EKSERJİ 2024

EKSERJİ VE UYGULAMALARI YAZ KURSU
2-4 Mayıs 2024, Pamukkale Üniversitesi, Denizli

Sistemlerin Enerji ve Ekserji Analizi: Uygulamalar

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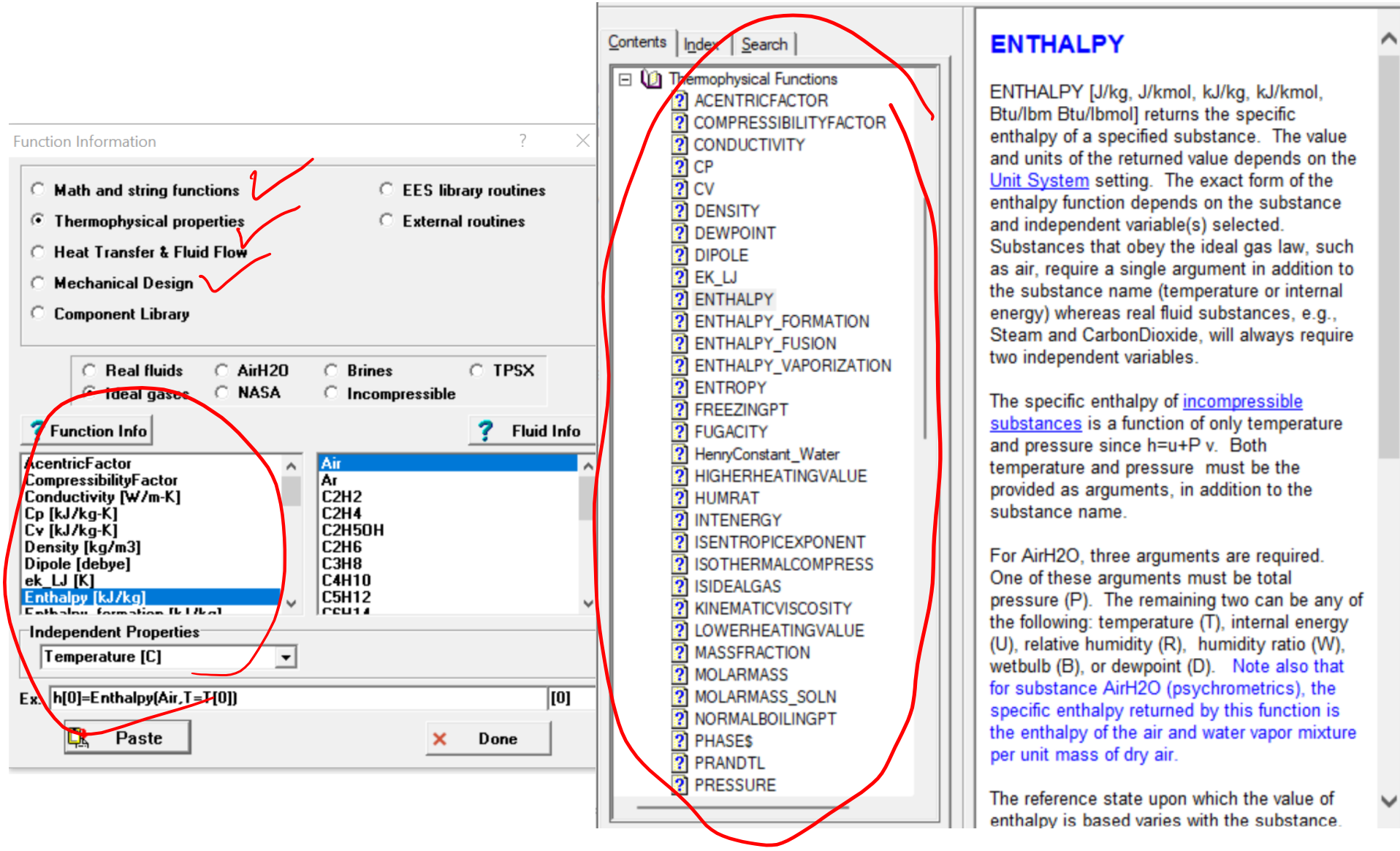
Yıldız Teknik Üniversitesi


