PARAMETRIC STUDY FOR THE LONG TERM ENERGETIC PERFORMANCE OF GEOTHERMAL ENERGY PILES

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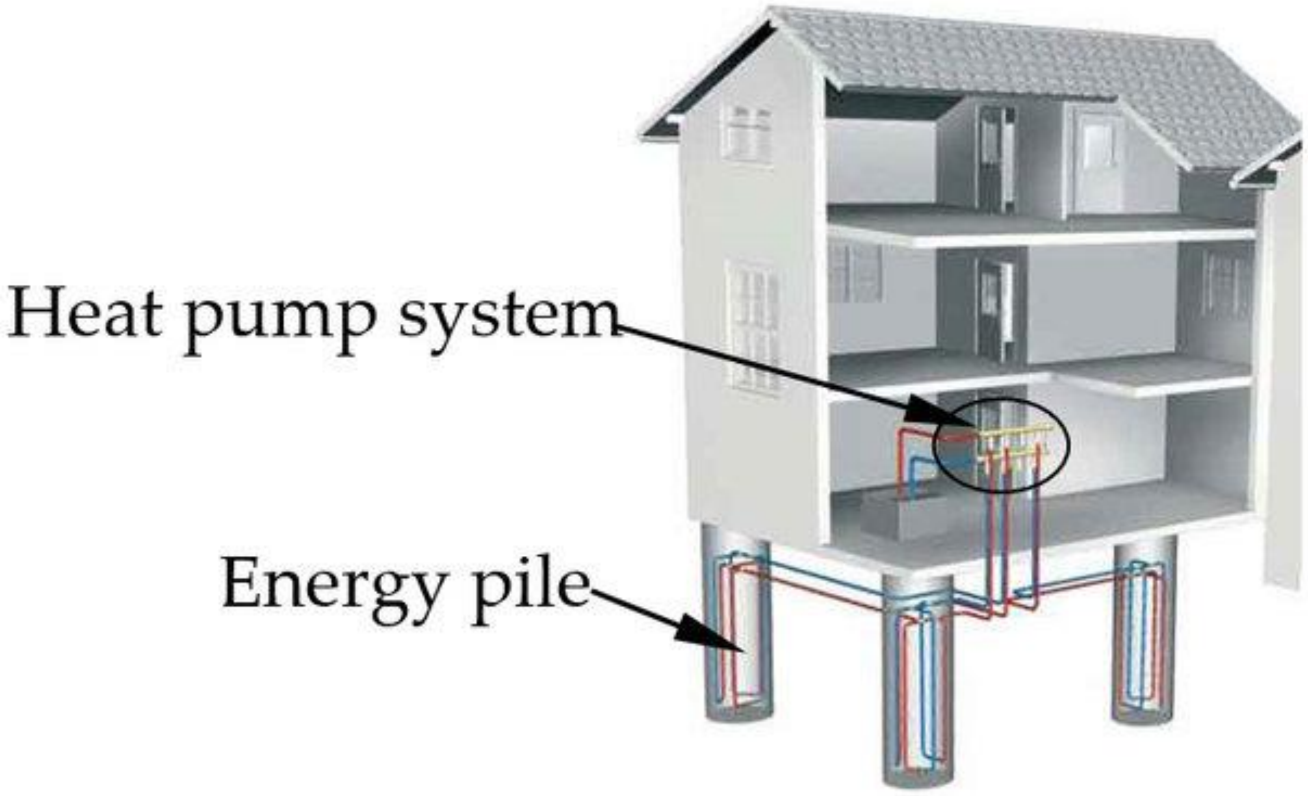
- Energy piles (GHE): U-shaped heat exchangers inserted inside the foundation piles of buildings.



