10-11 November
Duschanbe

SYSTEM joint stock company AVTOMATIKA

CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE

Solar-assisted district heating in CIS - Solar energy cheaper than oil and gas

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Мультикомпонентная воздушно-водянная солнечная установка

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Research project

- Continental climate, G ≈ 1.500 kWh/m²a

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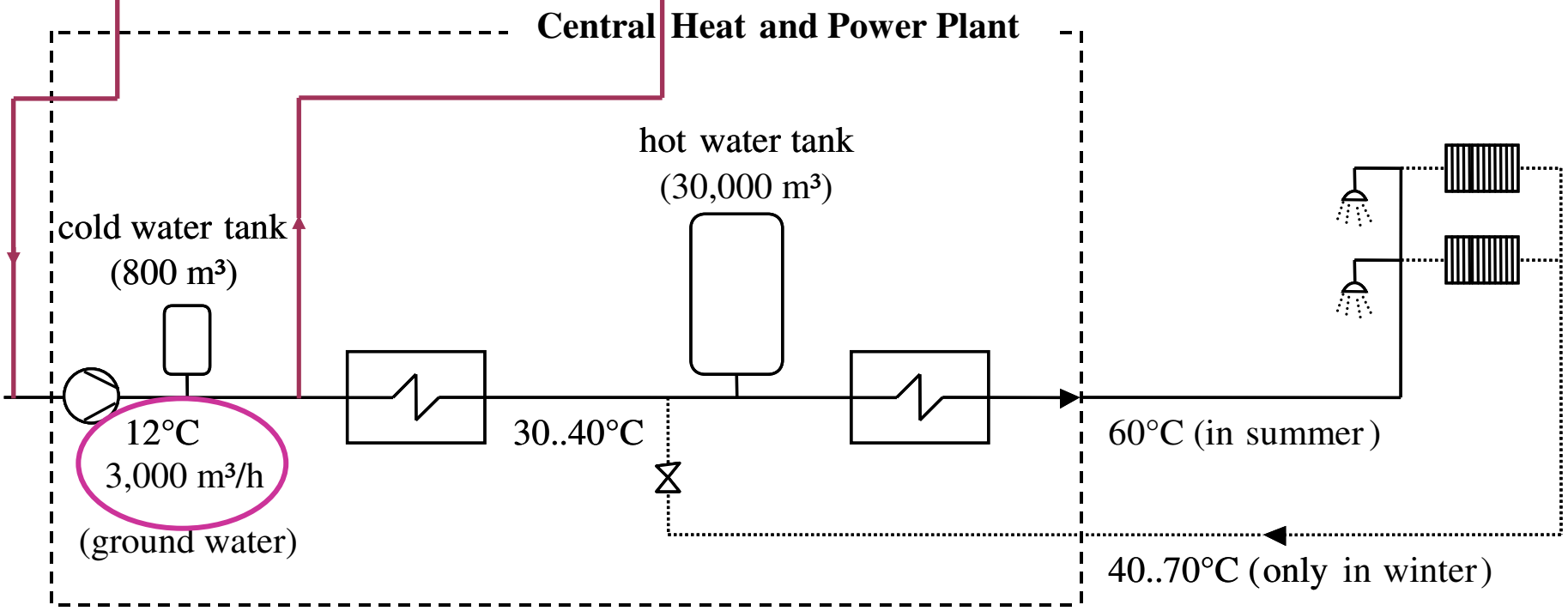
Open district heating net