Function Information
Math and string functions
Thermophysical properties
Heat Transfer & Fluid Flow
Mechanical Design
Component Library
EES library routines
External routines
Real fluids
Ideal gases
AirH2O
NASA
Brines
Incompressible
TPSX
Function Info
Fluid Info
AcentricFactor
CompressibilityFactor
Conductivity [W/m-K]
Cp [kJ/kg-K]
Cv [kJ/kg-K]
Density [kg/m3]
Dipole [debye]
ek_LJ [K]
Enthalpy [kJ/kg]
Air
Ar
C2H2
C2H4
C2H5OH
C2H6
C3H8
C4H10
C5H12
Independent Properties
Temperature [C]
Ex.
h[0]=Enthalpy(Air,T=T[0])
[0]
Paste
Done
Contents
Index
Search
Thermophysical Functions
ACENTRICFACTOR
COMPRESSIBILITYFACTOR
CONDUCTIVITY
CP
CV
DENSITY
DEWPOINT
DIPOLE
EK_LJ
ENTHALPY
ENTHALPY_FORMATION
ENTHALPY_FUSION
ENTHALPY_VAPORIZATION
ENTROPY
FREEZINGPT
FUGACITY
HenryConstant_Water
HIGHERHEATINGVALUE
HUMRAT
INTENERGY
ISENTROPICEXPONENT
ISOTHERMALCOMPRESS
ISIDEALGAS
KINEMATICVISCOSITY
LOWERHEATINGVALUE
MASSFRACTION
MOLARMASS
MOLARMASS_SOLN
NORMALBOILINGPT
PHASE$
PRANDTL
PRESSURE
ENTHALPY
ENTHALPY [J/kg, J/kmol, kJ/kg, kJ/kmol, Btu/lbm Btu/lbmol] returns the specific enthalpy of a specified substance. The value and units of the returned value depends on the Unit System setting. The exact form of the enthalpy function depends on the substance and independent variable(s) selected. Substances that obey the ideal gas law, such as air, require a single argument in addition to the substance name (temperature or internal energy) whereas real fluid substances, e.g., Steam and CarbonDioxide, will always require two independent variables.
The specific enthalpy of incompressible substances is a function of only temperature and pressure since h=u+P v. Both temperature and pressure must be the provided as arguments, in addition to the substance name.
For AirH2O, three arguments are required. One of these arguments must be total pressure (P). The remaining two can be any of the following: temperature (T), internal energy (U), relative humidity (R), humidity ratio (W), wetbulb (B), or dewpoint (D). Note also that for substance AirH2O (psychrometrics), the specific enthalpy returned by this function is the enthalpy of the air and water vapor mixture per unit mass of dry air.
The reference state upon which the value of enthalpy is based varies with the substance.

EES – Student ($160) (single-user for one year)

EES - Commercial

- ○ Single User License ($600) (Includes Instant Update and Technical Service for one year)
- ○ 5 User License ($2400) (Includes Instant Update and Technical Service for one year)
- ○ 10 User License ($3900) (Includes Instant Update and Technical Service for one year)
- ○ 20 User License ($6000) (Includes Instant Update and Technical Service for one year)
- ◉ Academic License ($2500) (Includes one year of Academic Update Service)

EES - Professional 32-bit (works on all 32 and 64-bit Windows Systems)

- ○ Single User License ($1200) (Includes Instant Update and Technical Service for one year)
- ○ 5 User License ($4800) (Includes Instant Update and Technical Service for one year)
- ○ 10 User License ($7800) (Includes Instant Update and Technical Service for one year)
- ○ 20 User License ($12000) (Includes Instant Update and Technical Service for one year)
- ◉ Academic License ($4750) (Includes one year of Academic Update Service)

EES - Renewal of Instant Update and Technical Service (IUTS) for One Year

When purchasing, you will need to supply your EES Registration Number. (See first screen of software for number.)

