



Czech RE Agency

Czech Renewable Energy Agency

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Czech RE Agency
Czech Renewable Energy Agency

Czech RE Agency, o.p.s.

non-profit organization

renewable energy sources

continuing sustainability

**representation of the Czech Republic in the project
SOLPOOL**

no business activities in the field of solar heating





SOLPOOL

**What is optimal in terms of user
and living environment**

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- **Project SOLPOOL**
- **Original idea**
 - glazed, non-glazed, vacuum
 - **Comparison from different points of view**
 - economic, ecologic, energetic
- **Other possibilities**

Project partners:



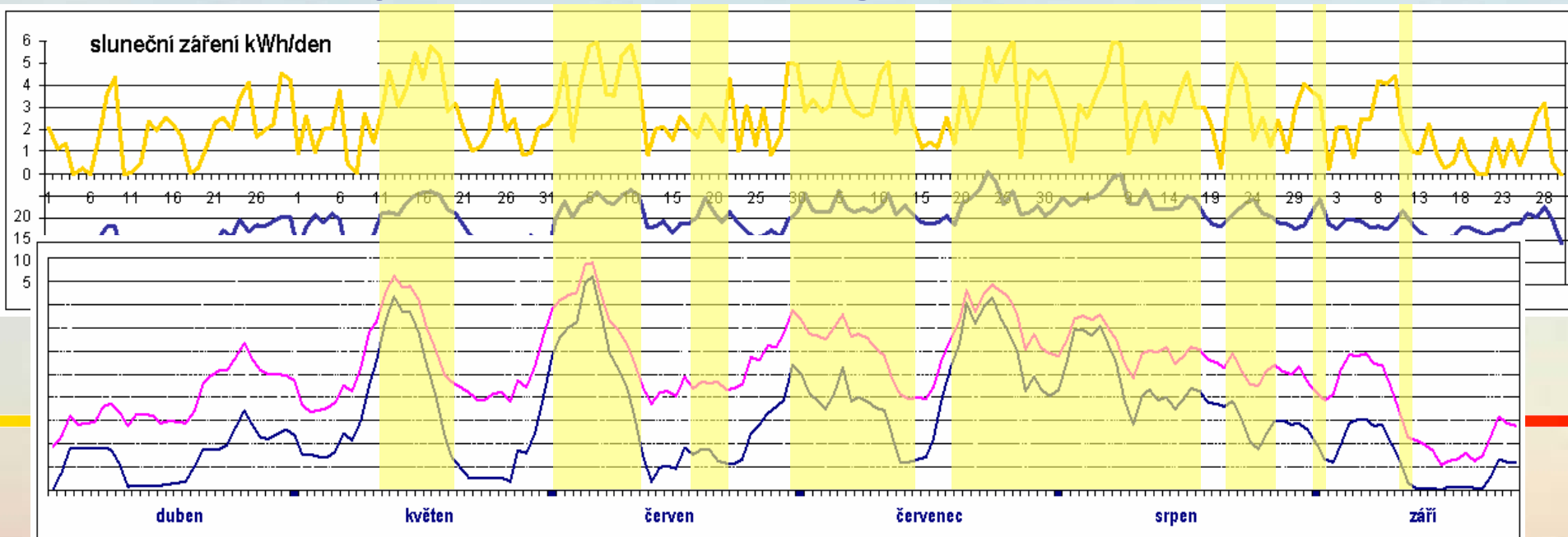
Main goal

Increasing utilization of solar thermal systems for water heating as for outside swimming pools, replacement of fossil fuels



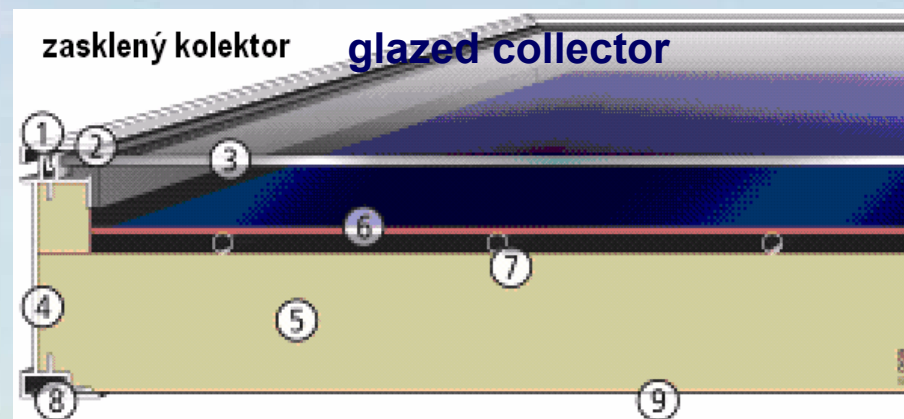
Why solar heating:

- Time coincidence of
 - operational season
 - period of the sufficient solar radiation
- Relatively little water heating

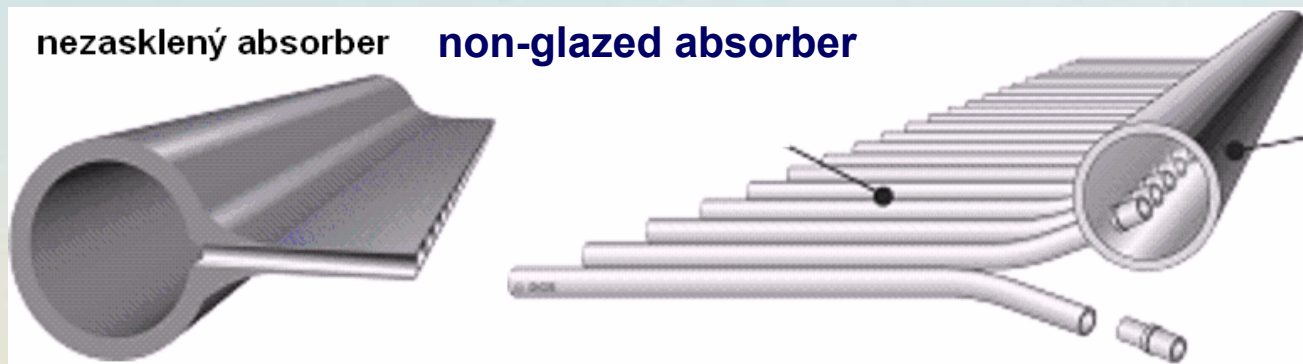


Glazed, non-glazed, vacuum?