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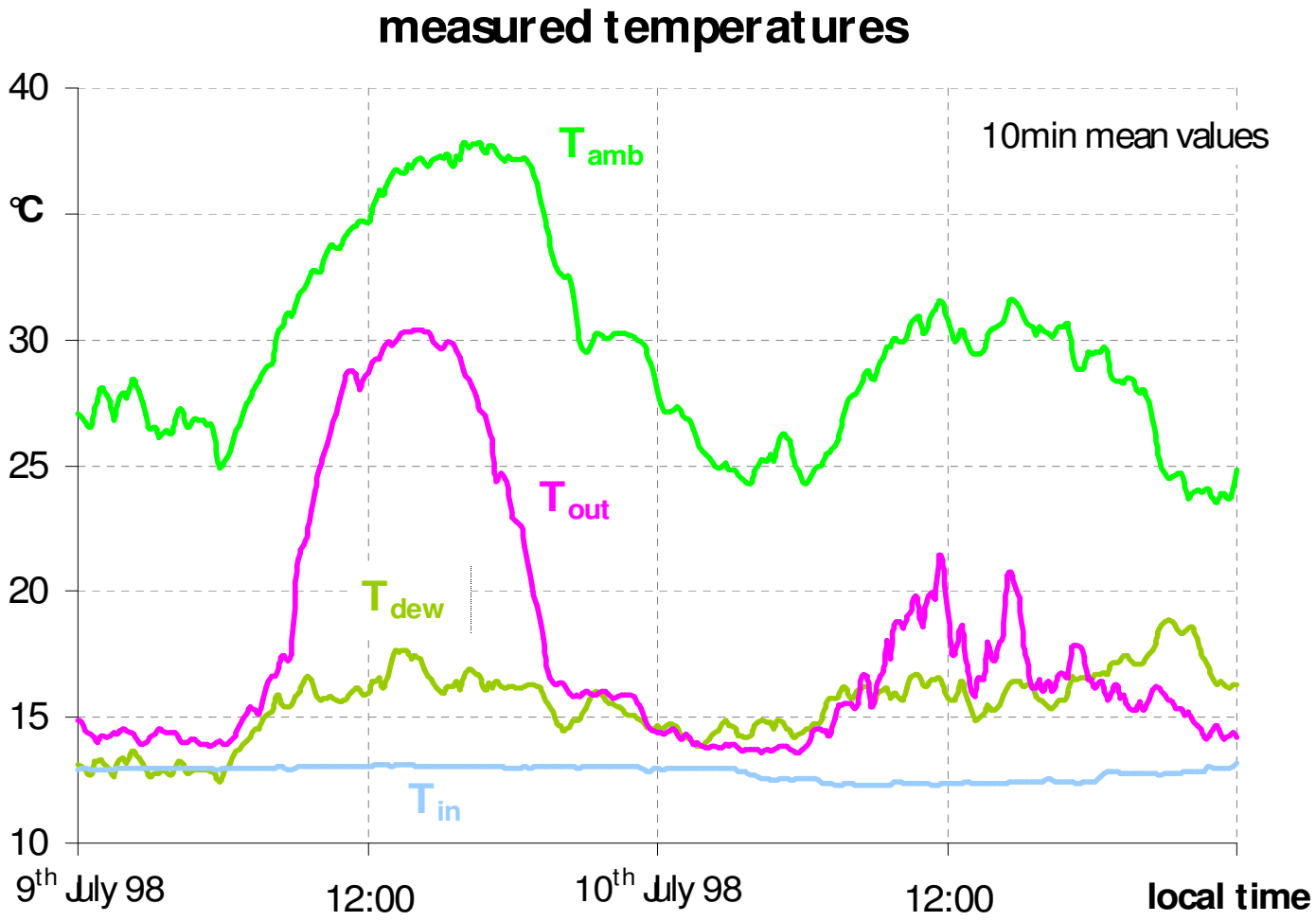
Open district heating net– Collector “efficiency“



