Appendix-A

Energy Analysis

B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	Energy Analysis															
	For HP															
								Steam		Enthalpy	MW					
		HP Turbine calculation						t/h	kg/s	kJ/kg						
		For HP	**Input Steam**					973	270.278	3390.6	916.404					
			Output					883.6	245.444	3059.3	750.888					
								85.03	23.6194	3059.3	72.259					
								4.37	1.21389	3059.3	3.71365					
									Work output		**89.543**					
		Without Solar										**With Solar**				
	For IP	m(t/h)	m(kg/s)	h	mxh(MW)						m(t/h)	m(kg/s)	h	mxh(MW)		
	input	883.6	245.4444	3537.1	868.161544				**input**		968.63	269.064	3537.1	951.7058814		
	output	49.53	13.75833	3362.1	46.2568925				**output**		804.513	223.476	2984.9	667.0531875		
		43.56	12.1	3165.6	38.30376						54.2963	15.0823	3362.1	50.70825462		
		54.53	15.14722	2984.9	45.2129436						47.7518	13.2644	3165.6	41.98978163		
		733.89	203.8583	2984.9	608.496739						59.7775	16.6049	2984.9	49.56384514		
		2.09	0.580556	2984.9	1.73290028						2.09	0.58056	2984.9	1.732900278		
			Work output		**128.158309**							**Work output**		**140.6579122**		
Power boosting when steam is not extracted from HP Turbine =							**12.4996**	MW								
												With Solar				
	For LP	m(t/h)	m(kg/s)	h	mxh(MW)						m(t/h)	m(kg/s)	h	mxh(MW)		
	Input	733.89	203.8583	2984.9	608.496739				**Input**		804.513	223.476	2984.9	667.0531875		
									Output		724.554	201.265	2382.2	479.453546		
	Output	660.95	183.5972	2382.2	437.365303						30.1792	8.38312	2639.8	22.12977221		
		27.53	7.647222	2639.8	20.1871372						25.3449	7.04024	2746.9	19.33883851		
		23.12	6.422222	2746.9	17.6412022						25.1147	6.97629	2515	17.54538031		

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
			733.89	203.8583	2984.9	608.496739						59.7775	16.6049	2984.9	49.56384514	
			2.09	0.580556	2984.9	1.73290028						2.09	0.58056	2984.9	1.732900278	
				Work output		**128.158309**							**Work output**		**140.6579122**	
	Power boosting when steam is not extracted from HP Turbine =							**12.4996**	MW							
													With Solar			
		For LP	m(t/h)	m(kg/s)	h	mxh(MW)						m(t/h)	m(kg/s)	h	mxh(MW)	
		Input	733.89	203.8583	2984.9	608.496739				**Input**		804.513	223.476	2984.9	667.0531875	
										Output		724.554	201.265	2382.2	479.453546	
		Output	660.95	183.5972	2382.2	437.365303						30.1792	8.38312	2639.8	22.12977221	
			27.53	7.647222	2639.8	20.1871372						25.3449	7.04024	2746.9	19.33883851	
			23.12	6.422222	2746.9	17.6412022						25.1147	6.97629	2515	17.54538031	
			22.91	6.363889	2515	16.0051806										
				Work output		**117.297916**							**Work output**		**128.5856505**	
	Power boosting when steam is not extracted from HP Turbine =							**11.2877**	MW							
		Total output of coal plant =			**334.9993**	**335**	**MW**									
Now																
	Total increase in ouput of solar coal hybrid power plant =						**23.7873**	**MW**								
	Therefore, total ouput of the hybrid plant =					**358.787337**	**MW**									
	therefore, to produce 335 MW power with solar energy steam required will be =									**908.491**	**t/h**					
	therefore, for generating 908.913 t/h steam the coal required will be =								**140.055**	**t/h**						
		Coal Saving		**9.94489**	**t/h**											

Exergy Analysis

```
% Exergy Analysis

Wnet = 309.875;

Qs = 72.26;

dP = 24;

eb=(21.7672+340.05187*C-831.916575*H+477.8328*O+5.25*N+2237.1669*S-48.81534*as)/1000;

ex_eff = Wnet/(41.67*eb);

ex_in = (1-((4*298)/(3*5777))*(1-0.28*log(1.35*10^-5)))*Qs;

Ex_Pi = dP/ex_in;

AA = [ex_eff,       Ex_Pi]
```

Economic Analysis

```
% Given data

d = 0.12; %

n = 25; % Life of power plant = 25 Years

PCF = 0.85; % Plant capacity factor = 0.85

APC = 0.075; % Auxiliary power consumption = 7.5%

FC = 0.03252; % Fuel Cost USD per kg
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```
FOM = 27.66; % USD/kWe

UHRnet = 7388.89; %

NCV =15907; % cccccccc or 15907 kJ/kg

Cvom = 0.003252; % Variable O&M per unit USD/kWh

e = 0.02; % Ref Suresh et al. (2%)

TCC =794.17*10^6; % Total Capital Cost in USD

PG = 670000; % Generator Output = 670*1000;

CC = TCC/PG; % The capital cost per unit (CC)

CRF = (d*(1+d)^n)/(((1+d)^n)-1); % Capital Recovery Factor

ACC = CC*CRF; % Annualised capital cost per kW

Pnet = 365*24*PCF*(1-APC); % Net annual energy generated

FCC = ACC/Pnet; % Fixed capital cost per unit

Cfom = FOM/Pnet; % Fixed O&M cost per unit

Cf = FC*UHRnet/NCV; % Fuel cost per unit

Cv = Cf + Cvom; % Total variable cost per unit

ACoE = FCC + Cfom + Cv; % Annualized cost of electricity generation

de = (d-e)/(1+e); % Equivalent discount rate with escalation

LF = ((((1+de)^n)-1)/((de*(1+de)^n)))*(((d*(1+d)^n))/(((1+d)^n)-1)); % Levellizing Factor

Cl = LF*(Cfom+Cv); % Levelised fuel & O&M cost
```

LCoE = FCC+Cl; % Levelised cost of electricity generation

SPP = (CC)/(ACoE*Pnet); % Simple payback period

AA=[TCC, PG, CC, CRF, ACC, Pnet, FCC, Cfom, Cf, Cv, ACoE, de, LF, Cl, LCoE, SPP]