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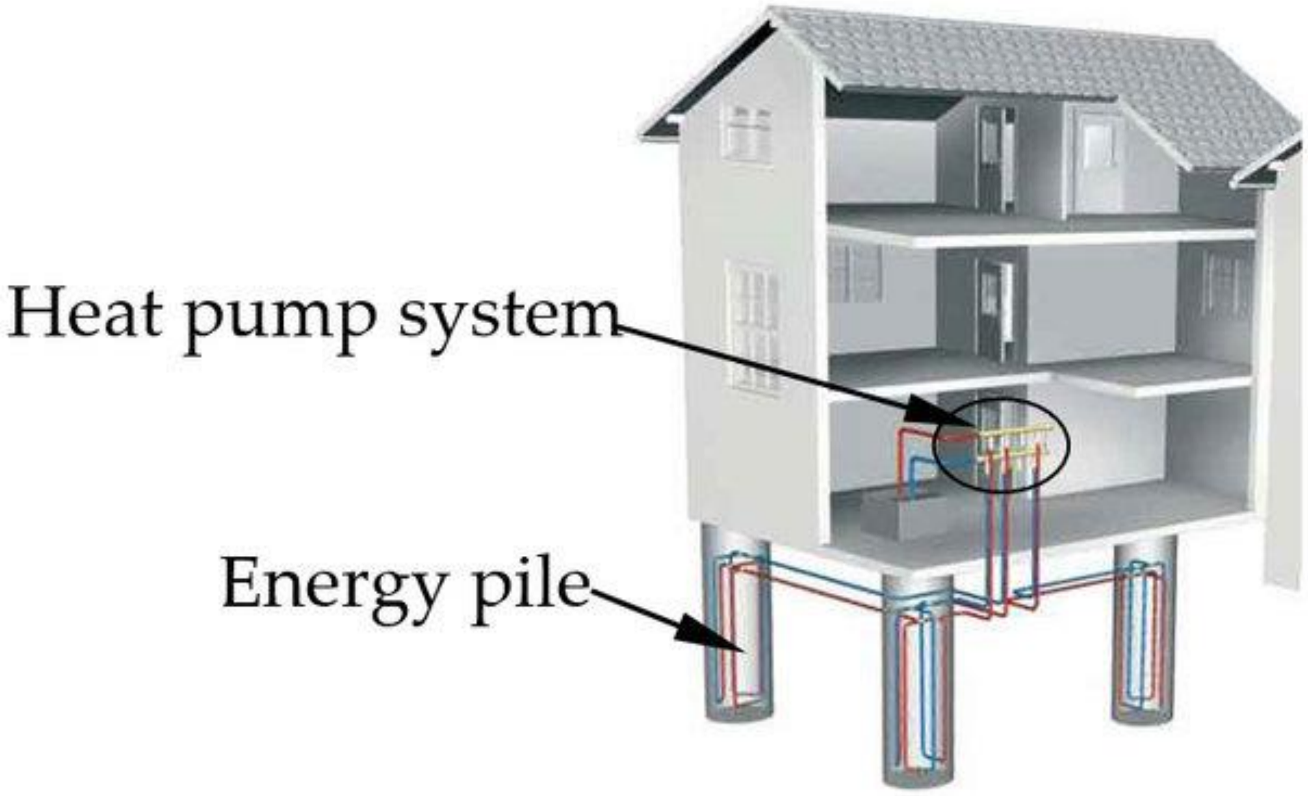

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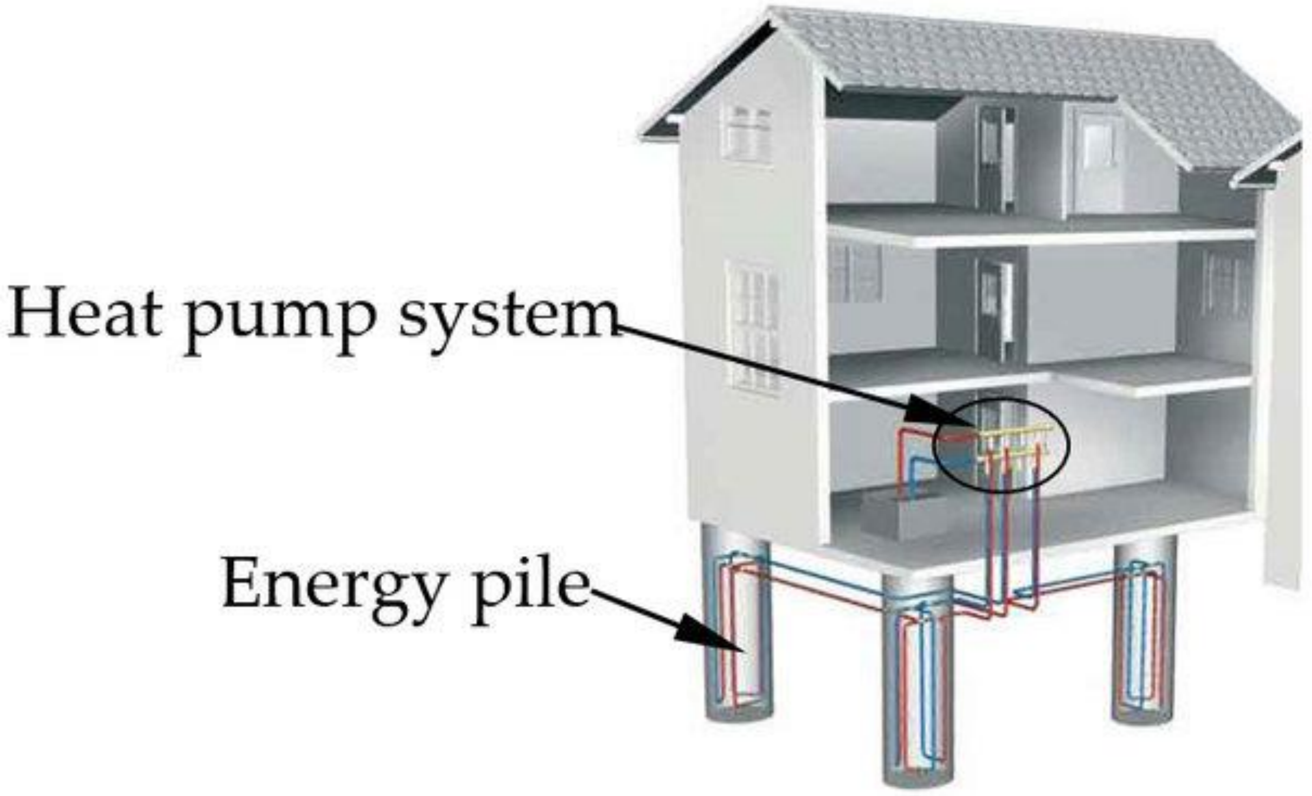
- Simulations often focus **only** on heat transfer in the **foundation soil**.
- A full parametric study **including the heat pump system above**.