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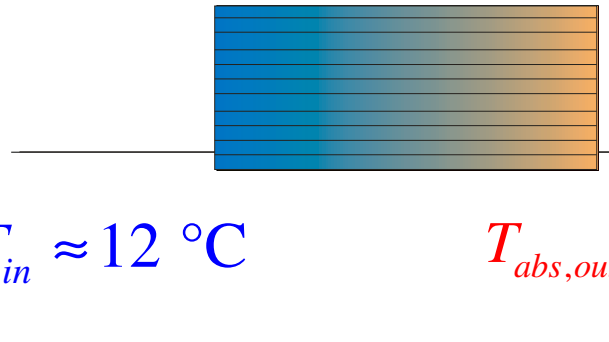
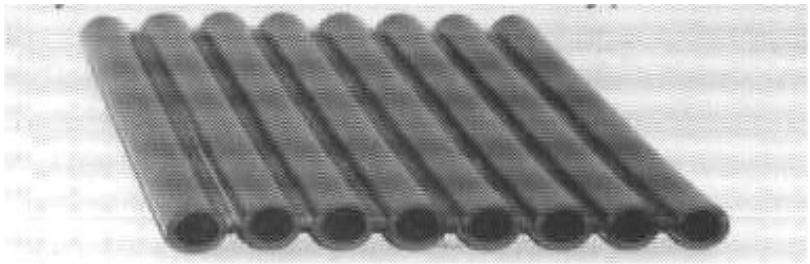
Multicomponent system

Uncovered collector





- Standard application: outdoor swimming pool water heating

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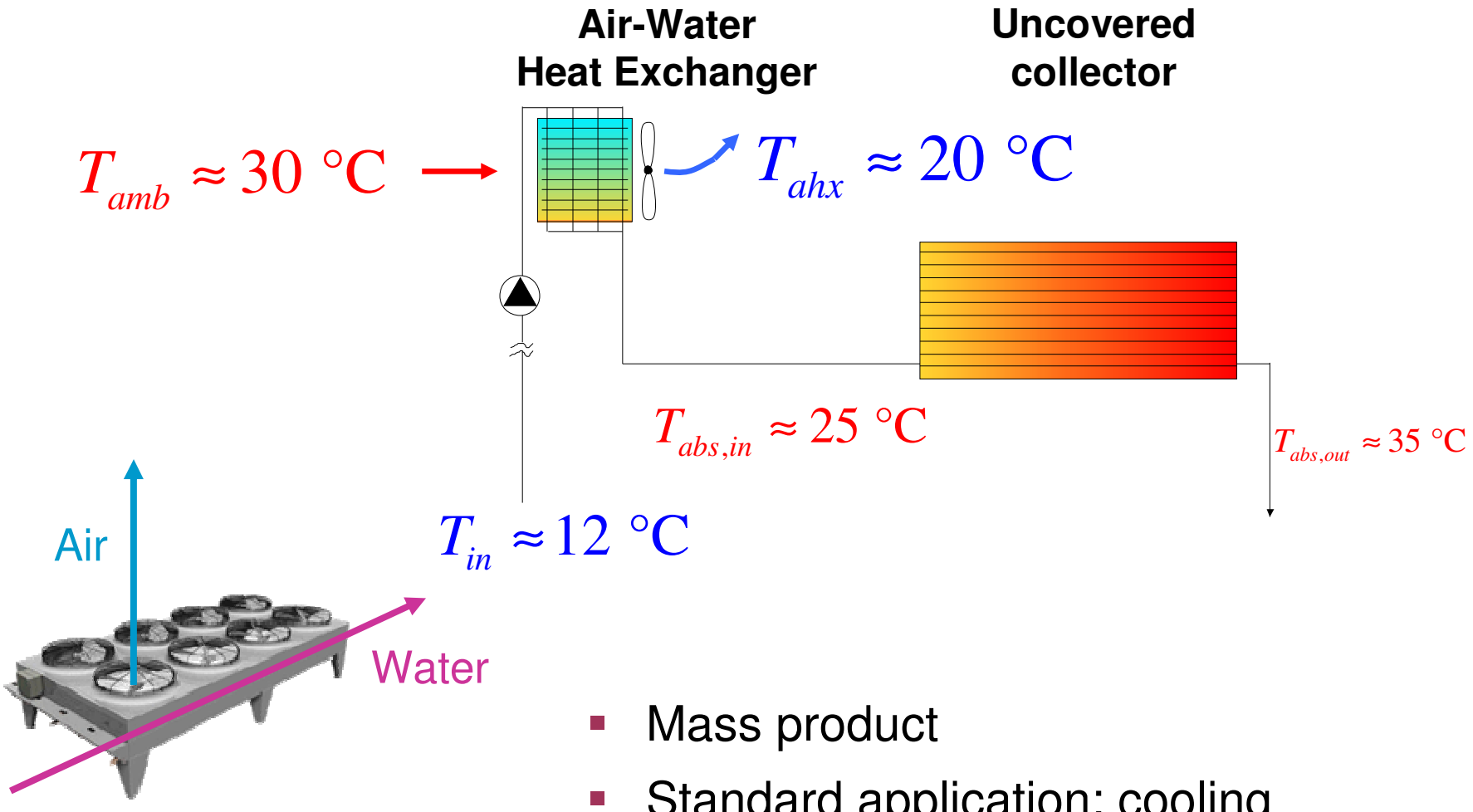
Multicomponent system