price
efficiency
ecologic impacts



nezasklený absorber non-glazed absorber

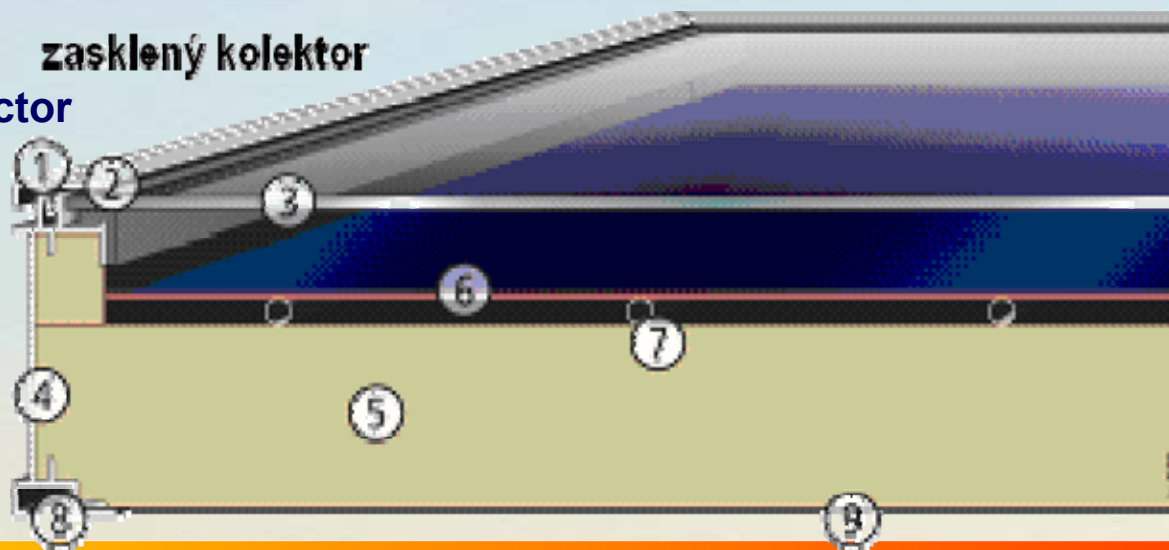


Glazed flat collectors

- higher price
- long durability
- higher efficiency at higher temperatures

1. Glazing frame
2. Sealing
3. Glazing
4. Collector frame
5. Thermal insulation
6. Flat absorber
7. Heat outlet
8. Reinforcement
9. Back wall

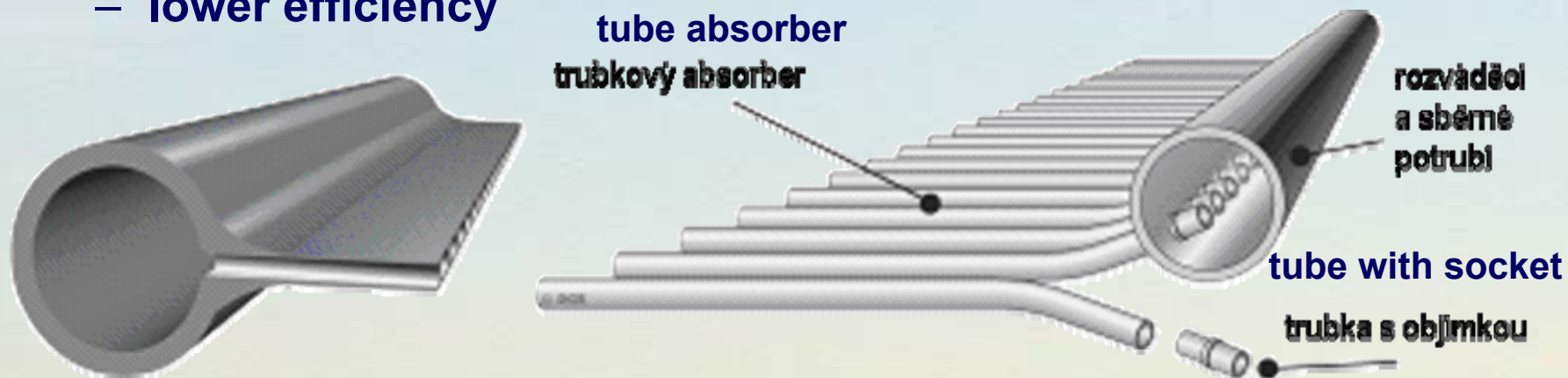
zasklený kolektor
glazed collector



1. rám zasklení
2. těsnění
3. zasklení
4. rám kolektoru
5. tepelná izolace
6. plochý absorber
7. odvod tepla
8. vyztužení
9. zadní stěna

