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Solar Collector Design in Apartment for DHW

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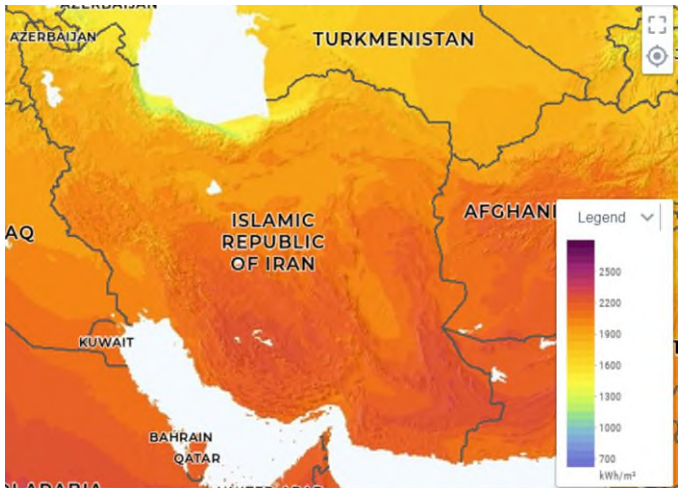
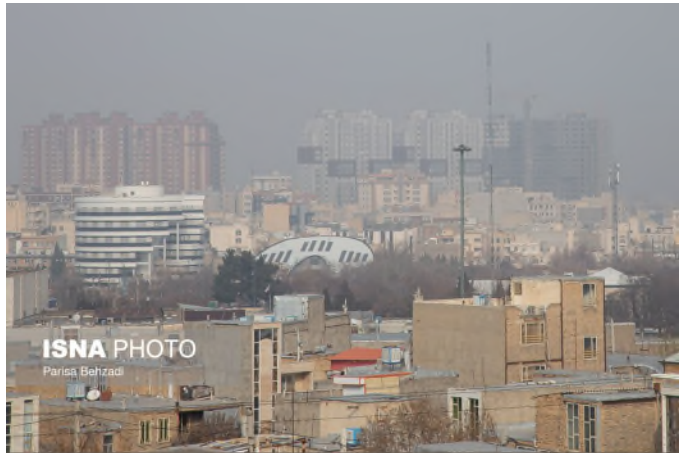
Location: Arak, Iran

Parameters :

Latitude	Longitude	Elevation	Application	Inlet water temperature	Demand Temperature	Demand Volume	Number of people	Tilt angle of Collector
34.072	49.723	1759	Domestic Hot Water	10 ˚C	50 ˚C	600 Liters per Day	12	34 ˚

Motivation :





- **High-Level Solar Radiance**
- **Air Pollution Reduction**
- **Long-Term Cost Savings**
- **Global Environmental Impact**
- **Energy Independence**