Note that IUTS cannot be renewed if 4 or more years have passed since the IUTS expiration date.

- ○ Commercial, less than 12 months past expiration ($120)
- ○ Commercial, >12 and <48 months past expiration ($240)
- ◉ Professional, less than 12 months past expiration ($240)
- ○ Professional, >12 and <48 months past expiration ($480)

Detaylar: https://fchartsoftware.com/ees/

Equations Window

```
X_1=1 {will display as X with a subscript 1}
X_infinity=2 { will display as X with subscript ?}
X_bar=3 {will display with a bar centered above the X}
X_dot=4  {will display with a dot centered above the X}
X_ddot=5  {will display with a double-dot centered above the X}
X_hat=6  {will display with a hat (^) centered above the X}
X_tilde=7   {will display with a tilde (~) center above the X}

X|minus=8 {will display as X superscript -}
X|o=9 {will display as X superscript o}
X|plus=10 {will display as X superscript+}
X|star=11 {will display as X*}

X_prime=12 {will display as X'}
X_dprime=13 {will display as X''}
X_tprime=14 {will display as X'''}
```

BW | US | Line: 16 Char: 35 | Wrap: On | Insert | Caps Lock: Off | SI K Pa J mass rad | Warnings: On | Unit Chk: On

Solution

Main

Unit Settings: SI K Pa J mass rad

$X_1 = 1$ $\quad \bar{X} = 3$

$\ddot{X} = 5$ $\quad \dot{X} = 4$

$X'' = 13$ $\quad \hat{X} = 6$

$X_\infty = 2$ $\quad X' = 12$

$\tilde{X} = 7$ $\quad X''' = 14$

$X^- = 8$ $\quad X^o = 9$

$X^+ = 10$ $\quad X^* = 11$

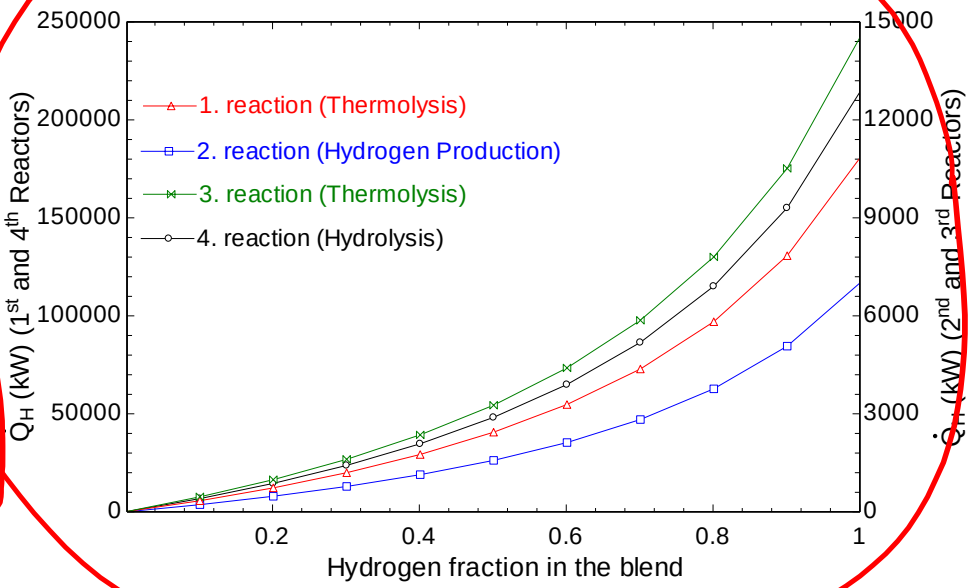
No unit problems were detected.

