

# Appendix C: Costs and Performance for New Power Plants

Table C-1: Cost and performance summary for pulverised coal without FGD (EPRI, 2012)

Technology	1x750 MW, No FGD	2x750 MW, No FGD	6x750 MW, No FGD	Technology	1x750 MW, No FGD	2x750 MW, No FGD	6x750 MW, No FGD
Heat Rate, kJ/kWh				Rated Capacity, MW Gross	804	1,608	4,824
Average Annual	9,707	9,707	9,707	Rated Capacity, MW Net	750	1,500	4,500
100% Load	9,664	9,664	9,664	Plant Cost Estimates (January 2012)			
75% Load	9,844	9,844	9,844	Total Overnight Cost, ZAR/kW	20,176	19,114	17,519
50% Load	10,371	10,371	10,371	Lead-times and Project Schedule, years	4	5	9
25% Load	12,524	12,524	12,524	Single Unit Expense Schedule, % of TPC per year	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%
Net Plant Efficiency, %	37.1	37.1	37.1	Full Project Expense Schedule, % of TPC per year (* indicates commissioning year of first unit)	10%, 25%, 45%, 20%	5%, 18%, 35%, 32%*, 10%	2%, 6%, 13%, 17%*, 17%, 16%, 15%, 11%, 3%
Plant Load Factor				Fuel Cost Estimates			
Typical Capacity Factor	85%	85%	85%	First Year (ZAR/GJ)	15.4	15.4	15.4
Maximum of Rated Capacity	100%	100%	100%	Expected Escalation (beyond inflation)	0%	0%	0%
Minimum of Rated Capacity	25%	25%	25%	Fuel Energy Content, HHV, kJ/kg	17,850	17,850	17,850
Water Usage				O&M Cost Estimates			
Per Unit of Energy, L/MWh	33.4	33.4	33.4	Fixed O&M, ZAR/kW-yr	433	409	367
Sorbent (Limestone) Usage				Variable O&M, ZAR/MWh	38.2	38.2	38.2
Per Unit of Energy, kg/MWh	0	0	0	Availability Estimates			
Air Emissions, kg/MWh				Equivalent Availability	91.7	91.7	91.7
CO <sub>2</sub>	930.2	930.2	930.2	Maintenance	4.8	4.8	4.8
SO <sub>x</sub>	9.03	0.90	9.03	Unplanned Outages	3.7	3.7	3.7
NO <sub>x</sub>	1.91	1.91	1.91	Performance Estimates			
Particulates	0.13	0.13	0.13	Economic Life, years	30	30	30
Solid Wastes, kg/MWh							
FGD solids	0.0	0.0	0.0				
Fly ash	166.2	166.2	166.2				
Bottom ash	3.3	3.3	3.3				

Table C-2: Technology costs reported in the revised Integrated Resource Plan (2012) (After EPRI, 2012)

	Pulverised coal, with FGD	Pulverised coal, with CCS	Fluidised bed combustion (coal) with FGD	Fluidised bed combustion (coal) with CCS	IGCC	IGCC, with CCS	Nuclear (single unit)	Nuclear fleet
Rated capacity, net (MW)	4500 (6 x 750)	4500 (6 x 750)	250	250	1288 (644 x 2)	1288 (644 x 2)	1600	9600 (6 X 1600)
Life of programme	30	30	30	30	30	30	60	60
Typical load factor (%)	85%	85%	85%	85%	85%	85%	92%	92%
Overnight capital costs (R/kW)	21572	40845	21440	40165	29282	39079	46841	44010
Lead time	9	9	4	4	5	5	6	16
Phasing in capital spent (% per year) (* indicates commissioning year of 1st unit)	2%, 6%, 13%, 17%*, 17%, 16%, 15%, 11%, 3%	2%, 6%, 13%, 17%*, 17%, 16%, 15%, 11%, 3%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	5%, 18%, 35%, 32%*, 10%	5%, 18%, 35%, 32%*, 10%	15%, 15%, 25%, 25%, 10%, 10%	3%, 3%, 7%, 7%, 8%, 8%*, 8%, 8%, 8%, 8%, 8%, 8%, 8%, 8%, 6%, 6%, 2%, 2%
Adjusted overnight capital costs, accounting for capex phasing (R/kW) and discount rate	25772	48789	23661	44325	32340	43160	58036	59226
Fixed O&M (R/kW/a)	552	923	543	902	794	951	532	532
Variable O&M (R/MWh)	51.2	81.4	110.8	149.1	42.5	65.4	29.5	29.5
Variable Fuel costs (R/GJ)	17.5	17.5	8.75	8.75	17.5	17.5	6.8	6.8
Fuel Energy Content, HHV, kJ/kg	17850	17850	17850	17850	17850	17850	3.9 x 10 <sup>9</sup>	3.9 x 10 <sup>9</sup>
Heat Rate, kJ/kWh, avg	9812	14106	10081	15425	9758	12541	10762	10762
Equivalent Avail	91.7	91.7	90.4	90.4	85.7	85.7	94.1	94.1
Maintenance	4.8	4.8	5.7	5.7	4.7	4.7	3	3
Unplanned outages	3.7	3.7	4.1	4.1	10.1	10.1	3	3
Water usage, l/MWh	231	320	33	43	256.7	1027	-	-
Sorbent usage, kg/MWh	15.8	22.8	38	59	0	0		
CO2 emissions (kg/MWh)	947.3	136.2	978	150	930	120		
SOx emissions (kg/MWh)	0.46	0.66	0.47	0.72	0.18	0.23		
NOx emissions (kg/MWh)	1.94	0.42	1.39	2.13	0.01	0.01		
Hg (kg/MWh)								
Particulates (kg/MWh)	0.13	0.18	0.13	0.2	0.04	0.05		
Fly ash (kg/MWh)	168	241.5	172.6	264.1				
Bottom ash (kg/MWh)	3.3	4.8	3.4	5.2				
FGD solids (kg/MWh)	25.2	36.2	61.1	93.4				
<b>Levelised Cost</b>								
Adjusted Capital (R/MWh)	287.10	543.51	263.58	493.78	360.27	480.80	524.14	534.89
O&M (R/MWh)	125.33	205.36	183.73	270.24	149.13	193.12	95.51	95.51
Fuel (R/MWh)	171.71	246.86	88.21	134.97	170.77	219.47	73.18	73.18
Total (R/MWh)	584.14	995.72	535.52	898.99	680.17	893.39	692.83	703.58