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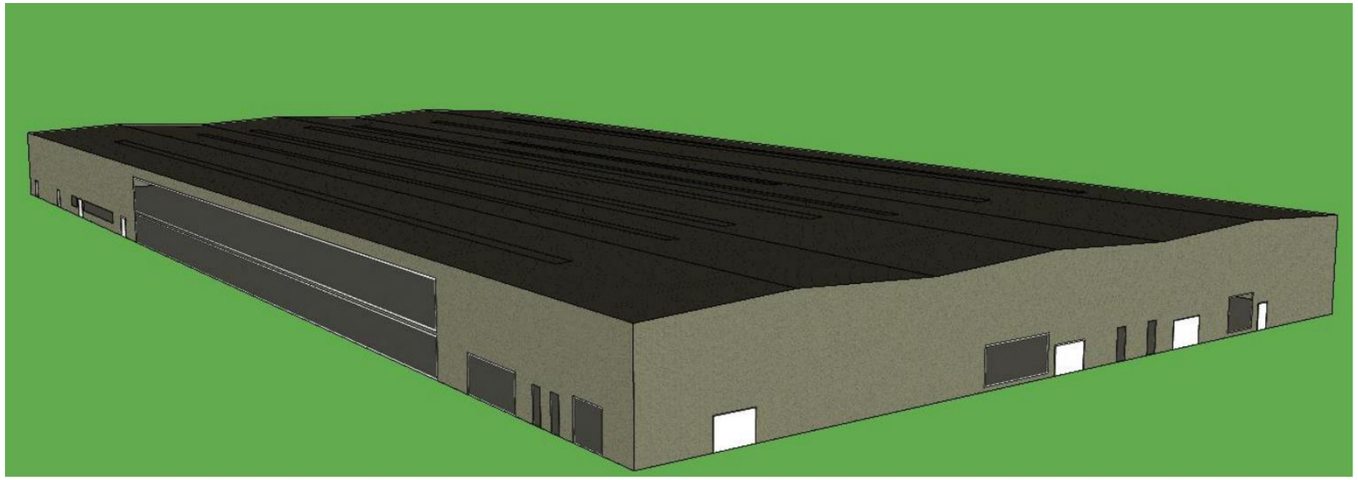

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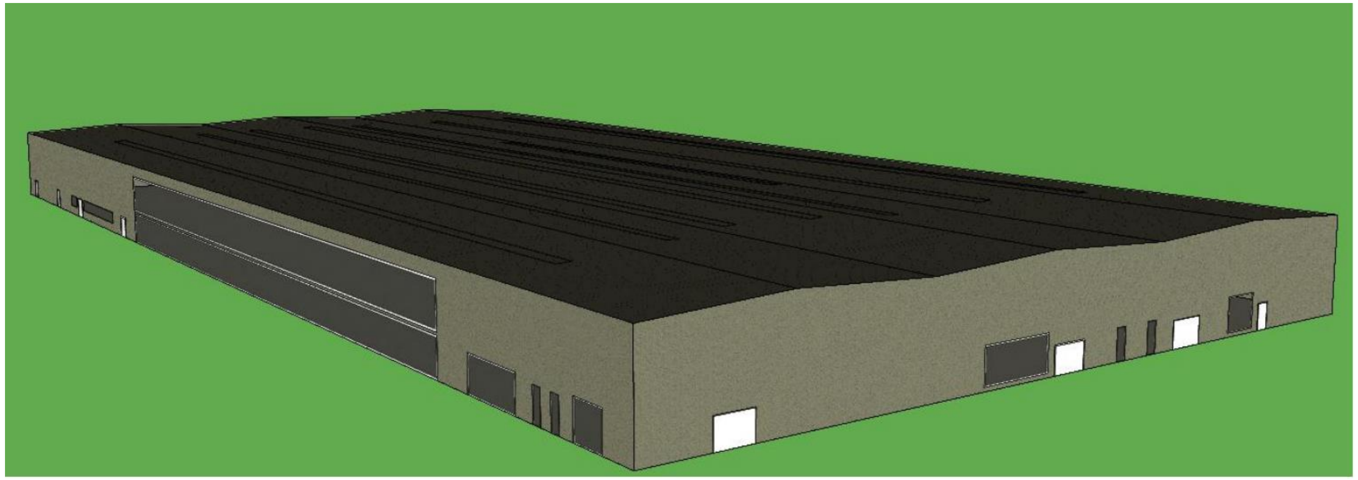

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- Simulations: 20 years. Many different building models depending on heat pump power, total length, specific heat extraction rate (W/m).
- Soil type: clay. No stratification, no thermal storage.