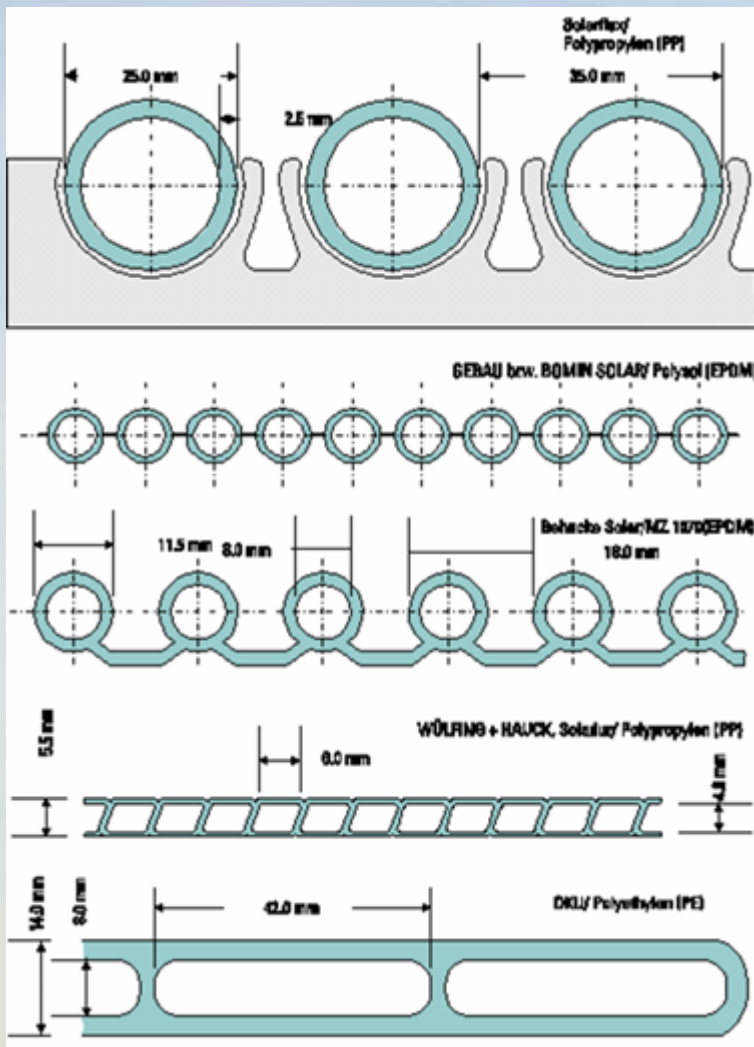
Non-glazed plastic absorbers

- low price
- resistance against the pool chemistry
- simple installation (self-help?)
- shorter durability
- lower efficiency



Plastic absorbers

- different profiles
 - mostly tubes
 - but also flat
- UV filtr
 - temporary protection
- resistant to chlorine
- resistant to hail
- must be emptied **for winter**





EPDM

- 100% resistant to UV radiation
- no softeners
 - long durability
- highly resistant to chlorine
- resistant to hail
- **resistant to frost**



Vacuum tube collectors

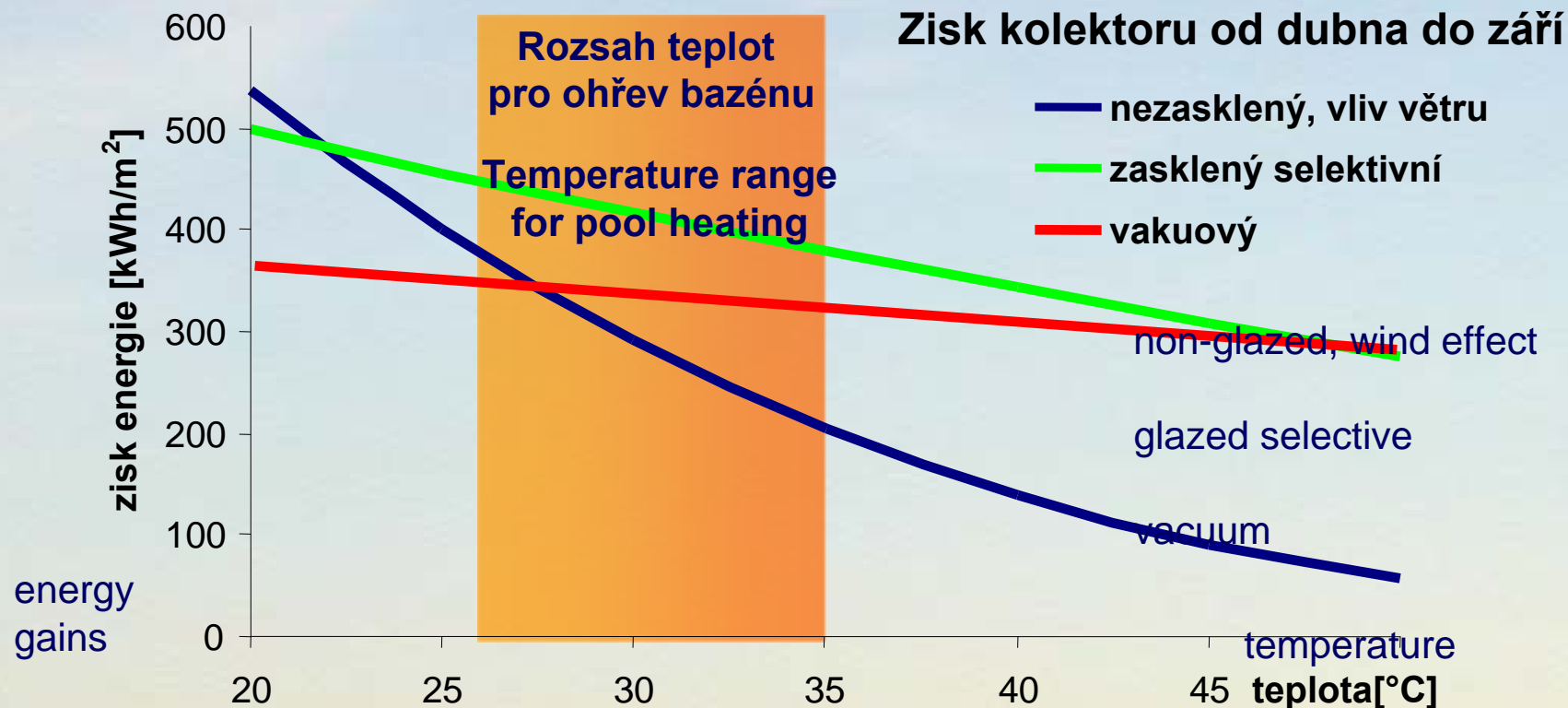
- high price
- for water heating in showers
- excess for pool heating



