

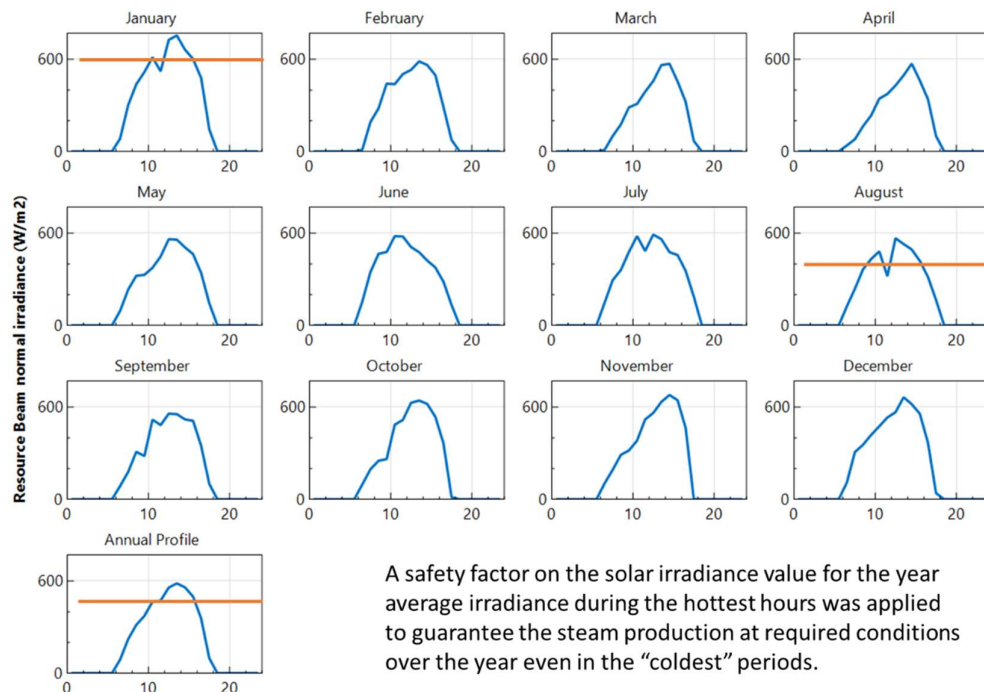
Dear Paul,

Thanks for your help. I have adjusted the Max Single Loop Flow Rate to 15 kg/s and using 8 SCA/HCE assemblies per loop instead of 6 as per your recommendation.

I must wrap up, because I have been working on this for over a month and I need to deliver results very soon. A CSP is required to deliver an uninterrupted flow of 500 klb/hr of steam at 400degC and 600 psi for thermal and mechanical uses in a refinery. To achieve so, a 60 MWt output will be required. No electricity will be produced.

From CSP Guru database information, Parabolic Trough was selected as the best cost/benefit option for the project. The **Parabolic Trough-Heat** model was selected according to the tutorial videos on NREL. Molten Salt was selected as HTF to achieve the minimum steam required temperature (400degC), and also Thermal Storage System. The parameters for these conditions were also adjusted according to the tutorial NREL video on Molten Salt and Storage.

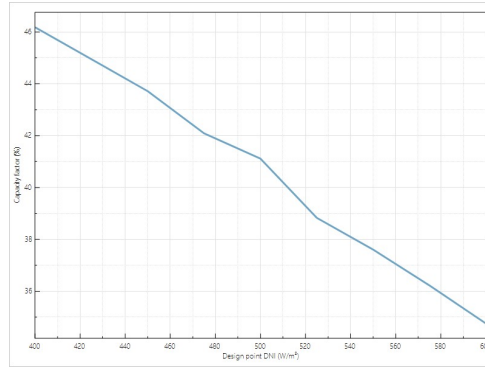
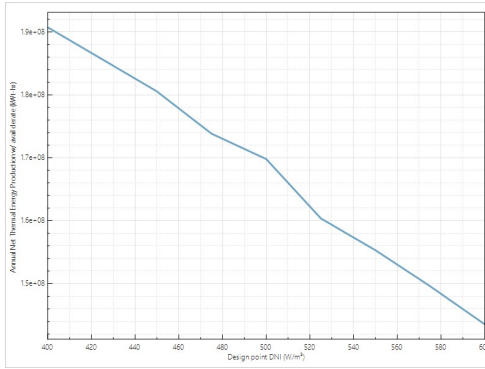
The selected Design Point DNI of 400 was taken after considering the average and minimum irradiance values for the location, and applying a safety factor, to guarantee the system operation at its design point for more hours of the year, generates steam at the desired temperature. Also, Target Solar Multiple value was selected as 2 according to the theory on SAM's Help feature, seeking to achieve the tradeoff between a solar field size that maximizes the system's thermal output and project revenue, while minimizing installation and operating costs.