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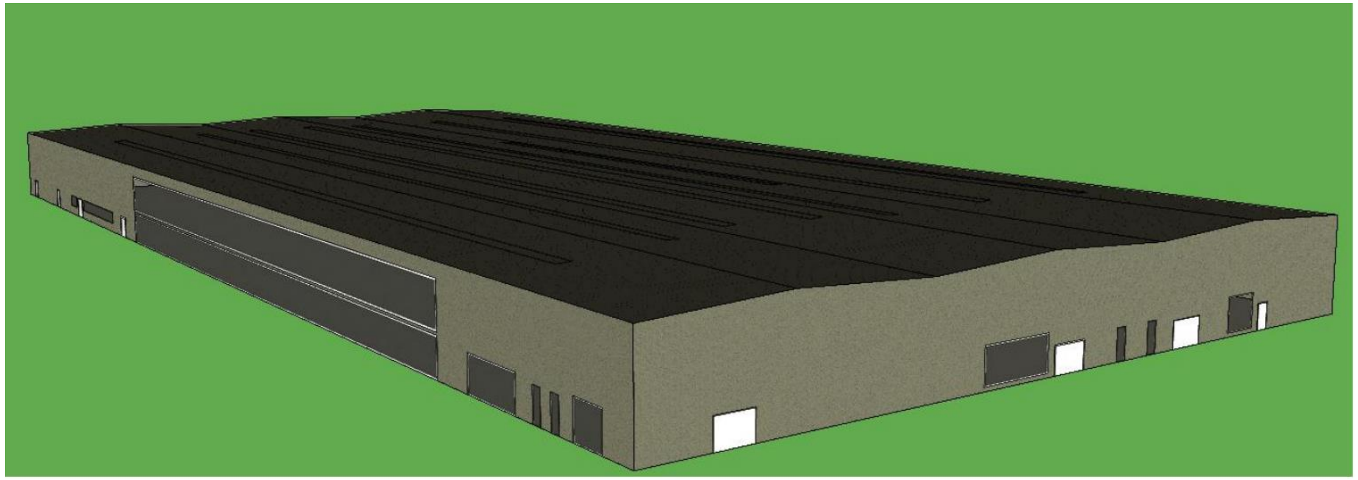

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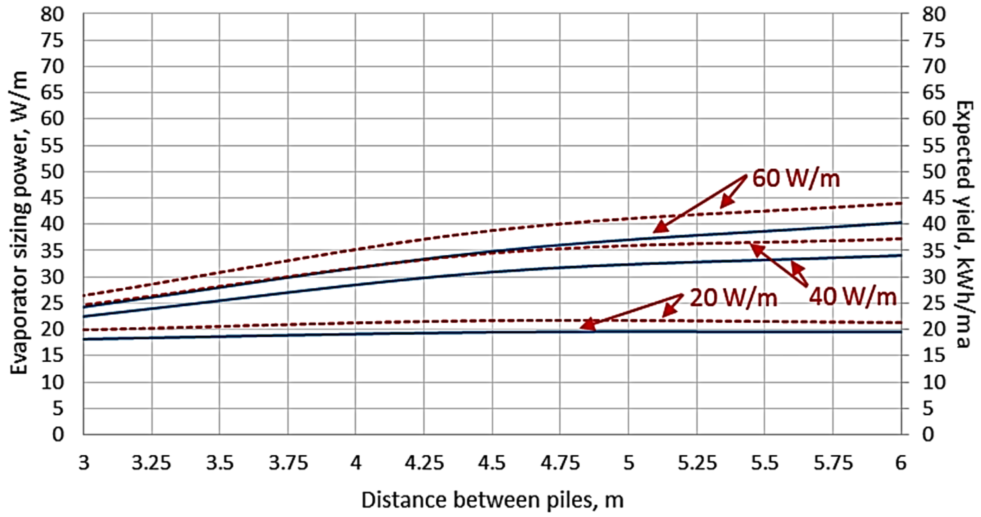

