transfer trough roof construction







$$U = \frac{1}{R_{si} + \left(\sum_{j=1}^{n} \frac{\delta_j}{\lambda_j}\right) + \frac{\delta_{вс}}{\lambda_{екв}} + R_{se}}, W/m^2K$$



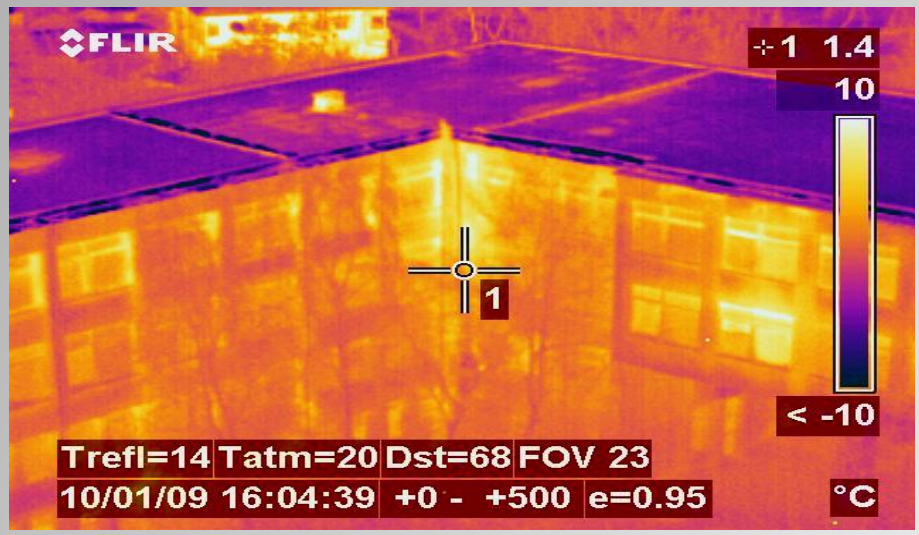
$$\lambda_{екв} = \lambda.\varepsilon_k$$

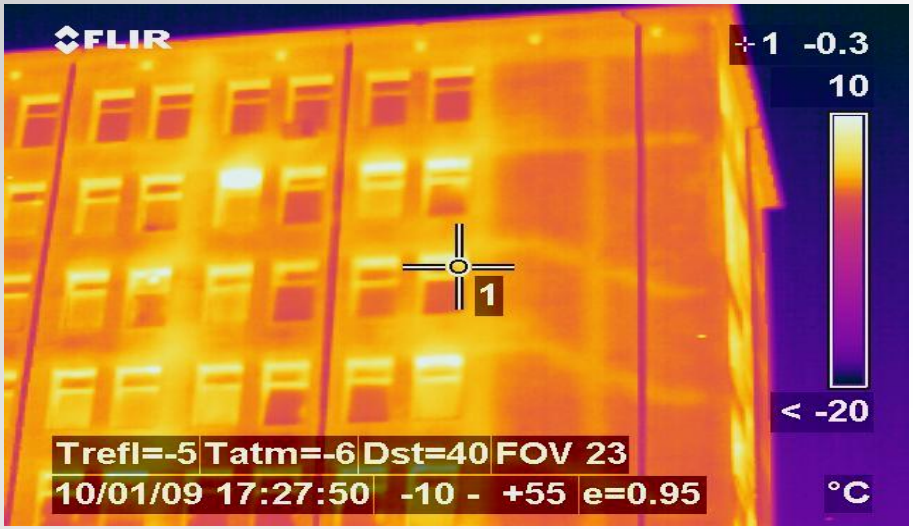
$$\varepsilon_k = f(Gr\,Pr)$$

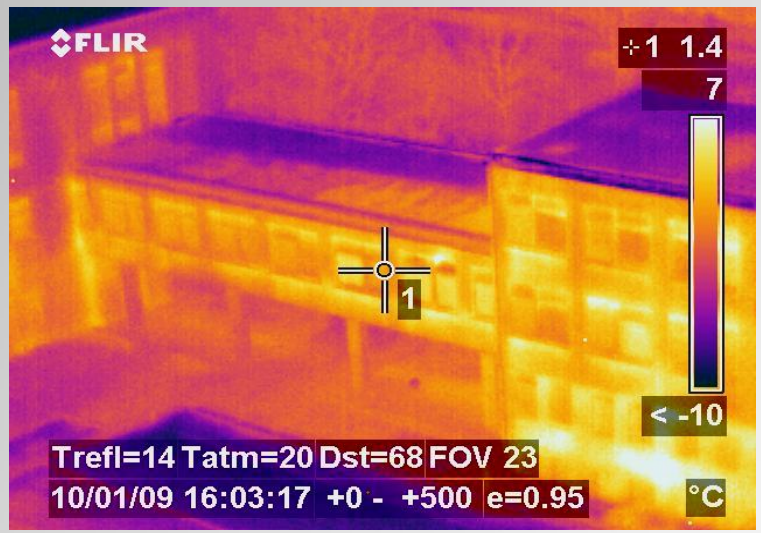
$$Gr = \frac{g\beta\delta_{вс}^3(\theta_{se1} - \theta_{si2})}{\nu^2}$$