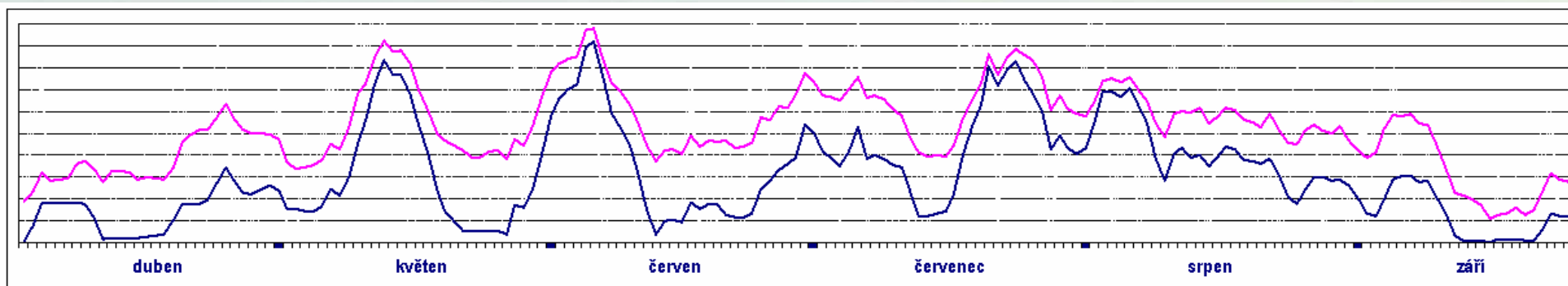
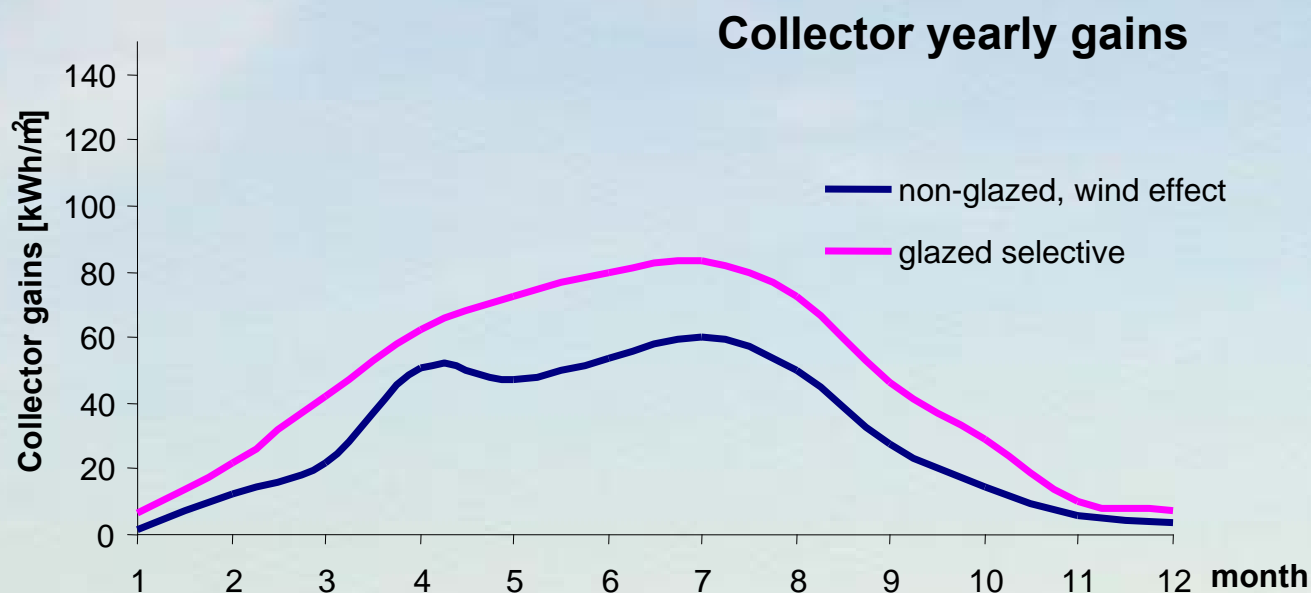
Glazed, non-glazed, vacuum?