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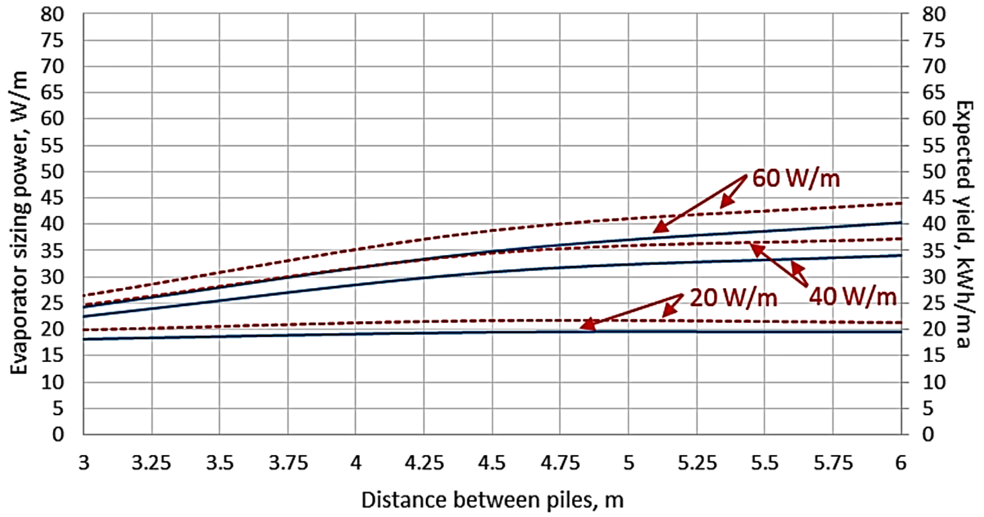
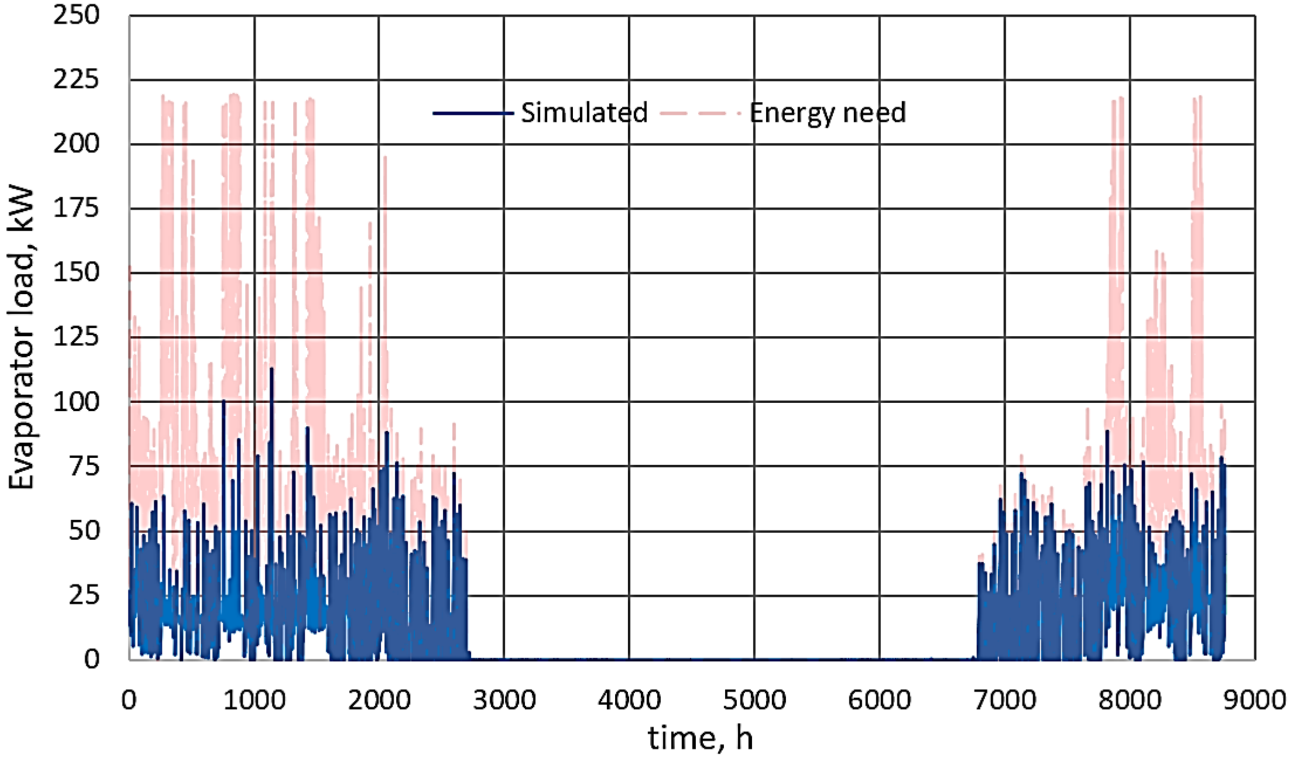


Example: 200 W/m, 6m spacing, L=30m,

Heat pump evaporator sized at ca 215 kW.



Initial heat pump evaporator Power [W/m]

		step 3m		step 4.5m		step 6m	
		15m	**30m**	**15m**	**30m**	**15m**	**30m**
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	yield, kWh/m	21	20	22	22		21
	ground area yield, kWh/m2a	34	62	14	27	-	20
	demand covered by the heat pump	97%	90%	97%	96%		97%
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	demand covered by the heat pump	83%	56%	92%	76%	94%	84%
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	yield, kWh/m	42	27	52	39	55	44
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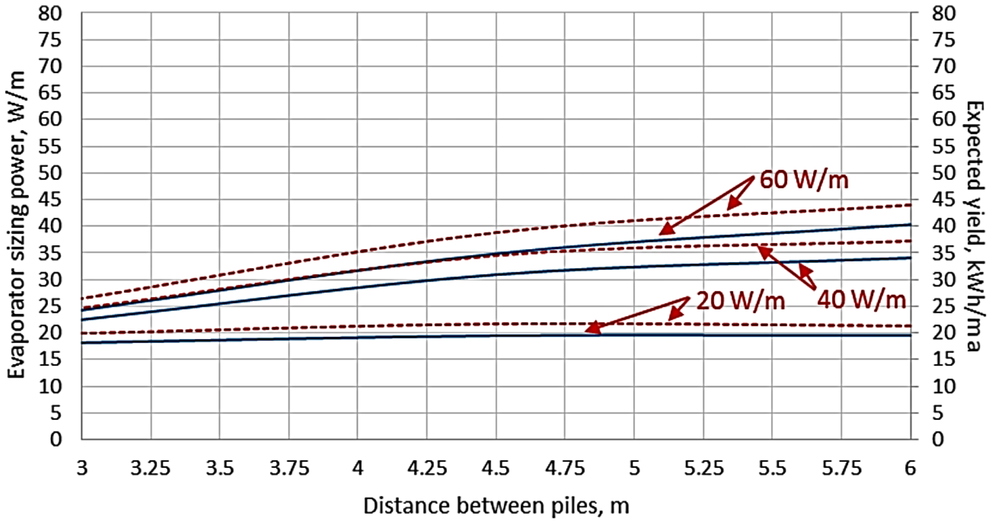
Evaporator power (solid) and condenser yield (dashed), L=30m