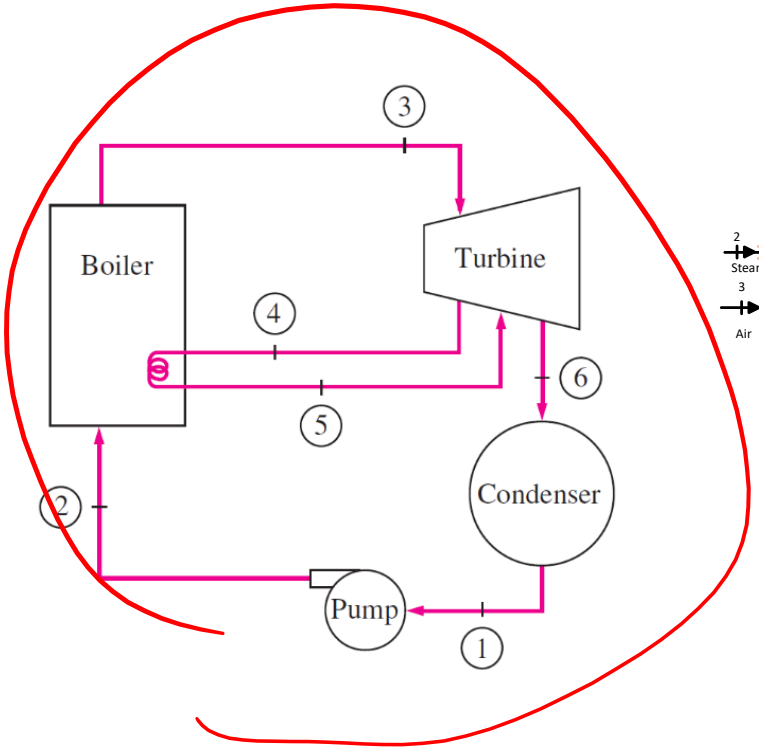
Compilation time = 31 ms Calculation

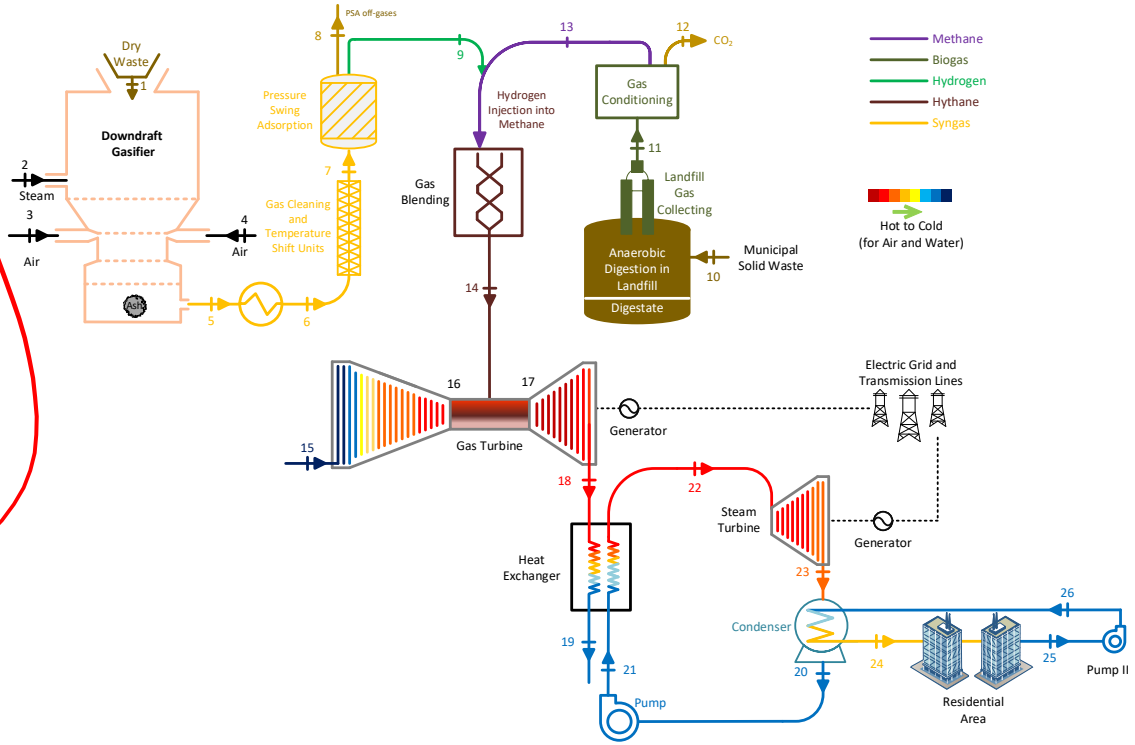
EES Variable Name	Upper Case Symbol	Lower Case Symbol	EES Variable Name	Upper Case Symbol	Lower Case Symbol
ALPHA	Α	α	MU	Μ	μ
BETA	Β	β	NU	Ν	ν
CHI	Χ	χ	THETA	Θ	θ
DELTA	Δ	δ	RHO	Ρ	ρ
EPSILON	Ε	ε	SIGMA	Σ	σ
PHI	Φ	ϕ	TAU	Τ	τ
gamma	Γ	γ	UPSILON	Υ	υ
ETA	Η	η	OMEGA	Ω	ω
IOTA	Ι	ι	XI	Ξ	ξ
JTHETA	ϑ	φ	PSI	Ψ	ψ
KAPPA	Κ	κ	ZETA	Ζ	ζ
LAMBDA	Λ	λ			