Collector gains since April to September

Energetic gains



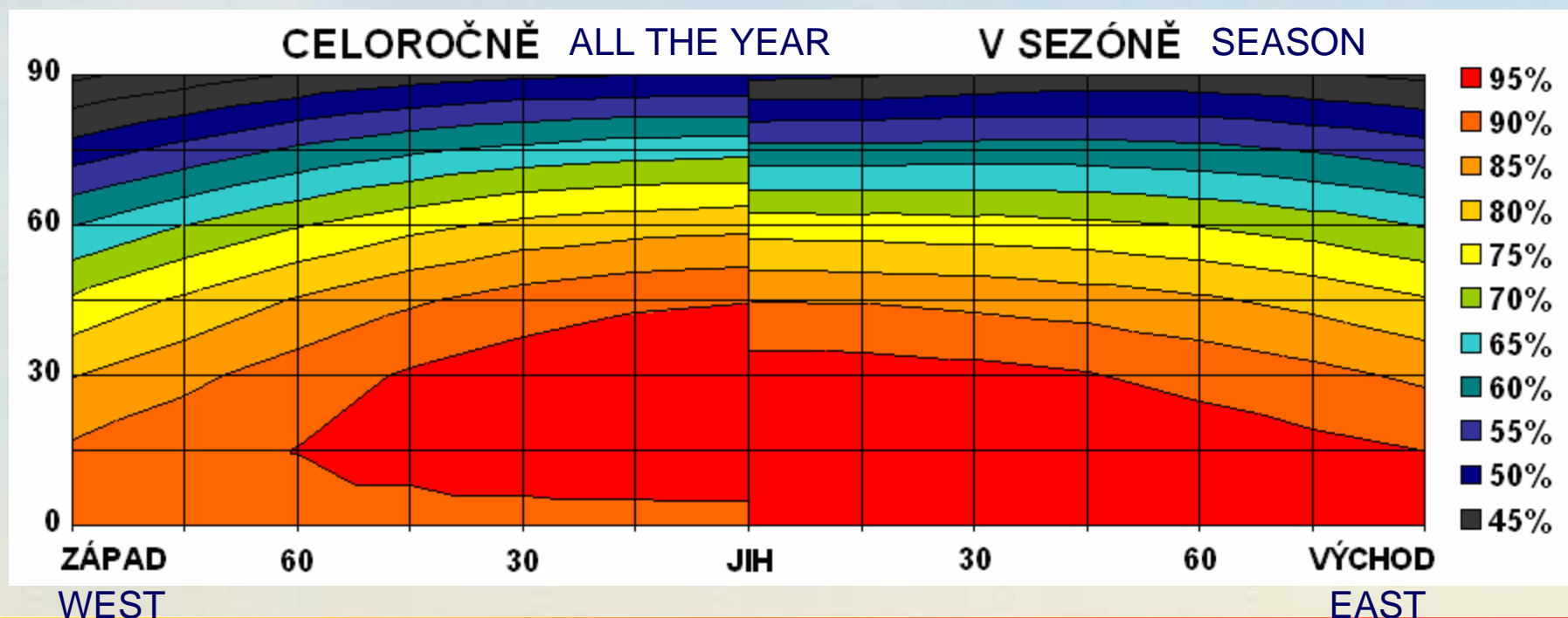
Energetic gains



Glazed, non-glazed, vacuum?

Gains from the solar radiation

- Influence of the orientation and collector slope



Expenses and gains

Collector area	Piping length	Non-glazed			Flat glazed collectors			Vacuum collectors
Plocha kolektorů m ²	Délka rozvodů m	Nezasklené			Ploché zasklené kolektory			Vakuové kolektory
		PP	EPDM		průměr	min	max	
			min	max				
Investiční náklady včetně instalace (v tis. Kč na instalaci) Investment cost including installation (thousands of CZK install.)								
500	100	950	1 700	1 950	3 700	3 400	4 500	8 000
100	50	220	370	420	850	780	1 000	1 800
10	20	28	42	47	125	116	160	240
Jednotkové investiční náklady (Kč/m²) Unit investment cost (CZK /m²)								
500	100	1900	3400	3900	7400	6800	9000	16 000
100	50	2200	3700	4200	8500	7800	11000	18 000
10	20	2800	4200	4700	12500	11600	16000	24 000
Zisk solární energie v kWh/m² za sezónu (závisí na střední teplotě výstupní vody) Solar energy gains per season								
min (35 °C)		140			370			300
max (25 °C)		350			450			350

Glazed, non-glazed, vacuum?

Grant

only for systems being operated all the year round, it means only glazed or vacuum

Impacts on the environment

Traditional sources

mining and transport of raw materials

production

mining and transport of fuels

emissions from production

disposal

Renewable sources

mining and transport of raw materials

production

-

-

disposal



Impacts on the environment

Heating system Systém ohřevu	CO ₂ emissions Emise CO ₂ v g/kWh
Elektrina Electricity	770
TČ vzduch-voda Air-water	151
TČ země-voda Ground-water	135
TČ voda-voda Water-water	118
Propan-butan (LPG)	
Zemní plyn Natural gas	356
Topný olej Heat oil	375
Solární termální Solar thermal	30
Dřevo Wood	30
černé uhlí Black coal	600
hnědé uhlí Brown coal	650

Collector recycling

Glazed

can be dismantled to single components and recycled

high return of materials

tank, frame, glass, supporting structure – nearly 100 %

thermal insulation – must be re-melted

corroded parts – lower recycling yield

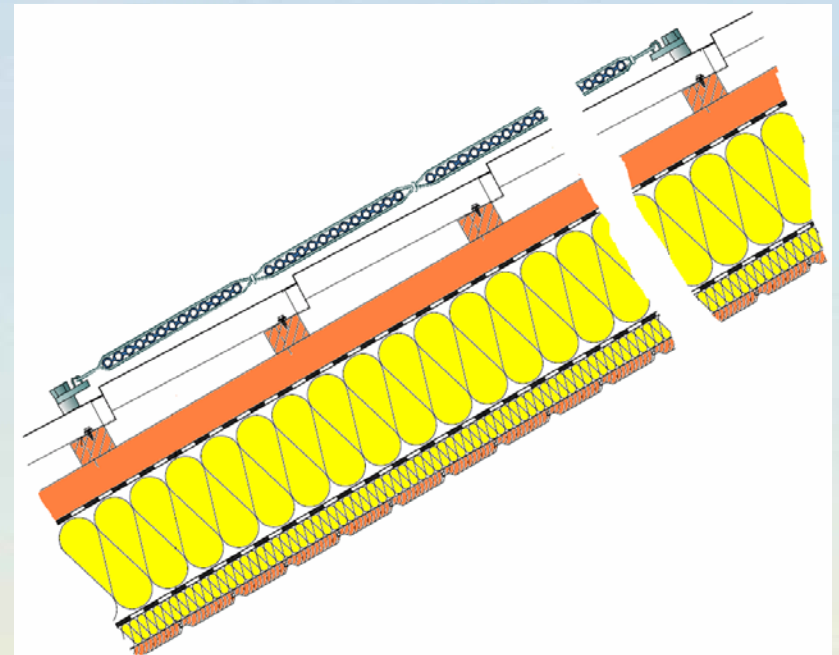
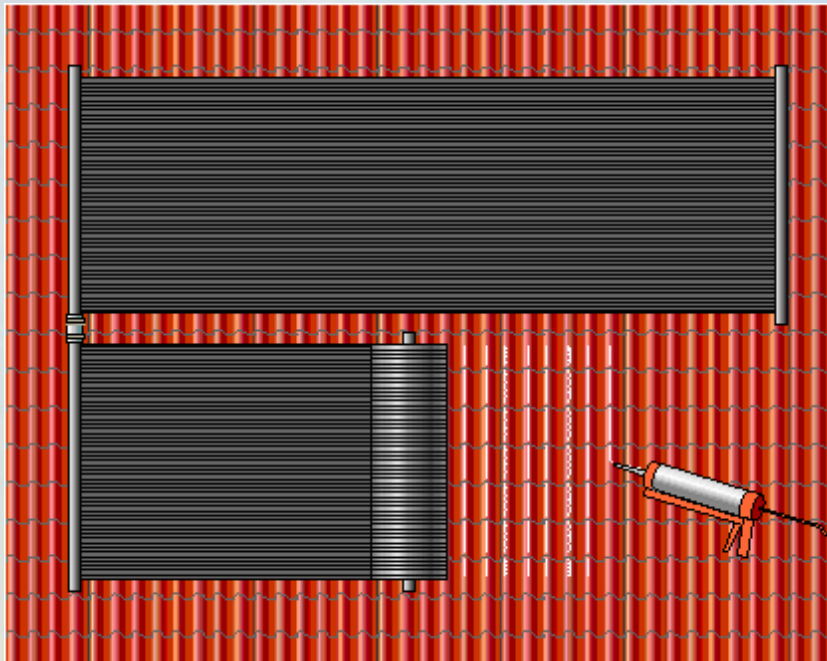
Non-glazed