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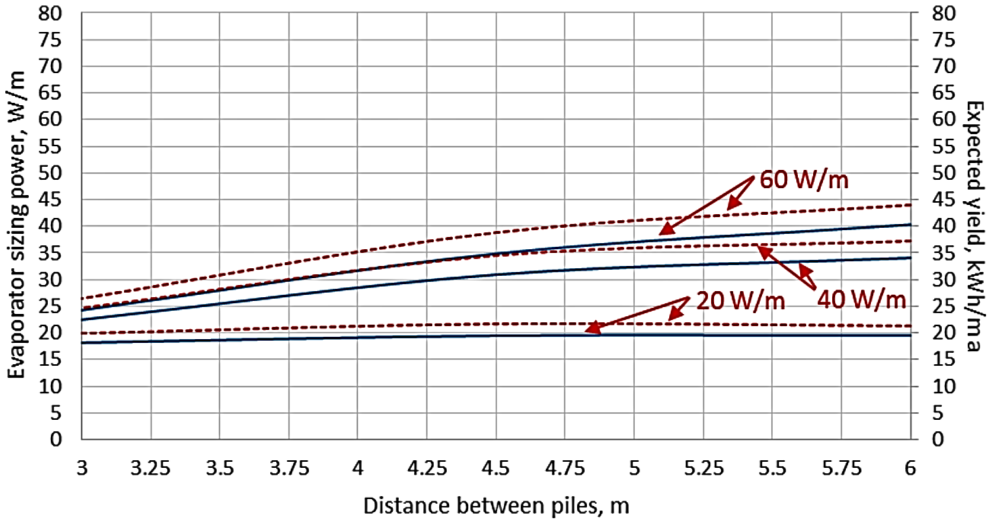

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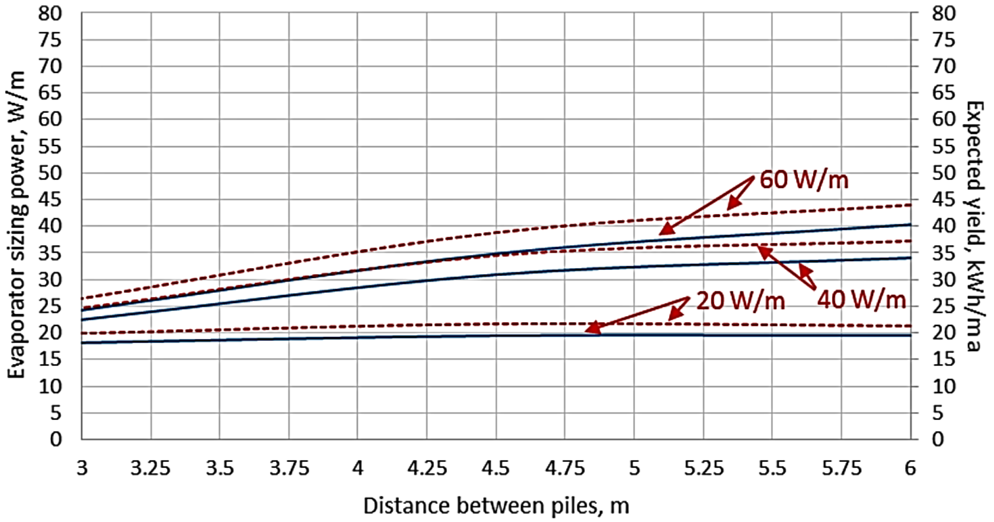