Table C-3: Technology costs reported in the revised Integrated Resource Plan (2012) (After EPRI, 2012)

	OCGT	CCGT	CCGT with CCS	Wind	CSP, Parabolic trough, 3 hrs	CSP, Parabolic trough, 6 hrs	CSP, Parabolic trough, 9 hrs	CSP, Central receiver, 3 hrs	CSP, Central receiver, 6 hrs	CSP, Central receiver, 9 hrs	PV, crystalline silicon, Fixed Tilt
Rated capacity, net (MW)	115	711	591	100 (50 x 2)	125	125	125	125	125	125	10
Life of programme	30	30	30	20	30	30	30	30	30	30	25
Typical load factor (%)	10%	50%	50%	30%	30.90%	36.90%	42.80%	31.80%	40.00%	46.80%	19.40%
Overnight capital costs (R/kW)	4357	6406	13223	15394	40438	51090	61176	37577	44866	51604	28910
Lead time	2	3	3	4	4	4	4	4	4	4	2
Phasing in capital spent (% per year) (* indicates commissioning year of 1st unit)	90%, 10%	40%, 50%, 10%	40%, 50%, 10%	5%, 5%, 10%, 80%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	10%, 25%, 45%, 20%	10%, 90%
Adjusted overnight capital costs, accounting for capex phasing (R/kW) and discount rate	4671	7089	14632	15945	44626	56381	67512	41469	49513	56949	29141
Fixed O&M (R/kW/a)	78	163	292	310	582	599	616	537	555	573	208
Variable O&M (R/MWh)	0.2	0.7	0.7	0	1.9	2	2	0	0	0	0
Variable Fuel costs (R/GJ)	92	92	92	0							
Fuel Energy Content, HHV, kJ/kg	39.3	39.3	39.3	0							
Heat Rate, kJ/kWh, avg	11926	7487	9010	0							
Equivalent Avail	88.8	88.8	88.8	94-97	95	95	95	92	92	92	95
Maintenance	6.9	6.9	6.9	6							5
Unplanned outages	4.6	4.6	4.6								
Water usage, l/MWh	19.8	12.7	19.2		299	304	308	310	302	300	
Sorbent usage, kg/MWh											
CO2 emissions (kg/MWh)	618	388	47								
SOx emissions (kg/MWh)	0	0	0								
NOx emissions (kg/MWh)	0.27	0.29	0.35								
Hg (kg/MWh)											
Particulates (kg/MWh)											
Fly ash (kg/MWh)											
Bottom ash (kg/MWh)											
FGD solids (kg/MWh)											
<b>Levelised Cost</b>											
Adjusted Capital (R/MWh)	442.29	134.25	277.10	575.93	1367.51	1446.80	1493.62	1234.81	1172.09	1152.24	1498.70
O&M (R/MWh)	89.24	37.91	67.37	117.96	216.91	187.31	166.30	192.77	158.39	139.77	122.39
Fuel (R/MWh)	1097.19	688.80	828.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (R/MWh)	1628.73	860.97	1173.39	693.89	1584.42	1634.11	1659.92	1427.58	1330.48	1292.01	1621.09