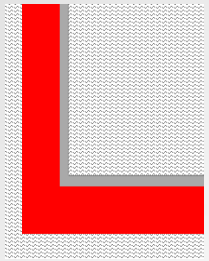
$$\delta_{вс} = \frac{V'}{A'}$$

Thermal bridges

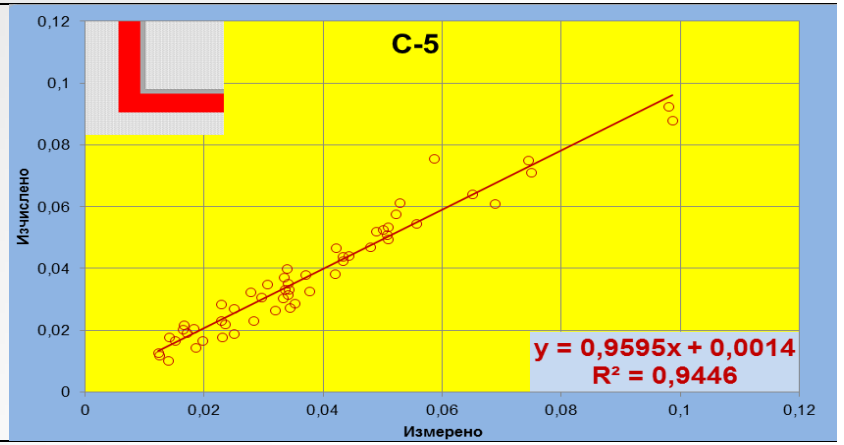








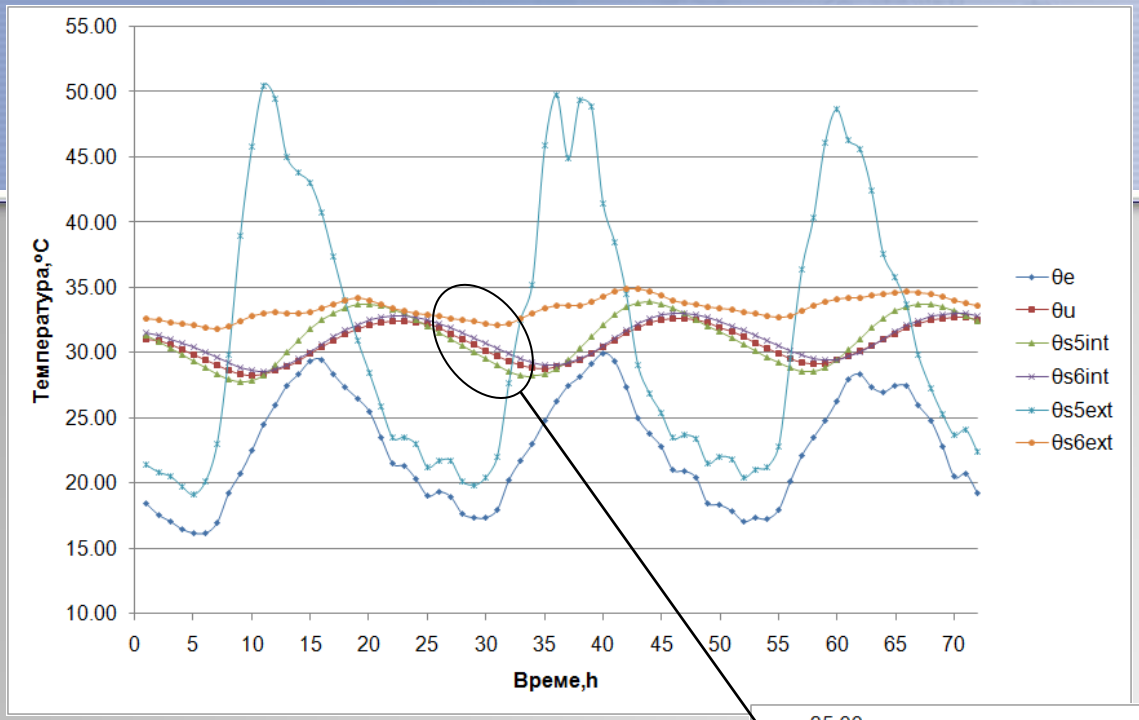
Фиг. 11