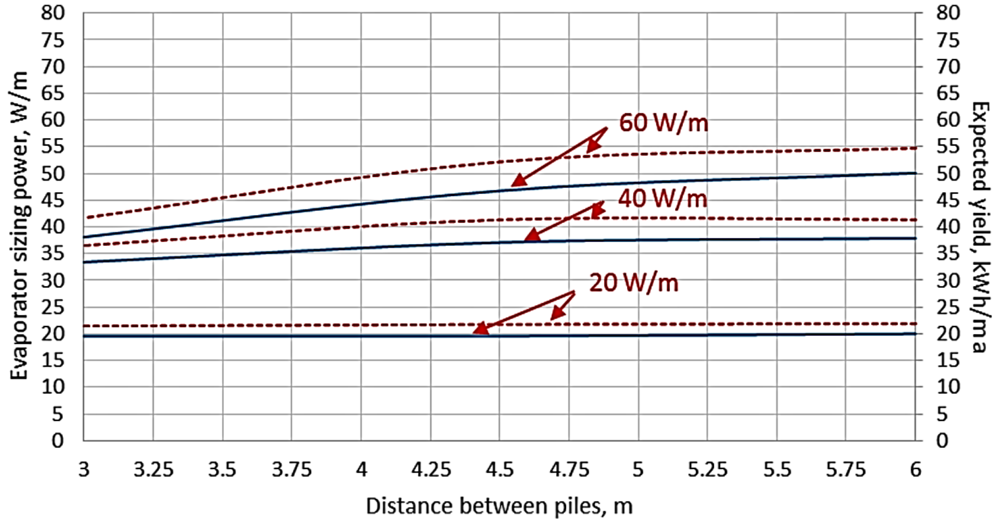

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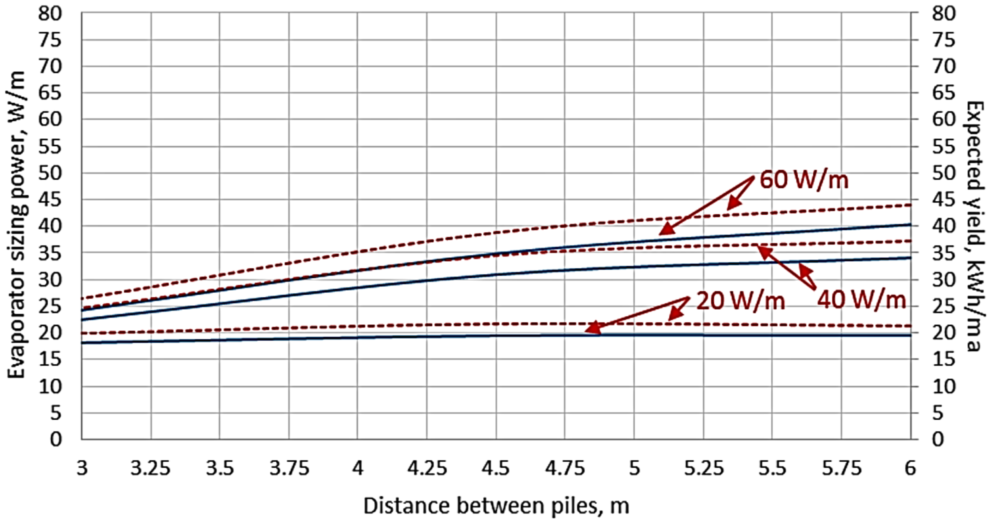