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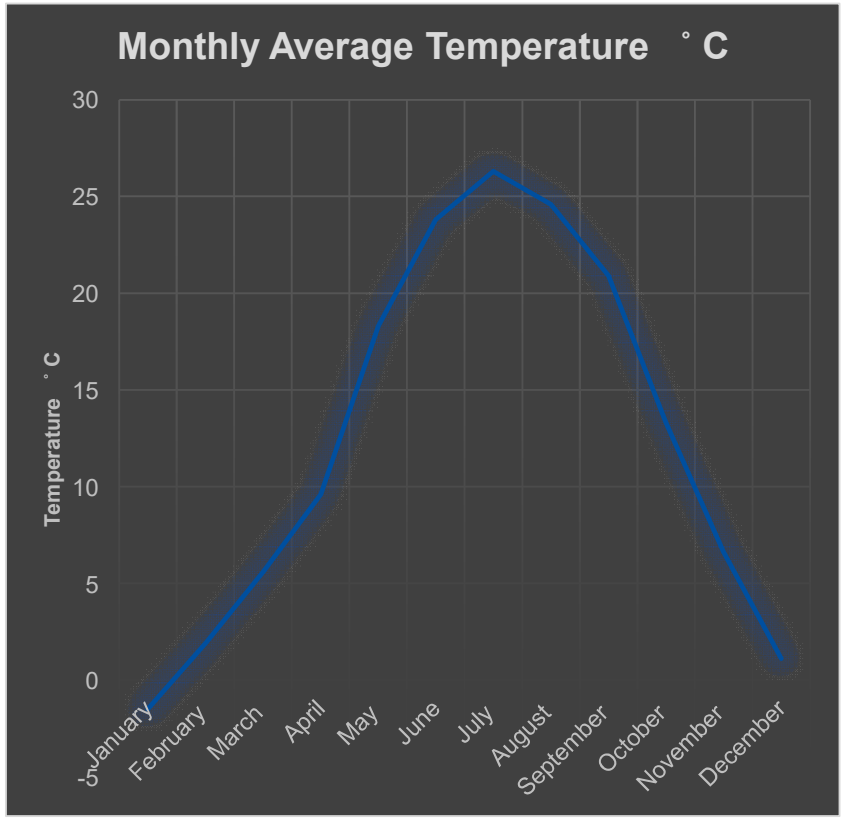
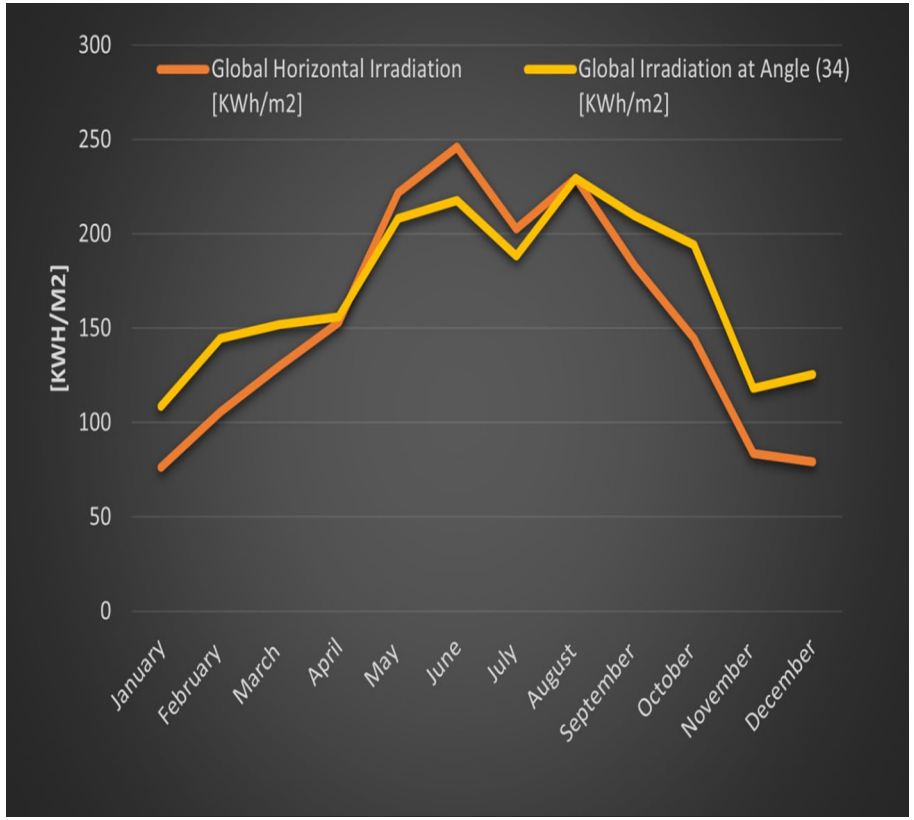
Meteorological conditions :