- Mass product
- Standard application: cooling

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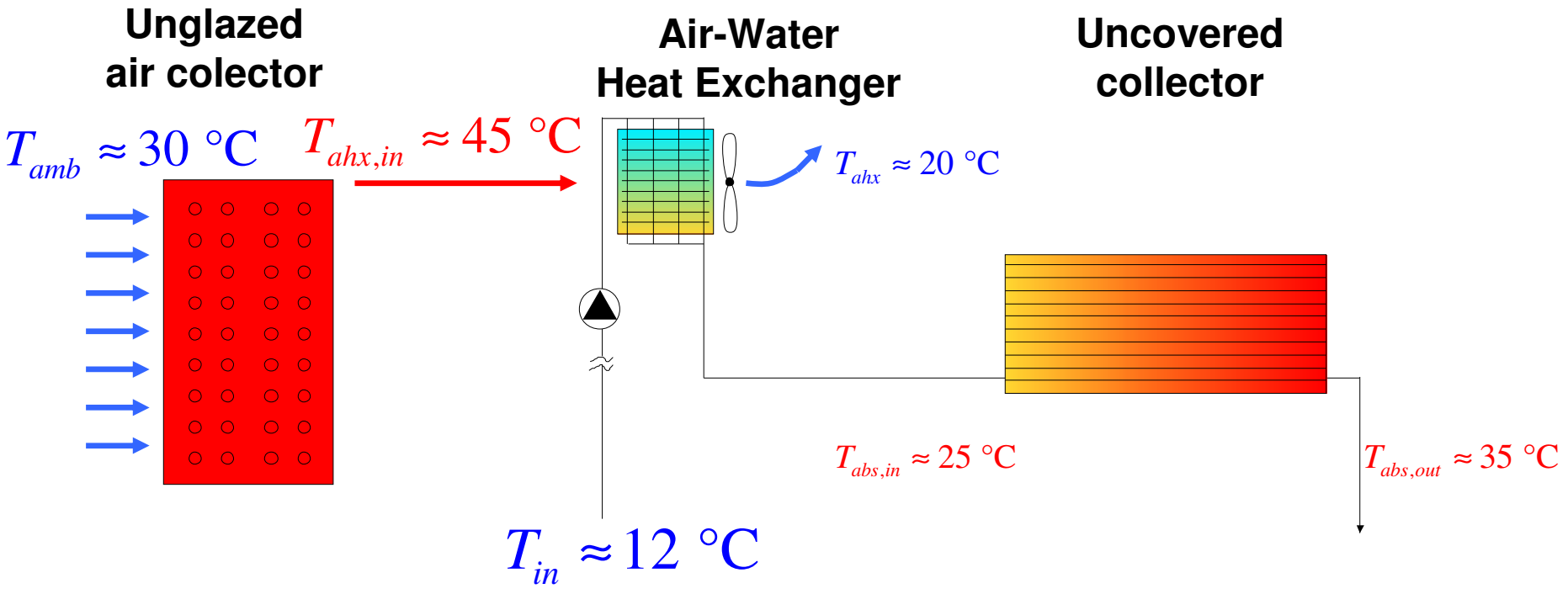
Multicomponent system



