



Panos Konstantin

Power and Energy Systems Engineering Economics

Applications Examples

Chapter 6 – Cost Allocation for Cogeneration Products

Notes:

1. Cells with black characters include inputs
2. Cells with red characters include formulas
3. Some examples need for calculations the installation of Add_Ins developed by the author. See installation instruction in the file introduction.

Last update
June 2015



Panos Konstantin

Disclaimer

The Examples are solely and exclusively indented to provide support and assistance to the readers for practicing and better understanding of the theoretical part of this book.

The author, Panos Konstantin, believes that all information and guidance provided and all calculations in these examples are correct. Nevertheless anyone using these examples should carry out their own due diligence and appraisal of the contents.

No warranty is made nor responsibility or liability is taken or accepted by the author for adequacy, completeness or accuracy of the examples or assumptions on which they are based.

The author does not assume any liability to anyone for any loss or damage caused by any error or omission in this work, regardless of whether such error or omission is the result of negligence or any other reason. Any and all such liability is completely disclaimed.

Panos Konstantin owns all intellectual property rights and all copyright shown in this website, unless otherwise stated.

Proposals for improvements of the contents are welcome and will be considered in upcoming updates!

Last Update June 2015

Ex. 6-1 and 7-1 Cost GT CHP

Item	Unit	Value
Power balance,engine CHP		
Electrical output, net	kW _e	1,500
Thermal output, $\sigma =70\%$	kW _t	2,143
Fuel Input $\eta =85\%$	kW _t	4,286
Energy balance, cogeneration		
Electricity generation 7,000 h/a	MWh _e / a	10,500
Heat generation 7,000 h/a	MWh _t / a	15,000
Fuel consumption 7,000 h/a	MWh _t / a	30,000
Financial constraints		
Gas price for LHV	€ / MWh _t	25.00
Electricity purchase price *)	€ / MWh _e	60.00
Annual costs		
Fixed costs **)	th.€ / a	176.0
Fuel costs	th.€ / a	750.0
Subtotal	th.€ / a	926.0
minus electricity credit ***)	th.€ / a	630.0
Residual costs of heat	th.€ / a	296.0
Specific cost of heat	€ / MWh_t	19.73

*) For purchase from grid + including use of system charges

**) Calculated in separate file (annuity CAPEX + fixed O&M costs)

***) Avoided costs for purchase electricity from the grid

Heat-Only Boiler

Heat generation	MWh _t / a	15,000
Fuel consumption $\eta =88\%$	MWh _t / a	17,045
Gas price in LHV	€ / MWh _t	25.00
Specific cost of heat	€ / MWh_t	28.41

Ex. 6-2 cost PP 600 MW

Heat Extraction from 600 MW Power Station			
Electricity generation cost $c_e =$		63.00 €/MWh	
Steam- pressure	Steam Temperature	Electrical equivalent	Heat cost
p bar	t_s °C	β kWh _e / kWh _t	$\beta \times c_e$ € / MWh _t
12.0	218	0.251	15.81
6.0	189	0.220	13.86
1.7	145	0.164	10.33

Note: Performance parameters from Cycle calculation

Electricity generation costs calculation in separate file

Ex. 6-3 heat rate PP 600 MW

Heat extraction from 600 MW power plant			
Heat rate of electricity		$q_e = 8.60 \text{ MJ/kWhe}$	
Steam- pressure	Steam Temperature	Electrical equivalent	Steam heat rate
p bar	$t_s + 30^\circ\text{C}$ $^\circ\text{C}$	β kWh _e / kWh _t	$\beta \times q_e$ MJ / kWh _t
12.0	218	0.300	2.58
6.0	189	0.270	2.32
1.7	145	0.190	1.63

Note: Electrical equivalent taken from figure 6-3, upper curve