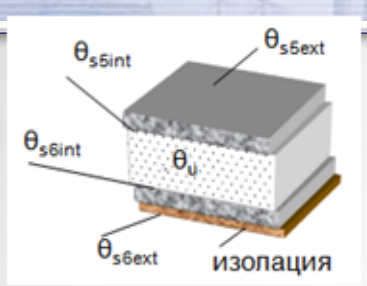


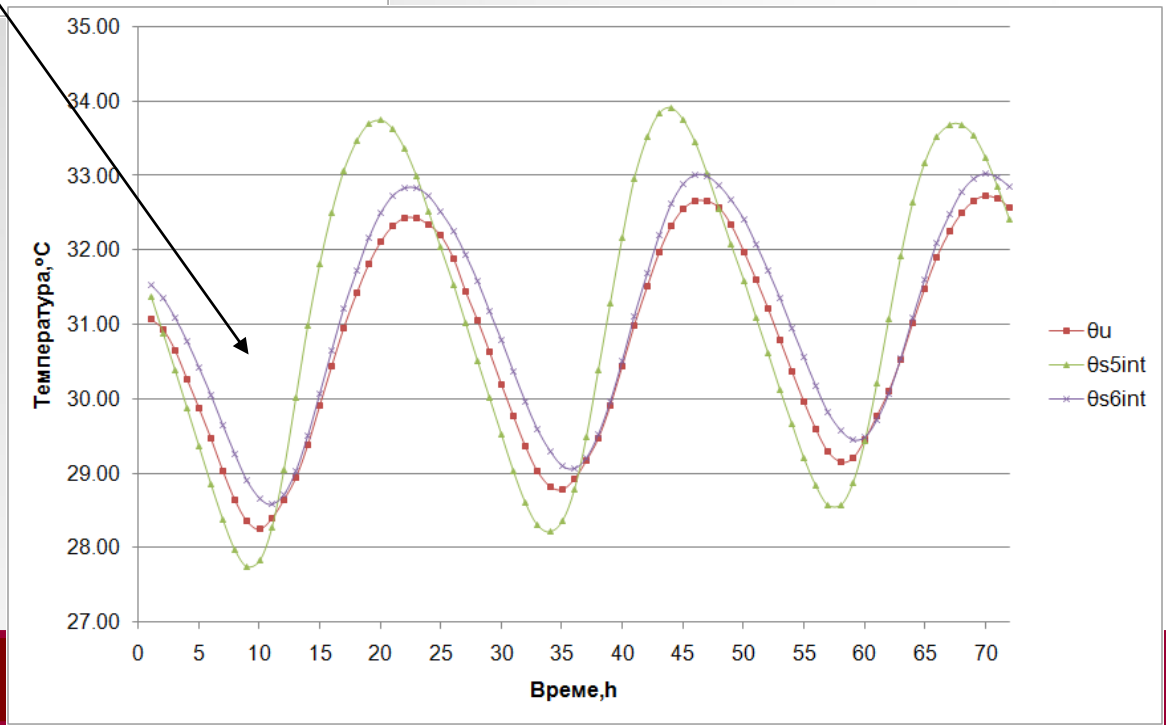
Модел C-5

$$\psi_{изч.(C-5)} = 0{,}388.\delta_{ст.}^{0{,}575}.\lambda_{ст.}^{0{,}087}.\delta_{из.}^{-0{,}685}.\lambda_{из.}^{1{,}086} \qquad (4)$$