- Standard application: space heating

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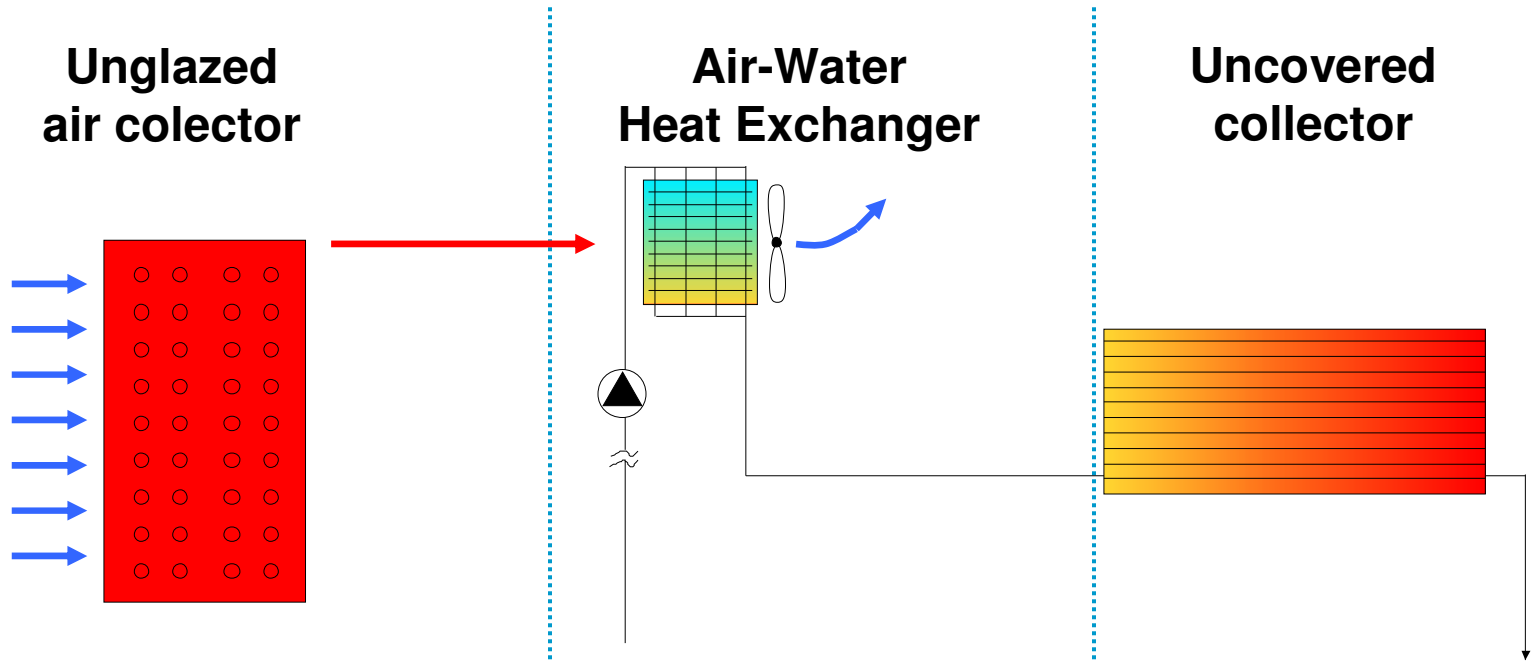

	Unglazed air colector	Air-Water Heat Exchanger	Uncovered collector
Planning	A_{UTC}, P_{fan}, …	A_{AHX}, P_{fan}, P_{pump}, …	A_{UC}, P_{pump}, …
Control	$\dot{V}_{air}$, …	$\dot{V}_{air}$, $\dot{V}_{wat}$, …	$\dot{V}_{wat}$, …
Weather	G_{UTC}, ϑ_a, v_w, …	ϑ_a, h_a	G_{UC}, ϑ_a, v_w, h_a, …
Mix terms	$\vartheta^4_{UTC} - \vartheta^4_{sky}$, $\vartheta_{UTC} - \vartheta_a$	$\vartheta_{AHX,in}$	$T^4_{UC,in} - \vartheta^4_{sky}$, $T_{UC,in} - \vartheta_a$