cannot be recycled to the same product

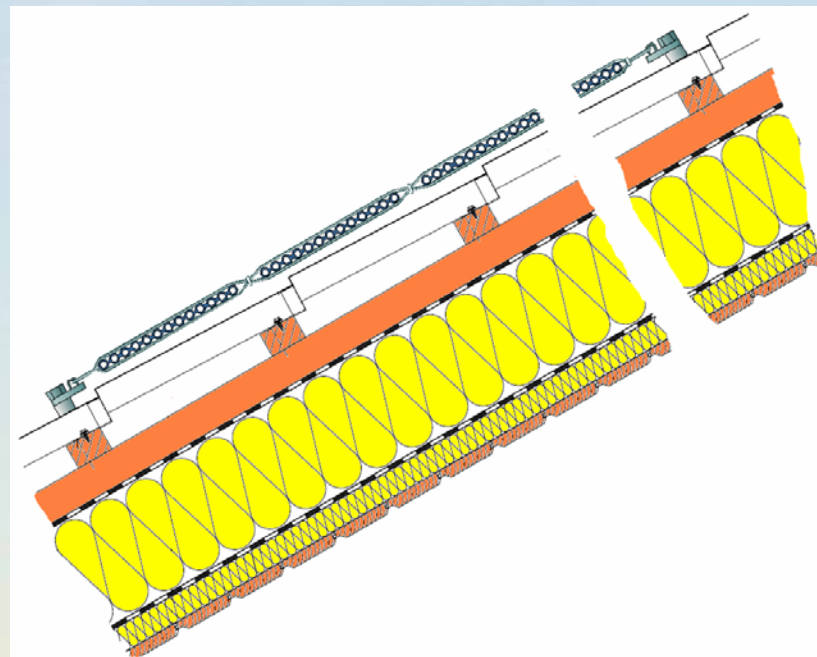
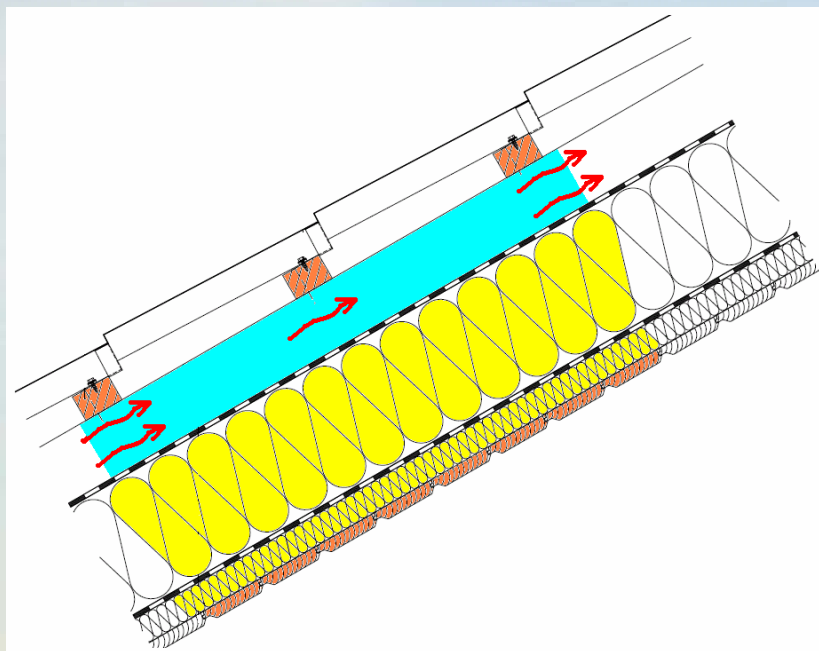
burning (emissions)