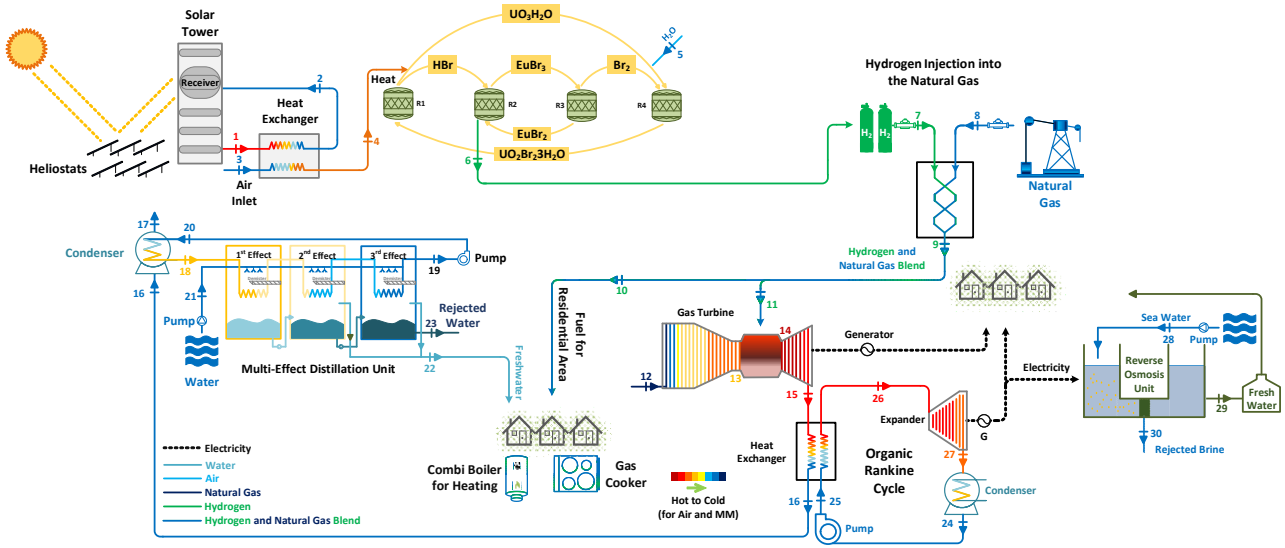
1..51	f [-]	f_{mass} [-]	f_{Air} [-]	f_{CH4} [-]	f_{CO2} [-]	$f_{exhaust,gases}$ [-]	f_{H2} [-]	f_{H2O} [-]	f_{N2} [-]	m_1 [kg/s]	$\dot{m}_{10}$ [kg/s]	$LHV_{hythane}$ [kJ/kg]	$LHV_{hythane,v}$ [kJ/m³]
Run 31	0.6	0.1586	5.263	0.4	0.4	5.963	0.6	1.4	4.163	0.2677	0.848	61113	1881
Run 32	0.62	0.1701	5.12	0.38	0.38	5.81	0.62	1.38	4.05	0.2834	0.8255	61920	1836
Run 33	0.64	0.1826	4.976	0.36	0.36	5.656	0.64	1.36	3.936	0.3	0.8018	62791	1790
Run 34	0.66	0.1961	4.832	0.34	0.34	5.502	0.66	1.34	3.822	0.3173	0.7769	63735	1745
Run 35	0.68	0.2107	4.689	0.32	0.32	5.349	0.68	1.32	3.709	0.3357	0.7507	64760	1700
Run 36	0.7	0.2267	4.545	0.3	0.3	5.195	0.7	1.3	3.595	0.355	0.723	65877	1654
Run 37	0.72	0.2442	4.402	0.28	0.28	5.042	0.72	1.28	3.482	0.3754	0.6938	67099	1609
Run 38	0.74	0.2634	4.258	0.26	0.26	4.888	0.74	1.26	3.368	0.397	0.6629	68443	1564
Run 39	0.76	0.2846	4.115	0.24	0.24	4.735	0.76	1.24	3.255	0.4199	0.6301	69927	1519
Run 40	0.78	0.3082	3.971	0.22	0.22	4.581	0.78	1.22	3.141	0.4442	0.5953	71574	1473
Run 41	0.8	0.3345	3.828	0.2	0.2	4.428	0.8	1.2	3.028	0.47	0.5583	73413	1428
Run 42	0.82	0.364	3.684	0.18	0.18	4.274	0.82	1.18	2.914	0.4975	0.519	75479	1383
Run 43	0.84	0.3975	3.541	0.16	0.16	4.121	0.84	1.16	2.801	0.5269	0.4769	77817	1338
Run 44	0.86	0.4356	3.397	0.14	0.14	3.967	0.86	1.14	2.687	0.5583	0.4319	80484	1292