$\vartheta_{AHX,in}$ → $T_{UC,in}$ → T_{out}

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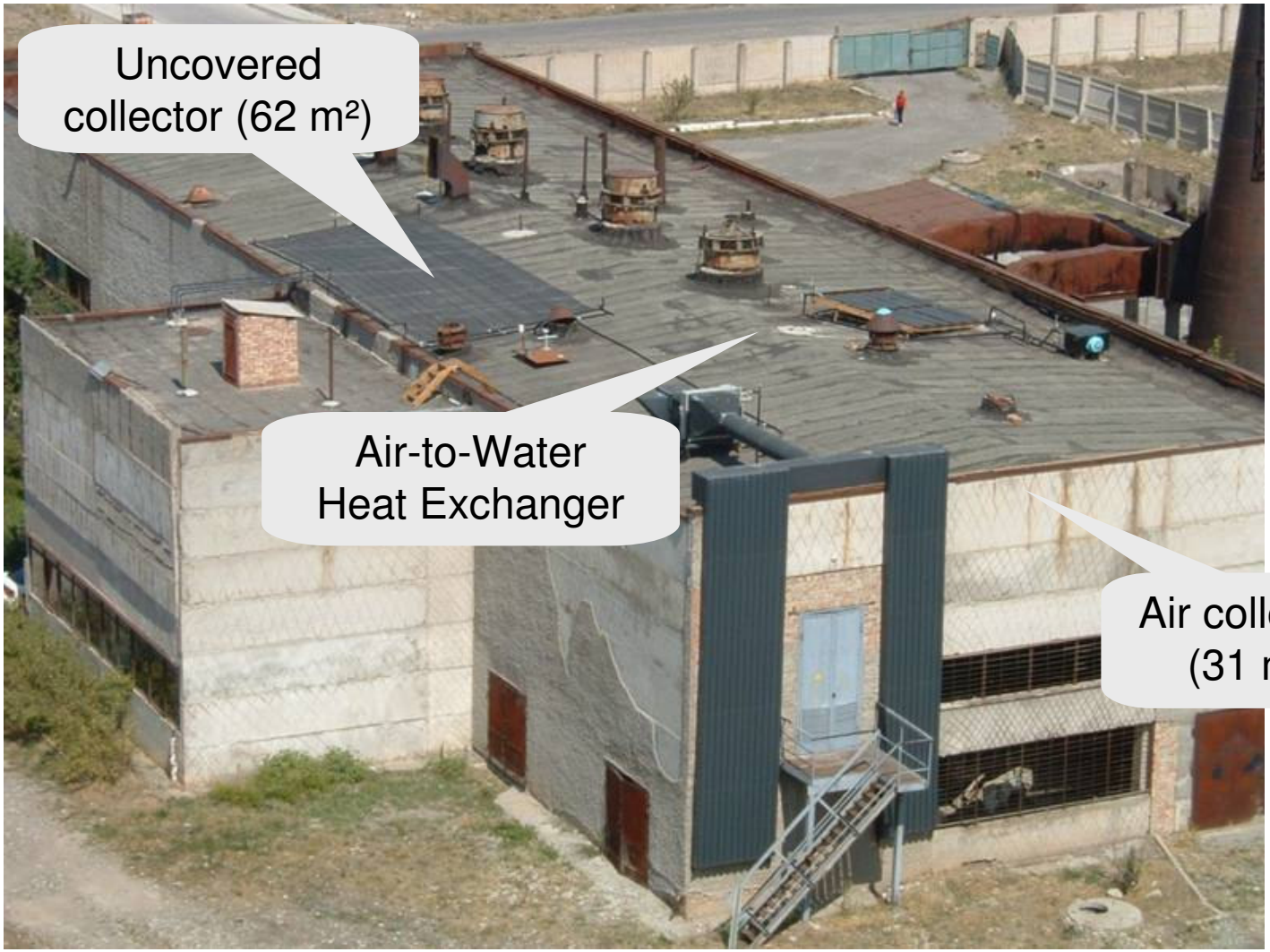
Test plant in Bishkek



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Test plant in Bishkek – hydraulic station