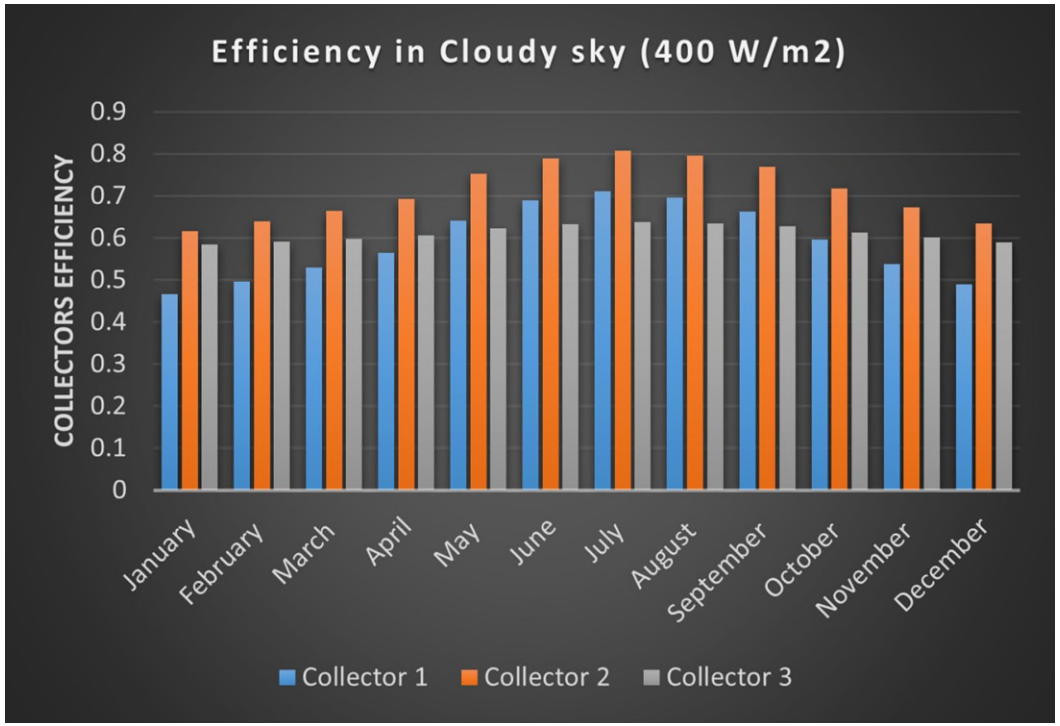


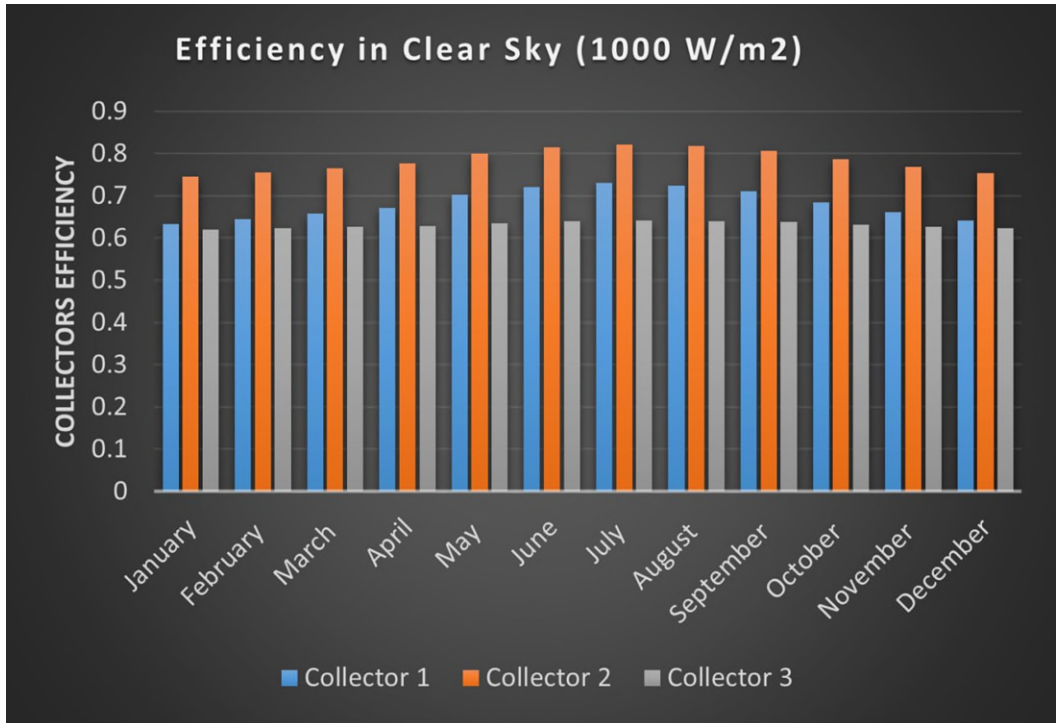


Solar Collectors Characteristics :