The **Capacity Factor** and the **Levelized Cost of Energy (LCOE)** were used as the metrics for optimizing the solar field size because they include the amount of electricity generated by the system, the project installation costs, and the O&M cost of the system over its life, finding the solar field aperture area that results in the lowest LCOE.

Parametric runs were performed to obtain the best combinations of values for Design Point DNI, Target Solar Multiple and Storage Hours that achieved the highest Capacity Factor and the lowest LCOE.

	Design point DNI (W/m ²)	Annual Net Thermal Energy Production w/ avail derate (kWt-hr)	Capacity factor (%)	First year kWh/kW (kWht/kWt)
1	400	1.90724e+08	46.1825	4045.59
2	425	1.85637e+08	44.9507	3937.69
3	450	1.80534e+08	43.7151	3829.45
4	475	1.73821e+08	42.0894	3687.03
5	500	1.69794e+08	41.1145	3601.63
6	525	1.60361e+08	38.8303	3401.53
7	550	1.55301e+08	37.6051	3294.21
8	575	1.49588e+08	36.2218	3173.03
9	600	1.43537e+08	34.7564	3044.66



When running Parametrics for Target Solar Multiple, the only value that did not present errors was 2.0

	Target solar multiple	Annual Net Thermal Energy Production w/ avail derate (kWt-hr)	Capacity factor (%)	First year kWh/kW (kWht/kWt)
1	1.5			
2	2	1.90724e+08	46.1825	4045.59
3	2.5			
4	3			
5	3.5			
6	4			

Error Message:

exec fail(trough_physical_iph): C_csp_trough_collector::on(...) COMPONENT defocus failed.

Simulation trough_physical_process_heat failed :Piping geometry file\

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Maximum fluid velocity: 3.00\

Minimum fluid velocity: 2.00\

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To section 1 header pipe diameter: 0.2064 m (8.12 in)\

To section 2 header pipe diameter: 0.1615 m (6.36 in)\

To section 3 header pipe diameter: 0.2064 m (8.12 in)\

To section 4 header pipe diameter: 0.2064 m (8.12 in)\

Loop No. | Diameter [m] | Diameter [in] | Diam. ID\

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1 | 0.1082 | 4.2600 | 1\

2 | 0.0847 | 3.3340 | 1\

3 | 0.0847 | 3.3340 | 1\

4 | 0.1082 | 4.2600 | 2\

SSC requires input 'annual_electricity_consumption', but was not found in the SAM UI or from previous simulations

Simulation iph_to_lcoefcr failed :precheck input: variable 'annual_electricity_consumption' (Annual electricity consumption with avail derate) required but not assigned

SSC requires input 'annual_energy', but was not found in the SAM UI or from previous simulations

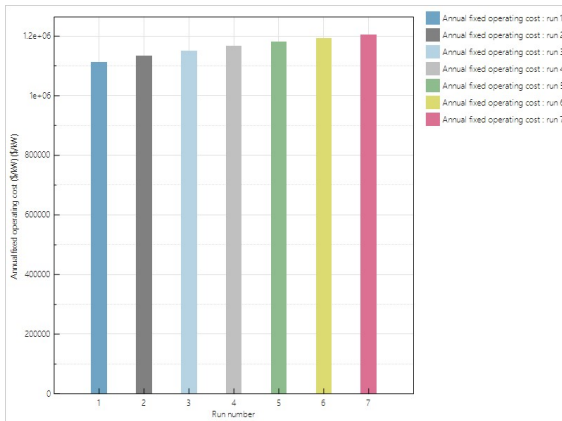
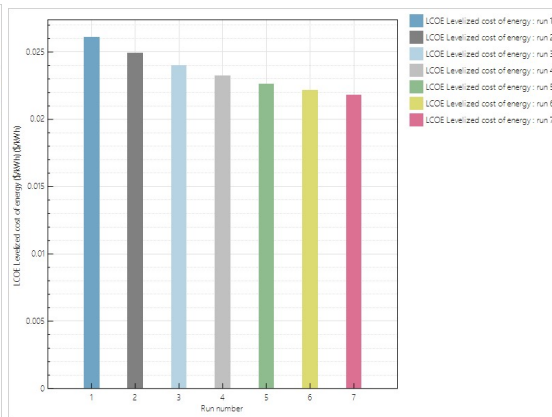
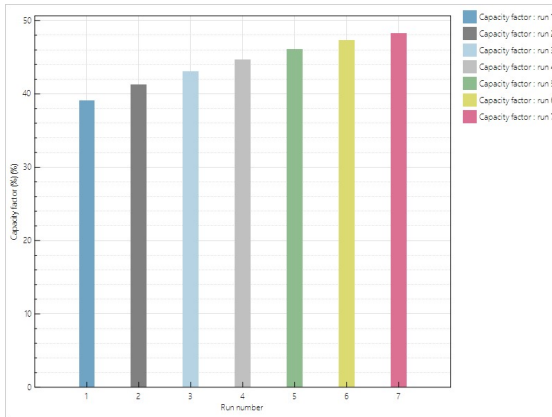
Simulation lcoefcr failed :precheck input: variable 'annual_energy' (Annual energy production) required but not assigned