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Preliminary results

- 4 years of operation experience
- Solar gains UC over 1000 kWh/m²a (in Germany about 250)
- Air collector (so far) too expensive
- Costs HX ≈ Uncovered Collector, depending on climate
- Serial connection of HX and UC not always reasonable
- Special adjustment on local conditions needed
- Being investigated:
  - Integration in CHP process
  - Optimization of HX construction
  - Hydraulic connection of large collector fields

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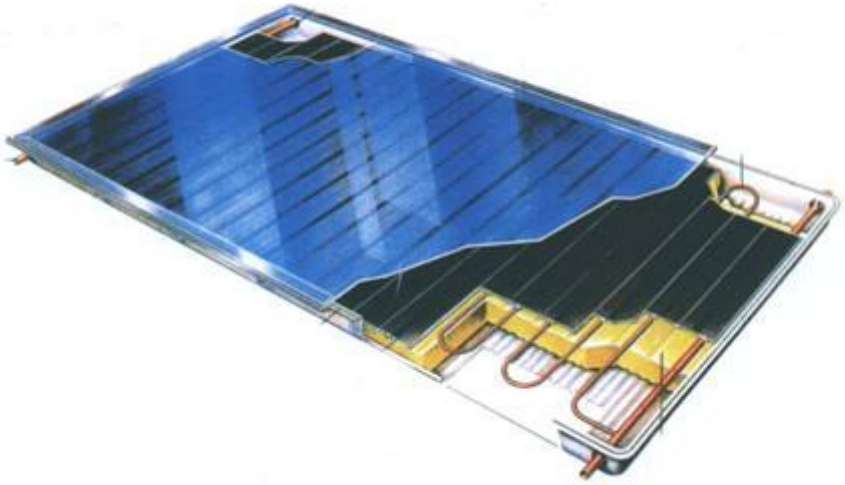
Difficult market conditions for renewables ...



in DE: ca. 50 ct/kWh$_{el}$

ca. 5...25 ct/kWh

Production costs in Kyrgyzstan:

Electr. 2 ct/kWh$_{el}$

District heat 1,5...2 ct/kWh

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Potential Bishkek

- Central Heat and Power Plant TEZ (2 GW_{th})
  - ca. 10.000 m^2 on the roofs
  - ca. 60.000 m^2 on the ground nearby

- Decentralized heat plant
  - ca. 3.000 m^2 on 4 plants (each plant 2 MW_{th})