Type of collector:	η_0	c_1	c_2	$\eta_{G=400\frac{w}{m^2}}$	$\eta_{G=1000\frac{w}{m^2}}$
Flat plate collector TSU008-13	0.743	3.51	0.009	0.466532	0.632426
Flat plate collector 011-7S3222F	0.832	2.74	0.014	0.616138	0.745676
Evacuated tubular collector 011-7S2628R	0.644	0.749	0.005	0.584985	0.620402

Collectors Performance :





Collector 2 has better performance.

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System Description :

License number :	011-7S3222F
License holder :	Meriaura Energy Oy
Brand :	Savosolar
Heat transfer medium :	Water-Glycole
Flow rate :	0.02 $\frac{Kg}{Sm^2}$
Aperture Area :	14.81 m^2
Monthly Demand :	3.01 GJ
Demanded Area :	12.49 m^2
Heat Exchanger Effectiveness :	1
Absorptance -Transmittance Product :	0.94
Storage Capacity :	600 $^{L}/_{day}$

F-chart :

$$f = 1.029Y - 0.065X - 0.245Y^2 + 0.0018X^2 + 0.0215Y^3$$

$$X = F_R U_L \frac{F'_R}{F_R}(T_{ref} - \overline{T_a})\Delta t \frac{A_c}{L}$$

$$Y = F_R(\tau\alpha)_n \frac{F'_R}{F_R}\frac{(\overline{\tau\alpha})}{(\tau\alpha)_n}\overline{H}_T N \frac{A_c}{L}$$

Month	X	Y	f-15°	f-34°	f-50°	f-60°
Jan	0.046943	0.427099	0.346129	0.393421	0.406933	0.402993
Feb	0.043288	0.64192	0.504867	0.562457	0.576364	0.568784
Mar	0.04851	0.644167	0.542719	0.563783	0.549244	0.525394
Apr	0.047663	0.649812	0.582419	0.568009	0.525529	0.485624
May	0.047762	0.957771	0.818812	0.776591	0.701105	0.634232
Jun	0.044614	1.036398	0.88749	0.824332	0.73026	0.647969
Jul	0.045113	0.872199	0.768034	0.722451	0.646846	0.581638
Aug	0.04575	1.160519	0.915331	0.894842	0.833599	0.772335
Sep	0.045518	1.084142	0.828013	0.85206	0.828967	0.793457
Oct	0.048505	0.98791	0.726158	0.795029	0.80859	0.796361
Nov	0.047265	0.537445	0.427365	0.482533	0.497999	0.492975
Dec	0.048091	0.559252	0.440163	0.499482	0.530995	0.534631