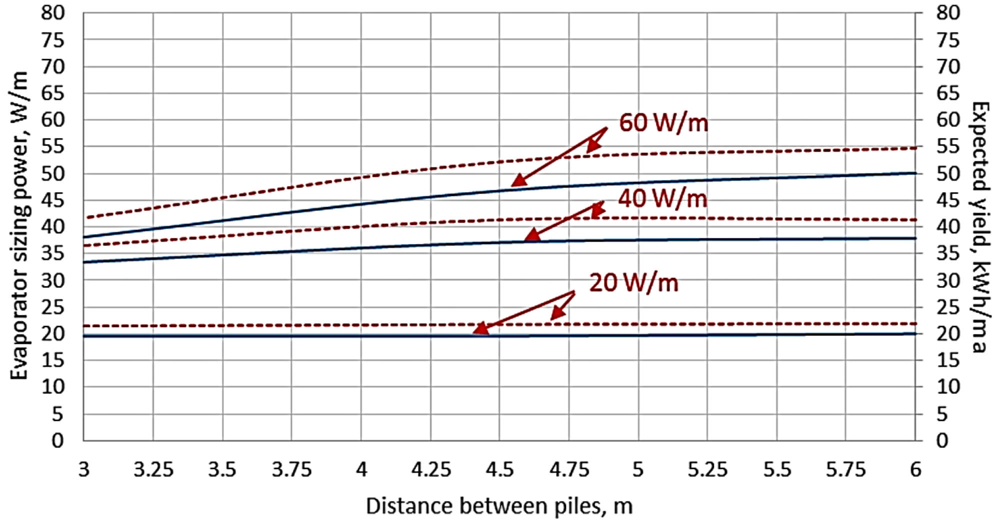

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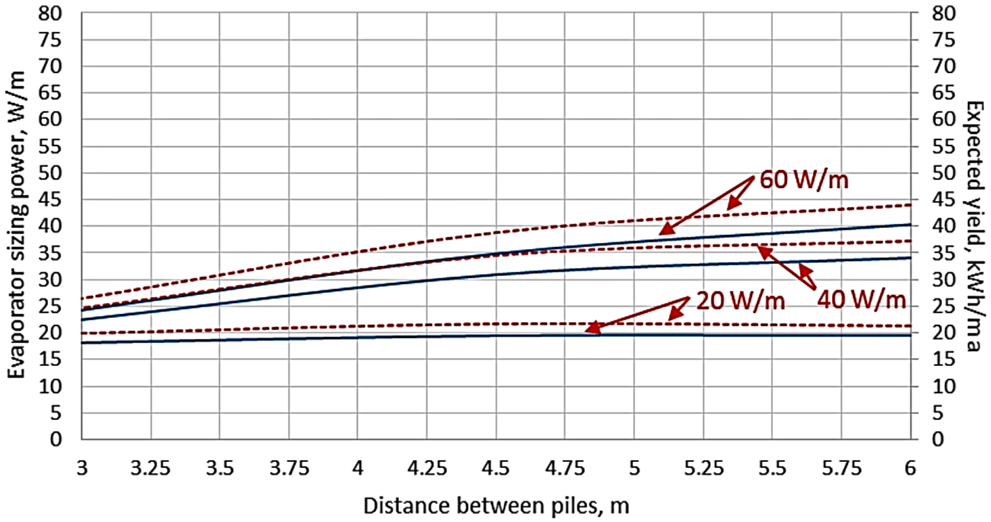

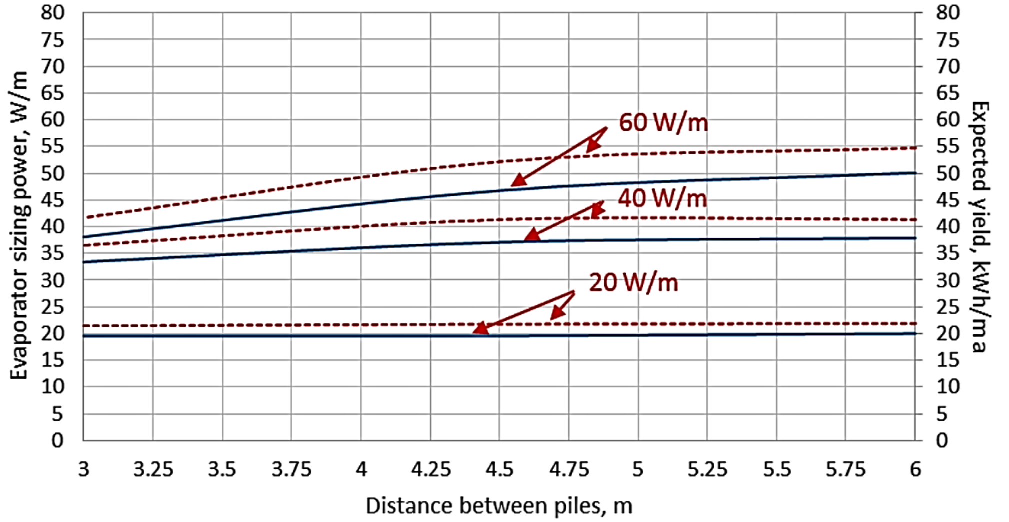

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ALL OF THE ABOVE IS WORK IN PROGRESS

THANK YOU FOR YOUR ATTENTION!

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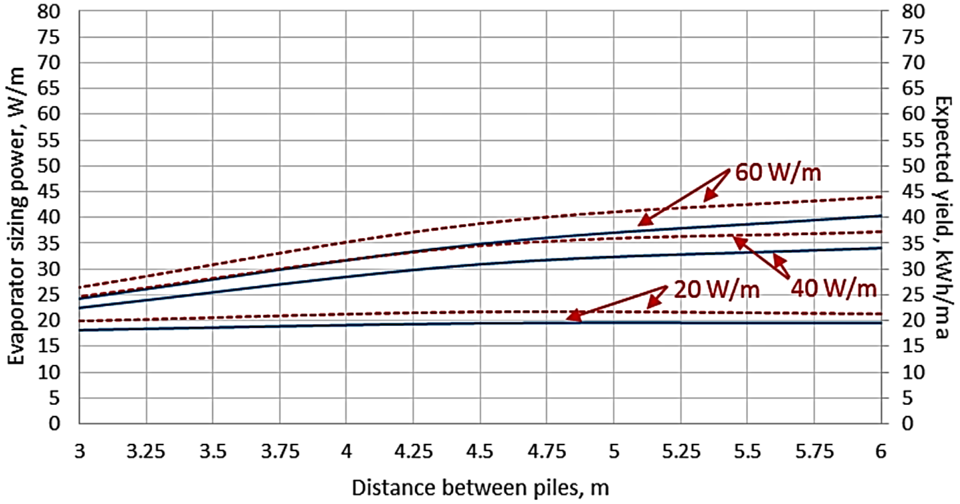
GEOTHERMAL PLANT SIZING GUIDE

1) Determine building design heat load and annual heating energy need: design heat load (design temperature -26°C) Q = 360 kW, annual energy need E ~183 MWh).

2) Size the heat pump evaporator: 180 kW for heat pump condenser, evaporator as Qevap = 140 kW.

3) Estimate total pile field length and condenser yield: assume 30m long piles, then simulation results give the specific yield per unit length E/L [kWh/m]. For 60 W/m we obtain 103 MWh for 6m pile step. 103 MWh<168 MWh (demand) -> more piles or thermal storage.



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