Last Digit in Student ID	Pressure Ratio (r_p)	Gas Turbine Inlet Temp. (T_4) (K)	Isentropic efficiency of gas turbine (η_{GT}) (%)	Steam Turbine Inlet Pressure (P_5) (MPa)
0	7	1200	75	8
1	8	1250	76	9
2	9	1300	77	10
3	10	1350	78	11
4	11	1400	79	12
5	12	1450	80	13
6	13	1500	81	14
7	14	1550	82	15
8	15	1600	83	16
9	16	1650	84	17




Boiler
Turbine
Condenser
Pump
1
2
3
4
5
6


Dry Waste
Downdraft Gasifier
Steam
Air
Air
Ash
PSA off-gases
Pressure Swing Adsorption
Gas Cleaning and Temperature Shift Units
Hydrogen Injection into Methane
Gas Conditioning
CO_2
Gas Blending
Landfill Gas Collecting
Anaerobic Digestion in Landfill
Digestate
Municipal Solid Waste
Methane
Biogas
Hydrogen
Hythane
Syngas
Hot to Cold (for Air and Water)
Gas Turbine
Generator
Electric Grid and Transmission Lines
Heat Exchanger
Steam Turbine
Generator
Condenser
Pump
Pump II
Residential Area


Solar Tower
Receiver
Heliostats
Heat Exchanger
Air Inlet
Heat
HBr
UO_3H_2O
$EuBr_3$
Br_2
$EuBr_2$
$UO_2Br_23H_2O$
H_2O
Hydrogen Injection into the Natural Gas
Natural Gas
Hydrogen and Natural Gas Blend
Condenser
1st Effect
2nd Effect
3rd Effect
Pump
Rejected Water
Freshwater
Water
Multi-Effect Distillation Unit
Fuel for Residential Area
Gas Turbine
Generator
Electricity
Sea Water
Pump
Reverse Osmosis Unit
Fresh Water
Rejected Brine
Expander
G
Heat Exchanger
Organic Rankine Cycle
Condenser
Pump
Combi Boiler for Heating
Gas Cooker
Hot to Cold (for Air and MM)
Electricity
Water
Air
Natural Gas
Hydrogen
Hydrogen and Natural Gas Blend

Organic Rankine cycle plant