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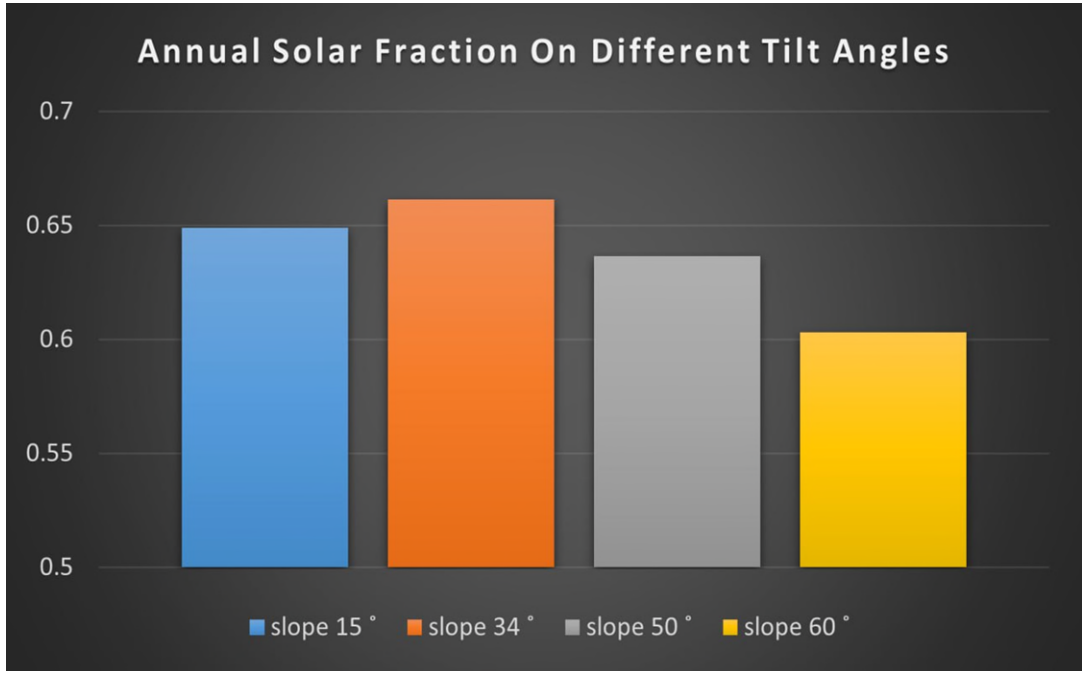
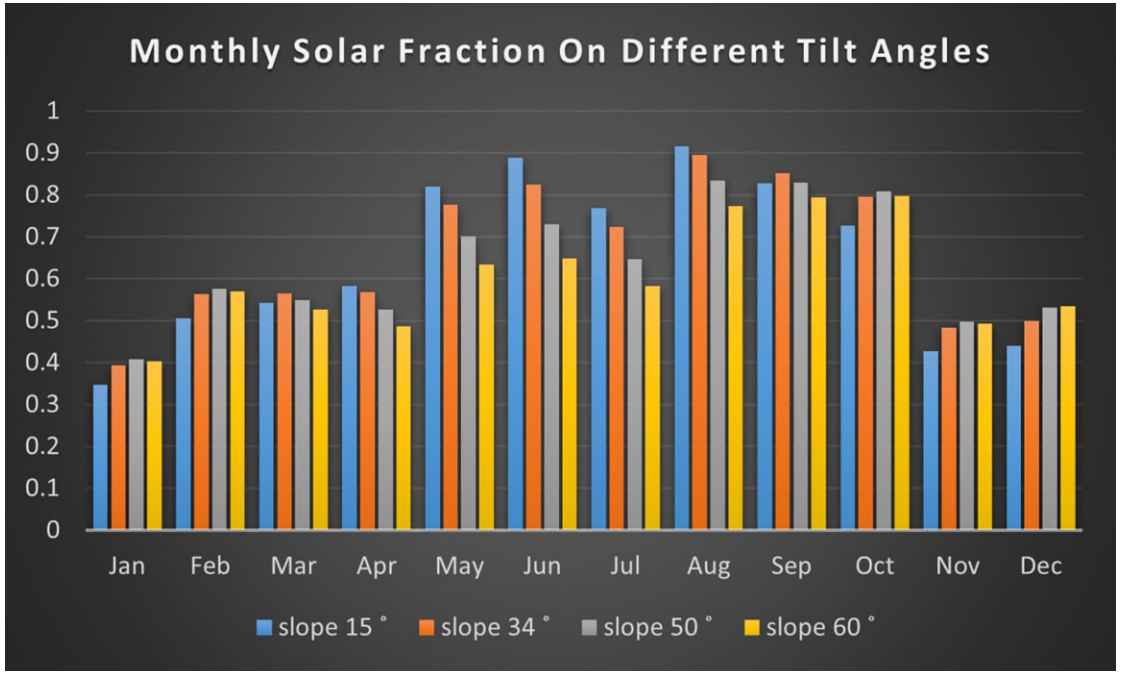
Comparing Solar Fraction On Various Collector Slopes :





Conclusion :

- ✓ The system has a reasonable potential to be implemented in the specified location.
- ✓ The system's performance varies with the collector slopes, but it remains acceptable at the latitude-aligned slope.
- ✓ Additional analysis can be conducted to assess the effectiveness of the heat exchanger and storage losses.
- ✓ The system performs efficiently and reliably, meeting expected criteria.

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Reference :

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