Running Parametrics on Field Subsections went fine, giving 6 the optimum number of field subsections.

	Number of field subsections	Annual Net Thermal Energy Production w/ avail derate (kWh-hr)	Capacity factor (%)	First year kWh/kW (kWh/kWt)
1	4			
2	6	1.90724e+08	46.1825	4045.59
3	8	1.89447e+08	45.8733	4018.5
4	10	1.87357e+08	45.3672	3974.17
5	12			

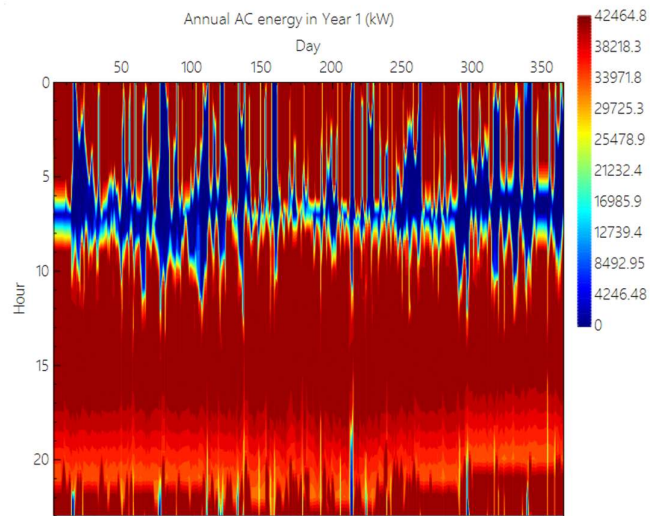
Then, after many trials, selecting Design Point DNI: 400, Target solar Multiple: 2, and Storage hours: 6. Last Parametrics run was done for Storage hours, successfully, with no errors. These were the results.

	Design point DNI (W/m ²)	Hours of storage at design point (hours)	Target solar multiple	Capacity factor (%)	Annual fixed operating cost (\$/kW)	LCOE Levelized cost of
1	400	6	2	39.1225	1.11233e+06	0.0260924
2	400	7	2	41.2422	1.13291e+06	0.0249236
3	400	8	2	43.0786	1.15074e+06	0.024004
4	400	9	2	44.6818	1.16674e+06	0.0232653
5	400	10	2	46.1253	1.18074e+06	0.022642
6	400	11	2	47.3378	1.19358e+06	0.0221534
7	400	12	2	48.2258	1.20375e+06	0.0218149



Finally, from the Parametrics result, the Storage hours value was set as 12, and the simulation was run with no issues. Results are here. The highest Capacity Factor and the lowest LCOE achieved so far.

Metric	Value
Annual energy (year 1)	199,162,688 kWh-t
Annual gross energy (year 1)	223,300,960 kWh-t
Annual thermal freeze protection (year 1)	24,138,258 kWh-t
Capacity factor	48.2%
Annual electricity load (year 1)	7,490,794 kWh-e
LCOH Levelized cost of heat	2.18 €/kWh-t



It seems that finally the simulation has been successful. Could you please, cross-check if everything is alright?

I want to thank you for your help. Still, I may need your guidance to obtain the best Financial parameters and graphics to support my design choices. I appreciate if you can indicate any useful tutorial on the financial analysis and reporting.

Best regards,

Julian Prieto