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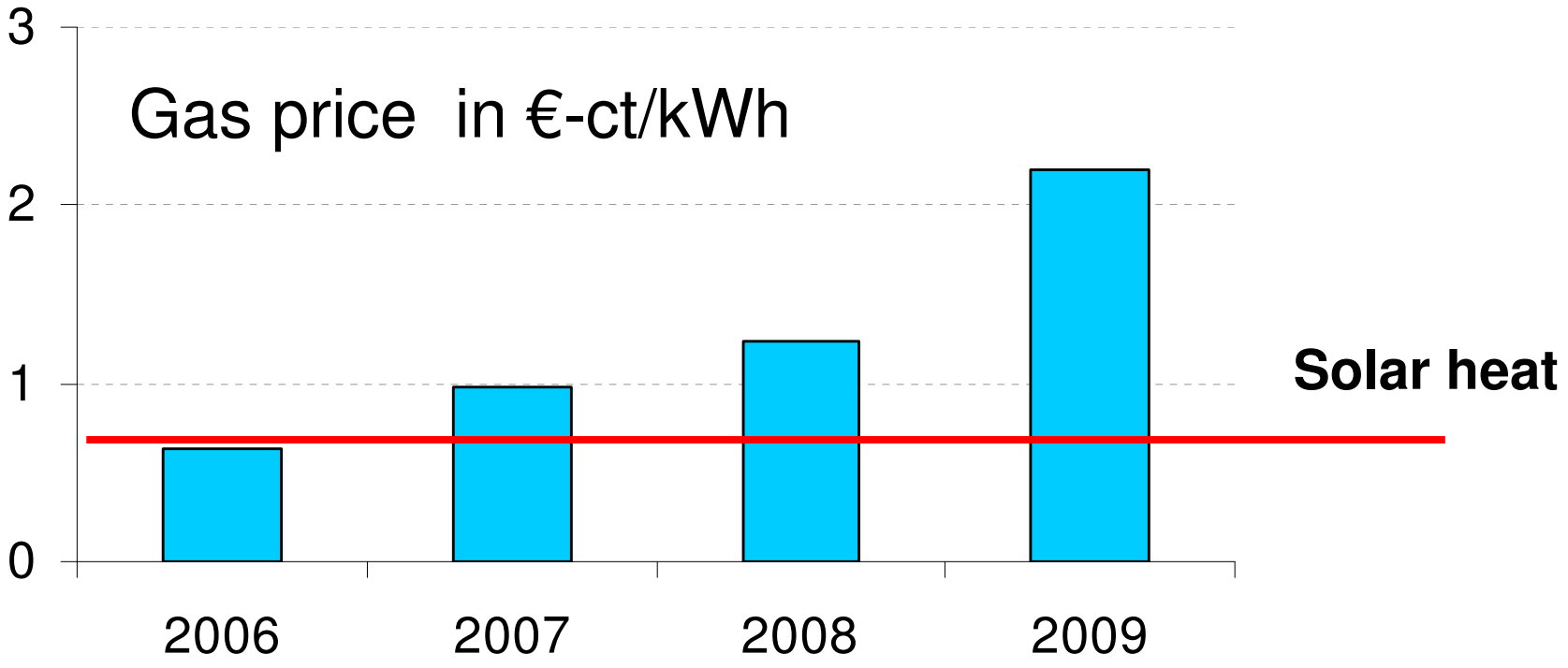
Economical feasibility

- Assumtions
  - 45.000 m² (2,7 Mio. €)
  - 60 €/m² investments
  - interest = 13 %/a
  - CO_2 certificates = 6 €



Gas import: 55 100 145 240 USD per 1000 m³

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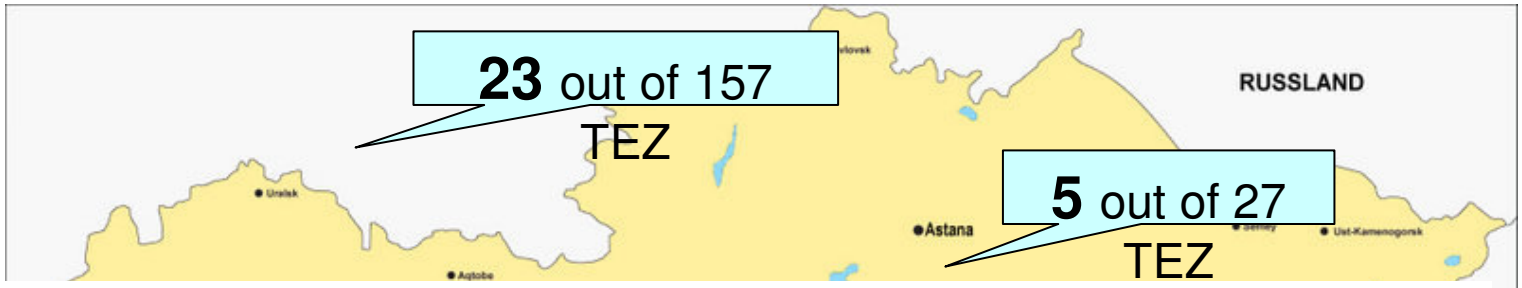
Potential in CIS countries



Overall about **40** out of **200** large CHP plants in CIS suitable

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Obstacles

- **Obstacles**
  - cultural
    - Scepticism about a new technology
  - economical: absence of appropriate credit programs
  - technical: area demand (up to 10 football fields)

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Conclusion

- Solar-assisted district heating in CIS countries
  - Technically feasible
  - Very high solar gains (≥ 1000 kWh/m²a)
  - Extremely cheap (≈ 0,5 ct/kWh)
  - 45.000 m² in Bishkek possible
  - Potential ≈40 CHPs in CIS

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