roads, sporting surfaces

Non-glazed absorber on the tilted roof

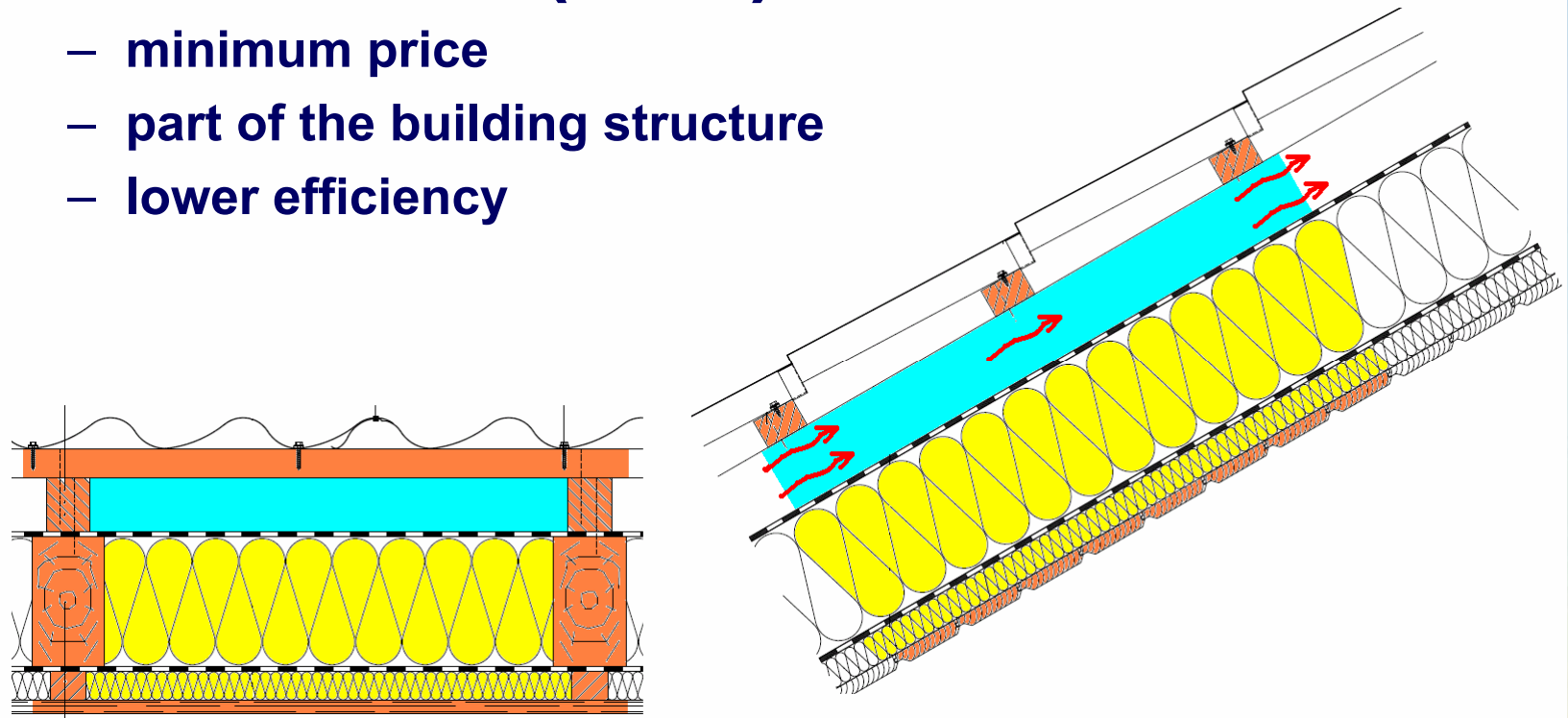


Non-glazed absorber on the tilted roof

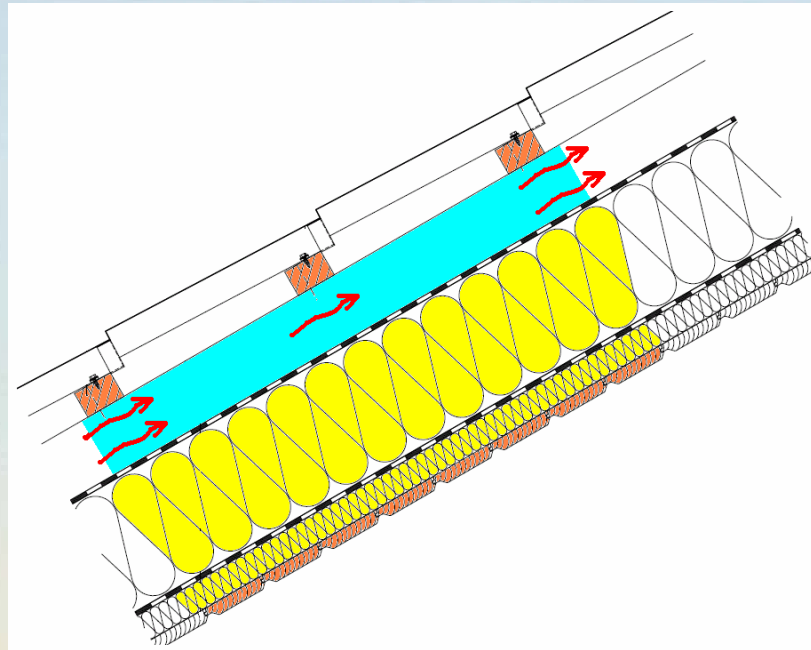
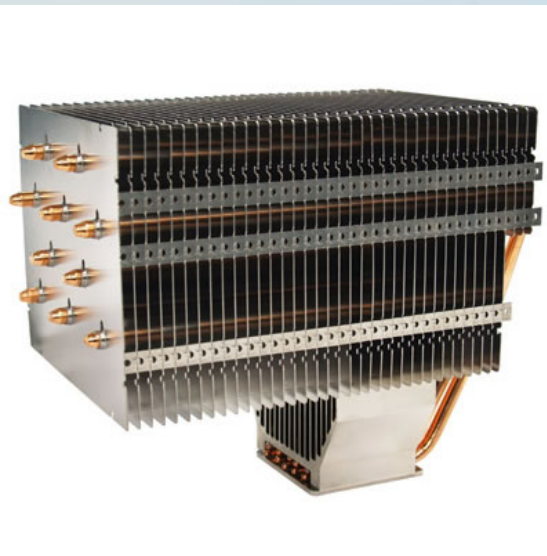


Air collector (roof)

- minimum price
- part of the building structure
- lower efficiency



Air collector (roof)



Recycling at the life end

Glazed

can be dismantled to single materials and recycled

high return of materials

tank, frame, glass, supporting structure – nearly 100 %

thermal insulation – must be re-melted

corroded parts – lower recycling yield

Non-glazed

cannot be recycled to the same product

burning (emissions)

roads, sporting surfaces

Air (roof)

minimal additional load, double material usage

Alternatives of the solar heating

SPORT  **SOLAR**





Double usage:

- summer – tennis court
- winter – skating ring

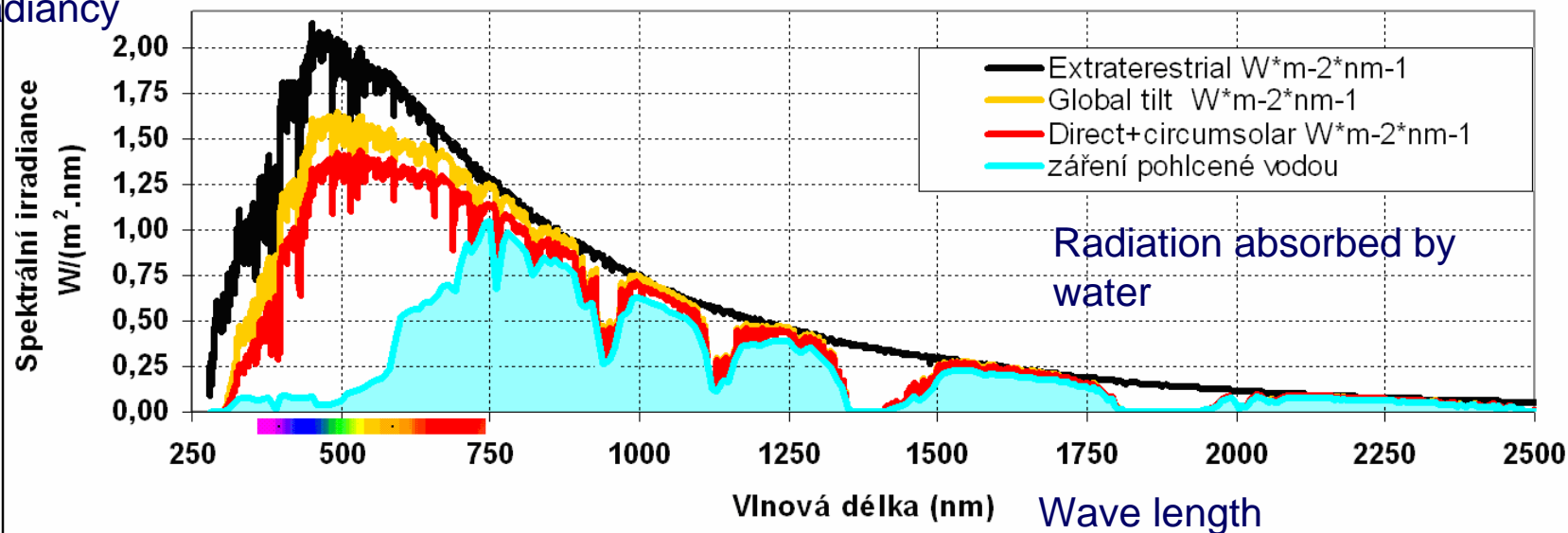


Gains from the solar radiation

- Energy absorption in the water

Spectral irradiance

ASTM G173-03 Referenční spektrum Reference spectrum

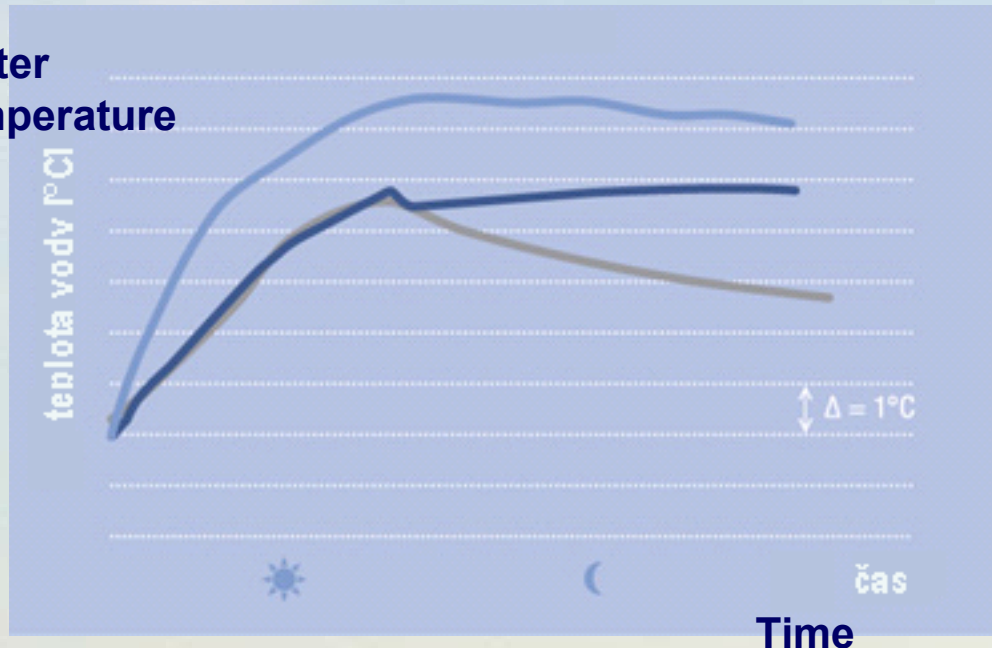


Non-traditional methods:

- Incoming water pre-heating in a shallow pool with black stones
- Dark walls and bottom of the pool

Covering the pool surface

Water temperature



Impact of covering the surface

Vliv zakrytí hladiny

průběh ohřevu a chladnutí vody v bazénu se zakrytím nebo bez zakrytí hladiny

Course of water heating and cooling in the pool with its surface being covered or not

výsledky laboratorních měření

Results of laboratory measurements

-  solární zakrytí solar cover
-  opakní zakrytí compact cover
-  bez zakrytí no cover

Other heat sources

- heat of condensation from heating plants (Oltherm)
- thermal springs (Karlovy Vary)
- pool roofing
- ...



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