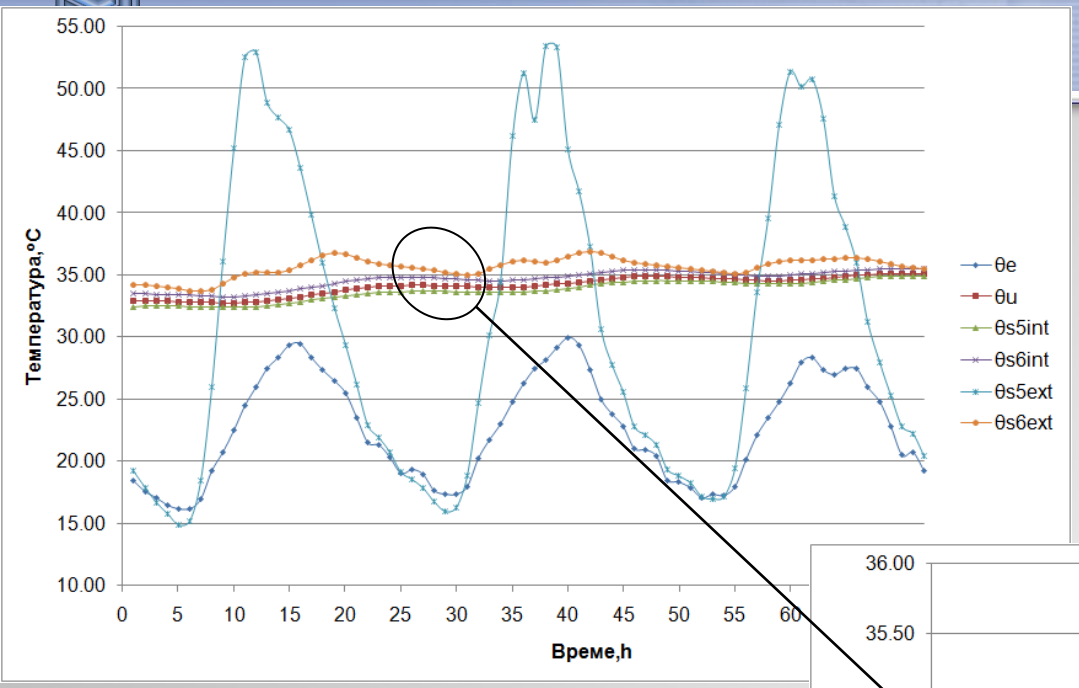
The thermal insulation on the roof

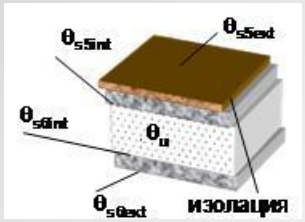


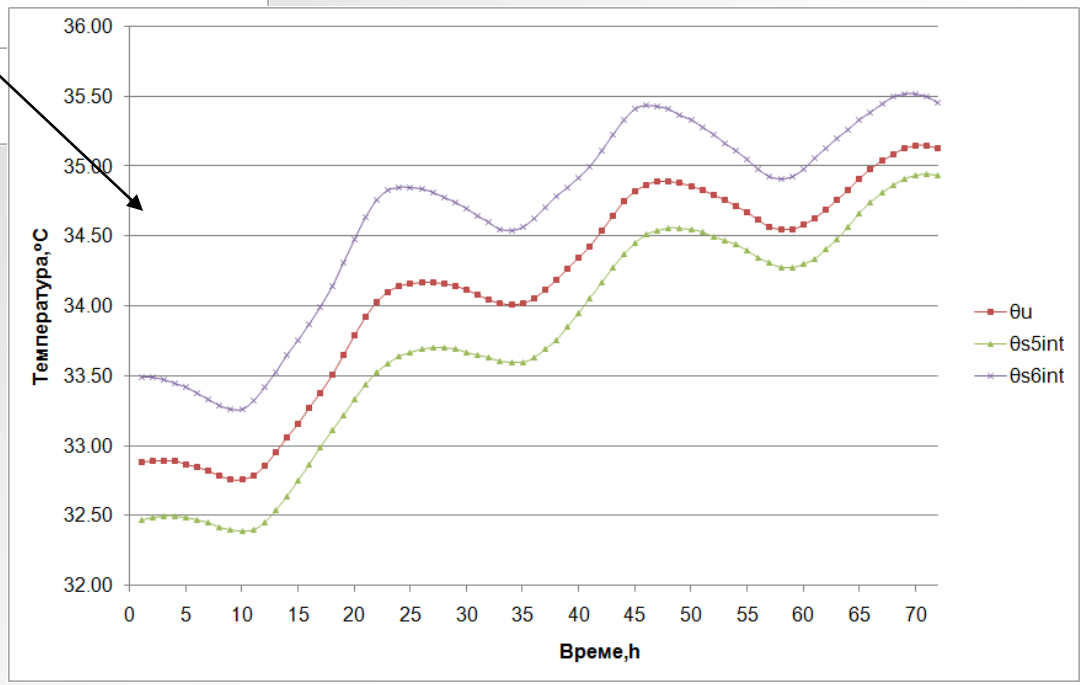




The thermal insulation on the roof







THANKS FOR YOUR ATTENTION !